Physikalisch-Technische Bundesanstalt
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INTERNATIONAL COOPERATION

Standards for the Photovoltaic Sector in Vietnam

Hợp tác Đức
DEUTSCHE ZUSAMMENARBEIT

Standards for the Photovoltaic Sector in Vietnam

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On behalf of

On behalf of the Federal Government of Germany, the Physikalisch-Technische Bundesanstalt promotes the improvement of the framework conditions for economic, social and environmentally friendly action and thus supports the development of quality infrastructure.

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Disclaimer

The views and opinions expressed in this study are those of the authors and do not necessarily reflect the official position of PTB.

Annexes

Executive Summary

Solar energy developed rapidly in Vietnam between 2017 and 2020. The demand for installing solar energy systems is increasing. The government has allowed an additional 2,600 MW of rooftop solar power by 2030 under the Power Development Plan (PDP) 8. Therefore, research and development of new standards and technical regulations in this field must continue. Vietnam is also home to many factories that manufacture equipment critically important for solar power systems, such as PV panels and inverters. Developing internationally compatible standards further supports the products supplied to the world market.

Standardization is a key pillar of Vietnam's National Quality Infrastructure (NQI). Standards are the guiding principles and ground rules for stakeholders to work together. This study presents the status of standardization in the field of photovoltaics (PV) and proposes development directions for the near future.

Key findings

The authors collected information from publicly available legal documents, the ISO and IEC websites, and other internet searches. They compared Vietnam's standards catalogue with those of other countries such as Indonesia, India, and Germany. The comparison shows that the number of approved Vietnamese PV standards is higher than in Indonesia but lower than in India and Germany. The standards' content is similar to those published in other countries.

The authors conducted thirteen interviews in August 2023 and collected twenty-nine online survey responses from September to December 2023. Stakeholders participating in interviews and surveys included equipment manufacturers, electrical construction companies, testing centers, government agencies, and grid operators. The questionnaire was related to compliance with standards, technical regulations, and interest in standards. One key result shows that less than 50 % of stakeholders fully comply with standards when providing their products or services.

Vietnam has issued the Law on Standards and Technical Regulations as a foundation for managing and promulgating national standards and regulations. STAMEQ is responsible for preparing documents related to the standardization process, addressing the parties involved, as well as for other related activities. VSQI, a sub-structure of STAMEQ, manages the standards development process and several Technical Committees. Among them, TCVN/TC/E13 is responsible for renewable energy. Vietnam is providing the human resources and legal structure needed to develop standards and technical regulations.

Recommendations

Vietnam's national standardization strategy is awaiting approval by MOST. However, the version proposed by STAMEQ only addresses the energy sector in general and does not explicitly address solar energy or battery storage. Therefore, STAMEQ needs to extend its strategy in the next phase of the national strategy development to cover the PV sector and offer orientation concerning product and service quality in this sector.

Comparing standards approved in Vietnam and corresponding international standards shows that some published standards are outdated or lack components. STAMEQ/VSQI must continuously update standards following international practices to ensure that Vietnam's industrial production level develops according to global standardisation. In this context, STAMEQ needs to consider extending TCVN/TC/E13 in terms of membership. It should be noted that IEC Technical Committee 82 (solar photovoltaic energy systems) is the most active TC in the IEC system and STAMEQ/VSQI should become part of it.

1 Introduction

1.1 Brief overview of policy encouraging PV in Vietnam

Since 2015, the Vietnamese government has encouraged renewable energy development with a vision for 2050. In the future, renewable energy resources will include small hydropower, biomass, wind energy, and solar energy. Solar energy is expected to supply 6 % of electricity in 2030 and 20 % in 2050[1].

In 2017, the government decided to encourage both solar farms and solar rooftop systems (RTS) through the feed-in-tariff mechanism[2]. Solar energy has enjoyed robust development, with a large number of solar farms and RTS being built from 2017 to 2020.

Decision No. 13/2020/QD-TTg[3] modified the price of the feed-in tariff and officially acknowledged RT systems. It allowed developers to sell electricity generated from RT systems to the national utility company without the need for an electricity operating license.

In 2021 and 2022, the PV market in Vietnam was at a standstill. The Government did not introduce any policies to promote RTS in Vietnam.

Since 2023, a few RTS projects carried out in industrial parks have been initiated in response to the Green Certification requirement for manufacturing.

Via its Power Development Plan 8 (PDP8)[4], the Vietnamese government has again emphasized the role of solar energy with a plan to have 50 % of office and residential buildings install solar rooftop systems by 2030[5].

The need to establish a regulatory framework for self-consumption of energy generated by a photovoltaic (PV) system has been recognized by the Ministry of Industry and Trade (MOIT), and the first draft of a decree was circulated in early December 2023. It prioritizes self-consumption and discourages the sale of electricity.[6]

1.2 Growth and potential of solar energy

Solar energy in Vietnam experienced significant growth from 2019 onward. There was a huge increase from 2019 to 2020, while growth was slower from 2020 to 2022. Figure 1 provides information on solar energy capacity growth.

Looking at a forecast focused on PV generation capacity, the increase follows a constant pattern, with incremental growth over the years (see Figure 2).

[1] Prime Minister (2015).

[2] Prime Minister (2017).

[3] Prime Minister (2020).

[4] Government News (2023).

[5] Prime Minister (2023).

[6] Vietnam Briefing (2024).

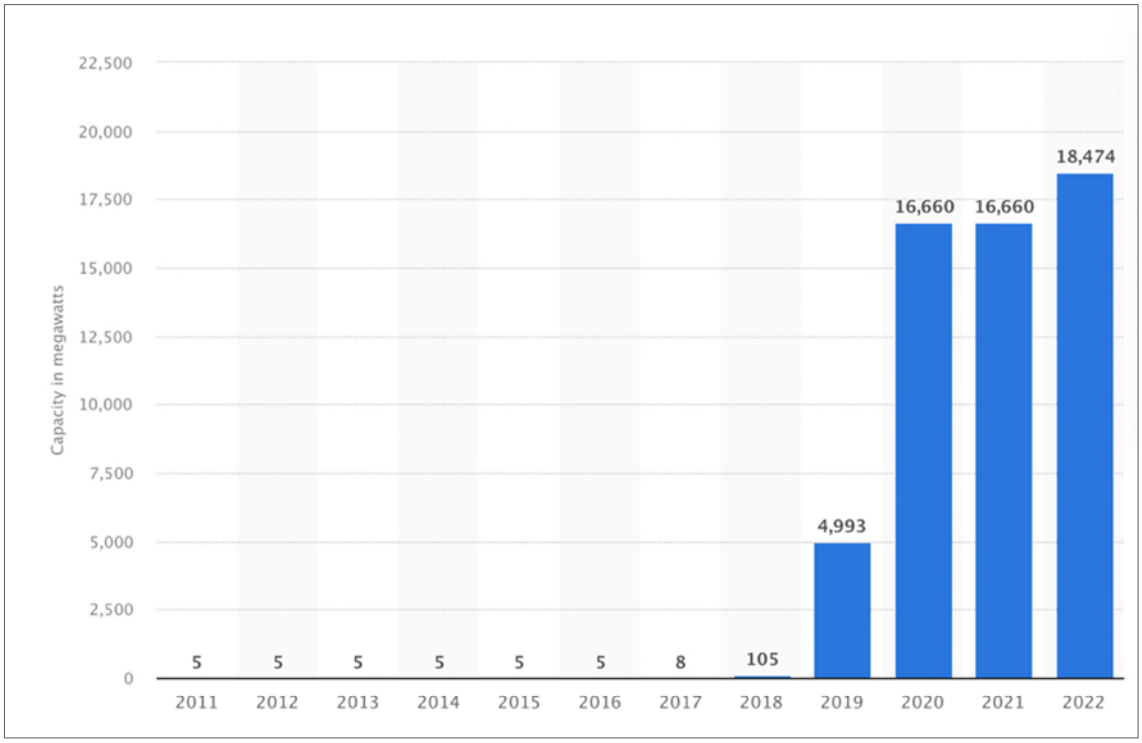

Figure 1: Growth of solar energy capacity in Vietnam[7]

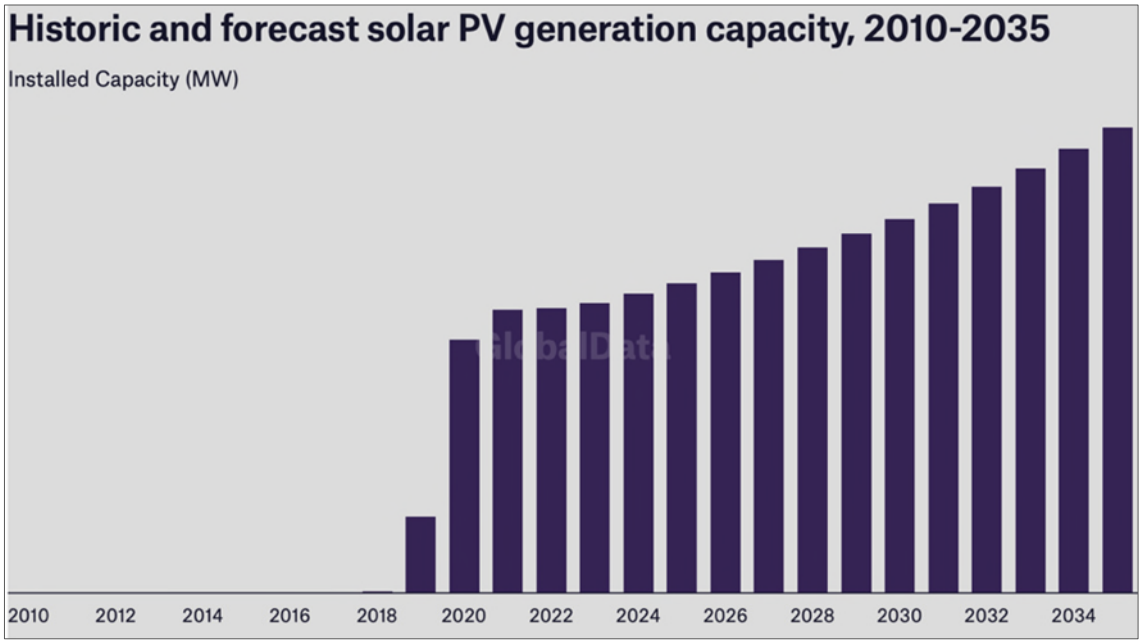

Figure 2: Growth of solar PV generation capacity[8]

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[7] Statista (2024).

[8] Power Technology (2023).

To respond to the growth in solar power, the Vietnam Standards and Quality Institute (VSQI), responsible for developing standards for the sector, has adopted 39 IEC standards to support the market concerned with the solar sector. The Technical Committee (TC) responsible for developing standards is TCVN/TC/E13, "Renewable Energy".

When assessing the availability of standards for the Vietnamese PV sector and benchmarking this with other countries in the region, gaps may be discovered that could compromise the market's ability to provide high-quality PV systems, installations, elements, and related services to its customers. This also applies to recommendations made by donors in technical cooperation programs.

In this context, PTB aims to improve Vietnamese standards and regulations to enhance the solar sector market in Vietnam via a project titled "Promotion of Quality Assurance Services for Sustainable Energy" in collaboration with STAMEQ, the National Commission for Standards, Metrology and Quality under the Ministry of Science and Technology (MOST), and VSQI.

1.3 Objective of this study

This study aims to analyze and assess gaps regarding currently available Vietnamese standards and technical regulations and to provide recommendations on how the repository of standards should be increased; it notes there are gaps, but also versions of existing standards that can be considered obsolete because newer versions of the adopted international standards are available.

The following activities were undertaken to make recommendations:

1) Analyze and assess gaps regarding the currently available standards and technical regulations in the solar sector by interviewing stakeholders or inviting them to participate in surveys.
2) Give a brief, structured overview of the current status of standards and technical regulations.
3) Compare standards currently available with those accessible in other countries.
4) Prioritize standards among the wide range available that should be developed in the near future and identify gaps.
5) Analyze and assess the standards development process to provide suggestions for improvements.

1.4 Methodology applied to search for information

The information collection method for the study was based on desk work and interaction with stakeholders relevant to the study.

Desk work involved internet searches using keywords and specifically addressed the ISO and IEC webstores to find information on PV standards. Catalogues of standards in India, Indonesia, Germany, and Vietnam were used as well.

While these sources provided documented information only and did not allow information to be found that originated directly from users and stakeholders, interviews with these parties were held; additionally, an online survey was conducted that addressed a wider range of users and stakeholders.

The interviews were conducted with 13 entities in Hanoi and Ho Chi Minh City from 2023-08-07 to 2023-08-23. Results and further details are in Chapter 6.2.

The online survey was open from 2023-09-06 to 2023-12-20. 29 replies were received. The results are documented in Chapter 6.3 and Annex A.

2 Standards for PV

2.1 International organizations developing standards for PV

Several organizations, associations and other entities have established standards that address PV. The first standards relevant to PV were developed by ASTM Committee E44 on Solar, Geothermal and Other Alternative Energy Sources in 1978.[9] ISO and IEC established Technical Committees in 1980 and 1981,[10] respectively; IEC/TC 82 on solar photovoltaic energy systems is today considered the most important body regarding photovoltaic related standardization.[11]

IEEE has a committee (SCC21, Coordinating Committee Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage) that was established in the 1990s and initially focused on standards for interconnecting distributed energy resources to the electric power system. In the early 2000s, standards development turned to stand-alone PV systems.[12]

2.2 Relevance of standards and technical regulations in the PV value chain

Standards in PV can serve as a terminology standard, a product standard, a process standard, a service standard, a testing standard, an interface standard, a standard on data to be provided, or a basic standard.

Standards in the PV sector address these functions while aligning with the elements of the value chain of the sector by including materials for production for components such as solar cells and by providing for testing methods and performance requirements; they can also address design and installation.

Technical regulations (TRs) in the PV sector, as in any sector, address health, safety and sustainability risks. TRs issued by a regulator or regulatory authority are thus related to safety in all aspects and environmental impacts. Safety includes such areas as electrical safety and fire safety; impacts on the environment are related, for example, to the end of life of a PV installation, including recycling of parts, elements, metals, plastics, and other materials used. This is discussed in Chapter 3.2.2.

2.2.1 Categories of standards along the value chain

A PTB publication titled "Quality Infrastructure for Photovoltaic Systems – Assuring safety, quality and sustainability in emerging and developing economies"[13] looks at six areas in which it is critical to ensure safety, quality, and sustainability along the value chain (VC) of PV:

- Manufacturing
- System design and equipment selection
- Transport, installation, and commissioning
- Operation and maintenance
- Grid integration and storage
- End of life, re-use, and recycling

Among other things, these services require standards for

- Production/manufacturing and transport of components
- Inverters
- Tendering and contracting
- Installation

[9] ASTM (undated). A list of standards is available in Annex B.

[10] ISO/TC 180 Solar energy established in 1980; IEC/TC 82 Solar photovoltaic energy systems established in 1981.

[11] PVResources (undated).

[12] Refer to Annex C for a list of standards developed by IEEE SCC21.

[13] PTB (2023).

- Operations, maintenance, and monitoring
- Performance
- Testing /test labs
- Calibration
- Planning, installation, and commissioning
- Maintenance
- Batteries/storage, stand-alone systems, and rural electrification

Chapter 6.3 and its sub-chapters address the scopes of standards (and, by extension, areas of implementation).

2.2.2 Technical regulations along the value chain

A state or government uses TRs to regulate and control products that may be detrimental to the health and safety of the population, fauna, flora, and the environment.[14]

The definition of what constitutes a technical regulation is contained in the World Trade Organization (WTO) Agreement on Technical Barriers to Trade (TBT Agreement), Annex 1: "a document which lays down product characteristics or their related processes and production methods, including applicable administrative provisions, with which compliance is mandatory".[15]

Due to its legal nature—any TR is a legal act—only a regulator or a regulatory authority, usually mandated with technical regulation in its area of expertise by a national act or a National Quality Policy (NQP)[16], may issue a technical regulation; the only areas to be regulated are those that fall under the scope of regulation as per the WTO TBT Agreement. TRs, therefore, cannot per se be used to regulate quality.

Vietnam does not have an NQP.

Establishing a technical regulation begins with identifying a need based on a risk emerging from a product, related production processes, or production methods. This is followed by a regulatory impact assessment (RIA), ensuring transparency and stakeholder engagement throughout the process.

The mandatory nature of a TR requires surveillance of compliance with the requirements of the respective TR.

Compliance with a TR is usually indicated by a mark or label applied to a product confirming that it meets the requirements of the TR, including standards referenced in the TR that describe technical aspects of fulfilling the TR.

Having the surveillance type be part of a TR is good practice. Depending on the risk identified for the product, it can require pre-market or post-market surveillance. The risk analysis paired with a RIA will deliver an adequate form of surveillance to the regulator.

Depending on the level of risk, a TR in a given area may require pre-market conformity assessment with the requirements of the TR when risks are high, and a product may present a danger to the user. Pre-market assessment may include inspection during the production process, verification of the implementation of a quality management system, type approval and testing. A pre-market assessment will either call for a first-party or third-party conformity assessment, depending on the level of a risk.

Post-market assessment takes place after a product has been placed on the market and is always implemented by a third party which should be a governmental agency or a subcontracted agency. This also explains why market surveillance is necessary if a TR is passed, regardless of the sector concerned: if first-party conformity assessment is considered sufficient, non-conformity could be discovered after the product is placed on the market when coincidental market surveillance is implemented.

The issue of how market surveillance is implemented should be part of the NQP or a similar framework, such as a product safety law. Market surveillance agencies, however, need to be equipped with the

[14] World Bank (2019).

[15] TBT Agreement (undated).

[16] Not all countries have an NQP; other frameworks such as a product safety law can be used. The president, a minister or another high-level power of a country can also mandate an instance in the system to develop a TR.

power to sanction non-conformities, be it the removal of a product from the shelves or the national market, the issuance of fines, or instructions on how to modify the product.

Standards can play a significant role in technical regulations, described in the WTO TBT Agreement, Annex 1: international standards should be referenced in national TRs. They do not present a barrier to trade, allowing all market participants equal access to markets. As soon as standard references are made to a TR (for example, via a legal act or an announcement in a national gazette or official journal), they are no longer standards but technical regulations. This is significant due to the different procedures in developing standards and TRs: standards are developed based on a needs analysis, while TRs are developed based on a risk assessment and RIA, as well as the different notification procedures for the WTO[17].

The areas where services are required in the PV VC indicate where regulation could be considered. Table 1 discusses potential risks emerging from a service in the PV VC, limited to ensuring health and safety, and the areas where the WTO TBT Agreement allows TRs.

Table 1: Risk potentials in the value chain of PV

	Risk level			
Areas in the PV VC with risk potentials	**High**	**Medium**	**Low**	**Discussion[18]**
Manufacturing		**x**		Risks can emerge during the manufacturing process and may lead to failure of elements or a system. Risk management is considered part of quality management. TRs in this service area should address the quality management system implemented in the manufacturing process.
System design[19]			**x**	System design is related to sizing a PV system based on energy demand and energy usage, and on operating time and the availability of solar energy at the site of energy generation. In case this is not done carefully, the output of the PV installation cannot meet the existing potential. A poorly designed system does not per se present a risk; instead, it is the selection of the equipment for such a system that presents a risk, see below.
Equipment selection		**x**		The selection of equipment is negotiated between the business partners (buyer/seller) and can be part of the contract between the partners. Risks may emerge if the seller selects equipment elements that are not compatible or chooses an unsuitable element for the system planned. Risks may emerge from an improper selection. TRs is this area should be designed to prevent this by setting requirements for the selection process of equipment without preventing innovation in the sector.
Transport			**x**	Transportation may lead to damage to elements. This is a risk that should not lead to a regulation but should be a matter of warranty and legal acts on warranty in general.

[17] See TBT Agreement (undated).

[18] Information provided on https://www.e-education.psu.edu-uae868/, query 2024-01-16, was used to discuss the risks of the services.

[19] Though system design and equipment selection are closely related, these topics are discussed here separately.

	Risk level			
Areas in the PV VC with risk potentials	**High**	**Medium**	**Low**	**Discussion[18]**
Installation	**x**			Improper installation may lead to safety risks for operators and users. Thus, a TR in this area is important to ensure safety, including fire safety / protection.
Commissioning	**x**			Commissioning has an impact on PV system performance, longevity of equipment, safety, financial investment and warranties by ensuring that a PV system meets the design specifications before the installation is handed over to the operator. Commissioning that is not implemented carefully and thoroughly can lead to manifold risks and the risk levels can be assessed to be high. TRs is this area should address risks in all the areas mentioned above; besides referencing standards, a guideline for the commissioning process that does not have the status of a TR may be useful.
Operation and maintenance			**x**	Maintenance has an impact on the performance of a PV system / installation and can contribute to optimal operation conditions. Preventive maintenance can contribute, among other things, to preventing breakdowns and production losses, while corrective maintenance can mitigate downtime. Routine maintenance includes inspection of modules, shading control, and electrical equipment maintenance. Even though electrical equipment failure can impose a risk on the system / installation and on users, TRs is this area should not be specific to the PV sector but address all electrical equipment. Guidelines on how to set up a maintenance plan, among other things, will support the industry in ensuring optimal operation.
Grid integration	**x**			Grid integration addresses the transmission of energy into a grid. The intended growth of the PV sector in Vietnam, including the increase in RTS, could have an impact on the capacity management of both the sending and the receiving ends as well as on managing electrical risks. If integration into the grid is not regulated, risks can incur on both ends.
Storage		**x**		Where used, batteries can present a fire hazard and a end-of-life/re-use/recycling risk. This risk is generally regulated under the heading of storage systems.
End of life, re-use, and recycling		**x**		Recycling and re-use of PV installations should be addressed with special emphasis in TR; worldwide experience in this area is still limited. TRs in this area could also be handled within TRs for waste in general.

3 The PV sector in countries in energy transition

3.1 Transition in Europe with a focus on Germany

In countries at an advanced stage of energy transition, standards and technical regulations have been developed for the sector.

Here, regulations set the framework while standards are generally used to describe technical details. Some standards are referenced in regulation, while many remain voluntary, offering knowledge and expertise aggregated in Technical Committees on international, regional and national levels.

In Europe, the Renewable Energy Directive (2009/28/EC) was revised as Directive EU/2018/2001, which entered into force in 2018 and has been legally binding since June 2021.

It established a new binding renewable energy target for the EU for 2030 of at least 32 %, with a clause for a possible upwards revision by 2023. This target is a continuation of the 20 % target for 2020. In order to help EU countries deliver on this target, the directive introduced new measures for various sectors of the economy, particularly on heating and cooling and transport, where progress has been slower (for example, an increased 14 % target for the share of renewable fuels in transport by 2030). It also included new provisions to allow users to play an active role in the development of renewables by enabling renewable energy communities and self-consumption of renewable energy and established better criteria to ensure bioenergy's sustainability.[20]

The Ecodesign for Sustainable Products Regulation, the draft of which was published in March 2022 and implemented in May 2023 after public consultation, is designed to improve EU products' circularity, energy performance, and other environmental sustainability aspects.

Directive 2012/19/EU addresses waste from electrical and electronic equipment (WEEE), which has legal implications for the photovoltaic sector.

Standards relevant for the European context, referenced in regulation or not, are listed in Annex D in their German-language versions.

3.2 Standards implemented in countries that began the energy transition

Next to Vietnam, embarking on an energy transition to renewables, many more countries are moving toward sustainable energy supplies and therefore also need standards, either as a basis for regulation or as a knowledge base for PV.

For example, India has adopted some 60 IEC standards relevant for the PV sector (refer to Annex E), while Indonesia has a repository of around 30 standards.[21]

When comparing the standards available in Vietnam[22], India, Indonesia, and Germany, certain standards have been adopted by all four countries. These standards can be considered essential for the PV sector. Some standards adopted by India, Indonesia, and/or Vietnam have been adopted by Germany, while others have not.

Therefore, Table 2 shows all IEC standards adopted by India, Indonesia, and Vietnam and indicates whether Germany has also adopted them.

Some of the IEC standards have been withdrawn, with or without being replaced; they are included in the list because one or more countries still list them in their catalogues.[23]

For Vietnam, the focus country of this study, the numbers of the national standards are added because they are different from the IEC standards.

[20] EC (2018).

[21] Refer to Annex F.

[22] For a list refer to Annex G.

[23] As of 2023-11.

Table 2: IEC standards adopted across the four countries

IEC standard	India	Indonesia	Vietnam	Germany[24]
IEC 60269-6			TCVN 5926-6:20216	
IEC 60364-7-712			TCVN 7447-7-712:2019	
IEC 60891	x			x
IEC 60904-1	x		TCVN 12678-1:2020	x
IEC 60904-1-1	x		TCVN 12678-1-1 : 2020	x
IEC 60904-10	x		TCVN 12678-10 : 2020	x
IEC 60904-2	x		TCVN 12678-2 : 2020	x
IEC 60904-3	x		TCVN 12678-3 : 2020	x
IEC 60904-4	x		TCVN 12678-4: 2020	x
IEC 60904-5	x		TCVN 12678-5:2020	x
IEC 60904-7	x		TCVN 12678-7 : 2020	x
IEC 60904-8	x		TCVN 12678-8 : 2020	x
IEC 60904-8-1	x		TCVN 12678-8-1 : 2020	x
IEC 60904-9	x		TCVN 12678-9 : 2020	x
IEC 61194[25]		x		
IEC 61215-1-1	x	x	TCVN 6781-1-1:2017	x
IEC 61215-1-2	x	x	TCVN 6781-1-2:2020	x
IEC 61215-1-3	x	x	TCVN 6781-1-3:2020	x
IEC 61215-1-4	x	x	TCVN 6781-1-4:2020	x
IEC 61215-1	x	x	TCVN 6781-1:2017	x
IEC 61215-2	x	x	TCVN 6781-2:2017	x
IEC 61345[26]	x			
IEC 61427-1		x	Adoption planned for 2021	x
IEC 61427-2			Adoption planned for 2021	
IEC 61439 series			Adoption planned for 2022	x[27]
IEC 61646[28]	x			
IEC 61683			TCVN 12674:2020	
IEC 61724-1			TCVN 13083-1:2020	x
IEC 61727:2016		x	Adoption planned for 2022	

[24] Including drafts and IEC standards adopted as European standards, mandatory adoption across all member states of the EU.

[25] This IEC standard has been withdrawn and partially replaced by IEC TS 61836:2007.

[26] This IEC standard has been withdrawn with no replacement.

[27] Germany adopted Part 2 of the series only.

[28] This IEC standard has been withdrawn.

IEC standard	India	Indonesia	Vietnam	Germany[24]
IEC 61730-1		x	TCVN 12232-1:2019	x
IEC 61730-2		x	TCVN 12232-2:2019	x
IEC 61810-10				x
IEC 61829			TCVN 12677:2020	x
IEC 61853-1	x		Adoption planned for 2021	x
IEC 61853-2	x		Adoption planned for 2021	x
IEC 61853-3	x		Adoption planned for 2021	x
IEC 61853-4	x		Adoption planned for 2021	x
IEC 62053			TCVN 7589 series[29]	
IEC 62109-1			TCVN 12231-1:2019	x
IEC 62109-2			TCVN 12231-2:2019	x
IEC 62109-3			Adoption planned for 2022	x
IEC 62116	x		Adoption planned for 2022	
IEC 62124		x		x
IEC 62257-1		x		
IEC 62257-4		x		
IEC 62446-1			TCVN 11855-1:2017	
IEC 62509			Adoption planned for 2021	x
IEC 62548			TCVN 12676:2020	
IEC 62688	x			x
IEC 62790			TCVN 12675:2020	x
IEC 62805-1	x		TCVN 13084-1:2020	
IEC 62805-2	x		TCVN 13084-2:2020	
IEC 62817	x		Adoption planned for 2022	
IEC 62852			TCVN 12718:2019	
IEC 62891			Adoption planned for 2022	x
IEC 62894			TCVN 12673:2020	
IEC 62920	x		TCVN 13085:2020	
IEC 62925	x			
IEC 62930			TCVN 12672:2019	
IEC 62941	x		Adoption planned for 2022	x
IEC 62979	x			x
IEC 63049	x			
IEC 63092-1			Adoption planned for 2021	

[29] No further information such as detailed numbers or publication available.

IEC standard	India	Indonesia	Vietnam	Germany[24]
IEC 63092-2			Adoption planned for 2021	
IEC 63112			Adoption planned for 2022	x
IEC 63202-1	x			x
IEC/TR 60904-14	x			
IEC TR 63226			Adoption planned for 2021	
IEC TR 63227			Adoption planned for 2021	
IEC/TR 63228	x			
IEC/TS 60904-1-2	x			x
IEC/TS 60904-13	x			x
IEC TS 61724-2			TCVN 13083-2:2020	
IEC TS 61724-3			TCVN 13083-3:2020	
IEC/TS 61836	x	x		
IEC/TS 62257-4		x		
IEC/TS 62257-7		x		
IEC/TS 62738	x		Adoption planned for 2022	
IEC/TS 62782	x			x
IEC/TS 62788-7-2				x
IEC/TS 62789	x			x
IEC/TS 62910			TCVN 12230:2019	x
IEC/TS 62915	x			x
IEC/TS 62916	x			
IEC/TS 62989	x			
IEC/TS 62994	x		Adoption planned for 2022	
IEC TS 63049			Adoption planned for 2022	
Totals	47	17	61	48

In examining the table, six standards can be identified that were adopted across the Asian countries and Germany:

- IEC 61215-1-1
- IEC 61215-1-2
- IEC 61215-1-3
- IEC 61215-1-4
- IEC 61215-1
- IEC 61215-2

Standards adopted by any two of the Asian countries, but not Germany, total only 2:

- IEC 60904-1
- IEC/TC 61836

This indicates that these two documents are significant for national industries (India and Vietnam, and India and Indonesia, respectively).

Standards adopted only by Vietnam and Germany are the following:

- IEC 61829
- IEC 62109-1

- IEC 62109-2
- IEC 62548
- IEC/TS 62910

No standard that was adopted by all the Asian countries but not by Germany can be identified, which might indicate a need originating from conditions in the region, e.g., due to climate or other environmental aspects. Disregarding the possibility that some of the IEC standards might have been nationally adopted in a modified version, this shows that international standards represent a universal repository of information that offers a wide range of technical knowledge.

Vietnam is using the option to adopt international standards, but cannot follow up on its plans, as seen in Table 11. Eleven standards were planned to be developed in 2021, and 13 were planned for 2022, but they were not developed due to budget constraints. VSQI can propose standards development, but ultimately, MOST makes the final decision. For 2023 and 2024, no PV standards are in the work plan.

What is interesting in this context is, that among the standards proposed for development in 2021 and 2022, seven are "stand-alone", meaning no other country in Table 2 has adopted them. Following a Good Standardization Practice approach, this indicates that a need was discovered among stakeholders, specifically for these standards:

- IEC 60269-6
- IEC 61427-2
- IEC 63092-1
- IEC 63092-2
- IEC TR 63226
- IEC TR 63227
- IEC TS 63049

When evaluating Table 2 from a Vietnamese perspective, STAMEQ and VSQI should utilise the information provided to further investigate the national need for standards by considering which standards have been adopted by other Asian countries. This could serve as an additional indicator in a needs assessment and when developing a strategic approach to PV standards.

3.3 Standards recommended for use in a development context by donors active in technical cooperation

The United States Agency for International Development (USAID) is one of the largest donors of technical assistance and cooperation. It is very active in the area of renewable energy, including PV, in developing countries, and also invested in scaling up renewable energy on national, regional and global levels. It has published a list of basic standards and guidelines for solar power systems installed in developing countries. These standards focus on safety, design, installation, and monitoring. The list mentions 21 IEC standards, 5 IEEE guidelines, 14 UL standards, and 2 ASTM standards. The complete list of these standards can be found in Annex H.

The recommendations of USAID are included in the scoring exercise in Chapter 6.

Of the 21 IEC standards, the following have been adopted by Vietnam (see Table 3).

Table 3: IEC standards suggested by USAID and adopted by Vietnam

IEC 60364-7-712:2017: Low-Voltage Electrical Installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems
IEC 61215-1:2016: Design Qualifications & Type Approval Part 1: Testing requirements (All chemistries)
IEC 61215-2:2016: Design Qualifications & Type Approval Part 2: Testing procedures (All chemistries)
IEC 61724-1:2017: Photovoltaic System Performance - Part 1: Monitoring
IEC 61730-1:2016: Photovoltaic (PV) Module Safety Qualification - Part 1: Requirements for construction
IEC 61730-2:2016: Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements for testing
IEC 62109-1:2010: Safety of Power Converters for Use in Photovoltaic Power Systems - Part 1: General requirements
IEC 62109-2:2011: Safety of Power Converters for Use in Photovoltaic Power Systems - Part 2: Particular requirements for inverters
IEC 62446-1:2016: Photovoltaic (PV) Systems - Requirements for Testing, Documentation, and Maintenance - Part 1: Grid connected systems - Documentation, commissioning tests and inspection.
IEC TS 61724-2:2016: Photovoltaic System Performance - Part 2: Capacity evaluation method
IEC TS 61724-3:2016: Photovoltaic System Performance - Part 3: Energy evaluation method

Standards not adopted by Vietnam are listed in Table 4.

Table 4: IEC standards suggested by USAID and not adopted by Vietnam

IEC 60269-6 ed1.0: Low-Voltage Fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems
IEC 60364-1 ed5.0: Low-Voltage Electrical Installations - Part 1: Fundamental principles, assessment of general characteristics, definitions
IEC 61727 ed2.0: Photovoltaic (PV) systems - Characteristics of the Utility Interface
IEC 62093:2005: Balance-of-System Components for Photovoltaic Systems - Design Qualification Natural Environments
IEC 62116:2014: Utility-Interconnected Photovoltaic Inverters - Test Procedure of Islanding Prevention Measures
IEC 62124 ed1.0: Photovoltaic (PV) Stand-Alone Systems - Design Verification
IEC 62253 ed1.0: Photovoltaic Pumping Systems - Design Qualification and Performance Measurements
IEC 62509 ed1.0: Battery Charge Controllers for Photovoltaic Systems - Performance and Functioning
IEC TS 61836:2016: Solar Photovoltaic Energy Systems - Terms, Definitions and Symbols

USAID has implemented numerous projects related to solar energy, energy security, and low-emission energy. It remains to be verified whether these programs have contributed to standards development.

The adoption of IEEE, UL and ASTM could not be verified.

4 Analysis of the current situation in Vietnam concerning standardization and the regulatory framework

4.1 Institutional set-up and procedures of standardization in Vietnam

4.1.1 Overview

Standards in Vietnam are developed by STAMEQ, the National Commission for Standards, Metrology and Quality; being active in the fields of standardization, metrology, and quality, it is a government agency under the Ministry of Science and Technology (MOST).

STAMEQ organizes the national standards development process and participation in international standardization, in addition to the following activities:

- preparing national policies, strategies, and legal documents on standardization, metrology and quality of products and goods for approval by the responsible authorities,
- being responsible for measurement standards and management of legal metrology,
- coordinating the quality of products and goods manufactured nationally or imported,
- managing conformity assessment activities, including accreditation[30]
- providing calibration, testing, inspection, certification, and other activities, such as holding the TBT enquiry point,

The Vietnam Standards and Quality Institute (VSQI) under STAMEQ manages the standards development process and interacts with the technical committees under the umbrella of VSQI. Figure 3 shows the structure of STAMEQ and the position of VSQI within the system.

[30] Vietnam established the Board of Accreditation in 1995. The information presented in this list was taken from the information STAMEQ, as an ISO member, provided to ISO.

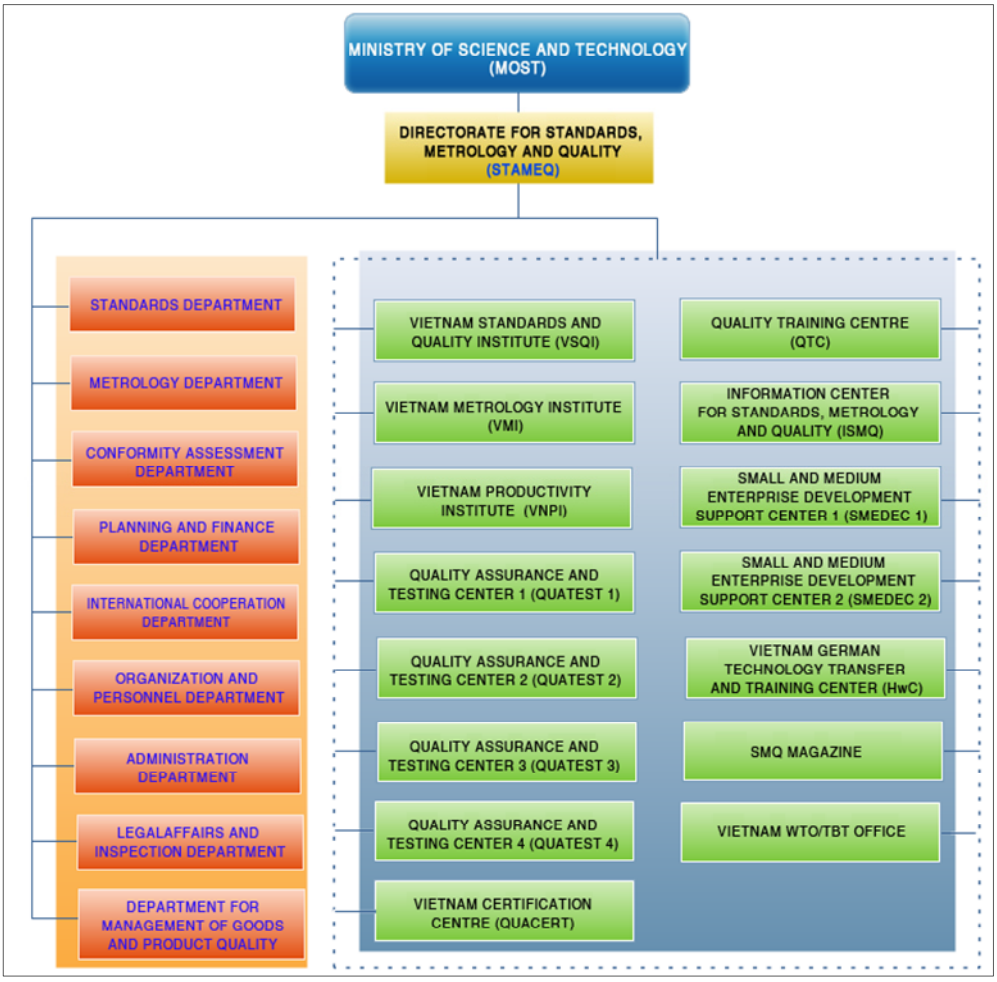


Figure 3: Structure of STAMEQ

Standardization activity follows Circular 11/2021/TT-BKHCN[31], detailing the formulation and application of standards.

In this circular, Article 5, Order and Procedures for the formulation, appraisal and promulgation of TCVN,[32] describes the drafting process for standards. There are separate procedures for standards proposed by ministries, ministerial-level agencies, and private organizations and individuals.

In addition to the Circular, there are basic standards that regulate the development of standards:

- TCVN 1-1:2015 Development of standards - Part 1: Procedures for developing national standards[33]
- TCVN 1-2:2008 Development of standards - Part 2: Rules for the structure and drafting of National Standards[34]

[31] MOST (2021).

[32] Abbreviation used for national standards.

[33] TCVN 1-1 (2015). It was not possible to access information on the standard directly at STAMEQ/VSQI because access was denied.

[34] TCVN 1-2 (2008). It was not possible to access information on the standard directly at STAMEQ/VSQI because access was denied.

Both standards are based on the ISO/IEC Directives, Part 1 and Part 2, with the adoption of Part 2 being partially modified. Both were developed by VSQI TC 1 General problem of standardization.

It should be noted that the ISO/IEC Directives, particularly Part 1, are reviewed and revised annually by the respective Boards at ISO and IEC. In Chapter 8, it is discussed how modifications of existing international standards and international practices impact standards development. Recommendations are provided on how to address such modifications on the national level.

4.1.2 Performance assessment of the standards development process in Vietnam by the World Bank Group

Using the Rapid Diagnostic Tool (RDT) developed jointly by PTB and the World Bank, the latter implemented a QI assessment of Vietnam in 2019, showing the results related to standards in the chart below.[35] Service delivery and technical competencies in standardization are marked in grey, see Figure 4.

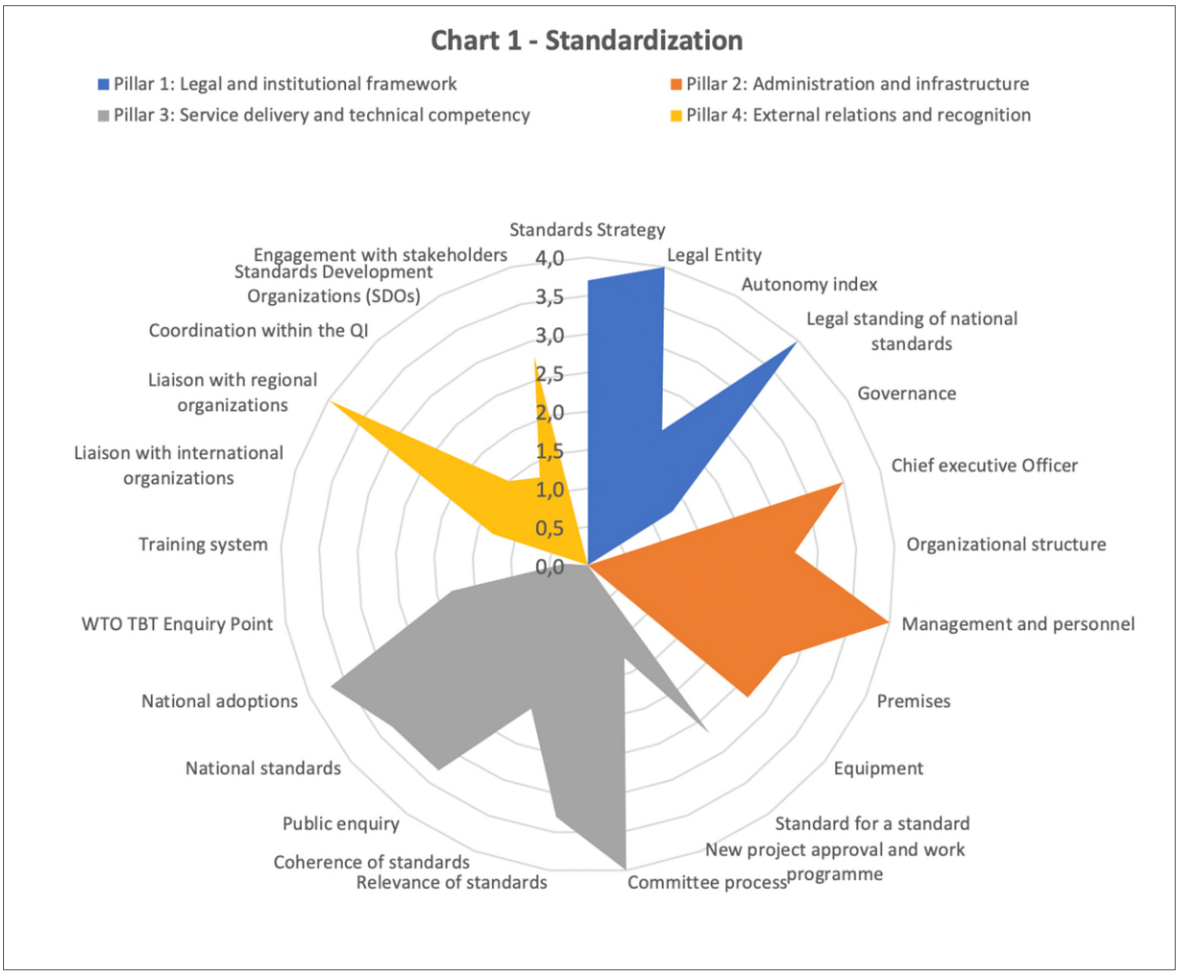


Figure 4: Assessment of performance of VSQI in 2019 using the World Bank tool

[35] World Bank 2019.

Recommendations of the World Bank that address the standards development process included the following:

- Update and strengthen the standards strategy
  - Although the standards strategy is in place, it is important to review, update, and strengthen it to ensure that it clarifies the vision and priorities for standards development, identifies priority sectors essential for private sector growth and development, and establishes and maintains relationships with stakeholders.
  - The process of developing a standards strategy is as important as the strategy itself. It should include all relevant stakeholders and be conducted in a participative and inclusive manner.
- Conduct standards demand assessment
  - The standards demand assessment is crucial in determining the standards needed by the industry and other sectors of the economy. Demand assessment could take place through surveys or engagement and dialogue with industry groups, chambers, and other private sector representatives. It is also important to collaborate with the line ministries to consider the priority sectors of the economy and monitor the new economic, scientific, and technological trends.
- Enhance the standardization process via the Technical Committee (TC)
  - Widen the TC participation base to include small and medium enterprises (SME) (in addition to major operators), entrepreneurs, academics, researchers, and other interested parties.
  - The number of TC members should not be limited and should be open to all interested parties.
  - Review and establish the TC operational manual covering good practices related to documentation, approval, and publication processes.
  - Develop sensitization program(s) for the TC members to keep them up to date with scientific, industrial, and technological developments.

It could not be verified which of these recommendations had been implemented since the assessment.

4.1.3 Assessment of the standards development process carried out by the World Bank in 2019

Even though the RDT of the World Bank Group and PTB was applied five years ago, similar findings were obtained in the PTB project, related e.g. to Good Standardization Practice, the National Standardization Strategy, project management applied to standardization, membership and composition of Technical Committees.

In an interview, STAMEQ articulated the following challenges in the development of standards:[36]

- Budget availability
- Attracting and engaging more technical experts in the TCs, particularly TCVN/TC/E13.
- Gaining experience concerning international participation.

Refer to Chapter 7 for details related to the standards development process and recommendations, including the three issues addressed by STAMEQ.

4.1.4 Re-assessment of the standards development process by PTB in 2024

Within the framework of an ASEAN-PTB project titled "Strengthening Quality Infrastructure in ASEAN," an activity was implemented where all member states of ASEAN (AMS) were requested to apply the WB-PTB RDT to define a base value across the AMS. This served as a starting point for STAMEQ/VSQI to determine future needs for improvement in Good Standardization Practice (GSP). The ASEAN-PTB project

[36] Interview with STAMEQ 2023-08-07.

started conducting activities to improve GSP performance, with STAMEQ/VSQI as one beneficiary.

The RDT was revised and updated several times between 2019 and 2024, so in 2024, PTB applied the latest version of this tool (version 8.5). The revisions included modifying some questions in the questionnaire and adjusting the indicators in pillars 1, 3 and 4.

Due to the methodological changes, a 1-to-1 comparison is difficult. However, filling the 2019 RDT version with 2024 data is possible. The result shows significant improvements in pillar 2 'Administration and Infrastructure' (from 2.3 to 3.4 average score) and pillar 3 'Service Delivery and Technical Competency' (from 2.0 to 3.1). Pillar 4 'External Relations and Recognition' (from 2.2 to 2.1) and Pillar 1 'Legal and Institutional framework' (from 3.0 to 2.6) slightly deteriorated. Overall, the GSP performance has moderately improved (using 2019 indicators: from 2.4 to 2.8 average scores). Since 2019, several donors have implemented training sessions that should have improved the procedures and performance of STAMEQ/VSQI.

The 2024 data, using the latest RDT version (see Figure 5), show that Vietnam performs well across all pillars, achieving values of good performance in pillars 2 and 3, and reasonable performance in pillars 1 and 4. Still, it also shows unevenness within each pillar. Pillar 1 value is decreased significantly by the low performance in governance. The VSQI not acting independently, board members not appointed, and the private sector and civil society not being represented in VSQI's governance contribute to this low score. In Pillar 2 'Management and Personnel', scores low due to unfilled positions. In Pillar 3, the need for fundamental development can be detected only concerning the relevance of standards.

The performance in pillar 4 is uneven. The liaison with international organisations needs enhancement. The low value concerning standards development organisations (SDO) is related to the lack of a recognition mechanism and legislation allowing this.

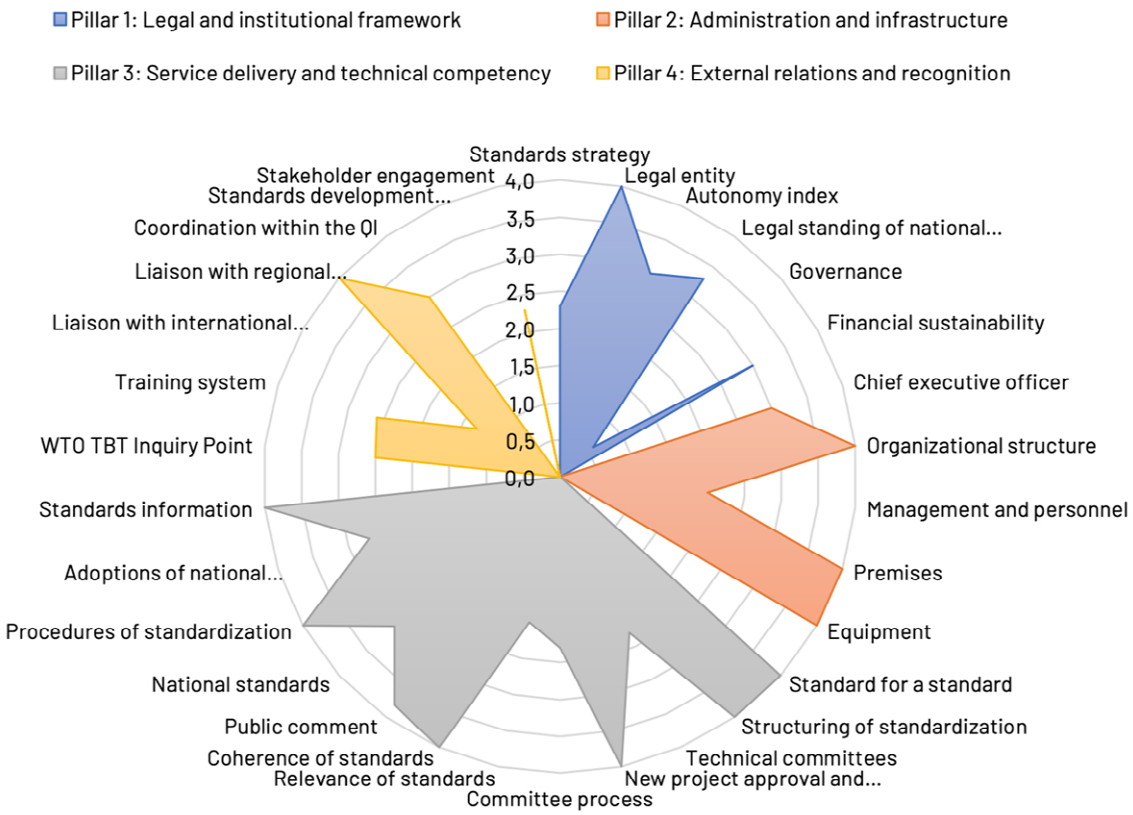


Figure 5: Assessment of performance of VSQI in 2024 using the World Bank tool

4.2 Legal and regulatory framework of standardization and formulation of technical regulations in Vietnam

In general, different types of documents, including circulars, technical regulations, and decrees, are used to regulate in Vietnam.

The function of circulars is to set out articles and clauses in the Code, Laws, and Decrees and prescribe measures to perform the state management function of ministers and heads of ministerial-level agencies (such as detailed regulations on procedures and forms). Ministers and heads of ministerial-level agencies usually issue circulars.[37]

A technical regulation, according to Clause 2, Article 3 of the Law on Standards and Technical Regulations 2006, means a regulation on the limits of technical characteristics and management requirements which products, goods, services, processes, the environment and other objects in socio-economic activities must comply with to

- Ensure safety, hygiene and human health
- Protect animals, plants and the environment
- Safeguard national interests and security, consumer interests and other essential requirements

A technical regulation for mandatory application is promulgated in a written form by a competent state agency. National technical regulations are identified by "QCVN", while local technical regulations are symbolized by "QCDP".[38]

Decrees issued by the government usually detail the articles, clauses and points assigned in the Code and Law and stipulate specific measures to organize the implementation of the Code and Law.

Unavoidable issues may arise within the competence of the National Assembly or Standing Committee of the National Assembly, but the conditions for formulating a Code/Law to meet the requirements of State management or socio-economic management have not been satisfied; in such cases, the government also promulgates decrees to regulate these issues in case the National Assembly Standing Committee approved them.[39]

STAMEQ is a government agency under MOST, and standards (which are voluntary, per the WTO definition) are strictly separated from technical regulations (which are mandatory, per the WTO definition); thus, Table 5 should be interpreted in such a way that standards can be prepared by MOST, with STAMEQ being under it. Table 5 does not mention that standards can also be proposed and developed by industry and other private stakeholders, while the development processes are under the auspices of STAMEQ/VSQI.

Table 6 lists several examples of legal instruments alongside one voluntary measure and information on which ministry prepared the document and who revised it.

Some ministries may have been restructured and subsequently renamed; in addition, some legal instruments appear to have been handled by different ministries during their lifetime. This may prompt establishing more efficient and effective communication processes among the developing entities.

Table 5: Forms of addressing topics related to PV in Vietnam

Description	Prepared by	Model	Form	Code	Revised and published by
Standard	MOST / other ministries	Voluntary	National standard	TCVN	MOST

[37] Le&Tran (2022a).

[38] Le&Tran (2022b).

[39] Le&Tran (2022a).

Description	Prepared by	Model	Form	Code	Revised and published by
Technical regulation	MOST / other ministries	Mandatory	National code TR Circular Decree	QCVN Circular Decree	Government/Ministries who prepared the documents

Table 6: Examples of the two forms

Document	Prepared by	Implementation	Form	Code	Revised and published by
QCVN 06:2020/BXD National Technical Regulation on Fire Safety of Buildings and Constructions	MOC	Mandatory	Technical Regulation	QCVN 06:2020/BXD	Prepared by MOC, revised by MOST
QCVN 12:2014/BXD National Technical regulation on Electrical installations of Dwelling and Public Buildings	MOC	Mandatory	Technical Regulation	QCVN 12:2014/BXD	Prepared by MOC, revised by MOST
Circular 39 STIPULATING THE ELECTRICAL DISTRIBUTION SYSTEM	ERAV-MoIT	Mandatory	Circular	Circular 39/ERAV	Prepared and published by MOIT
Decree 154/2018/ND-CP Amending and supplementing operating conditions of organizations providing inspection, calibration and testing services	Government	Mandatory	Decree	Decree 154/2018/ND-CP	Prepared by MOST, issued by the government
Dispatch No. 2075/C07-P4 Guidelines for approving the designs of fire protection	Police department of fire prevention, fighting and rescue	Mandatory	Dispatch	Dispatch No. 2075/C07-P4	Published by police department of fire prevention, fighting and rescue
TCVN standards concerned with solar system (39)	MOST	Voluntary	National standards	TCVN	Prepared by MOST, published by MOST

As discussed in Chapter 3.2.2, TRs without a functioning market surveillance system cannot deliver the required impact and cannot be sufficiently enforced.

In Vietnam, market surveillance of the energy sector is under the Ministry of Industry and Trade (MOIT). Decision 34/2018/QD-TTg regulates the functions, tasks, powers, and organizational structure of the General Department of Market Surveillance.

The Electricity and Renewable Energy Authority is a separate directorate under the MOIT, as is the Electrical Regulatory Authority.[40] Cooperation and collaboration between these departments is not clear.[41]

[40] MOIT (undated).

[41] The website http://www.qltt.gov.vn, indicated on the website of the agency at https://moit.gov.vn/en/administrative-departments/directorate-agency/market-surveillance-agency, query 2024-01-15, could not be accessed.

4.3 Inventory of existing national standards in the PV sector in Vietnam

The catalogue of VSQI standards on PV (TCVN) contains 39 standards published between 2017 and 2020. This timeframe should be seen in the context of national initiatives to strengthen PV installation and the PV market.[42]

All but two national standards are based on IEC standards. Annex G shows these standards with a TCVN number, the number of the adopted IEC standard, and titles in Vietnamese and English.

The number of a standard is issued by VSQI. Numbers are not allocated to specific sections or areas of standards but are derived from their sequence in development; thus, numbers of new standards are issued on an ongoing basis following the latest one. When a standard is cancelled, the number is discontinued and not allocated to any other standard. Revisions of standards will not lead to the standards receiving a new number.

This procedure is also applied when adopting international standards as national standards, resulting in the Vietnamese versions having their own number that is not identical to the number of the international standard. This may make it difficult for a standard user to find a version of a standard they need, either because the search function makes it difficult or because a user does not know the number of the standard in either version.

Some standards in the list need to be updated if the adopted international standard has been revised. Thus, the existing national standards are no longer in line with the international standards. The impact of this is discussed in Chapter 8.

STAMEQ also lists standards that should have been adopted in 2021 and 2022; some were published, while the majority are still in the pipeline. Refer to Annex I for these proposed work items.

The National Standardization Strategy, which is currently under development and awaiting the Prime Minister´s approval, does not address standards for PV specifically. A master plan is to be developed to address standards in detail and will include PV standards; no information concerning the responsibility for or timeframe of the master plan could be provided at the time this guide was written. It remains to be seen how the proposals for standards will be addressed in the master plan, including such topics as the budget and timeline/schedule for development for the next several years.

[42] Figure 7 in Chapter 5.4 shows the areas of application of the existing TCVN.

5 Industry and energy sector demand for PV standards in Vietnam

5.1 Overview[43]

Demand for solar PV is increasing and expanding in many countries worldwide, including residential and commercial applications. In 2020, the capacity of solar PV installations worldwide reached 760 GWp, with significant growth in the three markets of China, the United States, and Vietnam. Vietnam has a solar potential of up to 300 GW, higher than countries like Germany or Japan. Investors seek to diversify investments from China to neighbouring countries to mitigate geopolitical risks.

Vietnam is an emerging country for solar PV installations. It made a breakthrough in 2019, with a growth of 45 times the total installed capacity in 2018, and 2.3 times in 2020. Vietnam is interested in PV mainly to meet the current electricity demand (increasing by up to 10 % annually), as well as to ensure energy security and meet the criteria of reducing emissions.

The increase in PV capacity can be traced back to feed-in-tariff (FIT) mechanisms established in 2017 and adjusted in the years since, making Vietnam the world's third-largest market for PV. FITs have obligated grid operators to purchase electricity generated from solar power plants and household RTS installations, while a RTS promotion program was launched in 2019.

Setting up smart grid systems is essential for the country to integrate and run large renewable energy plants. RTS installations do not impact the electric grid if the power generated is used to self-supply offices and homes. Vietnam plans for 50 % of all office buildings and homes to have solar rooftops by 2030.

5.2 Interview results

Interviews have confirmed that many standards used by industry in Vietnam have been developed by IEC, whether they have been adopted by STAMEQ as national standards or in their international versions in English. The application of these standards is voluntary as long as they are not turned into TRs by legal acts.

STAMEQ would like standards to be referenced in legal instruments, to ensure the safety and functionality of PV systems. Developing "home-grown" standards is not a goal, though it is often requested. For exporting PV modules as a factor in economic development and trade, international standards are essential, whether in their original version or as national adoptions. They can be used as a reference in international contracts and, if referenced in national TRs, as a tool to ensure that no barriers to trade are created.

As standards are voluntary by nature, STAMEQ has no overview of their actual use. Nonetheless, STAMEQ sees a need to make more standards available for the sector but is limited by its budget, which is provided on an annual basis. It must adapt its plans to the resources made available by MOIT.

Most of the standards proposals come from ministries; it should be verified if there is a gap between the needs brought forward by authorities and those from industry. Interview partners from industry, however, expressed that they do not have a strong relationship with STAMEQ and do not regularly propose new standards or adopt them.

This might contribute to the fact that some industries or other types of entities use their own technical specifications that, in some cases, duplicate Vietnamese TCVN.

Testing institutes interviewed confirmed that they rely on IEC standards for procedures and requirements. Since testing is not available in Vietnam as needed and necessary, testing is also carried out outside of Vietnam to satisfy the needs of importers in

[43] Based on Scholarly Community Encyclopedia (2022) and Mittelstand Global (2023).

other countries, so the availability and use of international standards are of utmost importance.

A specific request concerning the availability of standards is related to person certification, based on ISO/IEC 17024:2012, Conformity assessment—General requirements for bodies operating certification of persons. A manual for interpreting ISO/IEC 17024 does not seem sufficient to reach the needed level of competence, so another format needs to be used. The request for a technical regulation for person certification for PV testing was articulated.

Power companies interviewed expressed the need for standards addressing the quality of power and the role of inverters to ensure quality, as well as addressing fire protection and fire prevention and a concept for these issues, including design and construction of buildings where rooftop systems are used. The power companies reported that many testing institutes can verify the quality of the output power of a solar system. However, institutes need more facilities to test the quality of significant components of the PV sector, such as inverters and PV panels. The existing standards and technical regulations concerning fire prevention and protection are insufficient. The power companies suggested comparing Vietnam's standards with those of other countries to improve the safety of solar systems.

The availability of more standards, specifically if drawn up in regulations, may increase owners' investment costs. Therefore, some stakeholders have reduced system costs by ignoring standards and testing of components. Most stakeholders agree with the technical specifications announced by the suppliers and do not test the components of PV systems. Due to the lack of local testing institutes, PV system components must be tested at overseas institutes, which is costly and time-consuming. In some cases, stakeholders use cheap supplies and accessories without quality assurance.

Manufacturers of PV components agreed in interviews that there is a sufficient number of TCVN standards similar to those used in other countries. For inverters, the existing regulations and standards focus only on electrical quality, but – as confirmed by power companies – do not address fire prevention. Some modern techniques for safety should be investigated, such as micro-inverters, optimizers, or rapid shutdown. Existing regulations require PV panels to be over 16 % efficient. However, most PV panels currently have an efficiency of over 20 %. Therefore, the standards and regulations should be reviewed and updated quickly to support competitiveness. Furthermore, PV panels in atypical or exceptional environments such as salt mist corrosion should be considered.

Interestingly, most interview partners from industry would like to see more technical regulations in the sector. As long as competition within the market is not strong, it would help to structure and shape the market. Industry, however, does not seem to have been called to participate in the development of regulations by the ministries responsible.

The end of life of PV installations does not seem to be a topic of high relevance to industry, possibly because the sector is still "young" and many installations have not reached the end of their lives. Here, the government could develop a strategy or concept before the end of life for a larger number of installations has been reached.

5.3 Survey results

A survey[44] among standards users in the PV sector was implemented to evaluate the use and need for standards, the origin of such standards, where they are procured, and which standards have been proposed by the participating parties to be available to them in addition to the existing standards on a national level, i.e., adopted as Vietnamese standards.

29 replies were received. This number does not provide a solid statistical basis but delivers an insight corroborating the outcomes of the expert interviews.

The areas of activities of the respondents are shown in Annex A, (question "Please indicate in which part of the PV value chain you are involved (…)"). Multiple answers were allowed due to the diverse areas of company activities.

[44] The questionnaire can be found in Annex J both in English and Vietnamese.

5.3.1 Structure for the presentation of the results

The presentation of the survey results for this study is structured into three categories:

- General and business data on the survey participants
- Information on the use of standards
- Procurement of standards

The most relevant results of the study are those on the use of standards. Information on general and business data on the participants concerning

- Company income
- Duration of the activity in the field of PV
- Number of projects per year
- Size of projects

and

- Involvement in the PV value chain

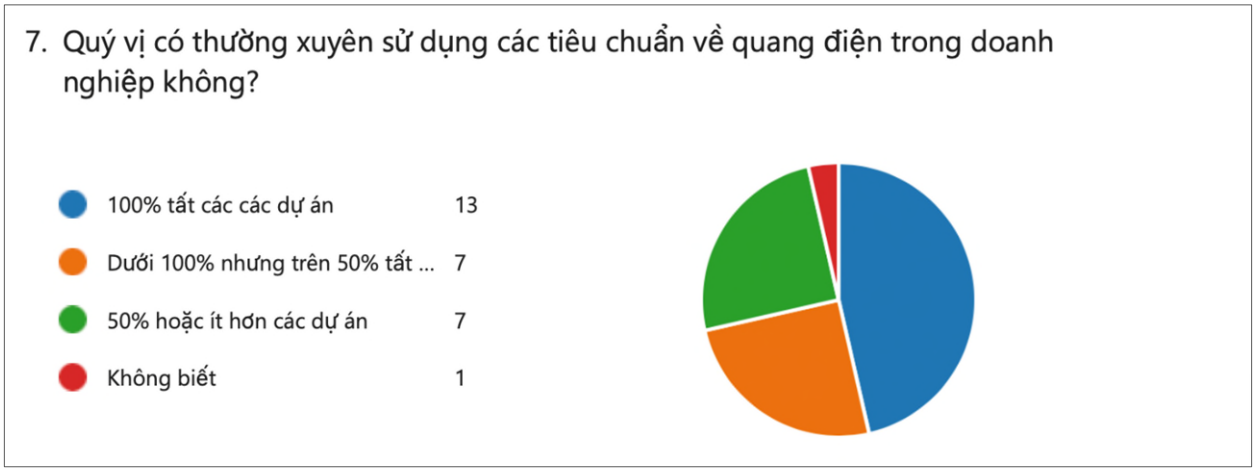
can be found in Annex A and is referenced in this main body of the study where relevant for the interpretation of data.

Information on the procurement of standards should be seen in the context of the performance of the standards body and its entities responsible for providing information on standards, access to standards, dissemination of relevant standards information and engagement with standards users.

5.3.2 Survey results on the use of standards in the PV sector

By far, the most prominent question when it comes to using standards is the implementation of the standards themselves.

The replies provide a divided picture: more than half of all the respondents use standards in all their projects; about a third use standards in less than half of their projects, see Figure 6.



Translation

Quý vị có thường xuyên sử dụng các tiêu chuẩn về quang điện trong doanh nghiệp không?	**How often did you use PV standards in your business?**
100 % tất các các dự án	100 % of all projects
Dưới 100 % nhưng trên 50 % tất cả các dự án	less than 100 % but more than 50 % of all projects
50 % hoặc ít hơn các dự án	less than 50 % of all projects
Không biết	Never

Figure 6: Use of standards

The implementation of standards in 100 % of a respondent's projects is independent of the number of projects a specific respondent implements per year and independent of the area of activity within the value chain. Companies that do not use standards in all projects explained that not all the standards they need are available, or some do not fulfil their requirements. Both groups, i.e., those using standards and those not doing so in all projects, see a need for standards specifically for grid quality/performance.

All standards users, independent of the degree of their use of standards were asked for the use of specific standards. These standards are the most relevant to PV modules, PV systems and AC/DC inverters.

Respondents use standards across these categories, depending on their type of activity in the PV sector, see Figure 7.

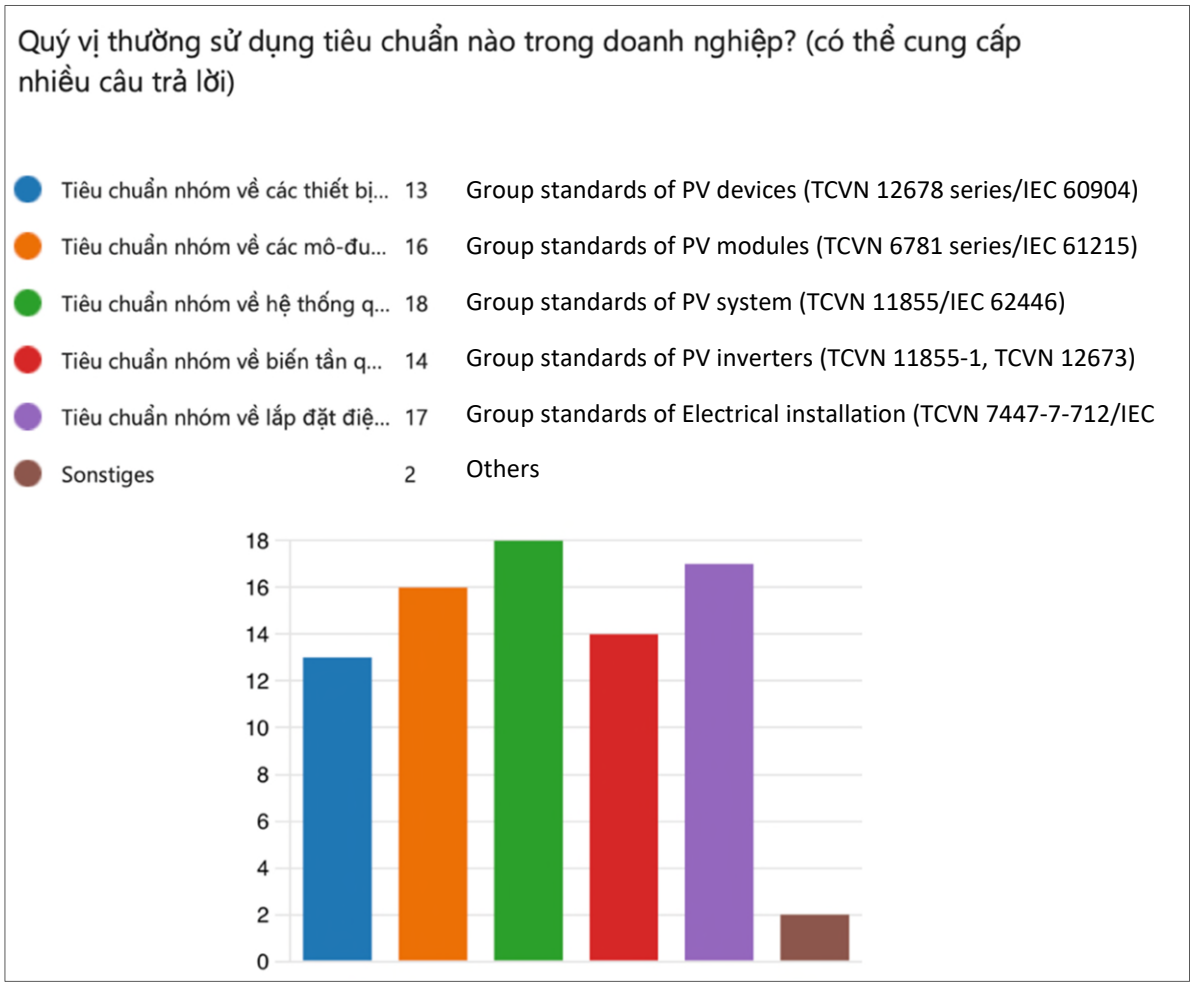


Figure 7: Use of specific standards in the PV value chain

5.4 Analysis of existing/planned versus required standards in the PV sector

Figure 8 presents the areas of application of existing TCVN standards, while Table 7 describes the gaps existing between standards available as TCVNs as well as which standards are still missing or where existing standards need to be updated because a new version of the IEC standard is available.

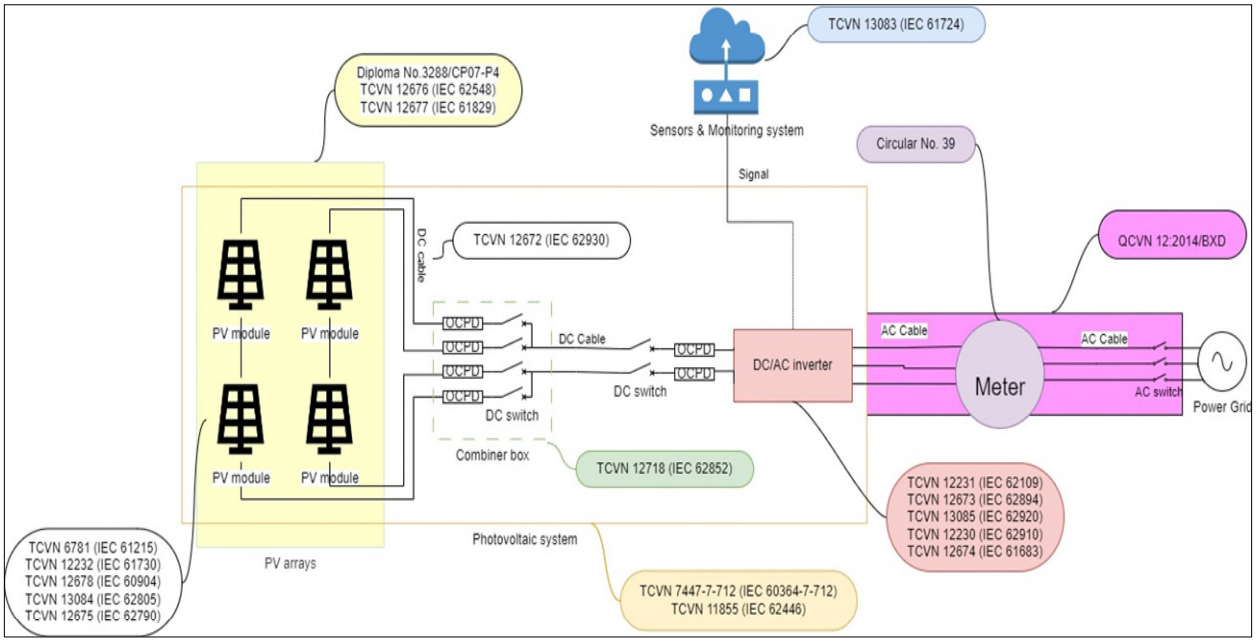


Figure 8: Application areas of PV standards existing in Vietnam

Table 7: Gaps discovered for PV standards in Vietnam

IEC standard	**TCVN status – parts of existing IEC standards not adopted**
IEC 62109 Safety of power converters for use in photovoltaic power systems	IEC 62109-3:2020
IEC 62446 Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning tests and inspection	IEC 62446-2:2020 IEC TS 62446-3:2017
IEC 60904 Photovoltaic devices	IEC TS 60904-1-2:2019 IEC TS 60904-13:2018 IEC TR 60904-14:2020
IEC standard	**TCVN status – Outdated parts of TCVN standards not having been revised based on revised IEC standards**
IEC 60904 Photovoltaic devices	TCVN 12678-1:2020 based on IEC 60904-1:2006, revised by IEC TCVN 12678-2 : 2020 based on IEC 60904-2:2015, revised by IEC TCVN 12678-8-1 : 2020 based on IEC 60904-8:2007, revised by IEC TCVN 12678-9:2020 based on IEC 60904-9:2007, revised by IEC in 2020

IEC standard	TCVN status – parts of existing IEC standards not adopted
IEC TS 62910 Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures	TCVN 12230:2019 based on IEC TS 62910:2015, revised by IEC in 2020
IEC 61724 Photovoltaic system performance	TCVN 13083-1:2020 based on IEC 61724-1:2017, revised by IEC in 2021
IEC 61730 Photovoltaic (PV) module safety qualification	TCVN 12232-1:2019 based on IEC 61730-1:2016, revised by IEC in 2023 TCVN 12232-2:2019 based on IEC 61730-2:2016, revised by IEC in 2023
IEC 61215 Terrestrial photovoltaic (PV) modules – Design qualification and type approval	TCVN 6781 series 2017 based on IEC 61215 series 2016; all parts revised by IEC in 2021

Existing TCVN standards in general are sufficient to construct a whole PV system, as shown in Figure 8. Both inverters and PV modules are covered by five standards already published. The published standards consider safety, general information to be provided on the nameplate, technical issues, and testing procedure.

The overall system is addressed by installation standard TCVN 7447-7-712 (IEC 60364-7-712). For other elements, such as the combiner box, the DC cable, and the monitoring system, standards have also already been adopted and are available as Vietnamese standards. However, as shown in Table 7, some Vietnamese standards need to be updated, or more parts of the existing IEC standards need to be adopted.

Other gaps in TCVN standards concern DC devices, such as DC fuses and DC switches, and standards for designing systems.

6 Recommendations on sequencing / prioritizing standards for adoption in the PV sector in Vietnam

6.1 Methodology for prioritization

Standards were prioritized using a scoring system based on the categories shown in Table 8.

The draft of the prioritization scheme was developed by the national expert and discussed with further experts recommended by PTB.

The scoring system includes four categories:

- Impact on safety
- Impact on technical issues
- Impact on developing the market
- The need in Vietnam

The fixed weights of each category are 40 %, 20d 20 %, respectively. Safety is considered more important than the other categories; hence, it has a higher ratio. The total score is the sum of each category point multiplied by the corresponding weight, see Table 8.

Table 8: The name, weight, and score of the categories in the proposed score system

Category name	Impact on safety	Impact on technical issues	Impact on developing the market	Need in Vietnam
Category weight	40 %	20 %	20 %	20 %
Score	High (1 point) - Medium (0.5 point) - Low (0 point).	High (1 point) - Medium (0.5 point) - Low (0 point).	High (1 point) - Medium (0.5 point) - Low (0 point).	Short-term (1 point) – Mid-term (0.5 point) – Long-term (0 point)

A form was developed for a survey among experts to determine the priorities they see for standards in Vietnam, either to be newly adopted or to be revised due to outdated content.

A list of standards was prepared based on the gap analysis of currently available standards and updated IEC standards (see Table 7), USAID's recommendations (refer to Annex H), and interview results (see Chapter 6.2), except for the planned standards (see standards marked hatched in Table 2).

The questionnaire was sent to five experts, three from PTB and two from VSQI TCVN/TC/E13, including the Chair and the Secretary.

6.2 Recommendation on scores

6.2.1 Categories used to analyze scores

Scoring was received from three PTB experts and two experts in VSQI TCVN/TC/E13, the latter being the TC Chair and the TC Secretary.

In the first step, the results concerning the options for handling standards offered for scoring were analysed using the combined results of both groups of experts into one figure.

The options offered were the update of existing standards and the development of new standards.

In the second step, the scores given to these two categories were assessed based on their origin, being either the PTB experts or the experts from the TC.

6.2.2 Analysis of scores on updating and new developments

Table 9 shows the IEC standards where an update is needed, and the scores they received by combining the scores of both expert groups.

These standards were published as national standards in Vietnam but have gaps due to being outdated (revised versions available at IEC), or where STAMEQ/VSQI did not adopt parts of the international standards.

Table 10 shows the IEC standards that do not yet exist as national standards, as well as the scores they received.

Table 9: Recommendation scores of IEC standards adopted in Vietnam that require an update

IEC standards	Scope	Impact on safety	Impact on technical issues	Impact on developing the market	Need in Vietnam	Total score
IEC 62446 Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning tests and inspection	PV system	60 %	90 %	80 %	60 %	70 %
IEC 60904 Photovoltaic devices	PV module	40 %	100 %	70 %	60 %	62 %
IEC TS 62910 Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures	Inverter	60 %	60 %	40 %	60 %	56 %
IEC 61724 Photovoltaic system performance	PV system	40 %	90 %	40 %	50 %	52 %
IEC 61730 Photovoltaic (PV) module safety qualification	PV module	100 %	90 %	60 %	70 %	84 %
IEC 61215 Terrestrial photovoltaic (PV) modules – Design qualification and type approval	PV module	60 %	90 %	60 %	70 %	68 %

Table 10: Recommendation scores of new proposed IEC standards

IEC standards	Scope	Impact on safety	Impact on technical issues	Impact on developing the market	Need in Vietnam	Total score
IEC 60891 Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics	PV module	0 %	70 %	50 %	30 %	30 %
IEC 61701 Salt mist corrosion testing of photovoltaic (PV) modules	PV module	50 %	80 %	30 %	50 %	52 %
IEC 61853 Photovoltaic (PV) module performance testing and energy rating	PV module	40 %	80 %	50 %	50 %	52 %
IEC TS 61836 Solar photovoltaic energy systems – Terms, definitions and symbols	PV system	30 %	50 %	30 %	50 %	38 %
IEC 62093 Balance-of-system components for photovoltaic systems – Design qualification natural environments	PV system	50 %	60 %	40 %	20 %	44 %
IEC 62124 Photovoltaic (PV) stand alone systems – Design verification	PV system	40 %	60 %	40 %	40 %	44 %

6.2.3 Scoring by the two groups of experts

In this analysis, the scores were studied by their origin: How did the two groups of experts, from PTB and from TCVN/TC/E13, rate standards in the two categories of new development and revisions of existing standards?

6.2.3.1 Scores for new standards

Figure 9 shows the differences in scores between PTB experts and national experts, who are members of TCVN/TC/E13, concerning new standards. The percentages behind the standard numbers are the overall scores received (see also Table 11).

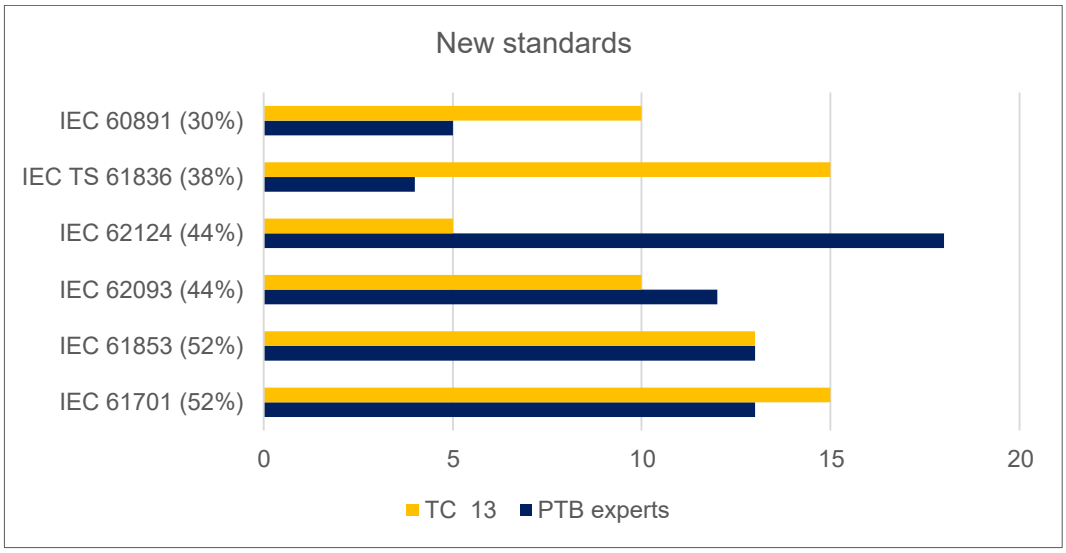


Figure 9: Ratings of PTB experts and experts in TCVN/TC/E13 on new standards[45]

Figure 9 shows that the two standards to be newly developed have received the highest overall score (52 %) by both PTB and national experts are

- IEC 61701 Salt mist corrosion testing of photovoltaic (PV) modules and
- IEC 61853 Photovoltaic (PV) module performance testing and energy rating

Here, the variation between the two expert groups was not very large, with some identical scores.

The same is true for

- IEC 62093 Balance-of-system components for photovoltaic systems – Design qualification natural environments (overall score 44 %).

The differences are significant for the following standards.

- IEC 62124 Photovoltaic (PV) stand-alone systems – Design verification (overall score 44 %)
- IEC TS 61836 Solar photovoltaic energy systems – Terms, definitions and symbols (overall score 38 %)
- IEC 60891 Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics (overall score 30 %).

Adopting IEC 62124 as a new standard seems to be very important from the perspective of PTB experts and much less from that of the national experts. At the same time, it is the other way around for IEC TS 61836 and IEC 60891: the national experts favour adopting these two standards.

This difference in views may originate from the PTB experts looking at the situation from an external perspective. In contrast, the views of the national experts, working with the national TC, reflect their insight into the national context as seen by TC members.

6.2.3.2 Scores for standards to be updated

Overall (see also Table 11), the standards to be updated received higher scores than the standards to be newly developed.

Analysing the scores by PTB experts and national experts, as shown in Figure 10, PTB experts assigned greater relevance to updating the six standards compared to the national experts.

[45] The rating scale used in the figure is a simplified addition of the numbers of the vertical scale in Figure 8.

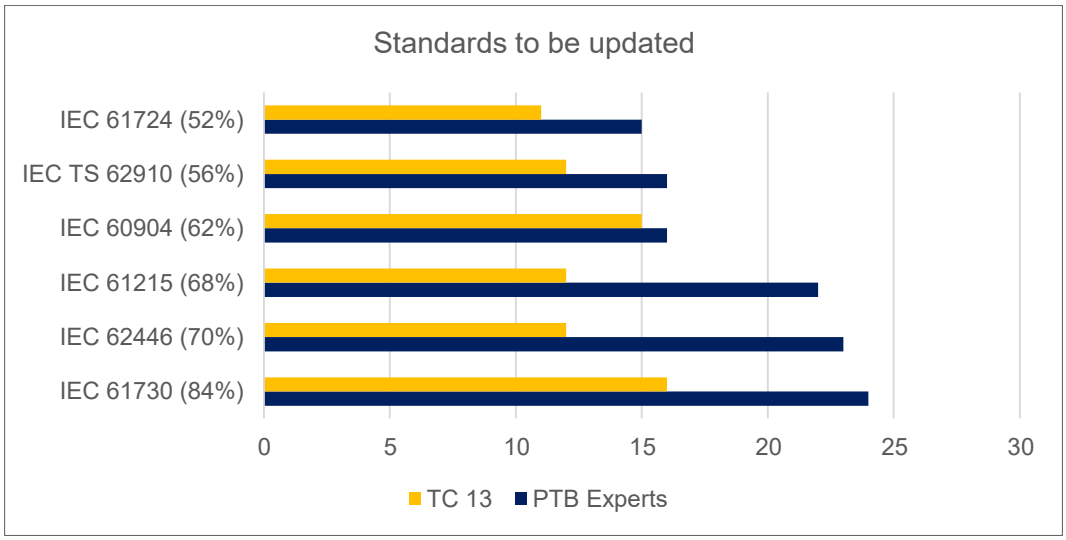


Figure 10: Ratings of PTB experts and experts in TCVN/TC/E13 on new standards[46]

The difference in scoring is significant for

- IEC 61730 Photovoltaic (PV) module safety qualification (overall score 84 %)
- IEC 62446 Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning tests and inspection (overall score 70 %)
- IEC 61215 Terrestrial photovoltaic (PV) modules – Design qualification and type approval (overall score 68 %)

These three standards received the highest overall scores, combining the scores of PTB and national experts, while the difference in scoring is smaller for

- IEC 60904 Photovoltaic devices (overall score 62 %)
- IEC TS 62910 Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures (overall score 56 %)
- IEC 61724 Photovoltaic system performance (overall score 52 %).

6.2.4 Overall scoring

Table 11 aggregates the numerical results of Tables 8 and 9, not considering who rated. It shows that updating existing standards has received higher ranks than developing new ones.

[46] The rating scale used in the figure is a simplifying addition of the numbers of the vertical scale in Figure 8.

Table 11: Prioritizing standards based on sequencing scores of Tables 8 and 9

IEC standard	Scope	Process	Total score
IEC 61730 Photovoltaic (PV) module safety qualification[47]	PV module	Update	84 %
IEC 62446 Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning tests and inspection	PV system	Update	70 %
IEC 61215 Terrestrial photovoltaic (PV) modules – Design qualification and type approval	PV module	Update	68 %
IEC 60904 Photovoltaic devices	PV module	Update	62 %
IEC TS 62910 Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures	Inverter	Update	56 %
IEC 61701 Salt mist corrosion testing of photovoltaic (PV) modules	PV module	New	52 %
IEC 61724 Photovoltaic system performance	PV system	Update	52 %
IEC 61853 Photovoltaic (PV) module performance testing and energy rating	PV module	New	52 %
IEC 62093 Balance-of-system components for photovoltaic systems – Design qualification natural environments	PV system	New	44 %
IEC 62124 Photovoltaic (PV) stand-alone systems – Design verification	PV system	New	44 %
IEC TS 61836 Solar photovoltaic energy systems – Terms, definitions and symbols	PV system	New	38 %
IEC 60891 Photovoltaic devices – Procedures for temperature and irradiance corrections to measured I-V characteristics	PV module	New	30 %

The overall rating per standard is also shown in Figure 10, but separately for each expert group. How these different ratings are used in the context of recommendations to STAMEQ/VSQI is documented in Chapter 7.4.

[47] This standard consists of two parts.

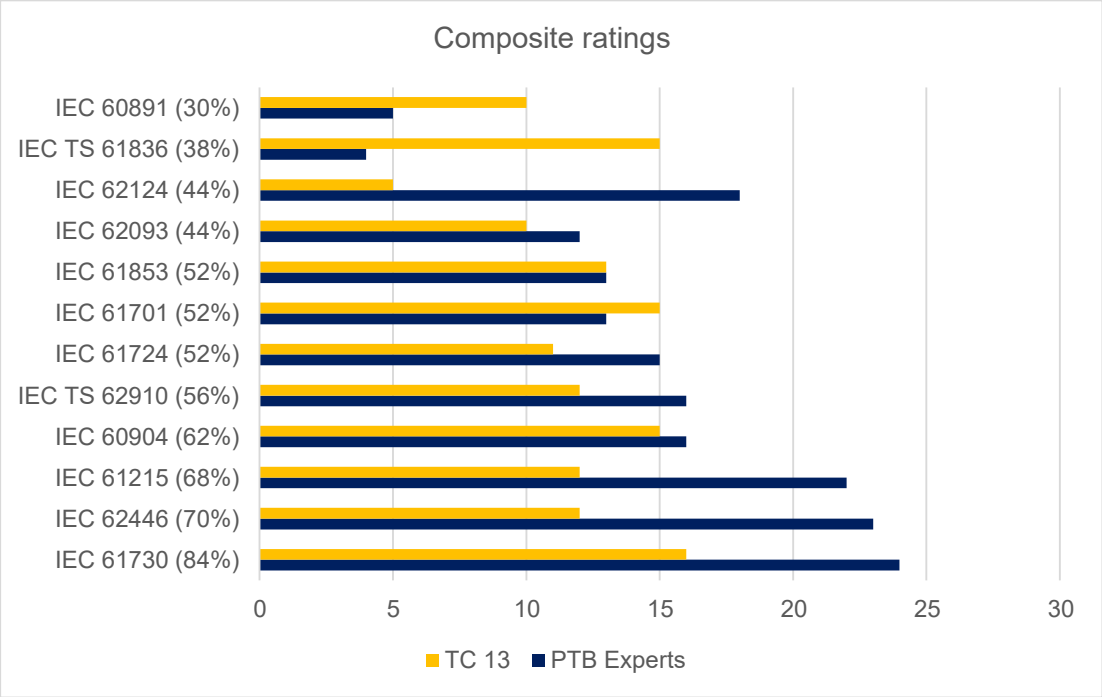


Figure 11: Composite ratings of PTB experts and experts in TCVN/TC/E13[48]

6.3 Discussion of scores

This chapter discusses the scoring of standards and how this should be seen in the context of future work of STAMEQ/VSQI related to either the revision of standards or new developments over the next several years to cover the needs for national standards.

IEC standards that received overall scores higher than 60 % will be discussed first, while other standards with ratings lower than 60 % will not be discussed in great detail, unless the scores of the PTB and the national experts show remarkable variations.

6.3.1 IEC 61730 – Revision indicated for TCVN 12232-1 and TCVN 12232-2

IEC 61730 received the highest scores, with TCVN 12232-1:2019 and TCVN 12232-2:2019 being the adopted national versions of IEC 61730-1:2016 and IEC 61730-2:2016 (refer also to Annex G).

Both IEC standards were revised and published very recently in new versions in September 2023 with technical revisions. The stability date for both is 2027.[49]

Particularly due to the technical modifications from the IEC version of 2016 to the one of 2023, the modifications need to be carefully studied by TCVN/TC/E13 to analyse and understand on the one hand the impact on standards users and on the other the relevance of making the newest version available to the expanding national market. Here, the revision

[48] The rating scale used in the figure is a simplifying addition of the numbers of the vertical scale in figure 8.

[49] Stability periods at IEC are based on an assessment of the maturity of the technology and future, foreseen changes due to the development or maintenance of associated publications. Typically, stability periods are between 3 and 12 years. Information can be found at the IEC Webstore (undated).

of an existing standard is not always considered necessary by STAMEQ/VSQI.[50]

Because both parts of the standard address safety – requirements for construction and requirements for testing – and because safety has been identified as the most important scoring category and a concern for legislators, the revision should be considered a high priority.

In addition, per good standardization practice, a standard should be reviewed every 5 years; 2024 would fall into this default period for a revision of the existing national standards. Thus, default revision coincides with the revision of these two standards due to their revision at IEC and the fact that they received the highest scores overall.

STAMEQ/VSQI should, however, consider an adequate transition period from the old national versions to the new national versions, as the period recommended by WTO TBT is 6 months.

6.3.2 IEC 62446 – Revision indicated for TCVN 11855-1 and new adoptions

IEC 62246 received the second highest score.

The IEC standard currently has three parts and a fourth part under development; the committee responsible for IEC 62446 is WG 3 of IEC TC 82.[51]

STAMEQ/VSQI has adopted IEC 62446-1 as TCVN 11855-1 in 2017; other parts were not adopted.[52]

In the expert survey, there was no distinction made concerning the different parts of the IEC standard, thus scoring was only on "IEC 62246".

IEC 62446-1:2016 was revised to include an amendment and republished in a consolidated version in August 2018. Both versions, that of 2016 and the one of 2018, are valid.

A new version of this part of the standard (ed. 2) is expected to be published in September 2024.[53]

IEC 62446-2 was published by IEC in March 2020; currently, no revision on the international level has been announced, yet because the stability date is 2024, an announcement for review can be expected in 2024.

The third part of the international standard is a Technical Specification (TS) published in June 2017; here, a revision has been started, with a publication date forecast for March 2025.[54]

The adoption of parts 2 and 3 of IEC 62446 is not available as national standards in Vietnam; the base standard received the second highest score by the PTB experts, while only being sixth in the scores by the TC13 experts and should be considered if a proposal for adoption is approved.

6.3.3 IEC 61215 – Revision indicated for TCVN 6781

This IEC standard received the third highest aggregated score. It consists of six parts, the newest versions available having been published in 2021 and 2022. WG 2 in IEC TC 82 is responsible for this standard.

STAMEQ/VSQI adopted all six parts in 2016 but did not revise them when new versions of the IEC standards were available.

Table 12 gives an overview of the IEC stability dates and of the review processes initiated for the six parts.

[50] See also Chapter 8.1.3.4.

[51] IEC 62446-1 (2018).

[52] USAID recommends the adoption of IEC 62446-1 only, which might have influenced the adoption of only this one part by STAMEQ/VSQI, see also Annex H.

[53] IEC 62446-1 (2018).

[54] IEC TS 62446-3 (2017).

Table 12: Parts of IEC 61215 and their stability dates

Standard	Publication date	Stability date	Project in progress
IEC 61215-1:2021 ED2	2021-02-23	2024	IEC 61215-1/AMD1 ED2 (ACD)[55]
IEC 61215-1-1:2021 ED2	2021-02-23	2024	IEC 61215-1-1/AMD1 ED2 (ACD)
IEC 61215-1-2:2021 ED2	2021-02-09	2026	
IEC 61215-1-2:2021/AMD1:2022 ED2	2022-03-28	2026	
IEC 61215-1-3:2021 ED2	2021-02-23	2027	
IEC 61215-1-3:2021/AMD1:2022 ED2	2022-03-28	2027	
IEC 61215-1-4:2021 ED2	2021-02-23	2027	
IEC 61215-1-4:2021/AMD1:2022 ED2	2022-03-28	2027	
IEC 61215-2:2021 ED2	2021-02-24	2024	IEC 61215-2/AMD1 ED2 (ACD)

If a review process has been started, the adoption process on a national level should not be initiated until the publication is available.

For those parts of IEC 61215 with a stability date in 2026 or 2027, adoption should be considered.

6.3.4 IEC 60904 – Revision indicated for TCVN 12678

This IEC standard received the fourth highest score among PTB experts and the second highest of TCVN/TC/E13 experts, along with two other standards. On an international level, it is under WG 2 of IEC TC 82.

The International Standard consists of 15 parts; the stability dates are listed in Table 13.

Table 13: Parts of IEC 60904 and their stability dates

Standard	Publication date	Stability date	Project in progress
IEC 60904-1:2020 ED3	**2020-09-25**	**2025**	
IEC 60904-1-1:2017 ED1	**2017-05-18**	**2027**	
IEC TS 60904-1-2:2019 ED1	2019-01-29	2024	IEC TS 60904-1-2 ED2 (PRVDTS)[56] Publication forecast for April 2024
IEC 60904-2:2023 ED4	**2023-06-19**	**2027**	
IEC 60904-3:2019 ED4	**2019-02-15**	**2026**	
IEC 60904-4:2019 ED2	**2019-11-12**	**2024**	
IEC 60904-5:2011 ED2	**2011-02-17**	**2028**	
IEC 60904-5:2011/AMD1:2022 ED2	2022-11-23	2028	
IEC 60904-7:2019 ED4	**2019-08-20**	**2027**	
IEC 60904-8:2014 ED3	**2014-05-08**	**2024**	**IEC 60904-8 ED4 (ACD) Publication forecast for May 2025**

[55] ACD: Approved for committee draft.

[56] PRVDTS: Preparation of the report of voting on the Draft Technical Specification.

Standard	Publication date	Stability date	Project in progress
IEC 60904-8-1:2017 ED1	**2017-05-18**	**2027**	
IEC 60904-9:2020 ED3	**2020-09-18**	**2024**	
IEC 60904-10:2020 ED3	**2020-09-18**	**2025**	
IEC TS 60904-13:2018 ED1	2018-08-29	2024	
IEC TR 60904-14:2020 ED1	2020-11-25	2026	

No option was offered to the experts to deliver scores on any individual part of the standard. Despite being the fourth priority, if an update to any of the national adoptions is considered, for those International Standards with a stability date of 2024 and/or having entered a revision, an adoption should only be considered for when the new IEC standards are available. Those standards having a stability date beyond 2025 should be taken into account when an update to any of the standards in the series is considered by STAMEQ/VSQI.

However, STAMEQ/VSQI has adopted only 11 parts of the IEC standard, all of which have expired. These are marked in bold in Table 13. The parts not adopted are shown in Table 14.

Table 14: Parts of IEC 60904 not adopted by STAMEQ/VSQI

Standard
IEC TS 60904-1-2:2019 ED1
IEC TS 60904-13:2018 ED1
IEC TR 60904-14:2020 ED1

If a decision is made also to adopt all these three standards or any one of these, the stability years of IEC should be a criterion for when to start the adoption process (see Table 13).

6.3.5 Standards with scores lower than 60 %

The three standards with the highest scores (IEC 61730, IEC 62446 and IEC 61215) have already been discussed. In all three cases, the PTB experts gave significantly higher scores than the TCVN/TC/E13 experts.

The difference in scoring for IEC 62124 is even larger, while overall scoring, thus combining the scores of both groups of experts, is at the lower end (see Figure 12).

PTB experts also gave higher scores for IEC 61724 and IEC TC 62910.

The TCVN/TC/E13 experts delivered significantly higher scores for IEC TS 61836 and IEC 60891 and slightly higher scores for IEC 61701. These three standards are the only ones for which the national experts delivered higher scores for any standard.

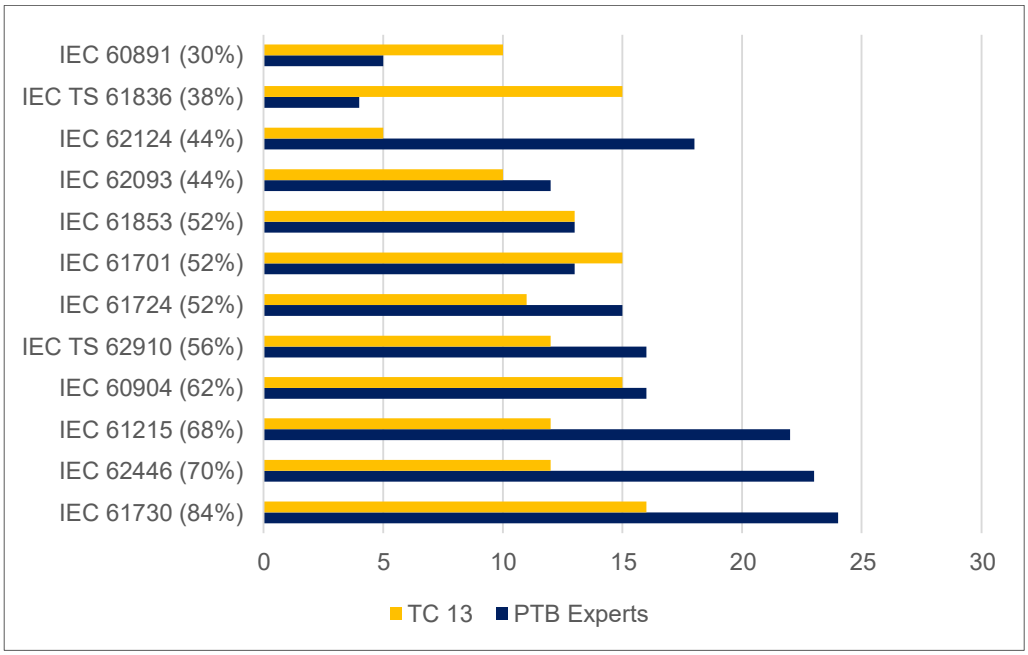


Figure 12: Comparison of scores (PTB and TCVN/TC/E13 experts)[57]

Scores were not significantly different for IEC 62093 and identical for IEC 61853.

In the following, these standards are addressed, from the highest overall rating in this lower category to the standard with the lowest overall score.

6.3.5.1 IEC TS 62910

This Technical Specification was published by IEC in July 2020. The version available at STAMEQ/VSQI as TCVN 12230 was adopted in 2019, just one year before the new IEC standard was available; thus, it is not up-to-date.

PTB experts recommend an update slightly higher than the TCVN/TC/E13 experts.

The IEC stability date is 2024; thus, a review process will likely be initiated in 2024.

Adoption should be considered if the standard is confirmed; the process should start in 2025. If the standard is to be revised, the publication of the new IEC standard should be awaited.

6.3.5.2 IEC 61724

This Technical Specification consists of 3 parts, developed under the responsibility of WG 3 of IEC TC 82.

STAMEQ/VSQI have adopted part 1 of the IEC standard as TCVN 13083-1 in 2020, based on the version of 2016 of IEC; thus, the national standard is not up-to-date.

The standard's stability date on an international level is 2026. If STAMEQ/VSQI considers updating the national standard, this process should be started immediately.

PTB experts recommend an update slightly higher than the TCVN/TC/E13 experts.

STAMEQ/VSQI also adopted part 2 of the International Standard, which is a Technical Specification, as TCVN 13083-2 in 2020, of the 2016 IEC specification. A review is underway at IEC, with the publication of the new version forecast for March 2025. An adoption by STAMEQ/VSQI should not be considered before the new IEC version is available.

[57] The percentages next to the numbers of the standards are the numerical average of the scores of both groups.

Part 3 of the IEC standard is also a Technical Specification, published by IEC in 2016. A review process is underway, with the publication of the new version forecast for March 2025. If an adoption is considered, it should be of the new version in 2025.

As a sidenote, USAID recommends the adoption of parts 2 and 3 only.

6.3.5.3 IEC 61701

STAMEQ/VSQI did not adopt the IEC standard. The TCVN/TC/E13 experts rated its adoption second highest, along with two other standards, and the PTB experts gave it a slightly lower score.

The standard was published in 2020, with WG 2 of IEC TC 82 responsible, and has a stability date of 2025. Considering this, an adoption should be considered when the new version becomes available.

6.3.5.4 IEC 61853

Both expert groups scored this standard identically. It consists of four parts. The stability date for all parts is 2024. The revision process for all has been initiated, and publication of the new versions is foreseen for mid-2025.

If adoption is considered, the new versions should be adopted; thus, the adoption process will not start before mid 2025.

6.3.5.5 IEC 62093

This standard was published by IEC in 2022, with a stability date of 2026. The overall rate for adoption was the third in rank, with the expert groups differing slightly. Due to the lower rank concerning adoption, the standard should not be developed in the near future; instead, the decision of the WG concerning review should be awaited.

6.3.5.6 IEC 62124

This IEC standard was published in 2004. It was developed by WG 3 of IEC TC 82.

It was not adopted by STAMEQ/VSQI; although it was recommended for adoption by USAID (see Annex H) and received the fourth highest score by the PTB experts (see Figure 12), it received the lowest score of all by the TCVN/TC/E13 experts.

The standard is about verification of the system design and performance of stand-alone photovoltaic systems; here, the two groups of experts apparently have contradicting perspectives on the relevance of the standard in the context of Vietnam.

The relevance of the standard could be assessed in the approval process for the proposal to adopt it, particularly in view of the development of the domestic market and national development policies.

The IEC standard has a stability date of 2027; thus, if considered and approved, an adoption should be initiated no later than early 2025.

6.3.5.7 IEC TS 61836

This IEC standard received a high score by the TCVN/TC/E13 experts and the lowest by the PTB experts. The latest version of the International Standard is from 2016, the responsibility with WG 1 of IEC TC 82, and the publication of a new version is forecast for January 2025.

The standard concerns terms, definitions, and symbols for solar PV energy systems and is thus a terminology standard. Terminology standards are usually developed early in the development of standards in a new field to ensure that those involved in the field—including participants in standards development work—understand and use terms and definitions in the same way, preventing misunderstandings and facilitating discussions.

The national experts gave the new version high scores, so even if the PTB experts gave it a low score, the adoption of it when it becomes available in 2025 should be considered.

6.3.5.8 IEC 60891

The standard received the lowest overall score but was considered more important to be adopted by the TCVN/TC/E13 experts than by PTB experts.

The current version of the standard, under WG 2 of IEC TC 82, was published in November 2021, the stability date being 2025.

Due to the low overall rating, the adoption of this standard should not be considered a priority.

6.4 Recommendations to STAMEQ/VSQI

The discussion of the standards in Chapter 6.3 concerning reviews and new developments showed that these decisions must be taken carefully to have the most recent and appropriate standards in place.

The resources needed at VSQI for either updating an existing standard or adopting a new standard should not be much different, because the update of a new standard from a project management perspective is to be considered a new process, including all steps that are also taken in the development of a new standard.

This for STAMEQ/VSQI means distinguishing between "update" and "new development" is irrelevant.

The scores delivered by the experts for several standards did not include the consideration of the status of the standards at IEC, meaning that even if a review/update or an adoption received high scores, the start of the processes should not be initiated if a new version of the IEC standard is announced for the near future, i.e. for 2024 or 2025. This has an impact on the allocation of priorities in Table 15.

Priority 1 was assigned to standards where the adoption process can be initiated immediately because the latest IEC versions were recently published.

Priority 2 was assigned to standards where new versions of standards are under development at IEC, where an IEC review process will start in 2024 or where the IEC standards have not yet been adopted nationally and thus require a discussion in TCVN/TC/E13 on their adoption.

Priority 3 was assigned to standards that are proposed for update and have a new version expected for 2025 or where the IEC standard is proposed for adoption with a new version coming up in 2025 or later.

Table 15: Recommendation to STAMEQ/VSQI by scores

Standard	Process	Recommendation	Time to start process	Priority
IEC 61730-1	Update	Adopt new version immediately	Immediately	1
IEC 61730-2	Update	Adopt new version immediately	Immediately	1
IEC 62446-1	Update	Wait for publication of new IEC standard	Adopt in Sept 2024	2
IEC 62446-2	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments in WG 3 concerning stability o If stability is extended, adopt; o If revision/amendment or similar is decided, wait for publication of new version.	Decide Observe	2
IEC 62446-3	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o If adoption is approved, wait for publication of the IEC standards in March 2025.	Decide March 2025	3
IEC TS 62446-4	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o Process of adoption to start upon availability of the IEC TS.	Decide Observe	2
IEC 61215-1	Update	Wait for publication of amended version	May 2025	2
IEC 61215-1-1	Update	Wait for publication of new IEC standard	April 2025	3
IEC 61215-1-2	Update	Observe developments in WG 3 concerning stability	Observe	2
IEC 61215-1-3	Update	Adopt new version immediately	Immediately	1
IEC 61215-1-4	Update	Adopt new version immediately	Immediately	1
IEC 61215-2	Update	Wait for publication of amended version	Adopt in May 2025	2
IEC 60904-1	Update	– Wait for decision on stability in 2025 o If stability is extended, adopt; o If revision/amendment or similar is decided, wait for publication of new version.	Observe	2
IEC 60904-1-2	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o If adoption is approved, start adoption process immediately after publication of the IEC standard	Adopt in April 2024	2
IEC 60904-2	Update	Adopt new version immediately	Immediately	1
IEC 60904-5	Update	Adopt new version immediately	Immediately	1
IEC 60904-8	Update	Wait for publication of new IEC standard	Adopt in May 2025	3
IEC 60904-9	Update	– Observe developments in WG 3 concerning stability o If stability is extended, adopt; o If revision/amendment or similar is decided, wait for publication of new version.	Observe	2
IEC 60904-10	Update	– Observe developments in WG 3 concerning stability o If stability is extended, adopt; o If revision/amendment or similar is decided, wait for publication of new version.	Observe	2
IEC 60904-13	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption.	Discuss	2

Standard	Process	Recommendation	Time to start process	Priority
		– Observe developments in WG 3 concerning stability o If stability is extended, adopt; o If revision/amendment or similar is decided, wait for publication of new version.	Observe	
IEC 60904-14	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments in WG 3 concerning stability o If stability is extended, adopt; o If revision/amendment or similar is decided, wait for publication of new version.	Observe	3
IEC TS 62910	Update	– Observe developments in WG 3 concerning stability o If stability is extended, adopt; o If revision/amendment or similar is decided, wait for publication of new version.	Observe	2
IEC 61724-1	Update	Adopt new version immediately	Immediately	1
IEC TS 61724-2	Update	Wait for publication of new IEC standard	Adopt in March 2025	3
IEC TS 61724-3	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o If adoption is approved, start adoption process immediately after publication of the IEC standard	Discuss Observe	3
IEC 61701	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o If adoption is approved, start adoption process immediately after publication of newest version of IEC standard	Discuss Observe	3
IEC 61853 (all parts)	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments in WG 3 concerning stability o If stability is extended, adopt; o if revision/amendment or similar is decided, wait for publication of new version.	Discuss Observe	3
IEC 62093	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o If adoption is approved, start adoption process immediately	Discuss Adopt Immediately	2
IEC 62124	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o If adoption is approved, start adoption process immediately	Discuss Adopt Immediately	2
IEC TS 61836	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o If adoption is approved, start adoption process immediately after publication of the newest version of the IEC standard	Discuss Adopt	3
IEC 60891	Adopt	– Initiate discussion in TCVN/TC/E13 to propose adoption. o If adoption is approved, start adoption process immediately after publication of the newest version of the IEC standard	Discuss Observe	3

6.4.1 Prioritizing immediate adoptions

The process should start immediately for seven standards to which priority 1 was allocated. The existing IEC standards are stable, and the PTB experts and the TCVN/TC/E13 experts identified a need for them.

STAMEQ/VSQI has limited resources to adopt any of those standards, while PTB will support the adoption or revision of three or more standards in 2024, and potentially more in 2025, depending on the resources needed for the process at STAMEQ/VSQI and those available in the PTB project.

To support the selection of standards to be adopted first, Table 16 suggests a sequence, with the two standards ranked most important by both groups first and the one with the lowest ranking last. For the remaining ones, recognizing that the national experts have a deeper insight into the situation on site concerning standards in Vietnam, also due to their positions in the TC, the ranking by the national experts determines the sequence.

Remember that any proposal for adoption should be discussed in TCVN/TC/E13 and that the sequence of the standards between 3 and 8, addressing parts of one series of IEC standards, can be modified. Because there are significant differences between the rankings for these by the two groups, PTB experts can be invited to explain why from their perspective the ranking is higher and what the justifications are to develop those first over what the national experts suggest.

Table 16: Sequencing standards development with immediate start of activities

Standard	PTB expert ranking[58]	TCVN/TC/E13 ranking	Overall score (%)	Sequence for development
IEC 61730-1	1	1	84	**1**
IEC 61730-2	1	1	84	**2**
IEC 61215-1-3	3	4	68	**9**
IEC 61215-1-4	3	4	68	**10**
IEC 60904-2	5	2	62	**4**
IEC 60904-5	5	2	62	**6**
IEC 61724-1	6	5	52	**11**

The list of standards with high development priority contains more standards than can be developed in 2024. Thus, any standard not developed in 2024 will be moved to the program for 2025 and addressed first.

In the overall context and to address the adaptation of work to existing capacities and resources, it is recommended that STAMEQ/VSQI set up a national standards work program for PV and a Business Plan for TCVN/TC/E13, or if existing, to revise it.

6.4.2 Planning for further adoptions and new developments

There are 15 standards that have a priority of 2 and 10, with priority 3 according to Table 15.

The reasons for this, which are often not in line with the overall scores, are mostly due to an existing IEC standard being relevant for Vietnam but currently undergoing a revision process at IEC or a review process to be initiated in 2024 or 2025. Thus, adopting these standards before the new versions are available cannot be recommended.

[58] Based on figure 11, rank 1 here being the highest.

This would lead to

- A waste of scarce resources, based on GSP having to start a review process of the adopted IEC standard because the adopted version was already obsolete, and to
- Irritation among standards users who do not appreciate whether they are affected by e.g. transition costs repeatedly over a short period of time.

Therefore, it is highly recommended for STAMEQ/ VSQI to

- Observe the development of a specific standard in IEC to know the decision of the respective IEC TC 82 WG concerning the stability date:
- Developments at IEC concerning stability and the related initiation of a review process can be followed on the website of IEC TC 82 and via announcements on the IEC Webstore website (among other places); this allows the appropriate process of national adoption, if approved, to be initiated:
  - Adopt if the stability period is extended, thus meaning that the standard will be valid for several years, or
  - Wait for the new version in case the IEC standard undergoes a revision process. TCVN/TC/E13 should assess the impact of the period until the revised version is available (default 36 months).

Information on this should also be sought directly from the secretariat of the WG responsible at IEC TC 82, concerning (for example) the start of the review process.

- If information on the publication date has already been announced, align the TCVN/TC/E13 work program and initiate the national adoption or revision process to it, and start the proposal process for adoption/revision as indicated in the TC project plan so that the new IEC standard can be adopted as soon as it is available.
- The discussions on adopting IEC standards, leading to a revision of existing national standards or completely new developments, should be a continuous process in the TC. Thus, it should also be implemented in 2024, with a view to subsequent publications or decisions concerning stability dates in IEC.

It needs to be reiterated that even if a standard has received a high priority in the development sequence, Tables 17 and 18 list standards that received lower overall scores. The proposed sequence for these standards with lower scores and priorities does not consider the distinctions made by the two groups of experts, but rather the availability of revised IEC standards.

Because resources for standards revision or adoption are limited, VSQI needs to enter into discussions with the TC to decide how to handle the standards in Table 16 that cannot be addressed yet in 2024.

Thus, a discussion of the standards work program is essential as well as setting up a standards work plan covering 6 months[59] but fewer than 12 months to offer orientation.

These discussions also need to address the impact of new regulations, new development plans and national policies.

[59] A period of 6 months is in line with the notification requirement of WTO TBT concerning the standards work program.

Table 17: Sequencing standards development of priority 2 with start of activities beyond 2024

Standard	Recommendation	Baseline information	PTB expert ranking[60]	TCVN/TC/E 13 ranking	Overall score (%)	Proposed sequencing
IEC 62446-1	Wait for publication of new IEC standard	New IEC version available in Sept 2024	2	4	70	**1**
IEC 62446-2	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments in WG 3 concerning stability	Observe	2	4	70	**3**
IEC TS 62446-4	Initiate discussion in TCVN/TC/E13 to propose adoption.	New IEC version available in Feb 2025	2	4	70	**2**
IEC 61215-1	Wait for publication of amended version	New IEC version available in May 2025	3	4	68	**2**
IEC 61215-1-2	Observe developments in WG 3 concerning stability	Observe	3	4	68	**3**
IEC 61215-2	Wait for publication of amended version	New IEC version available in May 2025	3	4	68	**2**
IEC 60904-1	Observe developments in WG 3 concerning stability	Observe	5	2	62	**3**
IEC 60904-1-2	Initiate discussion in TCVN/TC/E13 to propose adoption.	New IEC version available in April 2024	5	2	62	**1**
IEC 60904-4	Observe developments in WG 3 concerning stability	Observe	5	2	62	**3**
IEC 60904-9	Observe developments in WG 3 concerning stability	Observe	5	2	62	**3**
IEC 60904-10	Observe developments in WG 3 concerning stability	Observe	5	2	62	**3**
IEC 60904-13	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments in WG 3 concerning stability	Observe	5	2	62	**3**
IEC TS 62910	Observe developments in WG 3 concerning stability	Observe	5	4	56	**3**

[60] Based on figure 11.

Standard	Recommendation	Baseline information	PTB expert ranking[60]	TCVN/TC/E 13 ranking	Overall score (%)	Proposed sequencing
IEC 62093	– Observe developments in WG 3 concerning stability – Initiate discussion in TCVN/TC/E13 to propose adoption.	Observe	8	6	44	**3**
IEC 62124	Initiate discussion in TCVN/TC/E13 to propose adoption.	Immediately	4	7	44	**1**

Table 18: Sequencing standards development of priority 3 with start of activities beyond 2024

Standard	Recommendation	Baseline information	PTB expert ranking[61]	TCVN/TC/E 13 ranking	Overall score (%)	Proposed sequencing
IEC 62446-3	Initiate discussion in TCVN/TC/E13 to propose adoption.	New IEC version available in March 2025	2	4	70	**1**
IEC 61215-1-1	Observe developments in WG 3 concerning stability	Observe	3	4	68	**2**
IEC 60904-8	Observe developments in WG 3 concerning stability	Observe	5	2	62	**2**
IEC 60904-14	Observe developments in WG 3 concerning stability	Observe	5	2	62	**2**
IEC TS 61724-2	Observe developments in WG 3 concerning stability	Observe	6	5	52	**2**
IEC TS 61724-3	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments in WG concerning stability	Observe	6	5	52	**1**
IEC 61701	– Initiate discussion in TCVN/TC/E13 to propose adoption.	Observe	7	2	52	**1**
IEC 61853 (all parts)	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments in concerning stability	Observe	7	3	38	**1**
IEC TS 61836	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments in WG concerning stability	Observe	9	2	38	**1**

[61] Based on figure 11.

Standard	Recommendation	Baseline information	PTB expert ranking[61]	TCVN/TC/E 13 ranking	Overall score (%)	Proposed sequencing
IEC 60891	– Initiate discussion in TCVN/TC/E13 to propose adoption. – Observe developments concerning stability	Observe	10	6	30	**1**

6.5 Need for other standards beyond PV

Vietnam is encouraging the installation of solar rooftops for office buildings and homes. These systems need batteries; thus, secondary cell standards should also be considered. Although such standards are not prioritised, they should be included in the plan for sequencing standards for the PV sector.

Table 19 gives a brief overview of battery standards.

Table 19: Selection of secondary cell battery standards relevant for PV available at IEC[62]

	Storage medium			
Application	**NiCd**	**NiMH**	**Li-Ion**	**Fuel cells**
Portable	IEC 62133-1:2017			
	IEC 61951-1:2017	IEC 61951-2 :2017	IEC 62133-2:2017&AMD1:2021 IEC 61960-3:2017	
Stationary			IEC 63056:2020 IEC 62619:2017 (IEC 62620:2014)	IEC 62282-3-100:2012 IEC 62282-6-100:2010

[62] Based on the presentation prepared by Dr. Gerhard Kleiss on the occasion of the World Standards Day celebration of BSN Indonesia on 2023-10-17.

7 Recommendations regarding the standards development process

7.1 Findings and recommendations regarding VSQI procedures, organizational structure and resources relevant for its standardization processes

7.1.1 The national standardization strategy

Standards bodies have national standardization strategies (NSS) to guide the national standards body in its standardization efforts. In developing countries, it is most often developed based on the ISO Methodology.[63]

Specifically, an NSS aims to identify and prioritise the needs that can be addressed through standardisation. These needs can be economic, societal, or environmental and can arise from existing conditions or address future opportunities and challenges such as new technologies, trade opportunities, and climate change.

An NSS is usually high-level, requesting that standards should address specific economic, trade-related, environmental, and other specific issues on a more general level. Though usually indicating priority areas, the NSS does not address in detail which standards should be developed.

This is done in the second stage by developing a national standardization plan (NSP),[64] which is also called a standards work program. Per ISO Methodology, it should address which standards are needed per sector and field (reflecting stakeholder needs), whether existing international standards are to be adopted as national standards, whether a "home-grown" standard should be developed because no international or regional standard exists, and whether active participation in specific areas of international standards development should be undertaken.

The availability of resources to implement such an NSP must be assessed; if resources are unavailable, the NSP needs to be adapted or revised.

STAMEQ developed an NSS with the support of an international expert. It is awaiting endorsement by MOST. After this endorsement, STAMEQ will develop a master plan—equivalent to an NSP following the ISO methodology or a standards work program—which is expected to take time. It is recommended that the NSS after its approval be studied to see whether conditions and needs addressed in the strategy have since changed.

The NSS of Vietnam in its current version does not address the PV sector in particular; it addresses the energy sector in general.

However, because Vietnam's development plan includes rooftop solar systems, batteries for storage are needed and should be addressed in the master plan.

The NSS and the NSP should also lead to a standards work plan, ideally covering a period of 6 months, in accordance with WTO TBT Agreement requirements.

7.1.2 Project management

Applying a project management approach to the standards development process is essential to ensuring that standards are being developed to address needs, that they use resources efficiently and effectively, and that products are delivered to the market within an appropriate timeframe.

GSP principles are embedded into the core and support activities of the NSB value chain, impacting the design of processes within the standards development process.

[63] ISO (2020).

[64] Terminology used in the ISO methodology.

In the following steps in the planning, development and publication processes and activities at STAMEQ/VSQI are addressed.

7.1.2.1 Proposal for new standards

Every fall in Vietnam, relevant stakeholders are approached by STAMEQ to articulate their demands and needs; their proposals are collected and passed to VSQI for evaluation with the support of its technical committees.

The proposals received by STAMEQ/VSQI are evaluated by the technical committee under which the proposal would fall. It is unclear to the authors of this study what the criteria are for such an evaluation.[65]

ISO Form 4[66] contains example criteria for evaluating a proposal.

A procedure should be developed for handling such a proposal, including options such as deferral, cancellation, withdrawal, and re-evaluation. This document should also address proposals that do not meet the criteria for a standard to be developed, how to handle these, and how communication with the proposal authors is implemented.

Furthermore, there is no clearly defined and documented procedure for what to do if the number of standards exceeds the budget, apart from postponing the development. In project management, this would be addressed by risk management, and STAMEQ/VSQI should implement such activity in the planning process (identification of potential risks) as well as in the development process of standards (treatment of risks).

As discussed in Chapter 7.4.2 and documented in Tables 17 and 18, there is a wide range of standards in the PV sector that are generally relevant for the PV sector in Vietnam but have not received a high priority as of today. This should be regularly verified because the sector is very agile, and needs for new standards may arise, not least via new national policies or areas where regulation seems urgent.

Recommendations on how this can be done are also given in Chapter 7.4.2.

7.1.2.2 The duration of the standardization process

Stakeholders consider the duration of the standards development process at STAME/VSQI (and, as a related topic, the availability of standards) a barrier to developing the PV sector in Vietnam.

STAMEQ/VSQI follows GSP in the standards development process, including stages for proposals, committee drafts, inquiries, a final draft, approval, and publication. This ensures that the standards development process is in line with international good practices; the duration of any process steps must consider the time needed to ensure transparency and openness, specifically regarding stakeholder participation.

However, there are processes internal to standards-developing organizations, such as managing activities related to preparing meetings and documents, preparing public enquiries, translating, editing, and managing the approval and publication process.

Such activities are usually documented in work instructions, but not in higher-level documents. They must be easily modifiable following reviews of good practices and their interpretation by (for example) WTO members during the triennial reviews of the operation and implementation of the TBT Agreement, meeting of the TBT Committee.[67]

For an NSB to be able to address the development time of standards, it is necessary to analyze in detail the human resources needed for core activities as

[65] Good practice based on WTO TBT Agreement Annex 3 calls for information on proposals to be made public so that all stakeholders are informed about a proposal for a new standard. There is also the requirement to make work programs publicly available every six months so that not only national stakeholders are informed, but all stakeholder members of WTO. – Vietnam provides a link on the WTO ISO Standards Information Gateway https://tbtcode.iso.org/list-of-standardizing-bodies.html to its work program; however, the link leads to the general website of STAMEQ/VSQI. When then continuing the search there are lists available on proposals and published standards, but only in the Vietnamese language and thus not useful for stakeholders interested in finding out about standards and standards projects in Vietnam. This can constitute a barrier to foreign investors.

[66] Retrievable from ISO Forms (undated).

[67] The latest review took place in March 2024. Based on TBT (undated).

well as supporting activities in the value chain of standards development. As a start, this can be done for one project with a very detailed work breakdown structure, which in practice does not need to be done for every project. However, it would create a model for allocating human resources, budgeting and calculating costs.

A project plan for every development or adoption project will ultimately yield verified default periods for the development of standards (depending, for example, on the complexity of the topic of a standard, availability of experts, and resources for meetings), but will also allow resources to be used more efficiently and effectively.

7.1.2.3 Dissemination, communication, and stakeholder engagement

Dissemination of information on standardization, standards, and any other activity by an NSB is essential to being visible and recognized.

Dissemination is usually considered a “one-way” form of communication, where no response or feedback is expected after sending out information. This format should, therefore, be used to make the general public aware of the NSB and what it does.

STAMEQ/VSQI, together with the information department, should develop a dissemination strategy that identifies topics relevant to the general public, formats of dissemination, and timing of dissemination.

Dissemination of information may also require better structures and management across and among the QI services so that all are on the same level of knowledge concerning standards.

Good standards depend on the engagement of and with stakeholders, and here, dissemination of information is not sufficient. It is recommended that VSQI develop a stakeholder engagement strategy based on an in-depth and careful analysis of stakeholders, both known and unknown, to help STAMEQ/VSQI gain insight into what stakeholders need from their individual perspectives.

A top-level strategy should identify stakeholders by category, following (for example) the eight ISO categories[68] and assessing stakeholders´ impact and influence on standards development and their relevance within the industry (among other places). In the following step, it needs to be deliberated how a specific stakeholder group or stakeholder should be addressed and whether this should be on an institutional or TC level. It is essential that the development, subsequent implementation and monitoring and review of the stakeholder engagement strategy is allocated to a dedicated instance; this instance could take the form of a working group composed of staff delegated from across the NSB.

7.1.2.4 Review of adopted standards

As documented in Table 7, some TCVNs are outdated as they do not correspond to the current version of an IEC standard.

When this was discussed with STAMEQ/VSQI, it was explained that there are cases where the Vietnamese adoptions are not revised because the newer version of an IEC standard might request a level of performance that cannot be achieved by the Vietnamese industry.

This technological argument requires justification. Modifying an existing international standard might not always result in "higher levels" of requirements but may lead to clarification of ambiguous content or where industry wants to bring new insights to the standards, or research indicates that values ought to be changed.

A standard is a recommendation, not a requirement. Industry decides on its use: users are free to choose to observe the standard or to use other technical solutions, although it is recommended to use any standard in its entirety.

Therefore, not adopting a new version of a standard might lead to a gap in the knowledge available to market participants in Vietnam, knowledge that would enhance their own expertise.

[68] Information on this is available in the ISO Global Directory, ISO GD (undated).

If an adopted standard that does not correspond to the newest version is used in a regulation as a dated reference, only the "outdated" Vietnamese version may be used. This would compromise the adaptation of the Vietnamese industry to the state of the art as documented in the new version of the standard, while potentially even hindering innovation in the PV sector.

It would be valuable to assess the process of reviewing existing standards; per GSP, this is done every five years for every standard. The review and revision process at IEC should be followed closely to find out when an IEC standard is under review so that the Vietnamese side can react.

It is not yet clear to the authors of this study who decides on the adoption of a new version of an IEC standard; it is recommended that this isto be discussed in the TC and disseminated to the broader public.

When adopting further standards relevant for PV in the future, STAMEQ/VSQI should always carefully assess and follow the status of any standard to be adopted from IEC.

7.1.2.5 The standards catalogue

As explained above, access to the standards catalogue is challenging due to its availability in Vietnamese only; therefore, its usability is difficult to assess.

In 2018, a bilateral project was implemented by DIN, the German National Standards Body, and STAMEQ to review the existing information system and to develop a roadmap to its improvement. At the time, this implied the integration of data on standards from Vietnam into Perinorm, a reference database used at that time for searching for and managing standards and technical rules, but which has since been discontinued. Nautos, offered by the same company, DIN Media (formerly Beuth Verlag), is a further developed successor system that provides support in mastering the challenges of digitalization, internationalization and increasing compliance requirements, including in standards management.[69]

Considering specifically the area of standards management, not only on the part of standards users, but also standards development, and providing information on standards, STAMEQ/VSQI should reconsider how to integrate information on its standards while having access to information of other standards developing organizations (SDO) and their standards.

A regional PTB project titled “Strengthening the Quality Infrastructure in ASEAN” is implementing an activity to provide a proposal for implementing a standards information repository for industry, explicitly addressing the access to standards information across all ASEAN member states. This could serve as another opportunity to assess the form of information sharing on standards and how to have a national catalogue that is compatible with user needs.

7.2 Findings and recommendations regarding member structure and procedures in the TCs relevant to renewable energy and the VSQI representation in the relevant international TCs

STAMEQ/VSQI is an associate member of IEC. As an associate member, STMEQ/VSQI has the right to access all working documents and can opt to send experts to participate in a limited number of technical committees/subcommittees. In these committees, the Vietnamese National Electrotechnical Committee (NEC) and its TCs may submit comments on the documents that have been circulated.

All associate members may participate as P-members in the work of a maximum of four pre-notified, already established technical committees and/or subcommittees.[70]

STAMEQ/VSQI has established an NEC and is a participating member (P-member) in three IEC TCs:

- TC 2 Rotating machinery
- TC 20 Electric cables
- TC 61 Safety of household and similar electrical appliances

STAMEQ/VSQI thus does not make full use of its rights as an associate member, nor does it observe the

[69] Nautos (undated).

[70] IRC (20218).

activities of any other IEC TC. Therefore, it neither participates nor observes the activities of IEC TC 82 Solar photovoltaic energy systems. This TC is the most active TC in IEC, having produced 200 standards for PV and listing 65 in its work program.

It should be discussed in STAMEQ/VSQI whether participation in IEC TC 82 or one of its working groups should be requested from IEC. Table 20 indicates working groups that the organization should study in detail.

Table 20: Working groups in IEC TC 82 of interest for Vietnam[71]

Type	Label	Description
Joint Working Groups	JWG 1	Renewable energy off grid systems, including access to electricity, rural electrification and hybrid systems
Joint Working Groups	JWG 11	Building-Integrated Photovoltaics (BIPV)
Working Group	WG 1	Glossary
Working Group	WG 2	Modules, non-concentrating
Working Group	WG 3	Systems
Working Group	WG 6	Balance-of-system components
Working Group	WG 7	Concentrator modules
Working Group	WG 8	Photovoltaic (PV) cells
Working Group	WG 9	BOS Components – Support Structures

STAMEQ/VSQI may decide to become a member of the TC but might also consider whether participation in a specific working group would be more beneficial to have early access to knowledge.

In this context, three working groups are of potential interest.

- WG 2 Modules, non-concentrating

  Scope: To develop international standards for non-concentrating, terrestrial photovoltaic modules. These standards will be in the general areas of photoelectric performance, environmental testing, quality assurance and quality assessment criteria.

  WG 2 is the most active working group in IEC/TC 82. Most standards in Table 11 are discussed in WG 2.

- WG 3 Systems

  Scope: To give general instructions for the photovoltaic system design, construction and maintenance. For each particular user's application, each activity should be the object of a separate study area. This working group's goal is to incorporate the existing standards on the functional blocks that are different from the photovoltaic array field and promote the production of new specific standards when necessary.

- WG 6 Balance-of-system components

  To develop international standards for balance-of-system components for PV systems. These standards will be in the general areas of performance, safety, environmental durability (reliability), quality assurance and quality assessment criteria. The standards ultimately produced should be universal and non-restrictive in their application, considering different environments and manufacturing technologies. In addition to the basic electrical and mechanical characteristics, standards will be written for other important factors such as thermal performance, electromagnetic interference, and climate applicability/rating.

When considering becoming a full member of IEC, STAMEQ/VSQI may also consider assessing participation, as either a P-member or an O-Member, in IEC

[71] For a full list, including scopes, refer to Annex K.

TCs developing battery standards, as listed in Table 18.

Table 21: IEC TCs active in standards for battery storage[72]

IEC Technical Committee	Title
IEC/TC 21	Secondary cells and batteries
IEC/TC 40	Capacitors and resistors for electronic equipment
IEC/TC 120	Electrical Energy Storage (EES) systems

STAMEQ/VSQI is adopting IEC standards for the PV sector, but the study team is not currently clear on how to comment on documents originating from IEC TC 82.

When setting up a dedicated national TC or subcommittee, the committee's composition should be carefully considered. This should be based on a thorough assessment of stakeholders and their categories, their specific interests and needs, and the expertise they can bring to standards development. The interests of medium-sized industry should also be considered, and representatives or companies should be invited to participate.

The decision on how the work in IEC is to be mirrored should be made by STAMEQ/VSQI. A national mirror committee (NMC) can be set up aside from TCVN/TC/E13 or TCVN/TC/E13 can be mandated with mirror work. Setting up a separate NMC usually results in additional coordination efforts on a national level with the TC, in this case TCVN/TC/E13 handling renewable energies on a national level (e.g. duplication of work, overlaps with national work). Having separate committees can also result in technical experts unwilling to engage in two committees, adding to their workload in standardization, when work can be implemented more efficiently in just one committee. TCVN/TC/E13 can establish a sub-committee dedicated to PV, announcing it as an NMC to IEC, while keeping it under its roof.

The IEC standards on PV will be adopted ex-post by STAMEQ/VSQI as they do not participate in any form in IEC TC 82; therefore, the development process is limited to studying the standards. Here, the participation of academia and research is certainly important. However, industry and other users will implement the standards, and their understanding of the IEC standard is crucial for successful implementation.

When using its right to participate in a fourth committee, STAMEQ/VSQI has the option to contribute to the development of the standards beyond studying a standard ex-post for adoption. Many neighbouring countries, such as Indonesia, Malaysia, the Philippines, Singapore, and Thailand, are P-members of IEC TC 82.

Procedures for standards development in the PV sector must not differ from those in any other area of standardization.

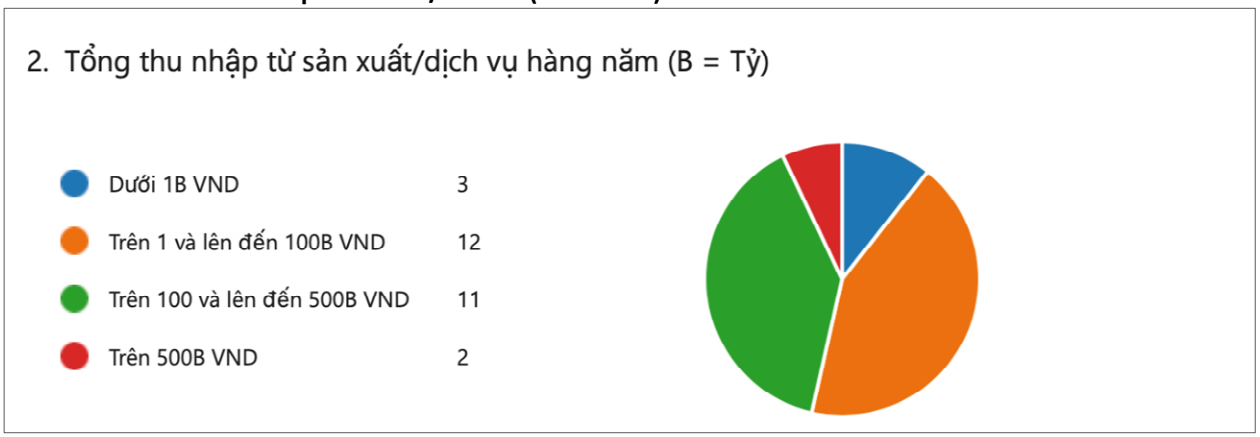
[72] Based on the presentation prepared by Dr. Gerhard Kleiss on the occasion of the World Standards Day celebration of BSN Indonesia on 2023-10-17.

Annexes

Annex A: Data on survey participants

The information provided in this Annex is based on survey results as of 2023-11-21. The headings are identical to the questions in English.

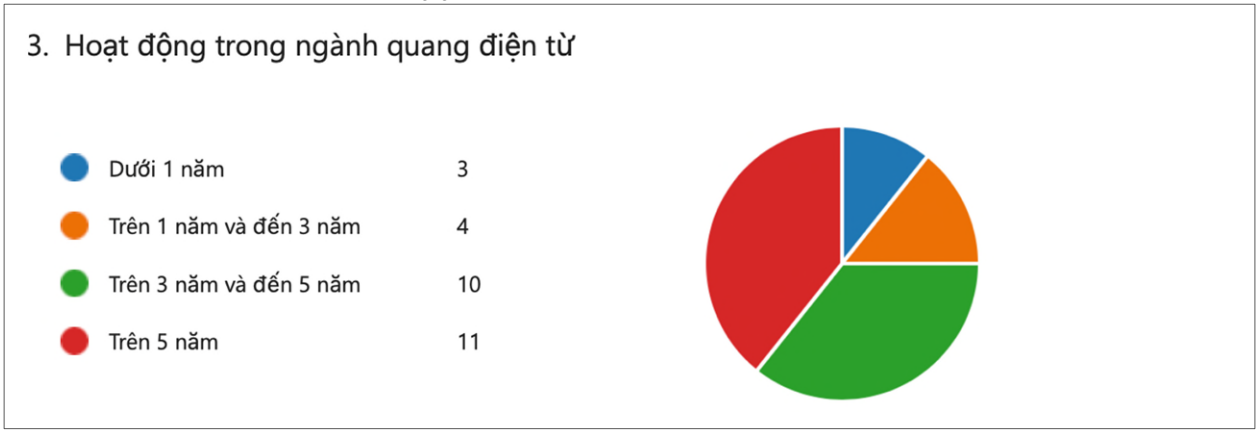
Overall annual income of production/service (B = Billion)



Translation of legend

Dưới 1B VND	Less than 1B VND
Trên 1 và lên đến 100B VND	More than 1 and up to 100B VND
Trên 100 và lên đến 500B VND	More than 100 and up to 500B VND
Trên 500B VND	More than 500B VND

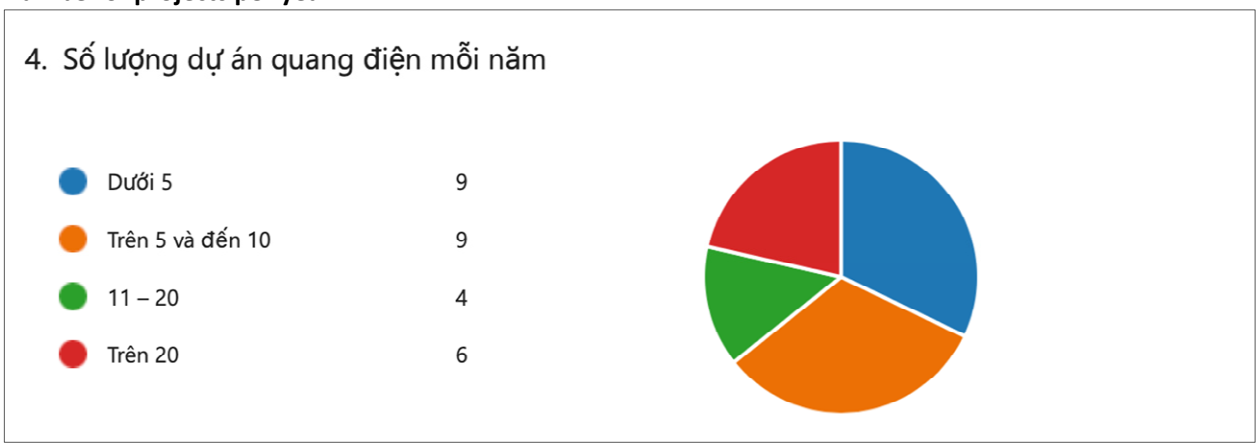
Active in the PV sector for how many years



Translation of legend

Dưới 1 năm	Less than 1 year
Trên 1 năm và đến 3 năm	More than 1 year and up to 3 years
Trên 3 năm và đến 5 năm	More than 3 years and up to 5 years
Trên 5 năm	More than 5 years

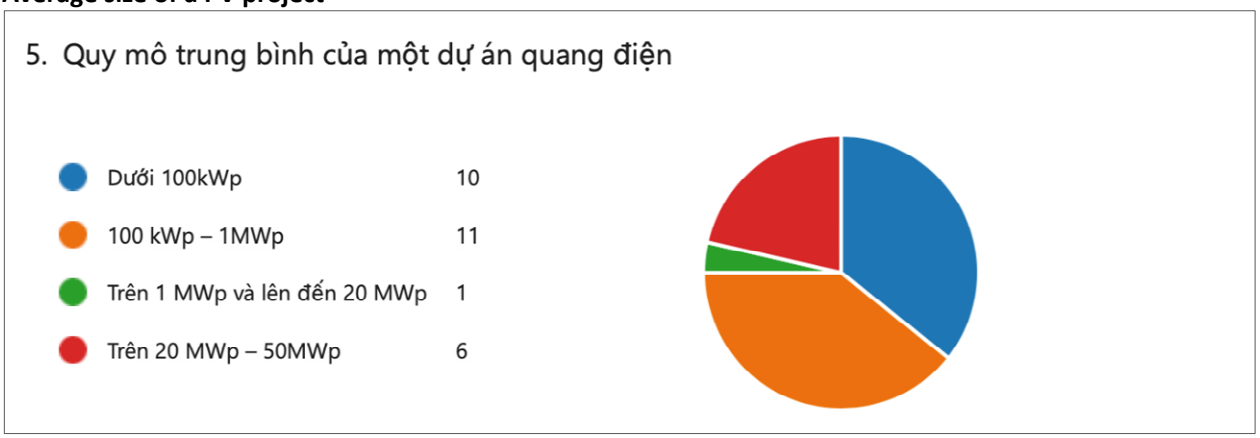
Number of projects per year



Translation of legend

Dưới 5	Fewer than 5
Trên 5 và đến 10	More than 5 and up to 10
11 – 20	11 – 20
Trên 20	More than 20

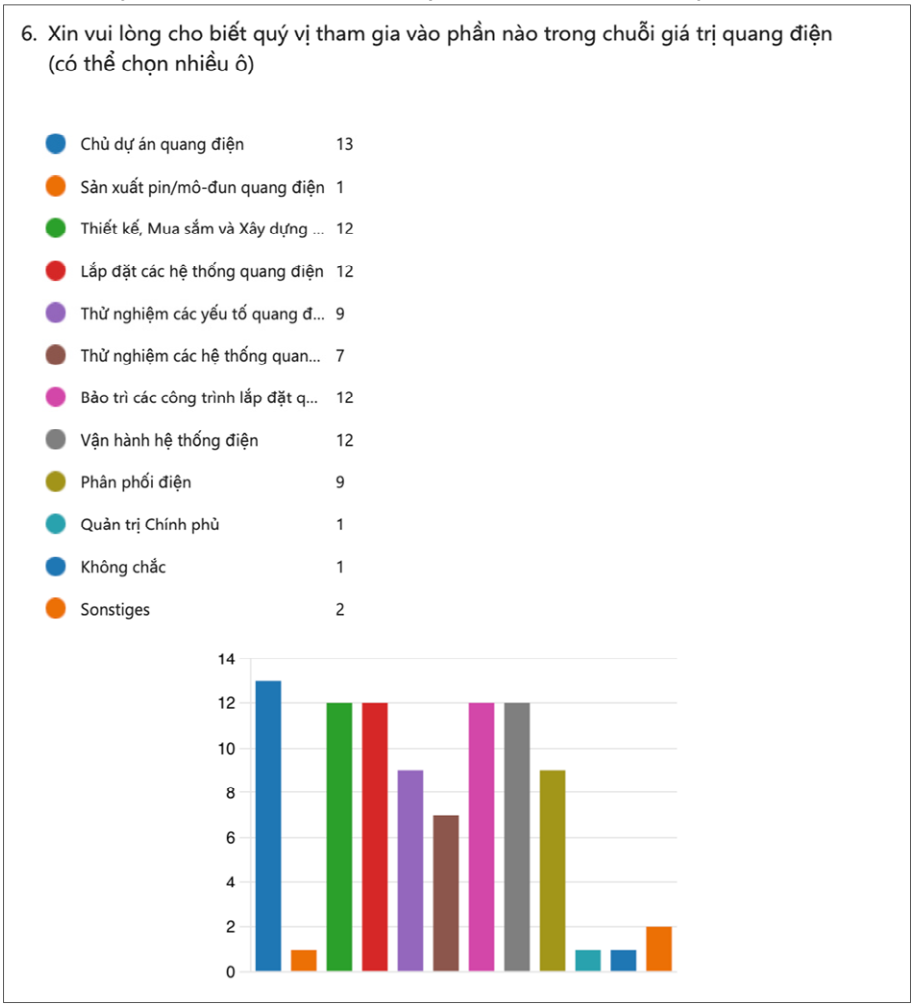
Average size of a PV project



Translation of legend

Dưới 100kWp	Less than 100kWp
100 kWp – 1MWp	100 kWp – 1MWp
Trên 1 MWp và lên đến 20 MWp	More than 1 MWp and up to20 MWp
Trên 20 MWp – 50MWp	More than 20 MWp – 50MWp

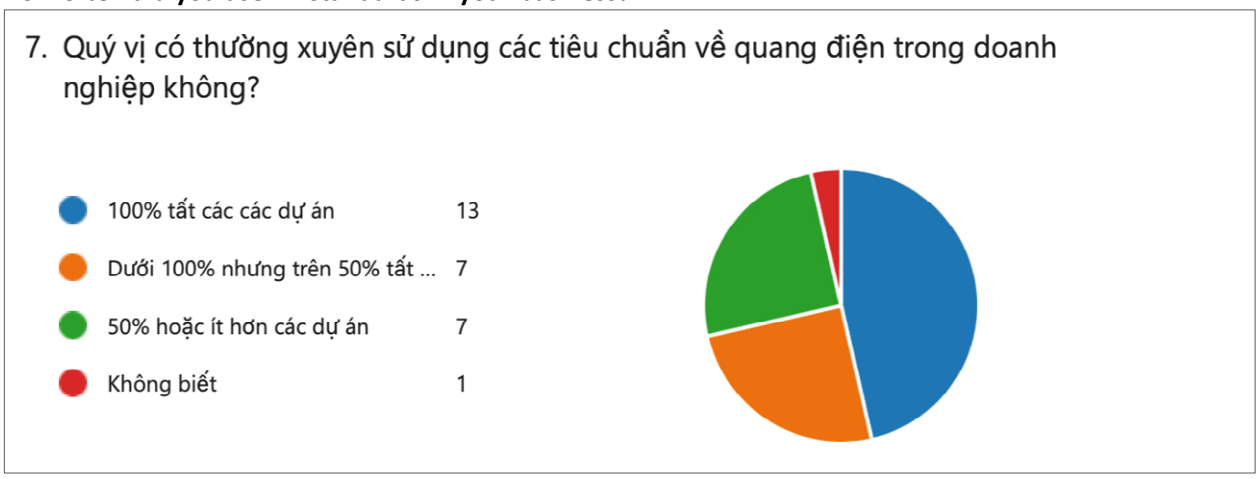
Please indicate in which part of the PV value chain you are involved (multiple answers allowed)



Translation of legend

Chủ dự án quang điện	PV project owner
Sản xuất pin/mô-đun quang điện	Manufacturing of PV cells / modules
Thiết kế, Mua sắm và Xây dựng (EPC)	Engineering, procurement and construction (EPC)
Lắp đặt các hệ thống quang điện	Installation of PV systems
Thử nghiệm các yếu tố quang điện	Testing of PV elements
Thử nghiệm các hệ thống quang điện	Testing of PV systems
Bảo trì các công trình lắp đặt quang điện	Maintenance of PV installations
Vận hành hệ thống điện	Power system operation
Phân phối điện	Power distribution
Quản trị Chính phủ	Government administration
Khác:	Others
Không chắc	I do not know

How often did you use PV standards in your business?



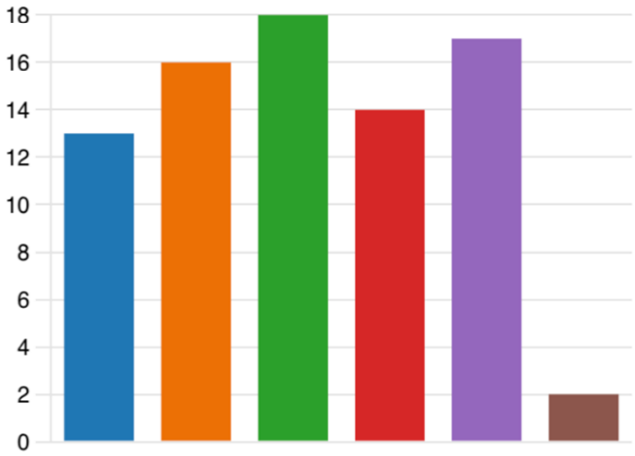
Translation of legend

100 % tất các các dự án	100 % of all projects
Dưới 100 % nhưng trên 50 % tất cả các dự án	less than 100 % but more than 50 % of all projects
50 % hoặc ít hơn các dự án	less than 50 % of all projects
Không biết	I do not know

Which standards did you often use in your business? (multiple answers allowed)

8. Quý vị thường sử dụng tiêu chuẩn nào trong doanh nghiệp? (có thể cung cấp nhiều câu trả lời)

Tiêu chuẩn nhóm về các thiết bị...	13	Group standards of PV devices (TCVN 12678 series/IEC 60904)
Tiêu chuẩn nhóm về các mô-đu...	16	Group standards of PV modules (TCVN 6781 series/IEC 61215)
Tiêu chuẩn nhóm về hệ thống q...	18	Group standards of PV system (TCVN 11855/IEC 62446)
Tiêu chuẩn nhóm về biến tần q...	14	Group standards of PV inverters (TCVN 11855-1, TCVN 12673)
Tiêu chuẩn nhóm về lắp đặt điệ...	17	Group standards of Electrical installation (TCVN 7447-7-712/IEC
Sonstiges	2	Others



Annex B: ASTM standards for the PV sector[73]

Number	Title
E948-16(2020)	Standard Test Method for Electrical Performance of Photovoltaic Cells Using Reference Cells Under Simulated Sunlight
E973-16(2020)	Standard Test Method for Determination of the Spectral Mismatch Parameter Between a Photovoltaic Device and a Photovoltaic Reference Cell
E1021-15(2019)	Standard Test Method for Spectral Responsivity Measurements of Photovoltaic Devices
E1036-15(2019)	Standard Test Methods for Electrical Performance of Nonconcentrator Terrestrial Photovoltaic Modules and Arrays Using Reference Cells
E1038-10(2019)	Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls
E1040-10(2020)	Standard Specification for Physical Characteristics of Nonconcentrator Terrestrial Photovoltaic Reference Cells
E1125-16(2020)	Standard Test Method for Calibration of Primary Non-Concentrator Terrestrial Photovoltaic Reference Cells Using a Tabular Spectrum
E1143-05(2019)	Standard Test Method for Determining the Linearity of a Photovoltaic Device Parameter with Respect To a Test Parameter
E1171-15(2019)	Standard Test Methods for Photovoltaic Modules in Cyclic Temperature and Humidity Environments
E1362-15(2019)	Standard Test Methods for Calibration of Non-Concentrator Photovoltaic Non-Primary Reference Cell
E1462-12(2018)	Standard Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules
E1597-10(2019)	Standard Test Method for Saltwater Pressure Immersion and Temperature Testing of Photovoltaic Modules for Marine Environments
E1799-12(2018)	Standard Practice for Visual Inspections of Photovoltaic Modules
E1802-12(2018)	Standard Test Methods for Wet Insulation Integrity Testing of Photovoltaic Modules
E1830-15(2019)	Standard Test Methods for Determining Mechanical Integrity of Photovoltaic Modules
E2047-10(2019)	Standard Test Method for Wet Insulation Integrity Testing of Photovoltaic Arrays
E2236-10(2019) S	Standard Test Methods for Measurement of Electrical Performance and Spectral Response of Nonconcentrator Multijunction Photovoltaic Cells and Modules
E2481-12(2018)	Standard Test Method for Hot Spot Protection Testing of Photovoltaic Modules
E2527-15(2019)	Standard Test Method for Electrical Performance of Concentrator Terrestrial Photovoltaic Modules and Systems Under Natural Sunlight
E2685-15(2019)	Standard Specification for Steel Blades Used with the Photovoltaic Module Surface Cut Test
E2766-13(2019)	Standard Practice for Installation of Roof Mounted Photovoltaic Arrays on Steep-Slope Roofs
E2848-13(2018)	Standard Test Method for Reporting Photovoltaic Non-Concentrator System Performance
E2908-12(2018)	Standard Guide for Fire Prevention for Photovoltaic Panels, Modules, and Systems

[73] ASTM (undated).

ANNEX B: ASTM STANDARDS IN THE AREA OF PV

Number	Title
E2939-13(2018)	Standard Practice for Determining Reporting Conditions and Expected Capacity for Photovoltaic Non-Concentrator Systems
E3006-20	Standard Practice for Ultraviolet Conditioning of Photovoltaic Modules or Mini-Modules Using a Fluorescent Ultraviolet (UV) Lamp Apparatus
E3010-15(2019)e1	Standard Practice for Installation, Commissioning, Operation, and Maintenance Process (ICOMP) of Photovoltaic Arrays
E3325-21	Standard Practice for Sampling of Solar Photovoltaic Modules for Toxicity Testing

Annex C: Standards developed by IEEE for PV[74]

The IEEE SCC21 committee is currently titled "Distributed Generation, Energy Storage and Interoperability Standards Committee". It has been in in existence since the 1990s and initially published IEEE 1547-2003 Standard for Interconnecting Distributed Energy Resources to the Electric Power System in 2003. This was followed by IEEE 1547.1-2005 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces.

In addition, more recently, the committee sponsored

- IEEE 1547.3-2023 IEEE Guide for Cybersecurity of Distributed Energy Resources Interconnected with Electric Power Systems
- IEEE 1547.9-2022 IEEE Guide for Using IEEE Std 1547 for Interconnection of Energy Storage Distributed Energy Resources with Electric Power Systems

In the early 2000s, the committee sponsored several standards related to stand-alone PV systems:

- IEEE 937 Recommended Practice for Installation and Maintenance of Lead-Acid Batteries for Photovoltaic (PV) Systems
- IEEE 1013 Recommended Practice for Installation and Maintenance of Lead-Acid Batteries for Photovoltaic (PV) Systems
- IEEE 1144 Recommended Practice for Sizing of Stand-Alone Photovoltaic (PV) Sytems (NiCd PV Sizing)
- IEEE 1145 Recommended Practice for the Installation and Maintenance of Nickel-Cadmium Batteries for Photovoltaic (PV) Systems (PV NiCd Installation & Maintenance)
- IEEE 1361 Guide for Selecting and Evaluating Batteries Used in Stand-Alone Photovoltaic (PV) Systems
- IEEE 1526 Recommended Practice for Testing the Performance of Stand-Alone Photovoltaic Systems
- IEEE P1547.9 Guide to Using IEEE Standard 1547 for Interconnection of Energy Storage Distributed Energy Resources with Electric Power Systems (connecting ESS to the Grid – joint w/SCC21)
- IEEE 1561 Guide for Optimizing the Performance and Life of Lead-Acid Batteries in Remote Hybrid Power Systems
- IEEE 1562 Recommended Practice for Sizing of Stand-Alone Photovoltaic (PV) Systems
- IEEE 1661 Guide for Test and Evaluation of Lead-Acid Batteries Used in Photovoltaic (PV) Hybrid Power Systems (Testing Lead-Acid in Hybrid Systems)

[74] Source: Email exchange with Mark Siira, IEEE SC 21 Chair, 2023-06-19.

Annex D: Standards relevant for the PV sector adopted in Germany[75,76]

Standards developed in Europe based on IEC standards[77]

Title/number
DIN EN IEC 60891 VDE 0126-6:2022-10 Photovoltaische Einrichtungen Verfahren zur Umrechnung von gemessenen Strom-Spannungs-Kennlinien auf andere Temperaturen und Bestrahlungsstärken
DIN EN IEC 60904-1 VDE 0126-4-1:2023-04 Photovoltaische Einrichtungen Teil 1: Messen der photovoltaischen Strom-Spannungs-Kennlinie
DIN EN IEC 60904-10 VDE 0126-4-10:2022-10 Photovoltaische Einrichtungen Teil 10: Methoden zur Messung der linearen Abhängigkeit und Linearität
DIN EN IEC 60904-3 VDE 0126-4-3:2020-01 Photovoltaische Einrichtungen Teil 3: Messgrundsätze für terrestrische photovoltaische (PV)-Einrichtungen mit Angaben über die spektrale Strahlungsverteilung
DIN EN IEC 60904-4 VDE 0126-4-4:2021-06 Photovoltaische Einrichtungen Teil 4: Referenz-Solarelemente – Verfahren zur Feststellung der Rückverfolgbarkeit der Kalibrierung
DIN EN IEC 60904-7 VDE 0126-4-7:2021-06 Photovoltaische Einrichtungen Teil 7: Berechnung der spektralen Fehlanpassungskorrektur für Messungen an photovoltaischen Einrichtungen
DIN EN IEC 60947-3 VDE 0660-107:2021-09 Niederspannungsschaltgeräte Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten
DIN EN IEC 61076-3-123 VDE 0687-76-3-123:2021-02 Steckverbinder für elektronische Einrichtungen – Produktanforderungen Teil 3-123: Rechteckige Steckverbinder – Bauartspezifikation für hybride Steckverbinder für industrielle Umgebungen, zur Stromversorgung und LWL-Datenübertragung, mit Push-Pull-Verriegelung
DIN EN IEC 61215-1 VDE 0126-31-1:2022-02 Terrestrische Photovoltaik(PV)-Module – Bauarteignung und Bauartzulassung Teil 1: Prüfanforderungen
DIN EN IEC 61215-1-1 VDE 0126-31-1-1:2022-02 Terrestrische Photovoltaik (PV)-Module – Bauarteignung und Bauartzulassung Teil 1-1: Besondere Anforderungen an die Prüfung von kristallinen Silizium-Photovoltaik(PV)-Modulen
DIN EN IEC 61215-1-2 VDE 0126-31-1-2:2022-02 Terrestrische Photovoltaik(PV)-Module – Bauarteignung und Bauartzulassung Teil 1-2: Besondere Anforderungen an die Prüfung von Photovoltaik(PV)-Dünnschichtmodulen aus Cadmiumtellurid (CdTe)
DIN EN IEC 61215-1-3 VDE 0126-31-1-3:2022-02 Terrestrische Photovoltaik(PV)-Module – Bauarteignung und Bauartzulassung

[75] VDE (undated)

[76] Due to lack of resources, the titles are presented in German only. When following the links, the version in English can be accessed.

[77] These standards are developed at European level on the basis of IEC standards, which serve as the primary normative reference and, where necessary, introducing European deviations or additional requirements to address specific regulatory, market, or technical conditions..

Title/number
Teil 1-3: Besondere Anforderungen an die Prüfung von Photovoltaik(PV)-Dünnschichtmodulen aus amorphem Silizium
DIN EN IEC 61215-1-4 VDE 0126-31-1-4:2022-02 Terrestrische Photovoltaik(PV)-Module – Bauarteignung und Bauartzulassung Teil 1-4: Besondere Anforderungen an die Prüfung von Photovoltaik(PV)-Dünnschichtmodulen aus Cu(In,Ga)(S,Se)2
DIN EN IEC 61215-2 VDE 0126-31-2:2022-02 Terrestrische Photovoltaik(PV)-Module – Bauarteignung und Bauartzulassung Teil 2: Prüfverfahren
DIN EN IEC 61439-2 VDE 0660-600-2:2021-10 Niederspannungs-Schaltgerätekombinationen Teil 2: Energie-Schaltgerätekombinationen
DIN EN IEC 61724-1 VDE 0126-25-1:2022-11 Betriebsverhalten von Photovoltaik-Systemen Teil 1: Überwachung
DIN EN IEC 61730-1 VDE 0126-30-1:2018-10 Photovoltaik(PV)-Module – Sicherheitsqualifikation
DIN EN IEC 61730-2 VDE 0126-30-2:2018-10 Photovoltaik(PV)-Module – Sicherheitsqualifikation Teil 2: Anforderungen an die Prüfung
DIN EN IEC 61810-10 VDE 0435-2023:2020-07 Elektromechanische Elementarrelais Teil 10: Hochleistungsrelais – Zusätzliche funktionale Aspekte und Sicherheitsanforderungen
DIN EN IEC 61853-3 VDE 0126-34-3:2019-05 Prüfung des Leistungsverhaltens von photovoltaischen (PV)-Modulen und Energiebemessung Teil 3: Energiebemessung von PV-Modulen
DIN EN IEC 61853-4 VDE 0126-34-4:2019-06 Prüfung des Leistungsverhaltens von photovoltaischen (PV)-Modulen und Energiebemessung Teil 4: Genormte Referenzklimaprofile
DIN EN IEC 62446-2 VDE 0126-23-2:2021-08 Photovoltaik(PV)-Systeme – Anforderungen an Prüfung, Dokumentation und Instandhaltung Teil 2: Netzgekoppelte Systeme – Instandhaltung von PV-Systemen
DIN EN IEC 62485-2 VDE 0510-485-2:2019-04 Sicherheitsanforderungen an Sekundär-Batterien und Batterieanlagen Teil 2: Stationäre Batterien
DIN EN IEC 62485-5 VDE 0510-485-5:2021-12 Sicherheitsanforderungen an sekundäre Batterien und Batterieanlagen Teil 5: Sicherer Betrieb von stationären Lithium-Ionen-Batterien
DIN EN IEC 62688 VDE 0126-36:2018-10 Konzentrator-Photovoltaik (CPV)-Module und -Anordnungen Sicherheitsqualifikation
DIN EN IEC 62787 VDE 0126-47:2022-10 Konzentrator-Photovoltaik (CPV)-Solarzellen und -Anordnungen von Solarzellen auf Trägern (CoC) Qualifikation
DIN EN IEC 62790 VDE 0126-500:2021-12 Anschlussdosen für Photovoltaik-Module Sicherheitsanforderungen und Prüfungen

ANNEX D: STANDARDS RELEVANT FOR THE PV SECTOR ADOPTED IN GERMANY

Title/number
DIN EN IEC 62892 VDE 0126-892:2019-12 Erweiterte Temperaturwechselprüfung von PV-Modulen
DIN EN IEC 62909-2 VDE 0558-909-2:2019-11 Bidirektionale netzgekoppelte Leistungsumrichter Teil 2: Schnittstelle des GCPC und dezentrale Energiequellen
DIN EN IEC 62934 VDE 0520-934:2022-11 Netzintegration der Erzeugung erneuerbarer Energien Begriffe und Definitionen
DIN EN IEC 62938 VDE 0126-85:2021-10 Ungleichmäßige Schneelastprüfung von Photovoltaikmodulen
DIN EN IEC 62941 VDE 0126-310:2021-12 Terrestrische Photovoltaik(PV)-Module Qualitätssystem zur Fertigung von PV-Modulen
DIN EN IEC 63056 VDE 0510-56:2021-04 Sekundärzellen und -batterien mit alkalischen oder anderen nicht-säurehaltigen Elektrolyten Sicherheitsanforderungen für Lithium-Sekundärzellen und -batterien für die Verwendung in elektrischen Energiespeichersys-temen
DIN EN IEC 63112 VDE 0126-112:2023-05 Photovoltaik(PV)-Generatorfelder Einrichtungen zum Erdschlussschutz – Sicherheit und sicherheitsrelevante Funktionalität
DIN EN IEC 63202-1 VDE 0126-4-11:2020-04 Photovoltaik-Zellen Teil 1: Messung der lichtinduzierten Degradation von kristallinen Silizium-Photovoltaikzellen
DIN IEC/TR 60269-5 VDE 0636-5:2023-05 Niederspannungssicherungen Teil 5: Leitfaden für die Anwendung von Niederspannungssicherungen
DIN IEC/TR 63225 VDE 0126-301:2021-12 Inkompatibilität von Steckverbindern für Gleichstromanwendungen in Photovoltaikanlagen
DIN IEC/TS 60904-1-2 VDE V 0126-4-1-2:2022-04 Photovoltaische Einrichtungen Teil 1-2: Messen der Strom-Spannungs-Kennlinien von bifazialen photovoltaischen (PV) Einrichtungen
DIN IEC/TS 60904-13 VDE V 0126-4-13:2019-09 Photovoltaische Einrichtungen Teil 13: Elektrolumineszenz von Photovoltaikmodulen
DIN IEC/TS 62446-3 VDE V 0126-23-3:2018-04 Photovoltaik(PV)-Systeme – Anforderungen an Prüfung, Dokumentation und Instandhaltung Teil 3: Photovoltaische Module und Betriebsanlagen – Infrarot-Thermografie im Freien
DIN IEC/TS 62578 VDE V 0558-578:2018-09 Leistungselektronische Systeme und Einrichtungen Betriebsbedingungen und Eigenschaften aktiver Netzstromrichter (AIC) inklusive Auslegungsempfehlungen für ihre Störaussen-dungswerte unter 150 kHz
DIN IEC/TS 62782 VDE V 0126-46:2017-06 Photovoltaik(PV)-Module Zyklische (dynamische) mechanische Belastungsprüfung
DIN IEC/TS 62788-2 VDE V 0126-37-2:2019-02

Title/number
Messverfahren für Werkstoffe, die in Photovoltaik-Modulen verwendet werden Teil 2: Polymerwerkstoffe – Frontsheets und Backsheets
DIN IEC/TS 62788-7-2 VDE V 0126-37-7-2:2019-04 Messverfahren für Werkstoffe, die in Photovoltaikmodulen verwendet werden Teil 7-2: Umweltbezogene Beanspruchungen – Schnellbewitterungsprüfungen von polymeren Werkstoffen
DIN IEC/TS 62789 VDE V 0126-70:2016-03 Spezifikation der Beschreibung von Konzentratorzellen
DIN IEC/TS 62804-1 VDE V 0126-37-1:2017-05 Photovoltaik-(PV)Module – Prüfverfahren für die Erkennung von spannungsinduzierter Degradation Teil 1: Kristallines Silicium
DIN IEC/TS 62910 VDE V 0126-16:2017-05 Photovoltaik-Wechselrichter in Stromversorgungsnetzen Prüfverfahren für LVRT-Maßnahmen
DIN IEC/TS 62915 VDE V 0126-75:2021-06 Photovoltaik(PV)-Module Bauartzulassung, Bauarteignung und Sicherheitsqualifizierung – Wiederholungsprüfung
DIN IEC/TS 63126 VDE V 0126-126:2022-10 Leitfaden zur Eignungsprüfung von PV-Modulen, Bauteilen und Werkstoffen zum Betrieb bei hohen Temperaturen
E DIN EN IEC 60384-14 VDE 0565-1-1:2021-04 Festkondensatoren zur Verwendung in Geräten der Elektronik Teil 14: Rahmenspezifikation – Festkondensatoren zur Unterdrückung elektromagnetischer Störungen, geeignet für Netzbetrieb
E DIN EN IEC 60904-2 VDE 0126-4-2:2023-02 Photovoltaische Einrichtungen Teil 2: Anforderungen an photovoltaische Referenzeinrichtungen
E DIN EN IEC 60947-2 VDE 0660-101:2022-09 Niederspannungsschaltgeräte Teil 2: Leistungsschalter
E DIN EN IEC 60947-4-1 VDE 0660-102:2023-02 Niederspannungsschaltgeräte Teil 4-1: Schütze und Motorstarter – Elektromechanische Schütze und Motorstarter
E DIN EN IEC 61215-1-2/A1 VDE 0126-31-1-2/A1:2022-12 Terrestrische Photovoltaik(PV)-Module – Bauarteignung und Bauartzulassung Teil 1-2: Besondere Anforderungen an die Prüfung von Photovoltaik(PV)-Dünnschichtmodulen aus Cadmiumtellurid (CdTe)
E DIN EN IEC 61215-1-3/A1 VDE 0126-31-1-3/A1:2022-12 Terrestrische Photovoltaik(PV)-Module – Bauarteignung und Bauartzulassung Teil 1-3: Besondere Anforderungen an die Prüfung von Photovoltaik(PV)-Dünnschichtmodulen aus amorphem Silizium
E DIN EN IEC 61215-1-4/A1 VDE 0126-31-1-4/A1:2022-12 Terrestrische Photovoltaik (PV)-Module – Bauarteignung und Bauartzulassung Teil 1-4: Besondere Anforderungen an die Prüfung von Photovoltaik(PV)-Dünnschichtmodulen aus Cu(In,Ga)(S,Se)2
E DIN EN IEC 61730-1/A1 VDE 0126-30-1/A1:2020-12 Photovoltaik(PV)-Module – Sicherheitsqualifikation Teil 1: Anforderungen an den Aufbau
E DIN EN IEC 61730-2 VDE 0126-30-2:2022-05 Photovoltaik (PV)-Module – Sicherheitsqualifikation

Title/number
Teil 2: Anforderungen an die Prüfung
E DIN EN IEC 62108 VDE 0126-33:2022-05 Konzentrator-Photovoltaik(CPV)-Module und -Anordnungen Bauarteignung und Bauartzulassung
E DIN EN IEC 62109-3 VDE 0126-14-3:2019-04 Sicherheit von Wechselrichtern zur Anwendung in photovoltaischen Energiesystemen Teil 3: Besondere Anforderungen für elektronische Einrichtungen in Kombination mit Photovoltaik-Elementen
E DIN EN IEC 62759-1 VDE 0126-38:2021-03 Photovoltaik(PV)-Module – Transportprüfung Teil 1: Transport und Versand von PV-Modulpaketen
E DIN EN IEC 62788-2-1 VDE 0126-37-2-1:2021-03 Messverfahren für Werkstoffe, die in Photovoltaik-Modulen verwendet werden Teil 2-1: Polymerwerkstoffe – Frontsheets und Backsheets – Sicherheitsanforderungen
E DIN EN IEC 62788-6-2 VDE 0126-37-6-2:2021-03 Messverfahren für Werkstoffe, die in Photovoltaik-Modulen verwendet werden Teil 6-2: Allgemeine Prüfungen – Permeationsprüfung mit polymeren Materialien
E DIN EN IEC 62909-1 VDE 0558-909-1:2023-05 Bidirektionale netzgekoppelte Leistungsumrichter Teil 1: Allgemeine- und Sicherheitsanforderungen
E DIN EN IEC 63104 VDE 0126-104:2019-02 Sonnennachführeinrichtungen Sicherheitsanforderungen
E DIN EN IEC 63163 VDE 0126-163:2021-05 Terrestrische Photovoltaik-(PV)-Module für Verbraucherprodukte Bauarteignung und Bauartzulassung
E DIN IEC 62891 VDE 0126-12:2015-05 Gesamtwirkungsgrad von Photovoltaik-Wechselrichtern
E DIN IEC/TS 63019 VDE V 0126-19:2018-09 Informationsmodell für die Verfügbarkeit photovoltaischer Energiesysteme

Standards and Technical Specifications developed in Europe and adopted in Germany[78]

Number and title
DIN CLC/TS 50625-3-5 VDE V 0042-13-35 Berichtigung 1:2018-10 Sammlung, Logistik und Behandlung von Elektro- und Elektronik-Altgeräten (WEEE) Teil 3-5: Technische Spezifikation der Schadstoffentfrachtung – Photovoltaik-Module
DIN CLC/TS 50625-3-5 VDE V 0042-13-35:2018-04 Sammlung, Logistik und Behandlung von Elektro- und Elektronik-Altgeräten (WEEE) Teil 3-5: Technische Spezifikation der Schadstoffentfrachtung – Photovoltaik-Module
DIN CLC/TS 51643-32 VDE V 0675-5-32:2022-12 Überspannungsschutzgeräte für Niederspannung

[78] All European standards must be adopted as national standards by Member States of the European Union and by all members of CEN and CENELEC; contradictory standards must be withdrawn.

Number and title
Teil 32: Überspannungsschutzgeräte für den auf der Gleichstromseite von Photovoltaik-Installationen – Auswahl und Anwendungsgrundsätze;
DIN CLC/TS 61836 VDE V 0126-7:2010-04 Photovoltaische Solarenergiesysteme Begriffe, Definitionen und Symbole
DIN EN 50380 VDE 0126-380:2018-07 Datenblatt- und Typenschildangaben von Photovoltaik-Modulen
DIN EN 50461 VDE 0126-17-1:2007-03 Solarzellen Datenblattangaben und Angaben zum Produkt für kristalline Silicium-Solarzellen
DIN EN 50513 VDE 0126-18:2009-12 Solarscheiben Datenblattangaben und Produktinformation für kristalline Silicium-Scheiben zur Solarzellenherstellung; Zu diesem Dokument ist eine englische Übersetzung verfügbar.
DIN EN 50524 VDE 0126-13:2022-12 Datenblattangaben für Photovoltaik-Wechselrichter
DIN EN 50530 VDE 0126-12:2013-12 Gesamtwirkungsgrad von Photovoltaik-Wechselrichtern
DIN EN 50583-1 VDE 0126-210-1:2016-10 Photovoltaik im Bauwesen Teil 1: BIPV-Module;
DIN EN 50583-2 VDE 0126-210-2:2016-10 Photovoltaik im Bauwesen Teil 2: BIPV-Anlagen
DIN EN 50618 VDE 0283-618:2015-11 Kabel und Leitungen – Leitungen für Photovoltaik Systeme;
DIN EN 50625-1 VDE 0042-13-1:2014-09 Sammlung, Logistik und Behandlung von Elektro- und Elektronik-Altgeräten (WEEE) Teil 1: Allgemeine Anforderungen an die Behandlung
DIN EN 50625-2-4 VDE 0042-13-24:2018-06 Sammlung, Logistik und Behandlung von Elektro- und Elektronik-Altgeräten (WEEE) Teil 2-4: Anforderungen an die Behandlung von Photovoltaik-Modulen
DIN EN 55011 VDE 0875-11:2022-05 Industrielle, wissenschaftliche und medizinische Geräte Funkstörungen – Grenzwerte und Messverfahren
DIN EN 55016-1-2 VDE 0876-16-1-2:2019-10 Anforderungen an Geräte und Einrichtungen sowie Festlegung der Verfahren zur Messung der hochfrequenten Störaussendung (Funkstörungen) und Störfestigkeit Teil 1-2: Geräte und Einrichtungen zur Messung der hochfrequenten Störaussendung (Funkstörungen) und Störfestigkeit – Koppeleinrichtungen zur Messung der leitungsgeführten Störaussendung
DIN EN 55016-2-1 VDE 0877-16-2-1:2019-11 Anforderungen an Geräte und Einrichtungen sowie Festlegung der Verfahren zur Messung der hochfrequenten Störaussendung (Funkstörungen) und Störfestigkeit Teil 2-1: Verfahren zur Messung der hochfrequenten Störaussendung (Funkstörungen) und Störfestigkeit – Messung der leitungsgeführten Störaussendung

ANNEX D: STANDARDS RELEVANT FOR THE PV SECTOR ADOPTED IN GERMANY

Number and title
DIN EN 55016-4-2 VDE 0876-16-4-2:2019-09 Anforderungen an Geräte und Einrichtungen sowie Festlegung der Verfahren zur Messung der hochfrequenten Störaussendung (Funkstörungen) und Störfestigkeit Teil 4-2: Unsicherheiten, Statistik und Modelle zur Ableitung von Grenzwerten (Störmodell) – Messgeräte-Unsicherheit
DIN EN 60269-6 VDE 0636-6:2011-11 Niederspannungssicherungen Teil 6: Zusätzliche Anforderungen an Sicherungseinsätze für den Schutz von solaren photovoltaischen Energieerzeugungssystemen
DIN EN 60384-14/A1 VDE 0565-1-1/A1:2017-04 Festkondensatoren zur Verwendung in Geräten der Elektronik Teil 14: Rahmenspezifikation – Festkondensatoren zur Unterdrückung elektromagnetischer Störungen, geeignet für Netzbetrieb
DIN EN 60904-1-1 VDE 0126-4-1-1:2018-06 Photovoltaische Einrichtungen Teil 1-1: Messen der Strom-Spannungs-Kennlinien von photovoltaischen (PV) Einrichtungen mit Mehrschichtsolarzellen
DIN EN 60904-2 VDE 0126-4-2:2015-11 Photovoltaische Einrichtungen Teil 2: Anforderungen an Referenz-Solarelemente
DIN EN 60904-5 VDE 0126-4-5:2011-12 Photovoltaische Einrichtungen Teil 5: Bestimmung der gleichwertigen Zellentemperatur von photovoltaischen (PV) Betriebsmitteln nach dem Leerlaufspannungs-Verfahren
DIN EN 60904-8-1 VDE 0126-4-8-1:2018-05 Photovoltaische Einrichtungen Teil 8-1: Messen der spektralen Empfindlichkeit von photovoltaischen (PV) Einrichtungen mit Mehrschichtsolarzellen
DIN EN 60904-9 VDE 0126-4-9:2008-07 Photovoltaische Einrichtungen Teil 9: Leistungsanforderungen an Sonnensimulatoren
DIN EN 60939-3 VDE 0565-3-4 Berichtigung 1:2018-11 Passive Filter für die Unterdrückung von elektromagnetischen Störungen Teil 3: Filter, für die Sicherheitsprüfungen vorgeschrieben sind
DIN EN 60939-3 VDE 0565-3-4:2016-09 Passive Filter für die Unterdrückung von elektromagnetischen Störungen Teil 3: Filter, für die Sicherheitsprüfungen vorgeschrieben sind
DIN EN 60947-2 VDE 0660-101:2020-11 Niederspannungsschaltgeräte Teil 2: Leistungsschalter
DIN EN 61427-1 VDE 0510-40:2014-02 Wiederaufladbare Zellen und Batterien für die Speicherung erneuerbarer Energien – Allgemeine Anforderungen und Prüfverfahren Teil 1: Photovoltaische netzunabhängige Anwendung
DIN EN 61557-8 VDE 0413-8:2015-12 Elektrische Sicherheit in Niederspannungsnetzen bis AC 1 000 V und DC 1 500 V – Geräte zum Prüfen, Messen oder Überwachen von Schutzmaßnahmen Teil 8: Isolationsüberwachungsgeräte für IT-Systeme
DIN EN 61643-31 VDE 0675-6-31 Berichtigung 1:2022-12 Überspannungsschutzgeräte für Niederspannung

Number and title
Teil 31: Anforderungen und Prüfungen für Überspannungsschutzgeräte in Photovoltaik-Installationen
DIN EN 61643-31 VDE 0675-6-31:2021-05 Überspannungsschutzgeräte für Niederspannung Teil 31: Anforderungen und Prüfungen für Überspannungsschutzgeräte in Photovoltaik-Installationen
DIN EN 61701 VDE 0126-8:2012-10 Salznebel-Korrosionsprüfung von photovoltaischen (PV-)Modulen
DIN EN 61829 VDE 0126-24:2016-09 Photovoltaische (PV) Modulgruppen Messen der Strom-Spannungs-Kennlinien am Einsatzort
DIN EN 61853-1 VDE 0126-34-1:2011-12 Prüfung des Leistungsverhaltens von photovoltaischen (PV-)Modulen und Energiebemessung Teil 1: Leistungsmessung in Bezug auf Bestrahlungsstärke und Temperatur sowie Leistungsbemessung
DIN EN 61853-2 VDE 0126-34-2:2017-05 Prüfung des Leistungsverhaltens von Photovoltaik-(PV-)Modulen und Energiebemessung Teil 2: Messung der spektralen Empfindlichkeit, des Einfallswinkels und der Modul-Betriebstemperatur
DIN EN 62093 VDE 0126-20:2005-12 BOS-Bauteile für photovoltaische Systeme Bauarteignung natürliche Umgebung
DIN EN 62108 VDE 0126-33:2017-08 Konzentrator-Photovoltaik(CPV)-Module und -Anordnungen Bauarteignung und Bauartzulassung
DIN EN 62109-1 VDE 0126-14-1 Berichtigung 2:2013-09 Berichtigung zu DIN EN 62109-1 (VDE 0126-14-1):2011-04; Deutsche Fassung EN 62109-1:2010
DIN EN 62109-1 VDE 0126-14-1:2011-04 Sicherheit von Wechselrichtern zur Anwendung in photovoltaischen Energiesystemen Teil 1: Allgemeine Anforderungen
DIN EN 62109-2 (VDE 0126-14-2):2012-04 Sicherheit von Leistungsumrichtern zur Anwendung in photovoltaischen Energiesystemen
DIN EN 62109-2 VDE 0126-14-2:2012-04 Sicherheit von Leistungsumrichtern zur Anwendung in photovoltaischen Energiesystemen Teil 2: Besondere Anforderungen an Wechselrichter
DIN EN 62116 VDE 0126-2:2014-11 Photovoltaik-Wechselrichter für den Anschluss an das Stromversorgungsnetz Prüfverfahren für Maßnahmen zur Verhinderung der Inselbildung
DIN EN 62124 VDE 0126-20-1:2005-10 Photovoltaische (PV) Inselsysteme Bauarteignung und Typprüfung
DIN EN 62253 VDE 0126-50:2012-05 Photovoltaische Pumpensysteme Bauarteignung und Prüfung des Leistungsverhaltens
DIN EN 62305-3 VDE 0185-305-3 Beiblatt 5:2014-02 Blitzschutz Teil 3: Schutz von baulichen Anlagen und Personen – Beiblatt 5: Blitz- und Überspannungsschutz für PV-Stromversorgungssysteme

Number and title
DIN EN 62446-1 VDE 0126-23-1:2019-04 Photovoltaik (PV)-Systeme – Anforderungen an Prüfung, Dokumentation und Instandhaltung Teil 1: Netzgekoppelte Systeme – Dokumentation, Inbetriebnahmeprüfung und Prüfanforderungen
DIN EN 62509 VDE 0126-15:2012-03 Leistung und Funktion von Photovoltaik-Batterieladereglern
DIN EN 62670-1 VDE 0126-35-1:2014-11 Konzentrator-Photovoltaik (CPV) – Leistungsmessung Teil 1: Standardprüfbedingungen
DIN EN 62670-2 VDE 0126-35-2:2015-12 Konzentrator-Photovoltaik (CPV) – Leistungsmessung Teil 2: Energiemessung
DIN EN 62670-3 VDE 0126-35-3:2017-12 Konzentrator-Photovoltaik (CPV) – Leistungsmessung Teil 3: Leistungsmessungen und Leistungsbemessung
DIN EN 62716 VDE 0126-39:2014-05 Photovoltaische (PV-)Module – Ammoniak-Korrosionsprüfung
DIN EN 62759-1 VDE 0126-38:2016-03 Photovoltaik(PV)-Module – Transportprüfung Teil 1: Transport und Versand von PV-Modulpaketen
DIN EN 62788-1-2 VDE 0126-37-1-2:2017-03 Messverfahren für Werkstoffe, die in Photovoltaikmodulen verwendet werden Teil 1-2: Verkapselungsstoffe – Messung des spezifischen Durchgangswiderstandes von Verkapselungsstoffen und anderen Polymer-Materialien von Photovoltaikmodulen
DIN EN 62788-1-4 VDE 0126-37-1-4:2017-08 Messverfahren für Werkstoffe, die in Photovoltaikmodulen verwendet werden Teil 1-4: Verkapselungsstoffe – Messung der optischen Transmission und Berechnung der solargewichteten Photonentransmission, des Vergilbungsindex und der UV-Grenzfrequenz
DIN EN 62788-1-5 VDE 0126-37-1-5 Berichtigung 1:2018-02 Messverfahren für Werkstoffe, die in Photovoltaikmodulen verwendet werden Teil 1-5: Verkapselungsstoffe – Messung der linearen Längenänderung von Verkapselungsstoffen in Folienform aufgrund der angewendeten thermischen Bedingungen
DIN EN 62788-1-5 VDE 0126-37-1-5:2017-05 Messverfahren für Werkstoffe, die in Photovoltaikmodulen verwendet werden Teil 1-5: Verkapselungsstoffe – Messung der linearen Längenänderung von Verkapselungsstoffen in Folienform aufgrund der angewendeten thermischen Bedingungen
DIN EN 62788-1-6 VDE 0126-37-1-6:2017-12 Messverfahren für Werkstoffe, die in Photovoltaik-Modulen verwendet werden Teil 1-6: Verkapselungsstoffe – Prüfverfahren zur Bestimmung des Aushärtungsgrads der Ethylen-Vinyl-Acetat-Verkapselung
DIN EN 62805-1 VDE 0126-4-20:2018-06 Verfahren für die Messung von photovoltaischem (PV) Glas DIN EN 62805-1 VDE 0126-4-20:2018-06 Verfahren für die Messung von photovoltaischem (PV) Glas Teil 1: Messung der gesamten Trübung und der spektralen Verteilung der Trübung (IEC 62805-1:2017); Deutsche Fassung EN 62805-1:2017
DIN EN 62805-2 VDE 0126-4-21:2018-06 Verfahren für die Messung von photovoltaischem (PV) Glas Teil 2: Messung von Transmissionsgrad und Reflexionsgrad

Number and title
DIN EN 62817 VDE 0126-61:2018-09 Photovoltaische Systeme Bauarteignung für Sonnen-Nachführeinrichtungen
DIN EN 62852 VDE 0126-300:2021-07 Steckverbinder für Gleichspannungsanwendungen in Photovoltaik-Systemen Sicherheitsanforderungen und Prüfungen
DIN EN 62920 VDE 0126-131:2018-07 Photovoltaische Stromerzeugungssysteme EMV-Anforderungen und Prüfverfahren für Leistungsumrichter
DIN EN 62920/A11 VDE 0126-131/A11:2021-02 Photovoltaische Stromerzeugungssysteme EMV-Anforderungen und Prüfverfahren für Leistungsumrichter
DIN EN 62925 VDE 0126-90:2017-11 Konzentrator-Photovoltaik (CPV)-Module Temperaturwechselprüfung für CPV-Module zur Bewertung erhöhter Temperaturwechselbeständigkeit
DIN EN 62979 VDE 0126-45:2018-09 Photovoltaik (PV)-Module Bypass-Diode – Prüfung des thermischen Durchgehens
DIN VDE 0100-712 VDE 0100-712:2016-10 Errichten von Niederspannungsanlagen Teil 7-712: Anforderungen für Betriebsstätten, Räume und Anlagen besonderer Art – Photovoltaik-(PV)-Stromversorgungssysteme;
DIN VDE V 0628-1 VDE V 0628-1:2018-02 Energiesteckvorrichtungen Teil 1: Einspeisung in separate Stromkreise
E DIN EN 60269-6/A1 VDE 0636-6/A1:2017-05 Niederspannungssicherungen Teil 6: Zusätzliche Anforderungen an Sicherungseinsätze für den Schutz von solaren photovoltaischen Energieerzeugungssystemen
E DIN EN 60904-5/A1 VDE 0126-4-5/A1:2022-03 Photovoltaische Einrichtungen Teil 5: Bestimmung der gleichwertigen Zellentemperatur von photovoltaischen (PV) Betriebsmitteln nach dem Leerlaufspannungs-Verfahren
E DIN EN 60904-9 VDE 0126-4-9:2018-04 Photovoltaische Einrichtungen Teil 9: Leistungsanforderungen an Sonnensimulatoren
E DIN EN 61701 VDE 0126-8:2019-01 Salznebel-Korrosionsprüfung von photovoltaischen (PV-) Modulen
E DIN EN 62093 VDE 0126-20:2018-02 Leistungsumrichter für photovoltaische Systeme Prüfung der Bauarteignung
E DIN EN 62788-1-4/A1 VDE 0126-37-1-4/A1:2019-09 Messverfahren für Werkstoffe, die in Photovoltaikmodulen verwendet werden Teil 1-4: Verkapselungsstoffe – Messung der optischen Transmission und Berechnung der solargewichteten Photonentransmission, des Vergilbungsindex und der UV-Grenzfrequenz
E DIN EN 62788-1-6/A1 VDE 0126-37-1-6/A1:2018-07

Number and title
Messverfahren für Werkstoffe, die in Photovoltaik-Modulen verwendet werden Teil 1-6: Verkapselungsstoffe – Prüfverfahren zur Bestimmung des Aushärtungsgrads der Ethylen-Vinyl-Acetat-Verkapselung
E DIN EN 62920/A1 VDE 0126-131/A1:2020-12 Photovoltaische Stromerzeugungssysteme EMV-Anforderungen und Prüfverfahren für Leistungsumrichter
E DIN EN 63027 VDE 0126-27:2018-02 Gleichstrom-Lichtbogenerfassung und -unterbrechung in photovoltaischen Energiesystemen
E DIN VDE 0100-100 VDE 0100-100:2021-09 Errichten von Niederspannungsanlagen Teil 1: Allgemeine Grundsätze, Bestimmungen allgemeiner Merkmale, Begriffe
E DIN VDE 0100-712 VDE 0100-712:2022-10 Errichten von Niederspannungsanlagen Teil 7-712: Anforderungen für Betriebsstätten, Räume und Anlagen besonderer Art – Photovoltaik-(PV)-Stromversorgungssysteme
E DIN VDE V 0126-95 VDE V 0126-95:2022-11 Steckersolargeräte für Netzparallelbetrieb Grundlegende Sicherheitsanforderungen und Prüfungen

Application rules developed for the German context

Number and title
VDE-AR-E 2126-4-100 Anwendungsregel:2021-11 Anforderungen an die Durchführung und Bewertung einer Prüfung für Licht- und Temperatur-induzierte Degradation (LETID) von Photovoltaik-Zellen und -Modulen
E VDE-AR-E 2283-6 Anwendungsregel:2017-11 Komponenten für Photovoltaik-Systeme: Anforderungen an Teilgeneratorverbindungssysteme
Anwendungsregel: VDE-AR-E 2100-712 Anwendungsregel:2018-12 Maßnahmen für den DC-Bereich einer Photovoltaikanlage zum Einhalten der elektrischen Sicherheit im Falle einer Brandbekämpfung oder einer technischen Hilfeleistung

Annex E: PV standards adopted in India

Standards related to PV are developed in the sectional committee ETD 28 Solar Photovoltaic Energy Systems Sectional Committee[79] within the Electrotechnical Department.

Number	Title
IS 12762 (Part 1) : 2010 IEC 60904-1 : 2006[80]	Photovoltaic devices: Part 1 measurement of photovoltaic current - Voltage characteristics (First Revision)
IS 12762 (Part 1) : 2010 IEC 60904-1 : 2006	Photovoltaic devices: Part 1 measurement of photovoltaic current - Voltage characteristics (First Revision)
IS 12762 (Part 1/Sec 1) : 2020 IEC 60904-1-1 : 2017	Photovoltaic Devices Part 1 Measurement of Current-Voltage Characteristics Section 1 Multi-junction PV devices
IS 12762 (Part 1/Sec 2) : 2020 IEC/TS60904-1-2:2019	Photovoltaic Devices Part 1 Measurement of Current-voltage Characteristics Section 2 Bi-facial photovoltaic (PV) devices
IS 12762 (Part 2) : 2018 60904-2 : 2015	Photovoltaic devices: Part 2 Requirements for photovoltaic reference devices (Second Revision)
IS 12762 (Part 3) : 2020 IEC60904-3:2019	Photovoltaic Devices Part 3 Measurement Principles for Terrestrial Photovoltaic PV Solar Devices with Reference Spectral Irradiance Data (Third Revision)
IS 12762 (Part 4) : 2014 IEC 60904-4 : 2009	Photovoltaic devices: Part 4 reference solar devices - Procedures for establishing calibration traceability
IS 12762 (Part 5) : 2014 IEC 60904-5 : 2011	Photovoltaic devices: Part 5 determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open - Circuit voltage method (First Revision)
IS 12762 (Part 7) : 2013 IEC 60904-7 : 2019	Photovoltaic Devices Part 7 Computation of the Spectral Mismatch Correction for Measurement of Photovoltaic Devices
IS 12762 (Part 7) : 2013 IEC 60904-7 : 2019	Photovoltaic Devices Part 7: Computation of the Spectral Mismatch Correction for Measurements of Photovoltaic Devices (First Revision)
IS 12762 (Part 8) : 2018 IEC 60904-8 : 2014	Photovoltaic devices: Part 8 measurement of spectral responsivity of a photovoltaic (PV) device (First Revision)
IS 12762 (Part 8/Sec 1) : 2020 IEC 60904-8-1 : 2017	Photovoltaic Devices Part 8 Measurement of Spectral Responsivity of a Photovoltaic (PV) Device Section 1 Multi-junction (PV) devices
IS 12762 (Part 9) : 2010 60904-9:2007	Photovoltaic devices: Part 9 solar simulator performance requirements
IS 12762 (Part 10) : 2014 IEC 60904-10 : 2009	Photovoltaic devices: Part 10 methods of linearity measurement (First Revision)
IS 12762 (Part 13) : 2020 IEC TS 60904-13:2018	Photovoltaic Devices Part 13 Electroluminescence of Photovoltaic Modules
IS 12762 (Part 14) : 2023 IEC TR 60904-14 : 2020	Photovoltaic devices Part 14: Guidelines for production line measurements of single-junction PV module maximum power output and reporting at standard test conditions
IS 12763 : 2013 IEC 60891 : 2009	Photovoltaic devices - Procedures for temperature and irradiance corrections to measured I - V characteristics (First Revision)

[79] ETD (undated)

[80] The information on the standards, including the numbering, is as it appeared on the respective BIS website.

ANNEX E: PV STANDARDS ADOPTED IN INDIA

Number	Title
IS 12834 : 2013 IEC/TS 61836 : 2016	Solar photovoltaic energy systems - Terms, definitions and symbols (First Revision)
IS 12834 : 2013 IEC/TS 61836 : 2016	Solar photovoltaic energy systems – Terms, definitions and symbols (Second Revision)
IS 14153 : 1994	Guide for general description of photovoltaic (PV) power generating system
IS 14286 : 2010 IEC 61215 : 2005	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval (First Revision)
IS 14286 (Part 1) : 2019 IEC 61215-1:2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval: Part 1 test requirements (Second Revision)
IS 14286 (Part 1) : 2019 IEC 61215-1:2021	Terrestrial Photovoltaic PV Modules Design Qualification and Type Approval Part 1: Test Requirements Third Revision
IS 14286 (Part 1/Sec 1) : 2019 IEC 61215-1-1:2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval: Part 1 test requirements: Sec 1 special requirements for testing of crystalline silicon photovoltaic (PV) modules (Second Revision)
IS 14286 (Part 1/Sec 1) : 2019 IEC 61215-1-1:2021	Terrestrial photovoltaic PV modules Design qualification and type approval Part 1-1: Special requirements for testing of crystalline silicon photovoltaic PV modules Third Revision
IS 14286 (Part 1/Sec 2) : 2019 IEC 61215-1-2:2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval: Part 1 test requirements: Sec 2 special requirements for testing of thin - Film cadmium telluride (CdTe) based photovoltaic (PV) modules (Second Revision)
IS 14286 (Part 1/Sec 2) : 2019 IEC 61215-1-2:2021	Terrestrial photovoltaic PV modules Design qualification and type approval Part 1-2: Special requirements for testing of thin-film Cadmium Telluride CdTe based photovoltaic PV modules (Third Revision)
IS 14286 (Part 1/Sec 3) : 2019 IEC 61215-1-3:2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval: Part 1 test requirements: Sec 3 special requirements for testing of thin - Film amorphous silicon based photovoltaic (PV) modules (Second Revision)
IS 14286 (Part 1/Sec 3) : 2019 IEC 61215-1-3:2021	Terrestrial photovoltaic PV modules Design qualification and type approval Part 1-3: Special requirements for testing of thin-film amorphous silicon based photovoltaic PV modules (Third Revision)
IS 14286 (Part 1/Sec 4) : 2019 IEC 61215-1-4:2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval: Part 1 test requirements: Sec 4 special requirements for testing of thin - Film Cu(In,ga)(S,se)2 based photovoltaic (Pv) modules (Second Revision)
IS 14286 (Part 1/Sec 4) : 2019 IEC 61215-1-4:2021 (First Revision)	Terrestrial photovoltaic PV modules Design qualification and type approval Part 1-4: Special requirements for testing of thin-film CuInGASSe2 based photovoltaic PV modules (Third Revision)
IS 14286 (Part 2) : 2019 IEC 61215-2:2021	Terrestrial photovoltaic (PV) modules - Design qualification and type approval: Part 2 test procedures (Second Revision)
IS 14286 (Part 2) : 2019 IEC 61215-2:2021	Terrestrial Photovoltaic PV Modules Design Qualification and Type Approval Part 2: Test Procedures (Third Revision
IS 16077 : 2013 IEC 61646 : 2008	Thin - Film terrestrial photovoltaic (PV) modules - Design qualification and type approval
IS 16149 : 2014 IEC 61345 : 1998	UV test for photovoltaic (PV) modules
IS 16169 : 2019 IEC 62116 : 2014	Utility - Interconnected photovoltaic inverters - Test procedure of islanding prevention measures

Number	Title
IS 16169 : 2019 IEC 62116 : 2014	Utility - Interconnected photovoltaic inverters - Test procedure of islanding prevention measures (First Revision)
IS 16170 (Part 1) : 2014 IEC 61853-1 : 2011	Photovoltaic (PV) module performance testing and energy rating: Part 1 irradiance and temperature performance measurements and power rating
IS 16170 (Part 2) : 2018 IEC 61853-2 : 2016	Photovoltaic (PV) module performance testing and energy rating: Part 2 spectral responsivity, incidence angle and module operating temperature measurements
IS 16170 (Part 3) : 2022 IEC 61853-3 : 2018	Photovoltaic PV Module Performance Testing and Energy Rating Part 3: Energy Rating of PV Modules
IS 16170 (Part 4) : 2023 IEC 61853-4 : 2018	Photovoltaic PV Module Performance Testing and Energy Rating Part 4: Standard Reference Climatic Profiles
IS/IEC 62688 : 2017	Concentrator Photovoltaic CPV Modules and Assemblies Safety Qualification
IS/IEC/TS 62738 : 2018	Ground-Mounted Photovoltaic Power Plants - Design Guidelines and Recommendations
IS/IEC/TS 62782 : 2016	Photovoltaic (PV) Modules Cyclic (Dynamic) Mechanical Load Testing
IS/IEC/TS 62789 : 2014	Photovoltaic Concentrator Cell Documentation
IS/IEC 62805-1 : 2017	Method for Measuring Photovoltaic (PV) Glass Part 1 Measurement of Total Haze and Spectral Distribution of Haze
IS 62805 (Part 2) : 2017	Method for Measuring Photovoltaic (PV) Glass Part 2 Measurement of Transmittance and Reflectance
IS/IEC 62805-2 : 2017	Method for Measuring Photovoltaic (PV) Glass Part 2 Measurement of Transmittance and Reflectance
IS/IEC 62817 : 2017	PHOTOVOLTAIC SYSTEMS - DESIGN QUALIFICATION OF SOLAR TRACKERS
IS/IEC/TS 62915 : 2018	Photovoltaic (PV) Modules Type Approval, Design and Safety Qualification - Retesting
IS/IEC/TS 62916 : 2017	Photovoltaic Modules Bypass Diode Electrostatic Discharge Susceptibility Testing
IS/IEC 62920 : 2017	Photovoltaic Power Generating Systems EMC Requirements and Test Methods for Power Conversion Equipment
IS/IEC 62925 : 2016	Concentrator Photovoltaic (CPV) Modules Thermal Cycling Test to Differentiate Increased Thermal Fatigue Durability
IS/IEC 62941 : 2016	Terrestrial Photovoltaic (PV) Modules Guidelines for Increased Confidence in PV Module Design Qualification and Type Approval
IS/IEC 62979 : 2017	Photovoltaic Modules Bypass Diode Thermal Runaway Test
IS/IEC/TS 62989 : 2018	Primary Optics for Concentrator Photovoltaic Systems
IS/IEC/TS 62994 : 2019	Photovoltaic PV Modules Through the Life Cycle - Environmental Health and Safety EHS Risk Assessment - General Principles and Nomenclature
IS/IEC 63049 : 2017	Terrestrial Photovoltaic (PV) Systems Guidelines for Effective Quality Assurance in PV Systems Installation Operation and Maintenance
IS/IEC 63202-1 : 2019	Photovoltaic Cells Part 1 Measurement of Light-Induced Degradation of Crystalline Silicon Photovoltaic Cells
IS/IEC/TR 63228 : 2019 IEC TR 63228: 2019	Measurement Protocols for Photovoltaic Devices Based on Organic Dye-Sensitized or Perovskite Materials
IS 17018 (Part 1) : 2022	Solar Photovoltaic Water Pumping Systems
IS 14286 (Part 1) : 2019 IEC 61215-1:2021	Terrestrial photovoltaic (PV) modules

ANNEX E: PV STANDARDS ADOPTED IN INDIA

Number	Title
IS 14286 (Part 1/Sec 1) : 2019 IEC 61215-1-1:2021	Crystalline silicon photovoltaic (PV) modules
IS 14286 (Part 1/Sec 2) : 2019 IEC 61215-1-2:2021	Thin - Film cadmium telluride (CdTe) based photovoltaic (Pv) modules
IS 14286 (Part 1/Sec 3) : 2019 IEC 61215-1-3:2021	Thin - Film amorphous silicon based photovoltaic (PV) modules
IS 14286 (Part 1/Sec 4) : 2019 IEC 61215-1-4:2021	Thin - Film Cu(In,ga)(S,se)2 based photovoltaic (Pv) modules
IS 16077 : 2013 IEC 61646 : 2008 Reviewed in 2018	Thin - Film terrestrial photovoltaic (PV) modules
IS 16169 : 2014 IEC 62116 : 2014	Utility - Interconnected photovoltaic inverters
IS 16221 (Part 2) : 2015 IEC 62109-2 : 2011 Reviewed in 2020	Power Converters

Annex F: International standards adopted by Indonesia[81,82]

Number	Titel of BSN standard
SNI 04-6393-2000	Sistem lampu fluoresen dengan catudaya rangkaian modul PV - Persyaratan dan prosedur uji kinerja
SNI 61730-2:2016	Kualifikasi keselamatan modul fotovoltaik (FV) – Bagian 2: Persyaratan pengujian (IEC 61730-2: 2016, IDT)
SNI 9121:2022	Metode perhitungan potensi energi surya
SNI IEC 60068-2-52:2017	Pengujian – pengujian Kb: Kabut Garam Siklik (larutan natrium klorida) (IEC 60068-2-52:2017,IDT)
SNI IEC 60904-1-1:2017	Perangkat fotovoltaik – Bagian 1-1: Pengukuran karakteristik arus-tegangan perangkat foto-voltaik (FV) multi-junction (IEC 60904-1-1:2017, IDT)
SNI IEC 60904-1:2020	Perangkat fotovoltaik - Bagian 1: Pengukuran karakteristik arus-tegangan fotovoltaik (IEC 60904-1:2020, IDT)
SNI IEC 60904-9:2020	Perangkat fotovoltaik - Bagian 9: Klasifikasi karakteristik simulator surya (IEC 60904-9:2020, IDT)
SNI IEC 61215-1-1:2016	Modul fotovoltaik (FV) terestrial– Kualifikasi desain dan pengesahan jenis – Bagian 1-1: Per-syaratan khusus untuk pengujian modul fotovoltaik (FV) silikon kristalin (IEC 61215-1-1:2016, IDT)
SNI IEC 61215-1:2016	Modul fotovoltaik (FV) terrestrial – Kualifikasi desain dan pengesahan jenis – Bagian 1: Per-syaratan uji (IEC 61215-1:2016, IDT)
SNI IEC 61215-2:2016	Modul fotovoltaik (FV) terestrial - Kualifikasi desain dan pengesahan jenis - Bagian 2: Prosedur uji (IEC 61215-2:2016, IDT)
SNI IEC 61427-1:2018	Sel dan baterai sekunder untuk penyimpanan energi terbarukan – Persyaratan umum dan metode uji – Bagian 1: Aplikasi pada fotovoltaik off-grid (IEC 61427-1: 2013, IDT)
SNI IEC 61701:2020	Pengujian korosi kabut garam pada modul fotovoltaik (FV) (IEC 61701:2020, IDT)
SNI IEC 61724-1:2017	Kinerja Sistem Fotovoltaik – Bagian 1 : Pemantauan (IEC 61724-1:2017, IDT)
SNI IEC 61727:2016	Sistem fotovoltaik (FV) - Karakteristik antarmuka utilitas (IEC 61727:2004, IDT)
SNI IEC 61730-1:2016	Kualifikasi keselamatan modul fotovoltaik (FV) – Bagian 1: Persyaratan konstruksi (IEC 61730-1:2016, IDT)
SNI IEC 62116:2014	Inverter fotovoltaik terhubung ke jaringan listrik – Prosedur uji tindakan pencegahan islanding (IEC 62116:2014, IDT)
SNI IEC 62124:2016	Sistem fotovoltaik yang berdiri sendiri - Verifikasi desain (IEC 62124:2004, IDT)
SNI IEC 62446-1:2016	SISTEM FOTOVOLTAIK (FV) – PERSYARATAN UNTUK PENGUJIAN, DOKUMENTASI DAN PEMELI-HARAAN – Bagian 1: Sistem terkoneksi jaringan listrik – Dokumentasi, uji komisioning dan in-speksi (IEC 62446-1:2016+AMD1:2018 CSV, IDT)
SNI IEC 62548:2016	Larik fotovoltaik (FV) – Persyaratan desain (IEC 62548:2016, IDT)
SNI IEC 62759-1:2022	Modul fotovoltaik (FV) – Pengujian transportasi – Bagian 1: Transportasi dan pengiriman unit kemasan modul (IEC 62759-1:2022, IDT)

[81] BSN (undated).
[82] Since most of these standards were adopted form IEC, and since the numbers of the Indonesian standards are identical to the IEC numbering, and adoption provided as part of the titles is also identical, the titles are not provided in English.

ANNEX F: INTERNATIONAL STANDARDS ADOPTED BY INDONESIA

Number	Titel of BSN standard
SNI IEC 62941:2019	Modul fotovoltaik (FV) terestrial – Sistem mutu untuk pabrikasi modul FV (IEC 62941:2019, IDT)
SNI IEC TS 61724-2:2016	Kinerja sistem fotovoltaik – Bagian 2: Metode evaluasi kapasitas (IEC TS 61724-2:2016, IDT)
SNI IEC TS 61724-3:2016	Kinerja Sistem Fotovoltaik – Bagian 3 : Metode evaluasi energi (IEC TS 61724-3:2016, IDT)
SNI IEC TS 62257-1:2016	Rekomendasi untuk sistem energi terbarukan dan hibrida untuk listrik perdesaan – Bagian 1: Pengantar umum untuk seri IEC 62257 dan listrik perdesaan (IEC TS 62257-1:2015, IDT)
SNI IEC TS 62738:2018	Pembangkit Listrik Tenaga Surya (PLTS) fotovoltaik yang dipasang ditanah – Panduan dan rekomendasi desain (IEC TS 62738:2018, IDT)
SNI IEC TS 62804-1:2015	Modul Fotovoltaik (FV) - Metode uji untuk mendeteksi degradasi terinduksi potensial - Bagian 1: Silikon kristalin (IEC TS 62804-1:2015,IDT)
SNI IEC TS 62915:2018	Modul Fotovoltaik (FV) - Pengesahan jenis, kualifikasi desain dan keselamatan - Pengujian ulang (IEC TS 62915-2018, IDT)
SNI IEC TS 63049:2017	Sistem fotovoltaik (FV) terestrial - Panduan jaminan mutu yang efektif dalam instalasi, pengoperasian dan pemeliharaan sistem FV (IEC TS 63049:2017,IDT)
SNI IEC/TS 61836:2018	Sistem energi fotovoltaik surya – Istilah, definisi dan simbol (IEC/TS 61836:2016, IDT)
SNI IEC/TS 62257-4:2018	Rekomendasi sistem untuk energi terbarukan dan hibrida untuk elektrifikasi perdesaan – Bagian 4 : Pemilihan dan rancangan sistem (IEC/TS 62257- 4:2015, IDT)
SNI IEC/TS 62257-7:2018	Rekomendasi sistem untuk energi terbarukan dan hibrida untuk elektrifikasi perdesaan - Bagian 7: Generator (IEC/TS 62557-7:2008, IDT)

Annex G: List of existing Vietnamese standards[83]

TCVN	Corresponding IEC deliverable	Title in Vietnamese	Title in English
TCVN 6781-1:2017	IEC 61215-1:2016	Môđun quang điện (PV) mặt đất – Chất lượng thiết kế và phê duyệt kiểu – Phần 1: Yêu cầu thử nghiệm	Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements
TCVN 6781-1-1:2017	IEC 61215-1-1:2016	Môđun quang điện (PV) mặt đất – Chất lượng thiết kế và phê duyệt kiểu – Phần 1-1: Yêu cầu cụ thể về thử nghiệm môđun quang điện (PV) tinh thể silic	Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules
TCVN 6781-1-2:2020	IEC 61215-1-2:2016	Môđun quang điện (PV) mặt đất – Chất lượng thiết kế và phê duyệt kiểu – Phần 1-2: Yêu cầu cụ thể đối với thử nghiệm môđun quang điện (PV) màng mỏng Cadmium Telluride (CdTe)	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-2: Special requirements for testing of thin-film Cadmium Telluride (CdTe) based photovoltaic (PV) modules
TCVN 6781-1-3:2020	IEC 61215-1-3:2016	Môđun quang điện (PV) mặt đất – Chất lượng thiết kế và phê duyệt kiểu – Phần 1-3: Yêu cầu cụ thể đối với thử nghiệm môđun quang điện (PV) màng mỏng silic vô định hình	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-3: Special requirements for testing of thin-film amorphous silicon based photovoltaic (PV) modules
TCVN 6781-1-4:2020	IEC 61215-1-4:2016	Môđun quang điện (PV) mặt đất – Chất lượng thiết kế và phê duyệt kiểu – Phần 1-4: Yêu cầu cụ thể đối với thử nghiệm môđun quang điện (PV) màng mỏng $Cu(In,Ga)(S,Se)_2$	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-4: Special requirements for testing of thin-film Cu(In,GA)(S,Se)2 based photovoltaic (PV) modules
TCVN 6781-2:2017	IEC 61215-2:2016	Môđun quang điện (PV) mặt đất – Chất lượng thiết kế và phê duyệt kiểu – Phần 2: Quy trình thử nghiệm	Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: Test procedures
TCVN 12232-1:2019	IEC 61730-1:2016	An toàn của môđun quang điện (PV) – Phần 1: Yêu cầu về kết cấu	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
TCVN 12232-2:2019	IEC 61730-2:2016	An toàn của môđun quang điện (PV) – Phần 2: Yêu cầu về thử nghiệm	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
TCVN 12676:2020	IEC 62548:2016	Dàn quang điện – Yêu cầu thiết kế	Photovoltaic (PV) arrays - Design requirements
TCVN 12677:2020	IEC 61829:2015	Dàn quang điện – Phép đo đặc tính dòng điện-điện áp tại hiện trường	Photovoltaic (PV) array - On-site measurement of current-voltage characteristics
TCVN 12678-1:2020	IEC 60904-1:2006	Thiết bị quang điện – Phần 1: Phép đo đặc tính dòng điện-điện áp quang điện	Photovoltaic devices - Part 1: Measurement of photovoltaic current-voltage characteristics

[83] List provided by VSQI in October 2023.

ANNEX G: LIST OF EXISTING VIETNAMESE STANDARDS

TCVN	Corresponding IEC deliverable	Title in Vietnamese	Title in English
TCVN 12678-1-1 : 2020	IEC 60904-1-1:2017	Thiết bị quang điện – Phần 1-1: Phép đo đặc tính dòng điện-điện áp quang điện của thiết bị quang điện nhiều lớp tiếp giáp	Photovoltaic devices - Part 1-1: Measurement of current-voltage characteristics of multi-junction photovoltaic (PV) devices
TCVN 12678-2 : 2020	IEC 60904-2:2015	Thiết bị quang điện – Phần 2: Yêu cầu đối với thiết bị chuẩn quang điện	Photovoltaic devices - Part 2: Requirements for photovoltaic reference devices
TCVN 12678-3 : 2020	IEC 60904-3:2019	Thiết bị quang điện – Phần 3: Nguyên lý đo dùng cho thiết bị quang điện mặt đất với dữ liệu phổ bức xạ chuẩn	Photovoltaic devices - Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data
TCVN 12678-4: 2020	IEC 60904-4:2019	Thiết bị quang điện – Phần 4: Thiết bị chuẩn quang điện – Quy trình thiết lập liên kết chuẩn hiệu chuẩn	Photovoltaic devices - Part 4: Reference solar devices - Procedures for establishing calibration traceability
TCVN 12678-5:2020	IEC 60904-5:2011	Thiết bị quang điện – Phần 5: Xác định nhiệt độ tương đương của tế bào của thiết bị quang điện bằng phương pháp điện áp hở mạch	Photovoltaic devices - Part 5: Determination of the equivalent cell temperature (ECT) of photovoltaic (PV) devices by the open-circuit voltage method
TCVN 12678-7 : 2020	IEC 60904-7:2019	Thiết bị quang điện – Phần 7: Tính toán hiệu chỉnh sự không phù hợp phổ đối với các phép đo của thiết bị quang điện	Photovoltaic devices - Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices
TCVN 12678-8 : 2020	IEC 60904-8:2014	Thiết bị quang điện – Phần 8: Phép đo đáp ứng phổ của thiết bị quang điện	Photovoltaic devices - Part 8: Measurement of spectral responsivity of a photovoltaic (PV) device
TCVN 12678-8-1 : 2020	IEC 60904-8-1:2017	Thiết bị quang điện – Phần 8-1: Phép đo đáp ứng phổ của thiết bị quang điện nhiều lớp tiếp giáp	Photovoltaic devices - Part 8-1: Measurement of spectral responsivity of multi-junction photovoltaic (PV) devices
TCVN 12678-9 : 2020	IEC 60904-9:2007	Thiết bị quang điện – Phần 9: Yêu cầu về tính năng của bộ mô phỏng mặt trời	Photovoltaic devices - Part 9: Solar simulator performance requirements
TCVN 12678-10 : 2020	IEC 60904-10:2009	Thiết bị quang điện – Phần 10: Phương pháp đo độ tuyến tính	Photovoltaic devices - Part 10: Methods of linearity measurement
TCVN 13083-1:2020	IEC 61724-1:2017	Tính năng của hệ thống quang điện – Phần 1: Theo dõi	Photovoltaic system performance - Part 1: Monitoring
TCVN 13083-2:2020	IEC TS 61724-2:2016	Tính năng của hệ thống quang điện – Phần 2: Phương pháp đánh giá công suất	Photovoltaic system performance - Part 2: Capacity evaluation method
TCVN 13083-3:2020	IEC TS 61724-3:2016	Tính năng của hệ thống quang điện – Phần 1: Phương pháp đánh giá năng lượng	Photovoltaic system performance - Part 3: Energy evaluation method
TCVN 13084-1:2020	IEC 62805-1:2017	Phương pháp đo kính quang điện – Phần 1: Đo tổng độ đục và phân bố phổ của độ đục	Method for measuring photovoltaic (PV) glass - Part 1: Measurement of

TCVN	Corresponding IEC deliverable	Title in Vietnamese	Title in English
			total haze and spectral distribution of haze
TCVN 13084-2:2020	IEC 62805-2:2017	Phương pháp đo kính quang điện – Phần 2: Đo độ truyền qua và độ phản xạ	Method for measuring photovoltaic (PV) glass - Part 2: Measurement of transmittance and reflectance
TCVN 7447-7-712:2019	IEC 60364-7-712:2017	Hệ thống lắp đặt điện hạ áp - Phần 7-712: Yêu cầu đối với hệ thống lắp đặt đặc biệt hoặc khu vực đặc biệt – Hệ thống nguồn quang điện mặt trời	Low voltage electrical installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems
TCVN 11855-1:2017	IEC 62446-1:2016	Hệ thống quang điện (PV) – Yêu cầu thử nghiệm, tài liệu và bảo trì – Phần 1: Hệ thống nối lưới – Lập tài liệu, thử nghiệm nghiệm thu và kiểm tra	Photovoltaic (PV) systems – Requirements for testing, documentation and maintenance – Part 1: Grid connected systems – Documentation, commissioning tests and inspection
TCVN 12231-1:2019	IEC 62109-1:2010	An toàn của bộ chuyển đổi điện dùng trong hệ thống quang điện (PV) – Phần 1: Yêu cầu chung	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
TCVN 12231-2:2019	IEC 62109-2:2011	An toàn của bộ chuyển đổi điện dùng trong hệ thống quang điện (PV) – Phần 2: Yêu cầu cụ thể đối với bộ nghịch lưu	Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters
TCVN 12673:2020	IEC 62894:2016	Bộ nghịch lưu quang điện – Tờ dữ liệu và tấm nhãn	Photovoltaic inverters - Data sheet and name plate
TCVN 13085:2020	IEC 62920:2017	Hệ thống phát điện quang điện – Yêu cầu về tương thích điện từ (EMC) và phương pháp thử nghiệm đối với thiết bị chuyển đổi điện	Photovoltaic power generating systems - EMC requirements and test methods for power conversion equipment
TCVN 12230:2019	IEC TS 62910:2015	Bộ nghịch lưu quang điện nối lưới – Quy trình thử nghiệm dùng cho các phép đo khả năng bỏ qua điện áp thấp	Utility-interconnected photovoltaic inverters - Test procedure for low voltage ride-through measurements
TCVN 12675:2020	IEC 62790:2020	Hộp kết nối dùng cho môđun quang điện – Yêu cầu an toàn và thử nghiệm	Junction boxes for photovoltaic modules - Safety requirements and tests
TCVN 12718:2019	IEC 62852:2014	Bộ nối dùng cho ứng dụng điện một chiều trong hệ thống quang điện – Yêu cầu an toàn và thử nghiệm	Connectors for DC-application in photovoltaic systems - Safety requirements and tests
TCVN 12672:2019	IEC 62930:2017	Cáp điện dùng cho hệ thống quang điện có điện áp một chiều danh định 1,5 kV	Electric cables for photovoltaic systems with a voltage rating of 1.5 kV DC
TCVN 12674:2020	IEC 61683:1999	Hệ thống quang điện – Bộ ổn định công suất – Quy trình đo hiệu suất	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
TCVN 6782:2000	--	Bộ điều khiển nạp dùng cho hệ quang điện. Chất lượng thiết kế và thử nghiệm điển hình	Charge controllers for small standalone photovoltaic power systems. Design qualification and type approval

ANNEX G: LIST OF EXISTING VIETNAMESE STANDARDS

TCVN	Corresponding IEC deliverable	Title in Vietnamese	Title in English
TCVN 6783:2000	--	Ngăn và bình acquy dùng cho hệ thống năng lượng quang điện. Yêu cầu chung và phương pháp thử nghiệm	Secondary cell and batteries for solar photovoltaic energy systems. General requirements and methods of test

Annex H: Standards considered relevant for PV by USAID[84]

The standards listed below are considered most relevant by USAID concerning procurement and installation of solar PV systems, and selected components.

Annex H.1: Procurement and installation

IEC standards

Balance of System

- IEC 62093:2005: Balance-of-System Components for Photovoltaic Systems - Design Qualification Natural Environments
- IEC 62109-1:2010: Safety of Power Converters for Use in Photovoltaic Power Systems - Part 1: General requirements
- IEC 62109-2:2011: Safety of Power Converters for Use in Photovoltaic Power Systems - Part 2: Particular requirements for inverters
- IEC 60269-6 ed1.0: Low-Voltage Fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems

Characteristics

- IEC 61727 ed2.0: Photovoltaic (PV) systems - Characteristics of the Utility Interface

Commissioning

- IEC 62446-1:2016: Photovoltaic (PV) Systems - Requirements for Testing, Documentation, and Maintenance - Part 1: Grid connected systems - Documentation, commissioning tests and inspection.

Design

- IEC 62124 ed1.0: Photovoltaic (PV) Stand-Alone Systems - Design Verification
- IEC 62253 ed1.0: Photovoltaic Pumping Systems - Design Qualification and Performance Measurements

Installation

- IEC 60364-1 ed5.0: Low-Voltage Electrical Installations - Part 1: Fundamental principles, assessment of general characteristics, definitions
- IEC 60364-7-712:2017: Low-Voltage Electrical Installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems

Monitoring

- IEC 61724-1:2017: Photovoltaic System Performance - Part 1: Monitoring
- IEC TS 61724-2:2016: Photovoltaic System Performance - Part 2: Capacity evaluation method
- IEC TS 61724-3:2016: Photovoltaic System Performance - Part 3: Energy evaluation method

[84] USAID (undated).

Performance

- IEC 62509 ed1.0: Battery Charge Controllers for Photovoltaic Systems - Performance and Functioning

Safety

- IEC 61730-1:2016: Photovoltaic (PV) Module Safety Qualification - Part 1: Requirements for construction
- IEC 61730-2:2016: Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements for testing

Terms

- IEC TS 61836:2016: Solar Photovoltaic Energy Systems - Terms, Definitions and Symbols

Testing

- IEC 61215-1:2016: Design Qualifications & Type Approval Part 1: Testing requirements (All chemistries)
- IEC 61215-2:2016: Design Qualifications & Type Approval Part 2: Testing procedures (All chemistries)
- IEC 62116:2014: Utility-Interconnected Photovoltaic Inverters - Test Procedure of Islanding Prevention Measures

IEEE standards

Interconnection

- IEEE 1547.2-2008: IEEE Application Guide for IEEE Std 1547(TM), IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
- IEEE 1547.3-2007: IEEE Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected with Electric Power Systems
- IEEE 1547-2018: IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces

Performance

- IEEE 1526-2003: IEEE Recommended Practice for Testing the Performance of Stand-Alone Photovoltaic Systems

Sizing

- IEEE 1562-2007: IEEE Guide for Array and Battery Sizing in Stand-Alone Photovoltaic (PV) Systems

Underwriters Laboratories (UL) standards

Balance of System

- UL-2703, 1st Edition: Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels
- UL 1741: Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
- UL-1699B: Standard for Photovoltaic (PV) DC Arc-Fault Circuit Protection
- UL-4703: Standard for Photovoltaic Wire
- UL-854: Standard for Service - Entrance Cables
- UL-4248-19: Fuseholders - Part 19: Photovoltaic
- UL-6703: Standards for Connectors for Use in Photovoltaic Systems

- UL-3730: Standard for Photovoltaic Junction Boxes

- UL-489B, 1st Edition: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures for Use with Photovoltaic (PV) Systems

Concentrated

- UL 8703, 3rd Edition: Concentrator Photovoltaic Modules and Assemblies

Flat-Plate PV

- UL 1703, 3rd Edition: Standard for Flat-Plate Photovoltaic Modules and Panels

Mounting

- UL 790, 8th Edition: Standard for Standard Test Methods for Fire Tests of Roof Coverings
- UL 1897, 7th Edition: Standard for Uplift Tests for Roof Covering Systems

Testing

- UL-SU 5703: Determination of the Maximum Operating Temperature Rating of Photovoltaic (PV) Back-sheet Materials

ASTM standards

Terms

- ASTM E772 - 15: Standard Terminology of Solar Energy Conversion

Testing

- ASTM E2848 - 13(2018) : Standard Test Method for Reporting Photovoltaic Non-Concentrator System Performance

Annex H.2: Inverter standards

International Electrotechnical Commission (IEC)

- IEC 62109-1:2010: Safety of Power Converters for Use in Photovoltaic Power Systems - Part 1: General requirements
- IEC 62109-2:2011: Safety of Power Converters for Use in Photovoltaic Power Systems - Part 2: Particular requirements for inverters

UL standards

- UL 1741: Standard for Inverters, Converters, Controllers, and Interconnection System Equipment for Use with Distributed Energy Resources

IEEE standards

- IEEE 1547: Standard for Interconnecting Distributed Resources with Electric Power Systems

Annex I: New work items for 2021 and 2022[85] of VSQI

Proposals for 2021 per area in the PV sector

Tên tiêu chuẩn **STANDARDS**	**Tiêu chuẩn tham khảo** **REFFERENCE STANDARDS**
Standards for photovolataics in building: general requirements, managing fire risk, lightning and surge voltage protection.	***Tiêu chuẩn về lắp đặt điện mặt trời cho toà nhà, bảo vệ chống sét, chống cháy đối với điện mặt trời cho tòa nhà***
Quang điện mặt trời dùng cho tòa nhà – Phần 1: Yêu cầu đối với các mô đun quang điện tích hợp với tòa nhà *Photovoltaics in buildings - Part 1: Requirements for building-integrated photovoltaic modules*	IEC 63092-1:2020 Edition 1.0 (2020-09-29)
Quang điện mặt trời dùng cho tòa nhà – Phần 2: Yêu cầu đối với các hệ thống quang điện tích hợp với tòa nhà *Photovoltaics in buildings - Part 2: Requirements for building-integrated photovoltaic systems*	IEC 63092-2:2020 Edition 1.0 (2020-09-29)
Quản lý rủi ro cháy liên quan đến hệ thống quang điện cho tòa nhà *Managing fire risk related to photovoltaic (PV) systems on buildings*	IEC TR 63226:2021 Edition 1.0 (2021-02-18)
Bảo vệ chống sét và chống đột biến điện áp đối với hệ thống nguồn quang điện *Lightning and surge voltage protection for photovoltaic (PV) power supply systems*	IEC TR 63227:2020 Edition 1.0 (2020-10-20)
Standards for Photovoltaic (PV) module performance testing and energy rating	***Bộ tiêu chuẩn về thử nghiệm và đánh giá các thông số tính năng của mô đun quang điện PV***
Thử nghiệm và đánh giá năng lượng của môđun quang điện – Phần 1: Phép đo tính năng và đánh giá công suất theo cường độ bức xạ và nhiệt độ *Photovoltaic (PV) module performance testing and energy rating - Part 1: Irradiance and temperature performance measurements and power rating*	IEC 61853-1:2011 Edition 1.0 (2011-01-26)
Thử nghiệm và đánh giá năng lượng của môđun quang điện – Phần 2: Phép đo đáp ứng phổ, góc tới và nhiệt độ làm việc của môđun *Photovoltaic (PV) module performance testing and energy rating - Part 2: Spectral responsivity, incidence angle and module operating temperature measurements*	IEC 61853-2:2016 Edition 1.0 (2016-09-06)
Thử nghiệm và đánh giá năng lượng của môđun quang điện – Phần 3: Đánh giá năng lượng của môđun quang điện *Photovoltaic (PV) module performance testing and energy rating - Part 3: Energy rating of PV modules*	IEC 61853-3:2018 Edition 1.0 (2018-08-30)
Thử nghiệm và đánh giá năng lượng của môđun quang điện – Phần 4: Biểu đồ khí hậu tham chiếu tiêu chuẩn *Photovoltaic (PV) module performance testing and energy rating - Part 4: Standard reference climatic profiles*	IEC 61853-4:2018 Edition 1.0 (2018-08-30)

[85] There were no proposals for 2023 and beyond when the list was delivered.

Tên tiêu chuẩn STANDARDS	Tiêu chuẩn tham khảo REFFERENCE STANDARDS
Standards for Secondary cells and batteries for renewable energy storage	***Tiêu chuẩn về pin dùng để lưu trữ điện mặt trời***
Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photo-voltaic off-grid application *Pin thứ cấp dùng để lưu trữ năng lượng tái tạo – Yêu cầu chung và phương pháp thử - Phần 1: Ứng dụng quang điện không nối lưới*	IEC 61427-1:2013
Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 2: On-grid applications *Pin thứ cấp dùng để lưu trữ năng lượng tái tạo – Yêu cầu chung và phương pháp thử - Phần 2: Ứng dụng nối lưới*	IEC 61427-2:2015
Bộ điều khiển nạp pin/acquy dùng cho hệ thống quang điện – Tính năng và hoạt động *Battery charge controllers for photovoltaic systems - Perfor-mance and functioning*	IEC 62509:2010 Edition 1.0 (2010-12-16)

Proposals for new work items in 2022

Tên tiêu chuẩn STANDARDS	Tiêu chuẩn tham khảo REFFERENCE STANDARDS
Standards for quality of the PV	***Tiêu chuẩn về chất lượng của mô đun quang điện***
Mô đun quang điện PV trong suốt tuổi thọ - Đánh giá rủi ro về sức khỏe và an toàn với môi trường (EH&S) – Nguyên tắc chung và thuật ngữ Photovoltaic (PV) modules through the life cycle - Environ-mental health and safety (EH&S) risk assessment - General principles and nomenclature	IEC TS 62994:2019 Edition 1.0 (2019-01-29)
Terrestrial photovoltaic (PV) modules - Quality system for PV module manufacturing *Mô đun quang điện mặt đất – Hệ thống chất lượng trong sản xuất môđun quang điện*	IEC 62941:2019 Edition 1.0 (2019-12-12)
Terrestrial photovoltaic (PV) systems - Guidelines for effec-tive quality assurance in PV systems installation, operation and maintenance *Mô đun quang điện mặt đất – Hướng dẫn để đảm bảo chất lượng hiệu quả trong việc lắp đặt, vận hành và bảo trì hệ thống PV*	IEC TS 63049:2017 Edition 1.0 (2017-09-06)
Photovoltaic (PV) arrays - Earth fault protection equipment - Safety and safety-related functionality *Dàn quang điện – Thiết bị bảo vệ sự cố chạm đất – Vận hành an toàn và liên quan đến an toàn*	IEC 63112 ED1
Photovoltaic (PV) systems - Characteristics of the utility in-terface *Hệ thống quang điện PV – Đặc tính của giao diện với nguồn lưới*	IEC 61727:2004 Edition 2.0 (2004-12-14)
Standards for inverters	***Tiêu chuẩn về bộ inverter chuyển đổi điện một chiều sang xoay chiều***

ANNEX I: NEW WORK ITEMS FOR 2021 AND 2022 OF VSQI

Tên tiêu chuẩn **STANDARDS**	**Tiêu chuẩn tham khảo** **REFFERENCE STANDARDS**
An toàn của bộ chuyển đổi điện dùng trong hệ thống quang điện – Phần 3: Yêu cầu cụ thể đối với thiết bị điện tử kết hợp với các phần tử quang điện *Safety of power converters for use in photovoltaic power systems - Part 3: Particular requirements for electronic devices in combination with photovoltaic elements*	IEC 62109-3:2020 Edition 1.0 (2020-07-08)
Bộ nghịch lưu quang điện nối lưới – Quy trình thử nghiệm các biện pháp ngăn ngừa phát điện ngược lên lưới điện trong trường hợp mất điện lưới *Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures*	IEC 62116:2014 Edition 2.0 (2014-02-26)
Hiệu suất bám theo điểm công suất lớn nhất của bộ nghịch lưu quang điện nối lưới *Maximum power point tracking efficiency of grid connected photovoltaic inverters*	IEC 62891:2020 Edition 1.0 (2020-07-15)
Standards for switchgear and controlgear assemblies, protection devices and Electricity metering equipment	***Tiêu chuẩn cho các thiết bị đấu nối và thiết bị bảo vệ trong hệ thống PV, công tơ điện***
Low-voltage switchgear and controlgear assemblies *Tủ điện đóng cắt và điều khiển hạ áp*	IEC 61439
Low-voltage fuses - Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems *Cầu chảy hạ áp – Phần 6: Yêu cầu bổ sung đối với dây chảy dùng để bảo vệ hệ thống điện mặt trời*	IEC 60269-6:2010+AMD1:2021 CSV
Electricity metering equipment - Particular requirements *Công tơ điện – Yêu cầu cụ thể*	IEC 62053
Standards for trackers	***Tiêu chuẩn về bộ bám theo mặt trời (tracker)***
Hệ thống quang điện – Chất lượng thiết kế bộ bám theo mặt trời Photovoltaic systems - Design qualification of solar trackers	IEC 62817:2014+AMD1:2017 CSV
Hệ thống quang điện – Quy định kỹ thuật của bộ bám theo mặt trời Photovoltaic systems - Specification for solar trackers	IEC TS 62727:2012

Annex J: Questionnaire used for the survey among standards users

Survey questions – version in English

Introduction

You can use a computer, a laptop or a mobile device to answer. Questions with an asterisk (*) need to be answered to move to the next section of the questionnaire. Time needed to respond to the survey: approximately 10 minutes

List of questions

<table>
<tr><th>Topic</th><th>Questions</th></tr>
<tr><td colspan="2">Information on your company*[86]</td></tr>
<tr><td colspan="2">Please provide some key information on your business.
Name of your company: _____
Overall annual income of production/service (B = Billion)
☐ Less than 1B VND | ☐ More than 1 and up to 100B VND | ☐ More than 100 and up to 500B VND | ☐ More than 500B VND

Active in the PV sector for
☐ Less than 1 year | ☐ More than 1 year and up to 3 years | ☐ More than 3 years and up to 5 years | ☐ More than 5 years

Number of PV projects per year
☐ Less than 5 | ☐ More than 5 and up to 10 | ☐ 11 – 20 | ☐ More than 20

Average size of a PV project:
☐ Less than 100kWp | ☐ 100 kWp – 1MWp | ☐ more than 1 MWp and up to20 MWp | ☐ more than 20 MWp – 50MWp</td></tr>
<tr><td colspan="2">6. Information on your involvement in the PV value chain* (multiple answers allowed)</td></tr>
<tr><td>Please indicate in which part of the PV value chain you are involved (multiple answers allowed)</td><td>☐ PV project owner
☐ Manufacturing of PV cells / modules
☐ Engineering, procurement and construction (EPC)
☐ Installation of PV systems
☐ Testing of PV elements
☐ Testing of PV systems
☐ Maintenance of PV installations
☐ Power system operation
☐ Power distribution
☐ Government administration
☐ Other: _____
☐ Not sure</td></tr>
</table>

[86] Topics/questions with an asterisk were mandatory to answer. If not answered, the respondent could not move to the next set of questions.

7. Use of standards*

How often did you use PV standards in your business?

☐ 100 % of all projects	☐ less than 100 % but more than 50 % of all projects	☐ less than 50 % of all projects	☐ Never	☐ I don't know

Which standards did you often use in your business? (multiple answers allowed)

☐ Group standards of PV devices (TCVN 12678 series/IEC 60904)
☐ Group standards of PV modules (TCVN 6781 series/IEC 61215)
☐ Group standards of PV system (TCVN 11855/IEC 62446)
☐ Group standards of PV inverters (TCVN 11855-1, TCVN 12673)
☐ Group standards of Electrical installation (TCVN 7447-7-712/IEC 60364-7-712)
☐ Others: _____

10. Searching for standards*	
Where do you find the standards you need/might need? **(multiple answers allowed)**	☐ IEC webstore ☐ STAMEQ catalogue ☐ Recommendations from other companies ☐ Other: _____ ☐ Don't know
Which tools do you use to search the standards you need? **(multiple answers allowed)**	☐ Internet search ☐ Phone calls and/or emails to receive recommendations from other companies ☐ Other: _____ ☐ I cannot answer this question
11. Origin of standards*	
PV standards are developed by various standardisation bodies; which standards, if any, do you mostly use? **(multiple answers allowed)**	☐ IEC ☐ IEEE ☐ ASTM ☐ European standards (EN) ☐ Standards from Japan ☐ Standards from Canada ☐ Standards from China ☐ Standards from India ☐ Standards adopted as national Vietnamese standards by STAMEQ ☐ Other: _____ ☐ Don't know
12. Procurement of standards*	
Where do you purchase the standards you need? **(multiple answers allowed)**	☐ At STAMEQ ☐ Online at IEC ☐ Online at ASTM ☐ Online at IEEE ☐ Other: _____ ☐ Don't know

13. Preferences of formats*	
Standards are available in a paper format and as downloadable PDF; which one do you use?	☐ Paper ☐ PDF ☐ Paper and PDF ☐ Don't know
14. Which format would you prefer?	☐ I prefer paper ☐ I prefer PDF ☐ I have no preference
Why? Please explain your preference.	*[Open text]*
Usability of standards*	
Did the standards you have purchased or used in the past meet your needs?	☐ Yes, fully ☐ Yes, partly ☐ No ☐ I don't know
Please explain why/why not	*[Open text]*
What are the additional PV topics for standards you have identified for your business, if any? Please list the topics as concretely as possible	
[Open text]	
What do you do in case a needed standard does not exist with STAMEQ (i.e. your strategy, past experiences)?	
[Open text]	
Comments	
Do you have additional remarks regarding your experiences with PV standards in Vietnam?	

Survey questions – version in Vietnamese

Giới thiệu

Quý vị có thể sử dụng máy tính, máy tính xách tay hoặc thiết bị di động để trả lời. Các câu hỏi có dấu sao (*) cần được trả lời mới có thể chuyển sang phần tiếp theo trong bảng câu hỏi. Thời gian cần thiết để trả lời khảo sát: khoảng 10 phút

Danh sách câu hỏi

Chủ đề	**Câu hỏi**
Thông tin về công ty quý vị (thông tin này sẽ không cung cấp cho bên thứ 3)	
Xin vui lòng [cung cấp một số thông tin chính về doanh nghiệp của quý vị. Tên công ty: _____	

Tổng thu nhập từ sản xuất/dịch vụ hàng năm (B = Tỷ)

☐ Dưới 1B VND	☐ Trên 1 và lên đến 100B VND	☐ Trên 100 và lên đến 500B VND	☐ Trên 500B VND

Hoạt động trong ngành quang điện từ

☐ Dưới 1 năm	☐ Trên 1 năm và đến 3 năm	☐ Trên 3 năm và đến 5 năm	☐ Trên 5 năm

Số lượng dự án quang điện mỗi năm

☐ Dưới 5	☐ Trên 5 và đến 10	☐ 11 – 20	☐ Trên 20

Quy mô trung bình của một dự án quang điện:

☐ Dưới 100kWp	☐ 100 kWp – 1MWp	☐ trên 1 MWp và lên đến 20 MWp	☐ trên 20 MWp – 50MWp

Thông tin về sự tham gia của qúy vị trong chuỗi giá trị quang điện* (có thể chọn nhiều câu trả lời)

Xin vui lòng cho biết quý vị tham gia vào phần nào trong chuỗi giá trị quang điện (có thể chọn nhiều ô)	☐ Chủ dự án quang điện ☐ Sản xuất pin/mô-đun quang điện ☐ Thiết kế, Mua sắm và Xây dựng (EPC) ☐ Lắp đặt các hệ thống quang điện ☐ Thử nghiệm các yếu tố quang điện ☐ Thử nghiệm các hệ thống quang điện ☐ Bảo trì các công trình lắp đặt quang điện ☐ Vận hành hệ thống điện ☐ Phân phối điện ☐ Quản trị Chính phủ ☐ Khác: _____ ☐ Không chắc

Sử dụng các tiêu chuẩn

Quý vị có thường xuyên sử dụng các tiêu chuẩn về quang điện trong doanh nghiệp không?

☐ 100 % tất các các dự án	☐ Dưới 100 % nhưng trên 50 % tất cả các dự án	☐ 50 % hoặc ít hơn các dự án	☐ Không biết

Quý vị thường sử dụng tiêu chuẩn nào trong doanh nghiệp? (có thể cung cấp nhiều câu trả lời)

☐ Tiêu chuẩn nhóm về các thiết bị quang điện (chuỗi TCVN 12678 /IEC 60904)
☐ Tiêu chuẩn nhóm về các mô-đun quang điện (chuỗi TCVN 6781 /IEC 61215)
☐ Tiêu chuẩn nhóm về hệ thống quang điện (TCVN 11855/IEC 62446)
☐ Tiêu chuẩn nhóm về biến tần quang điện (TCVN 11855-1, TCVN 12673)
☐ Tiêu chuẩn nhóm về lắp đặt điện (TCVN 7447-7-712/IEC 60364-7-712)
☐ Khác: _____

Tìm kiếm các tiêu chuẩn

Quý vị có thể tìm kiếm các tiêu chuẩn cần thiết/có thể cần thiết ở đâu? **(có thể chọn nhiều câu trả lời)**	☐ Trang web về IEC ☐ Ấn phẩm của STAMEQ ☐ Khuyến nghị từ các công ty khác

	☐ Khác: _____ ☐ Không biết
Quý vị sử dụng các công cụ nào để tìm kiếm các tiêu chuẩn cần thiết **(có thể chọn nhiều câu trả lời)**	☐ Tìm kiếm trên Internet ☐ Gọi điện và/hoặc gửi email để nhận được đề xuất từ các công ty khác ☐ Khác: _____ ☐ Tôi không trả lời câu hỏi này được
Nguồn gốc các tiêu chuẩn	
Các tiêu chuẩn về quang điện do các cơ quan thiết lập tiêu chuẩn khác nhau xây dựng; quý vị chủ yếu sử dụng tiêu chuẩn nào, nếu có? **(có thể chọn nhiều câu trả lời)**	☐ IEC ☐ IEEE ☐ ASTM ☐ Tiêu chuẩn Châu Âu (EN) ☐ Tiêu chuẩn của Nhật Bản ☐ Tiêu chuẩn của m Canada ☐ Tiêu chuẩn của Trung Quốc ☐ Tiêu chuẩn của Ấn Độ ☐ Tiêu chuẩn được STAMEG công nhận là tiêu chuẩn quốc gia Việt Nam ☐ Khác: _____ ☐ Không biết ☐
Mua các tiêu chuẩn	
Quý vị mua/có được các tiêu chuẩn mình cần ở đâu? **(có thể chọn nhiều câu trả lời)**	☐ Tại STAMEQ ☐ Trực tuyến tại IEC ☐ Trực tuyến tại ASTM ☐ Trực tuyến tại IEEE ☐ Khác: _____ ☐ Không biết
Tùy chọn định dạng	
Các tiêu chuẩn có sẵn ở định dạng văn bản giấy và dưới dạng PDF có thể tải xuống; Bạn sử dụng định dạng nào?	☐ Văn bản giấy ☐ PDF ☐ Giấy và PDF ☐ Không biết
Quý vị mong muốn định dạng nào hơn?	☐ Tôi thích định dạng văn bản giấy hơn ☐ Tôi thích định dạng PDF hơn ☐ Tôi thế nào cũng được
Tại sao? Xin vui dòng giải thích lý do cho sự lựa chọn này	*[Có thể viết tùy ý]*
Khả năng sử dụng của các tiêu chuẩn	
Các tiêu chuẩn mà quý vị đã mua hoặc sử dụng trước đây có đáp ứng nhu cầu của quý vị không?	☐ Có, hoàn toàn phù hợp ☐ Có, phù hợp một phần ☐ Không ☐ Không biết
Xin vui lòng giải thích lý do	*[Có thể viết tùy ý]*

Quý vị đã bao giờ xác định các tiêu chuẩn về quang điện cần có thêm cho doanh nghiệp mình chưa? Vui lòng liệt kê các chủ đề tiêu chuẩn đó càng cụ thể càng tốt
[Có thể viết tùy ý]
Quý vị thường làm gì trong trường hợp tiêu chuẩn quý vị cần mà STAMEG không có (ví dụ như chiến lược, kinh nghiệm của quý vị)?
[Có thể viết tùy ý]
Ý kiến đóng góp
Quý vị có điều gì khác cần chia sẻ liên quan đến kinh nghiệm của mình với các tiêu chuẩn về quang điện ở Việt Nam không?

Annex K: Working groups, project teams, joint working groups and advisory groups in IEC TC 82[87]

Type	Label	Description	Scope
Advisory Groups	AG 12	Chair's Advisory Group (CAG)	Provide strategic input and build consensus within the TC
Joint Working Groups	JWG 1	Renewable energy off grid systems, including access to electricity, rural electrification and hybrid systems	To prepare standards and technical specifications for renewable energy off grid systems, including access to electricity, rural electrification and hybrid systems. The contents of the IEC 62257 series are a resource for the identification of energy solutions and products that are technically best suited within the economic context. These documents are intended for use as guidelines, including assessing the quality of the service to the end users. (Note: According to the topics, this joint working group will work with other IEC TCs and SCs as needed. Previous collaboration has included TC 88 and TC 21.)
Joint Working Groups	JWG 11	Building-Integrated Photovoltaics (BIPV)	The new JWG would assume responsibility for ISO TS 18178 and the IEC 63092 series. The JWG would also address several other topics related to BIPV. Projects under the responsibility of TC 82: 1. IEC 63092-1, Photovoltaics in buildings - Part 1: Building integrated photovoltaic modules; 2. IEC 63092-2, Photovoltaics in buildings - Part 2: Building integrated photovoltaic systems; 3. Proposed IEC 63092-3, Photovoltaics in buildings - Part 3: Evaluation methodology of SHGC for building integrated photovoltaic modules. Projects under the responsibility of ISO TC 160/SC 1: 1. ISO TS 18178 Ed 1.0, Glass in building - Laminated solar photovoltaic glass for use in buildings. Since IEC 63092-1 and IEC 63092-2 have reached the approval stage, it will be continued published as a single IEC logo and only considered as a dual logo standard in the next maintenance process.
Joint Working Groups	JWG 11	Building-Integrated Photovoltaics (BIPV)	The new JWG would assume responsibility for ISO TS 18178 and the IEC 63092 series. The JWG would also address several other topics related to BIPV. Projects under the responsibility of TC 82: 1. IEC 63092-1, Photovoltaics in buildings – Part 1: Building integrated photovoltaic modules; 2. IEC 63092-2, Photovoltaics in buildings – Part 2: Building integrated photovoltaic systems; 3. Proposed IEC 63092-3, Photovoltaics in buildings – Part 3: Evaluation methodology of SHGC for building integrated photovoltaic modules; Projects under the responsibility of ISO TC 160/SC 1: 1. ISO TS 18178 Ed 1.0, Glass in building - Laminated solar photovoltaic glass for use in buildings. Since IEC 63092-1 and IEC 63092-2 have reached the approval stage, it will be continued published as a single IEC logo and only considered as a dual logo standard in the next maintenance process.
Project Team	PT 600	Vehicle Integrated Photovoltaic Systems	To develop two new technical reports: 1. IEC TR 6XXXX: Monitoring three-dimensional solar irradiance around the automobile using array of pyranometers 2. IEC TR 6XXXX: Modelling solar irradiance and its distribution and its distribution to VIPV affected by shading by buildings
Working Group	WG 1	Glossary	To prepare a glossary.

[87] IEC TC 82 (undated)

Type	Label	Description	Scope
Working Group	WG 2	Modules, non-concentrating	To develop international standards for non-concentrating, terrestrial photovoltaic modules. These standards will be in the general areas of photoelectric performance, environmental test, quality assurance and quality assessment criteria. The standards ultimately produced should be universal and non-restrictive in their application, taking into account different environments and manufacturing technologies. In addition to the basic electrical and mechanical characteristics, standards will be written for other important factors such as module thermal performance, high voltage performance, fault resistance and fault-tolerant design.
Working Group	WG 3	Systems	To give general instructions for the photovoltaic system design, construction and maintenance. For each particular user's application, each activity should be the object of a separate study area. The Working Group should incorporate the existing standards on the functional blocks that are different from the photovoltaic array field, and promote the production of new specific standards when necessary.
Working Group	WG 6	Balance-of-system components	To develop international standards for balance-of-system components for PV systems. These standards will be in the general areas of performance, safety, environmental durability (reliability), quality assurance and quality assessment criteria. The standards ultimately produced should be universal and non-restrictive in their application, taking into account different environments and manufacturing technologies. In addition to the basic electrical and mechanical characteristics, standards will be written for other important factors such as thermal performance, electromagnetic interference, and climate applicability/rating.
Working Group	WG 7	Concentrator modules	To develop international standards for photovoltaic concentrators and receivers. These standards will be in the general areas of safety, photoelectric performance and environmental reliability tests. The standards ultimately produced should be universal and non-restrictive in their application, taking into account different environments and manufacturing technologies. In addition to the basic electrical and mechanical characteristics, standards will be written for other important factors such as thermal performance, high voltage performance, fault resistance and fault-tolerant design.
Working Group	WG 8	Photovoltaic (PV) cells	To develop international standards for non-concentrating, terrestrial photovoltaic cells. These standards will be in the general areas of photoelectric performance, environmental test, quality assurance and quality assessment criteria
Working Group	WG 9	BOS Components – Support Structures	To develop international standards for photovoltaic support structures. These standards are in the general areas of safety, design qualification, engineering integrity, durability, and verification testing. The standards address structural, mechanical, electrical, and controller characteristics, strength classification, performance, fault tolerance, serviceability, and documentation requirements as appropriate. The support structures addressed by these standards may include trackers, fixed tilt, ballasted foundations, among others. The standards produced are intended to be universal and non-restrictive in their application.

There are also some ISO standards dealing with the usage and calibration of irradiance sensors of monitoring systems and are also relevant for the PV sector.

Number	Title[88]
ISO 9060	Solar energy — Specification and classification of instruments for measuring hemispherical solar and direct solar radiation
ISO 9846	Calibration of a pyranometer using a pyrheliometer
ISO 9847	Solar energy — Calibration of pyranometers by comparison to a reference pyranometer
ISO 9901	Solar energy — Pyranometers — Recommended practice for use

[88] ISO/TC 180 (undated)

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Abbreviations and acronyms

ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
BIS	Bureau of Indian Standards
BSN	Badan Standardisasi Nasional, National Standards Body Indonesia
DIN	DIN Deutsches Institut für Normung e.V.; German Institute for Standardization
EVN	Vietnam Electricity Corporation
ERAV	Electricity Regulatory Authority of Vietnam
FIT	Feed-in-tariffs
GSP	Good Standardization Practice
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
MOC	Ministry of Construction
MOIT	Ministry of Industry and Trade
MOST	Ministry of Science and Technology
NQP	National Quality Policy
NEC	National Electrotechnical Committee
NMC	National mirror committee
NSP	National Standardization Plan
PDP	Power Development Plan
PTB	Physikalisch-Technische Bundesanstalt; German National Metrology Institute
PV	Photovoltaic(s)
QCVN	Vietnam National Technical Regulation
RTS	Solar rooftop systems; rooftop solar
SDO	Standards developing organization
SME	Small and medium enterprises
STAMEQ	National Commission for Standards, Metrology and Quality
TBT	Technical Barriers to Trade
TCVN	Vietnam Standard
TR	Technical regulation
TS	Technical Specification

ABBREVIATIONS AND ACRONYMS

USAID	United States Agency for International Development
VC	Value chain
VSQI	Vietnam Standards and Quality Institute
WB	World Bank
WTO	World Trade Organization

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