UNEZA
UTILITIES FOR NET ZERO ALLIANCE

Standards and certifications for the energy transition

www.uneza.com

ISBN: 978-92-9260-664-0

Citation: UNEZA (2025), *Standards and certifications for the energy transition*, Utilities for Net Zero Alliance, Abu Dhabi.

About UNEZA

The Utilities for Net Zero Alliance (the "Alliance") is the international platform for co-operation among entities operating within the power utilities ecosystem, to address and overcome common barriers to the realisation of net-zero ambitions and more near-term emissions reduction targets. The Alliance seeks to shape dynamic new partnerships and forge effective channels for dialogue with key public and private stakeholders. UNEZA's members and partners recognise that the key to unlocking the utility sector's global energy transition potential lies in the ability to deliberately target existing structural, regulatory and financial impediments and challenges that may stand in the way of progress. UNEZA operates under the guidance of the International Renewable Energy Agency (IRENA) and the UN Climate Change High-Level Champions, ensuring a focused and strategic approach to achieving a sustainable energy future.

Acknowledgements

UNEZA would like to express its gratitude to all members and partners who participated in implementing specific actions, meetings and discussions that informed this report. The Alliance also thanks the United Arab Emirates for its voluntary contribution supporting this publication. The report was produced by IRENA, with publications support provided by Francis Field and Stephanie Clarke. The text was edited by Stefanie Durbin, with design provided by Elkanodata.

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2030 BREAKTHROUGHS

UNEZA UTILITIES FOR NET ZERO ALLIANCE

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Abbreviations

ACP	Affiliate Country Programme
COP	Conference of the Parties
DC	direct current
G20	Group of 20
IEC	International Electrotechnical Commission
IECRE	IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications
IEEE	Institute of Electrical and Electronics Engineers
INSPIRE	International Standards and Patents in Renewable Energy
IoT	Internet of Things
IRENA	International Renewable Energy Agency
ISO	International Standards Organization
ITU	International Telecommunication Union
LVDC	low voltage direct current
PV	photovoltaic
REFIT	Renewable Energy Feed-In Tariff
RfG	requirements for generators
RFID	radio-frequency identification
RoI	return on investment
TC	technical committee
TSO	transmission system operator
UN	United Nations
UNEZA	Utilities for Net Zero Alliance
VRE	variable renewable energy
WSC	World Standards Cooperation

Executive summary

The Utilities for Net Zero Alliance (UNEZA) provides an international platform for co-operation among actors in the power utilities ecosystem to address and overcome common barriers in realising net-zero ambitions and near-term emissions reduction targets. This powerful global community, currently co-chaired by TAQA and SSE, includes 64 utilities and power sector suppliers. The alliance was launched at the 28th Conference of the Parties to the United Nations (UN) Framework Convention on Climate Change (COP28) under the guidance of the International Renewable Energy Agency (IRENA) and the UN Climate Change High-Level Champions.

A key goal of UNEZA's *Roadmap to 2030 and beyond* is to collectively contribute to the global commitment for tripling renewable power and doubling energy efficiency by 2030, with a view to achieving net-zero emissions by 2050 (UNEZA, 2024a).

The power system sits at the heart of the global energy transition and is central to industry-wide decarbonisation strategies. This means that countries contributing to this commitment need to build the necessary infrastructure and invest at scale in efficient, quality and sustainable power systems. It will also require firm actions to advance policy and regulations for facilitating targeted investments and to de-risk supply chains. At the same time, it means strategically realigning institutional capacities to help ensure that skills and capabilities match the energy system we aspire to create.

Standards and conformity assessment systems to certify or verify compliance with regulations, technical requirements or sustainability criteria are pivotal in achieving these goals, serving as essential instruments for policy makers and regulators to drive progress towards their objectives. According to the UNEZA Action Plan (UNEZA, 2025), one of the key pillars focuses on facilitating policy and regulatory frameworks, as well as actions centred on standardising key energy transition equipment to unlock global supply chains, enhancing efficiency and scalability.

UNEZA plans to launch a global supply chain initiative that will, among other actions, call for standardising key energy transition equipment that can unlock global supply chains. Within the initiative, a road map will define key equipment types for standardisation, considering regional differences.

Countries and relevant organisations can participate in the standardisation efforts at the international, national or regional level. Their participation will help to ensure reliability, sustainability and efficiency in the global energy transition. This report provides a basis for the global supply chain initiative and highlights how international standards can support the clean energy transition by improving safety, efficiency and integration of new technologies. It includes real-world examples, illustrates how standards help overcome policy challenges and highlights the benefits for energy providers involved in standardisation.

1. Standards facilitate the energy transition

International standards reflect the consensus of industry leaders and experts from across the world coming together to set quality and best practices thresholds that ensure safer and more efficient systems, processes and products for various domains in society.

With respect to global energy infrastructure, standards enable renewable energy systems to function safely, reliably and efficiently, whether connected to the grid or operating off-grid. They also support the integration of renewable energy systems into the electrical grid (IEC, 2025a).

Standards essentially provide the framework on which our society is built. Hydropower provides a good example of how this framework operates. Standardisation bodies like the International Electrotechnical Commission (IEC) produce international standards specifying the design, manufacture, installation, testing, operation and maintenance of hydraulic machines including turbines, storage pumps and pump turbines. Such standards also serve as the basis for testing and certification of components, devices and systems, thus ensuring system reliability.

In the context of expanding global trade, collaboration in clean energy research and development, and improved distribution, standards and certification play vital roles in enhancing the uptake, awareness and confidence in renewable energy markets, directly supporting climate change mitigation efforts. As noted in the United Nations (UN) Foundation's *Energy access practitioner network report*, poor-quality technologies risk undermining consumer trust and damaging the market. Conversely, well-written standards improve communication, trade, legislation, environmental protection and resource efficiency, while fostering trust in products and services. However, poorly designed standards can act as barriers to innovation, deployment and trade, particularly if they are biased or overly restrictive (SE4All and UN Foundation, 2012).

However, the effectiveness of standards also depends on their implementation. This requires robust quality control and conformity assessment systems to verify compliance and ensure consistent performance.

Because standards are often consensus-based, they may reflect minimum thresholds for quality, performance or safety, which might be suboptimal or vary in relevance across regions or sectors. Establishing global standards remains a challenge due to diverse stakeholder needs and, at times, limited stakeholder engagement.

Effective integration of standards into renewable energy initiatives is essential. Without certification, verification or auditing, it becomes difficult to assess the real impact of standards. Political discussions often focus on defining minimum requirements or threshold values, which allow for measuring product performance, service quality, energy use, emissions and other metrics over time (IRENA, 2020).

According to the International Renewable Energy Agency (IRENA), international standards are also central to the integration of variable renewable energy (VRE) into power systems. These standards shape the technical specifications for design, installation and commissioning, and often align with, or inform, national grid codes, particularly on issues such as voltage, frequency and power quality. This creates a dynamic and bidirectional relationship: while grid codes are binding, the adoption of international standards remains voluntary, yet crucial for interoperability and system reliability (IRENA, 2022).

Achieving harmonisation and interoperability remains a challenge, given the variation in acceptable parameter ranges across different power systems. However, requirements for generators (RfGs) and standards developed by the Institute of Electrical and Electronics Engineers (IEEE) provide valuable guidance to transmission system operators (TSOs) in defining consistent and acceptable parameter thresholds.

Box 1 Definitions of key terms used in this report, based on IEC terminology

A "standard" is an agreed method of doing something in a consistent and repeatable manner. It sets minimum requirements for safety, reliability, efficiency and trust.

An "international standard" is a document created through the consensus of experts from multiple countries and approved by a globally recognised body. It sets out rules, guidelines, processes or characteristics that enable users to achieve consistent outcomes repeatedly.

The process of developing and implementing "technical standards" is based on consensus among stakeholders such as industry, government, consumers and experts to ensure the safety, reliability, efficiency and interoperability of electrical and electronic systems and devices.

"Conformity assessment" is any activity carried out to determine whether products, systems, services or, in some cases, individuals meet the requirements and characteristics outlined in a standard or specification. These requirements may relate to performance, safety, efficiency, effectiveness, reliability, durability or environmental impacts such as pollution or noise. Verification is typically conducted through testing and/or inspection, and it may involve ongoing verification processes.

"Certification" is a type of third-party conformity assessment that provides independent, impartial assurance that a product, system, service or process meets the specific requirements set out in a standard or specification. It involves verification – typically through testing and inspection – carried out by an entity that is independent of both the seller and the buyer.

Source: (IEC, n.d.a).

2. Leveraging emerging technologies for a smarter and cleaner energy sector

With the rapid pace of evolving technologies, standards are also essential to facilitate a common language for systems and applications to work cohesively. Power system digitalisation is an instructive example. Digital twins in the energy sector – real-time digital representations of physical grid assets – rely on standardised data models and secure data exchange to support interoperability and effective grid management (IEC, 2024a).

A 2024 IEC white paper, *Virtualizing power systems: How digital twins will revolutionize the energy sector*, outlines the benefits digital twins can bring, and how standards can be leveraged to implement the technology safely and effectively. The white paper looks at how the effective use of digital twin technologies can help grid planners and grid operators manage their systems efficiently, helping them overcome infrastructural challenges. This also enables industry to meet net-zero goals by helping planners monitor and identify design alternatives to reduce carbon emissions (IEC, 2024a).

As engineers, policy makers, companies and others set out to target their infrastructural goals and decarbonisation commitments, they can rely on standards and specifications to guide them in effectively implementing technologies. Despite these technologies being relatively new to the market, by meeting international standards, they can be assured of the quality of the systems and potential safeguards that have been carefully assessed and agreed upon by global experts. This further helps reduce risk of investment in such projects.

Similarly, power electronics are another technological domain that can benefit massively from international standardisation. Power electronics, which mostly deal with transforming, conducting or delivering electrical energy, play a pivotal role in achieving net-zero goals while still contributing to economic growth in a society that is increasingly electric. In this case, standards are essential throughout the entire innovation cycle, from research to end product, ensuring a smooth transition from development to real-world applications by establishing key metrics and methodologies (Slama and Wilkowski, 2024).

One critical area within power electronics is the role of power semiconductors. A 2023 IEC white paper takes an incisive look at the role power semiconductors play in transitioning to a net-zero and energy-efficient society (IEC, 2023a).

Addressing significant challenges – such as the need for change in industry practices when transitioning from linear to circular economies and the shortage of skilled personnel required for power semiconductor development – IEC's 2023 white paper stresses the need for strategic actions at the policy-making level. Here, standards play a pivotal role in removing significant technical risks, increasing product quality and enabling faster market acceptance.

3. Case studies: Governments adopting standards to achieve policy targets

Policy makers can use international standards and conformity assessment to support their public policies and turn objectives into real actions.

3.1. Case study 1: India adopts standards to scale technologies for energy access

Standardisation work by IEC on technologies like low voltage direct current (LVDC) is proving be key to facilitating energy access in hard-to-reach areas and promoting integration of more renewables for a clean energy supply (IEC, n.d.b).

The IEC provides the technical foundation that facilitates the building of a safe and affordable off-grid infrastructure that can later be connected and expanded. IEC International Standards also guide its design and installation and with these the benchmarking and comparison of such infrastructure investment.

An example of its use in energy access projects is the IEC 62257 series, which provides a planned and tested approach for rural electrification projects (IEC, 2023b, 2024b).

In the case of LVDC too, IEC is committed to making the technology safe for use everywhere where direct current (DC) power can be used directly without losses in energy conversion. LVDC is becoming one of the most useful technologies being leveraged for rural electrification because it is low cost and provides a relatively simple way to integrate renewable energy. Using LVDC can help improve energy efficiency, thereby also reducing the global carbon footprint. It can power data centres, office buildings and hospitals. In low- and middle-income economies, LVDC has the potential to provide affordable and sustainable electricity access to people who would otherwise have to wait many years for a connection to the main electricity grid.

India, a key champion of the technology, is also a participating member of the IEC LVDC Systems Committee. As a committee member, it brings its experience and learnings to the international community and collaborates with worldwide experts to produce meaningful standards for the global community. This work has resulted in a standard that represents a big step in the scaling of electricity access technologies. Adopting this standard allows regulators and administrators to benchmark DC microgrid solutions from different vendors of LVDC-related technology. It also provides assurance to funding bodies, investors and insurers, enabling new players to enter the market and expediting energy access in rural areas. This shows how participation in international standardisation allows for converging of expertise in certain cases, which in turn can facilitate the scaling of new approaches and technologies (IEC, n.d.c).

3.2. Case study 2: Standards enable Namibia to accelerate its solar energy production

Namibia has made significant strides in integrating solar photovoltaic (PV) technology into its energy sector. In doing so, it has relied on IEC standards when specifying equipment used in the construction of renewable energy plants, including on-grid and off-grid technologies. This applies to commissioning these plants as well as operating and maintaining them. The reporting methodologies for renewable energy are determined with reference to IEC standards and guides.

To date, 15 projects under the Namibia Renewable Energy Feed-In Tariff (REFIT) programme are operational. In addition, five large independent power producer solar plants as well as many business and residential solar systems are operational and compliant with industry standards. To ensure quality and safety, NamPower, the national electric power utility company of Namibia, has a technical team responsible for compliance. NamPower performs tests, investigations and assessments using internationally recognised IEC standards (IEC, 2023c).

Namibia's involvement in the international standardisation arena has offered additional benefits. Participating in the IEC Affiliate Country Programme (ACP) has enabled Namibia to adopt IEC standards, and its participation is helping the country build its influence in the standardisation process. Through this programme, Namibia has been able to adopt 59 IEC International Standards and actively participate in 15 IEC technical committees (TCs) and subcommittees, including those related to solar PV energy systems (IEC, n.d.d; Mouyal, 2020).

Since 2010, Namibia has deepened its standardisation efforts by establishing the National Electrotechnical Committee and achieving Affiliate Plus status with IEC, granting it access to up to 400 IEC standards and mentoring opportunities for how countries can best leverage standards for their policy objectives (Mouyal, 2020).

Standardisation has provided Namibia with a structured foundation for adopting and implementing solar PV technology efficiently. By aligning with IEC TC 82: Solar Photovoltaic Energy Systems (IEC, 2010), Namibia benefits from off-grid energy access standards, which support government initiatives to bring electricity to rural communities beyond the national grid.

Additionally, Namibia's work with IEC TC 61: Safety of Household and Similar Electrical Appliances, as well as wiring and security standards, ensures quality, risk management and reliability in its solar energy projects (IEC, n.d.e). Through its involvement in the standardisation world, Namibia has relied on standards to enable various government initiatives to move forward in expansion of its solar power plans and to tackle its rural electrification challenges (Mouyal, 2020).

4. Standards assist governments and utilities in meeting targets

In enabling a clean energy transition, governments and policy makers face several key challenges. These include:

1. overcoming supply chain bottlenecks, which can delay the availability of necessary materials and technologies;
2. encouraging investments in renewable energy projects to ensure sufficient funding and support;
3. facilitating permitting processes, which are crucial to expediting the development and implementation of clean energy infrastructure; and
4. ensuring the right skills for the transition.

Standards can help overcome all these challenges effectively.

4.1. Helping reduce supply chain bottlenecks

International standards can help reduce supply chain bottlenecks in several ways.

Improving interoperability and compatibility

International standards create common specifications and protocols that allow different devices, systems, processes and technologies to work together seamlessly across the supply chain. This reduces friction and delays caused by incompatible systems.

Enhancing transparency and visibility

Standards for data sharing and tracking (like those using radio-frequency identification [RFID] or blockchain) enable greater end-to-end visibility in supply chains. This allows companies to identify and address bottlenecks more quickly.

Streamlining customs and regulatory compliance

Harmonised international standards in combination with testing and certification make it easier for goods to clear customs and regulatory checks without delays.

Promoting best practices

International standards codify global best practices for efficient operations, inventory management, logistics, *etc.* This helps companies optimise their processes to prevent bottlenecks.

Supplier diversification and supply chain resilience

The use of international standards together with testing and certification (to verify compliance with standards) makes it easier for organisations to onboard new suppliers or switch between suppliers, increasing supply chain resilience. This approach allows for supply base growth and can ensure that spare parts are available for far longer and are more affordable overall.

Standards and common technical specifications play a key role in improving supply chain resilience. They help guarantee the safety, security and interoperability of electrical installations, while also promoting investment in electricity infrastructure and accelerating project implementation. The implementation of these standards, paired with streamlined tendering and modularisation, helps reduce strain on component supply chains and manufacturers' engineering capacities. The benefits of standardisation are fully realised when proper testing and certification are carried out, ensuring the safety and reliability of new suppliers and components (UNEZA, 2024b).

Enabling automation and digitalisation

International standards for technologies like the Internet of Things (IoT) and robotics allow for greater automation of supply chain processes, reducing human error and increasing efficiency.

Improving risk management

International standards for risk assessment and mitigation help companies proactively identify potential bottlenecks and develop contingency plans.

Ensuring cyber security

Applying standards providing essential guidelines for cyber security helps defend systems against security threats.

Standards provide a comprehensive set of guidelines that can be implemented in any operational environment, including smart factories and critical infrastructure, such as power plants and transport networks.

Enhancing quality control

Standardised quality management systems, together with testing and certification, reduce defects and rework, preventing bottlenecks caused by quality issues.

Facilitating collaboration

Common standards and terminology foster better communication and collaboration between supply chain partners, allowing for more co-ordinated responses to potential bottlenecks. UNEZA, as an international platform within the power and utilities sector, plays a crucial role in this process by addressing barriers that hinder emissions reduction and the achievement of global net-zero targets. Through the platform, the Alliance will shape dynamic new partnerships in the sector and forge effective channels for dialogue with key public and private stakeholders. By promoting the adoption of common standards across the sector, UNEZA helps streamline processes, reduce supply chain bottlenecks, and ensure a more resilient and efficient energy transition.

By providing a common framework in terms of processes, methodologies and procedures – including verification – international standards, together with testing and certification, can significantly reduce friction points and inefficiencies that lead to bottlenecks.

These standards provide state-of-the-art, globally accepted criteria to measure and verify the operations, data exchange, reliability, interoperability and performance of devices, systems and services across global supply chains. This enables smoother, more resilient supply chain operations even in the face of disruptions or volatility.

Figure 1 How international standards help address supply chain bottlenecks

4.2. Stimulating investments

The use of international standards together with testing and certification can stimulate investment in many ways.

Improving quality and consistency

By adhering to international standards, companies and countries can demonstrate their commitment to quality, safety and reliability. This adherence also ensures that spare parts are available for longer and at more affordable prices, and the objects of investments can be maintained and repaired. This increases confidence among potential investors and trading partners. It reassures investors of the long-term viability of their investment and provides trust that they will be able to collect their return on investment (ROI).

Facilitating market access

Meeting international standards allows companies to more easily enter and contribute to global value chains and access new markets. This makes investment in those companies and countries more attractive.

Enhancing competitiveness

International standards help level the playing field and allow companies to compete based on industry-wide accepted quality and reliability criteria rather than just price. This can make investments more viable and profitable.

Reducing risk

For investors, knowing that a company or country adheres to recognised international standards reduces perceived risk and uncertainty. This can encourage greater investment flows.

Promoting technology transfer

International standards are foundational for the transfer of knowledge and best practices. This stimulates focussed innovation that can be measured with existing solutions. This approach also makes investments in new technologies more secure.

Attracting foreign direct investment

Multinational companies are more likely to invest in countries and suppliers that can meet international standards. Strong use of and compliance with international standards – and the trust provided by testing and certification – signals a conducive business environment.

Improving productivity

The adoption and use of international standards lead to improved processes and productivity gains. This makes investments more likely to generate good returns.

Facilitating trade

The broad adoption and use of international standards in manufacturing, policy making and regulation, together with testing and certification, helps reduce technical barriers to trade by harmonising requirements across borders. This expands market opportunities and makes investment more attractive.

Building trust

International standards provide a common language and set of expectations between trading partners. When their use is also tested and verified, this builds trust and can lead to more stable, long-term investment relationships.

Demonstrating good governance

Countries that adopt and enforce international standards and accept the certificates of conformity assessment bodies signal their commitment to good governance and responsible business practices. This can attract investors looking for stable, well-regulated environments.

By focusing on the development of the capacity to meet international standards and by building quality infrastructure, countries and companies can create a more attractive environment for both domestic and foreign investment. This is particularly important for developing countries seeking to participate more fully in global value chains and to attract quality foreign direct investment.

Figure 2 How international standards can stimulate investments

4.3. Facilitating permitting

International standards can facilitate permitting by regulators in various ways.

Harmonising requirements

By adopting internationally recognised standards, regulators can harmonise permitting requirements across jurisdictions, reducing duplication and compliance costs for businesses operating in multiple markets.

Providing a common technical language

International standards establish a shared global language that can streamline the permitting process by ensuring all parties are using consistent terminology and frameworks. This common language facilitates clearer communication between regulators and applicants.

Incorporating up-to-date technical knowledge

International standards are regularly updated to reflect state-of-the-art technical and safety requirements. By referencing these standards in permitting processes, regulators can ensure they are using the most current and relevant technical information without having to develop and maintain this expertise internally.

Supporting innovation

International standards can act as a launchpad for innovation by establishing common performance metrics and requirements. This allows regulators to focus on outcomes rather than prescriptive requirements, potentially speeding up the permitting process for novel technologies or approaches and avoiding stifling future innovation.

Enhancing transparency and predictability

The use of widely recognised international standards in permitting processes can increase transparency and predictability for applicants, as the requirements are clearly defined and accessible. It also avoids island solutions resulting from proprietary specifications and allows many different stakeholders to contribute.

Facilitating trade

Many international trade agreements require the use of international standards in technical regulations when aligned with regulatory objectives. By incorporating these standards into permitting processes, regulators can help reduce barriers to trade and support their country's international trade obligations.

Improving efficiency

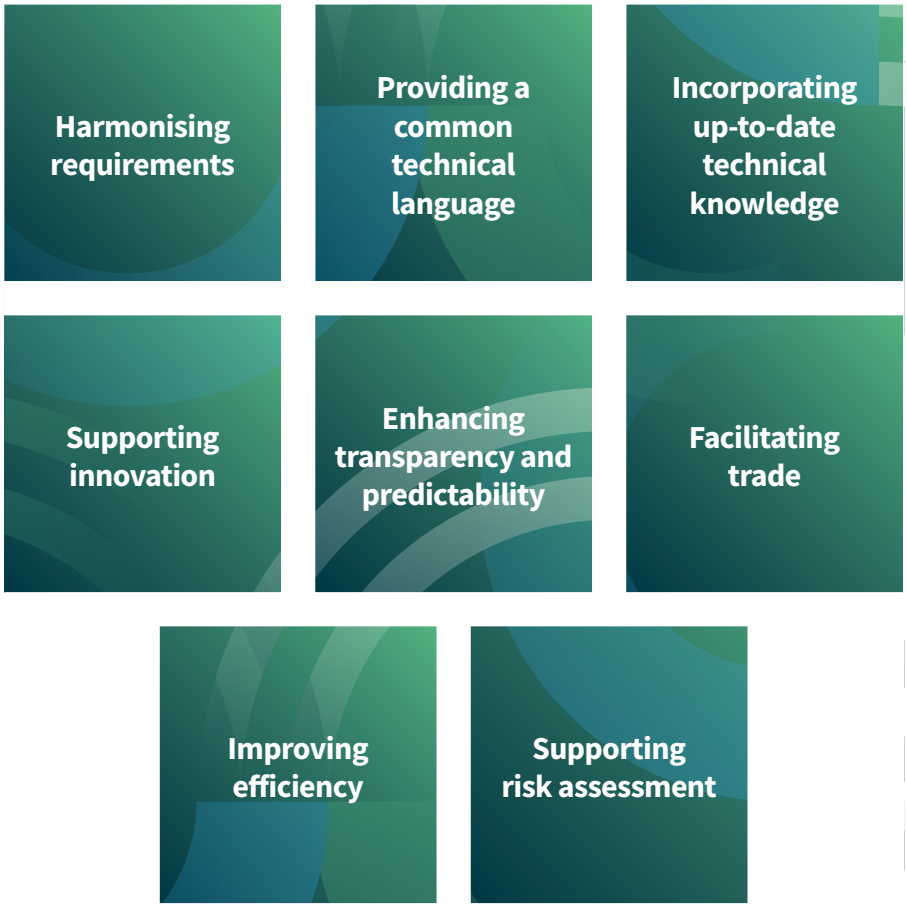
Adopting international standards and verifying their proper use can help streamline permitting procedures by providing regulators with ready-made, consensus-based requirements and assessment methods, and the confidence that performance and interoperability promises have been kept. This can reduce the time and resources needed to develop and implement permitting processes.

Supporting risk assessment

International standards include methodologies for safety and risk assessment, which can help regulators make more informed decisions in the permitting process.

By leveraging international standards, regulators can create more efficient, transparent and globally aligned permitting processes that support innovation and trade while maintaining necessary safeguards for public health, safety and the environment.

Figure 3 How international standards facilitate permitting



4.4. Ensuring the right skills for the transition

In addition to training new energy professionals, reskilling, upskilling and continuous development are essential to prepare the current workforce for evolving skill requirements. Defining national qualifications aligned with occupational standards for critical roles in renewable energy helps clarify the competencies and expertise needed. These standards should be validated by skills councils that bring together industry, government and academic representatives.

A strong national qualification framework ensures that training and education programmes are aligned with the demands of the energy transition. It also provides a basis for accrediting institutions, overseeing examinations and updating qualifications as needed. At a regional level, harmonised qualification standards can promote labour mobility by enabling mutual recognition of credentials and consistency in skill levels across countries (IRENA, 2024).

5. Benefits of active participation in standardisation for energy providers

Energy providers are organisations that generate, distribute or supply energy to consumers, such as utilities and renewable energy companies. By participating in standardisation, they can influence industry guidelines, reduce costs, improve interoperability and enhance safety. This engagement also provides a competitive edge, ensures regulatory compliance and supports innovation, helping energy providers strengthen their operations and contribute to a more efficient and resilient energy sector.

Influence on standards development

By participating in the standardisation process, energy providers can help shape the international standards that allow the whole industry to move forward in line with technological capabilities. This allows them to have a voice in creating standards that are practical and beneficial for their operations.

Cost reduction

Adopting standardised technologies and practices can lead to significant cost savings.

Standardised components have internationally agreed-upon specifications, which means fewer errors and more efficiency gains, further reducing production costs. Standardised components can allow for bulk production, saving both time and money. Plus, conforming to standards often brings the added assurance that products are compliant with regulatory and market needs, which can reduce extensive research and testing costs.

Improved interoperability

International standards promote compatibility between different systems and components. This is particularly important as energy grids become more complex and interconnected.

Enhanced safety and reliability

Standardisation helps establish best practices for safety and reliability in energy systems. Since energy providers are responsible for their infrastructure, rather than governments; as such, it is in their interest to guide the standardisation process.

Regulatory compliance

Active participation helps energy providers stay informed about upcoming regulatory changes. In addition, active participation affords energy providers the opportunity to weigh in with their needs and influence the development of standards, as well as giving them early insights into technological advancements, market trends and impending regulations. This allows them to ensure their systems and practices remain compliant and keep pace with regulatory changes.

Competitive advantage

Understanding and implementing standards early on can give energy providers a competitive edge. It allows them to develop products and services that are compliant with emerging standards before their competitors.

Innovation support

International standards can provide a foundation for innovation by establishing common platforms and interfaces. This allows energy providers to focus on developing new technologies and services rather than reinventing basic infrastructure.

By actively participating in standardisation efforts, energy providers can help create a more efficient, reliable and innovative energy ecosystem, while also benefiting their own operations and bottom line.

Figure 4 Benefits of active participation in standardisation for energy providers

6. A practical guide to international standards and conformity assessment

6.1. Understanding international standards

As mentioned in Chapter 1, a standard is an agreed-upon way of doing something consistently in a repeatable way, across countries and industry.

An IEC International Standard follows a well-established and rigorous process involving experts from many countries, ensuring a global consensus. The development process ensures that all views are considered, major issues are addressed and significant opposition is overcome. The process invites contributions through an extensive network of national members. International standards increase market relevance and acceptance and are the cornerstone of global trade and development.

International standards cover a wide range of tangible and intangible items, including products, processes, measuring methods and services. These standards are essential for quality and risk management; facilitating international trade; and ensuring the safety, efficiency and interoperability of electrical and electronic products and systems. By providing a common "language" for technology and business practices, standards play a crucial role in modern commerce and everyday life.

6.2. A note on conformity assessment

Conformity assessment is an equally essential, complementary tool to international standards. Standards provide written instructions, while conformity assessment ensures that these instructions are properly applied in real-world technical devices and systems (IEC, 2025b).

This is especially useful to manufacturers and suppliers across various industries. Before a product can be placed on the market, it typically must demonstrate to buyers or regulators that it meets key requirements such as safety, energy efficiency, reliability and sustainability.

Conformity assessment provides the necessary proof, based on standards.

With conformity assessment (IEC, 2025b):

- Governments can more easily evaluate infrastructure resilience and better safeguard the public from avoidable risks.
- Insurers gain assurance that relevant risks have been addressed and safety considerations properly integrated.
- Buyers obtain proof about a product's or system's safety, performance and reliability.
- Investors are able to trust that industry-wide best practice has been applied, helping to secure their investment.
- Users of equipment and consumers can trust that electrical and electronic devices are safe to use and perform to expectations.

The IEC runs four conformity assessment systems (IEC, 2024c). IECRE (IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications) is specifically designed for renewable energy systems and supports the trade of equipment and services in the solar, wind and marine sectors while maintaining the necessary standards of safety and performance (IECRE, 2025).

Similarly, a new portfolio of carbon footprint verification and circular economy services has been launched by IEC via the IEC Quality Assessment System to support the development of trust and credibility in a company's commitment to tracking and lowering its emissions and applying circular economy principles effectively (IECQ, 2025).

Conformity assessment requires a standardised approach, guided by clearly defined rules to guarantee consistency and replicable results.

The IEC and International Organization for Standardization (ISO) have established and published a series of international standards outlining how conformity assessment should be conducted. The ISO/IEC 17000 series, along with various ISO/IEC Guides – collectively known as the CASCO Toolbox – offers comprehensive resources for ensuring that conformity assessments are carried out consistently and reliably (IEC, 2025b).

6.3. World Standards Cooperation

The World Standards Cooperation (WSC) is a long-standing co operation and high-level collaboration among the IEC, ISO and International Telecommunication Union (ITU). Through this joint effort, the three bodies work together to uphold and promote the shared goal of advancing the voluntary, consensus-driven system of international standards.

Recently, the three organisations, under the auspices of the WSC, have been collaborating on topics of climate action, emerging technologies like artificial intelligence, and international co operation events such as the Group of 20 (G20) and COP every year.

6.4. IRENA INSPIRE

The International Standards and Patents in Renewable Energy (INSPIRE), developed by IRENA, offers current information on renewable energy standards and patents.

INSPIRE users can explore and analyse a database containing over 2 million patents and more than 400 international standards.

INSPIRE presents technical content on patents, standardisation and quality assurance. The main menu guides users through topics such as how to file a patent, the role of standards, and how to establish quality assurance processes for renewable technologies.

Through the standards section, users can access international standards related to renewable energy and identify practices that reflect internationally recognised approaches to project implementation.

7. Conclusion

A significant amount of work remains in the effort to achieve decarbonisation goals – which rely on improving energy efficiency and increasing renewable energy generation – with a special emphasis on the need for investment, infrastructure and capacity building. Harmonised international standards and conformity assessment systems that certify or verify compliance can be powerful tools in helping policy makers and climate action decision makers advance their objectives.

Adopting these standards and systems is especially helpful with regard to global efforts towards achieving net zero. Trusted, globally agreed standards can help turn climate commitments and plans into effective, measurable action, providing a consistent and harmonised approach to climate action that can be adopted across borders. This report strongly encourages the use of international standards as a tool to efficiently guide policies and implement objectives.

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