University Mohamed Khider of Biskra
Faculty of Science and Technology
Department of Electrical Engineering

Sector : Electrical engineering
Option: Renewable energies
2nd Year Master

Chapter No-3

Standardizing renewable energies

Prepared by :

Dr. SAADI Aicha

University year: 2025 – 2026

Table of contents

Chapter I

Standardizing renewable energies

Table of Contents

I.1 Standardizing Renewable Energies Worldwide

Standardizing renewable energies worldwide is crucial for ensuring a consistent and efficient transition to clean energy. This involves creating uniform regulations, technical standards, and best practices that can be adopted globally [**?**].

I.1.1 Components of renewable energies Standardization

I.1.1.1 Regulations and policies

Governments need to establish clear and consistent policies that support renewable energy development. This includes incentives for renewable energy projects, subsidies, and tax benefits.

I.1.1.2 Technical standards:

Developing technical standards ensures that renewable energy systems are compatible and interoperable. This includes standards for solar panels, wind turbines, and energy storage systems.

I.1.1.3 Certification and testing:

Implementing certification and testing procedures ensures that renewable energy products meet specific quality and performance criteria. This helps to build trust and reliability in the market.

I.1.1.4 International cooperation:

Collaboration between countries is essential for sharing knowledge, resources, and best practices. International organizations like the International Renewable Energy Agency (IRENA) play a key role in facilitating this cooperation.

I.1.1.5 Education and training:

Providing education and training programs for professionals in the renewable energy sector ensures that they are equipped with the necessary skills and knowledge to implement and maintain renewable energy systems.

I.1.2 Benefits of standardization

Standardization benefits businesses through increased efficiency and market growth by creating economies of scale and brand consistency. Increased efficiency comes from simplified processes and reduced waste, while market growth is driven by easier entry into new global markets and consistent marketing. Standardization can also positively impact

the environment by promoting efficient resource use and can give companies a global reach through consistent, recognizable products and branding (see Figure I.1).

Figure I.1: Benefits of Standardization.

I.1.2.1 Increased efficiency

Standardization leads to more efficient production and installation processes, reducing costs and improving overall performance.

I.1.2.2 Market growth

Clear and consistent standards attract investment and promote market growth by providing a stable and predictable environment for businesses.

I.1.2.3 Environmental impact

Standardized renewable energy systems contribute to reducing greenhouse gas emissions and mitigating climate change.

I.1.2.4 Global reach

Standardization allows for the widespread adoption of renewable energy technologies, making clean energy accessible to more people around the world.

I.2 International Renewable Energy Agency (IRENA)

The International Renewable Energy Agency (IRENA) is a global intergovernmental organization dedicated to promoting the widespread and sustainable use of renewable energy. Here is an overview of its history, membership, and core objectives.
The International Renewable Energy Agency (IRENA) was officially established on January 26, 2009, in Bonn, Germany, following a long-standing vision for a dedicated global renewable energy body that dated back to the 1980s. The agency was founded by 75 founding member countries who signed its statute, which then entered into force on July 8, 2010, making it a

formal legal entity. After a preparatory commission phase, IRENA became fully operational in 2011 with its permanent headquarters in Abu Dhabi, United Arab Emirates. Its creation marked a pivotal moment of global consensus on the critical need to promote the widespread and sustainable adoption of renewable energy to address energy security, climate change, and sustainable development. As of 2025, IRENA has a near-global membership of 170 members, which comprises 169 countries and the European Union. This broad membership underscores the international consensus on the importance of renewable energy. Any member state of the United Nations is eligible to join.
IRENA's core mission is to support countries in their transition to a sustainable energy future. It serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, and financial knowledge on renewable energy. Its work is guided by the principles in its statute, which highlight the vast opportunities of renewable energy for :

- ✿ Sustainable Development and Energy Access,
- ✿ Energy Security and Price Stability,
- ✿ Climate Stabilization and Greenhouse Gas Reduction,
- ✿ Economic Growth and Job Creation.

I.3 Renewable Energies in Algeria

Algeria is starting a green energy dynamic by launching an ambitious renewable energy development (EnR) and energy efficiency program. This vision of the Algerian government is based on a strategy focused on the development of inexhaustible resources such as solar and their use to diversify energy sources and prepare the Algeria of tomorrow. Thanks to the combination of initiatives and intelligence, Algeria is embarking on a new sustainable energy era.
The updated renewable energy program consists of installing a renewable power source of around 22,000 MW by 2030 for the national market, with the maintenance of the export option as a strategic objective, if market conditions allow it.
The updated energy efficiency program aims to achieve energy savings by 2030 of the order of 63 million Tons of oil equivalent(TOE), for all sectors (building and public lighting, transport, industry) by introducing high-performance lighting, thermal insulation and solar water heaters, clean fuels (Liquefied Petroleum Gas and Compressed Naturel Gas) (LPG and CNg), and high-performance industrial equipment.
The energy efficiency program will reduce CO2 emissions by 193 million tons.

Algeria is committed to the path of renewable energies in order to provide global and sustainable solutions to environmental challenges and issues of conservation of energy resources of fossil origin by launching an ambitious renewable energy development program adopted by the government in February 2011, revised in May 2015 and made a national priority in February 2016.

I.4 Renewable Energy Development Program

Through this renewable energies program, Algeria intends to position itself as a major player in the production of electricity from photovoltaic and wind power, as well as biomass, cogeneration, geothermal energy and, beyond 2021, solar thermal energy. These energy sources will drive sustainable economic development, providing the impetus for a new model of economic growth.

37% of installed capacity by 2030, and 27% of electricity production for national consumption, will be of renewable origin. As the country's renewable energy potential is strongly dominated by solar energy, Algeria sees this as an opportunity and a lever for economic and social development, particularly through the establishment of industries that create wealth and jobs.

However, this does not rule out the launch of numerous wind farm projects and the implementation of experimental biomass, geothermal and cogeneration projects.

Renewable energy projects to produce electricity for the domestic market will be carried out in two stages:

First phase 2015 - 2020: This phase will see the construction of 4010 MW of photovoltaic and wind power, and 515 MW of biomass, cogeneration and geothermal power.

Second phase 2021 - 2030: The development of the electrical interconnection between the North and the Sahara (Adrar), will enable the installation of large-scale renewable energy plants in the regions of In Salah, Adrar, Timimoune and Bechar, and their integration into the national energy system. By this time, solar thermal energy could be economically viable.

Algeria's strategy in this area is to develop a genuine renewable energies industry, combined with a training and knowledge capitalization program that will eventually make it possible to employ local Algerian engineering and project management talent. The renewable energy program will create several thousand direct and indirect jobs to meet the electricity needs of the national market.

N.B: (CSP) is a Concentrated Solar Power.

Unité : MW	â€‹ 1ère phase 2015-2020	2ème phase 2021-2030	TOTAL
Photovoltaïque	3 000	10 575	13 575
Eolien	1 010	4 000	5 010
CSP	-	2000	2 000
Cogénération	150	250	400
Biomasse	360	640	1 000
Géothermie	05	10	15
TOTAL	**4 525**	**17 475**	**22 000**

Figure I.2: Renewable Energy Development Program.

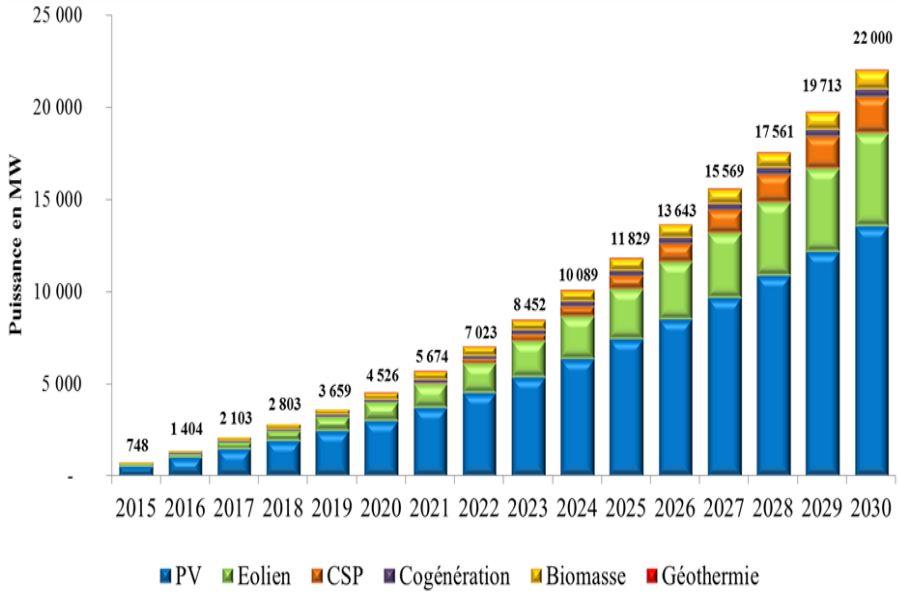

Figure I.3: The national market of RE over the 2015-2030 period is 22,000 MW.

I.5 The essential international standards for photovoltaic energy

The essential standards for photovoltaic may vary from country to country and region to region, but there are a number of internationally recognized standards. These standards aim to ensure the quality, safety and interoperability of photovoltaic systems. Here are just a few of the essential standards for photovoltaic:

I.5.1 IEC 61215

This standard specifies performance and qualification requirements for photovoltaic modules. It covers aspects such as mechanical strength, durability and manufacturing quality, and includes tests to assess module performance under different environmental conditions. Classification of photovoltaic modules: The standard defines different classes of modules according to their electrical, thermal and mechanical characteristics (see Table I.1).

Table I.1: Standards specifies performance of photovoltaic modules.

Performance requirements	It specifies the performance criteria that solar modules must meet, such as energy yield, long-term stability, and resistance to environmental conditions.
Mechanical tests	The standard details the mechanical tests that modules must undergo to ensure their robustness in the face of the mechanical and climatic stresses to which they may be exposed.
Electrical testing	Establishes procedures for evaluating the electrical performance of modules, including voltage and current characteristics, resistance to electrostatic discharge, etc.
Environmental testing	The standard defines climatic tests to evaluate the resistance of modules to environmental conditions such as exposure to heat, humidity, frost, etc.

I.5.2 IEC 61730

As safety is a major concern in photovoltaic installations, this standard establishes safety requirements for photovoltaic modules intended for use in fixed installations. It covers aspects such as resistance to fire, mechanical shock and weathering.

Table I.2: Standards of photovoltaic installations.

Safety requirements	The standard establishes safety criteria for photovoltaic modules to minimize potential risks to people, animals and property.
Construction tests	It specifies tests to assess module construction, particularly with regard to electrical insulation, protection against electric shock, and weather resistance.
Mechanical tests	The standard includes mechanical tests to assess the resistance of modules to mechanical stresses, such as snow loads, wind loads and mechanical shocks.
Durability testing	It defines tests to assess the durability of modules over time, including resistance to thermal cycles, humidity and other environmental conditions.
Electrical tests	The standard includes electrical tests to assess the electrical safety of modules, including resistance to overvoltage and electrostatic discharge.

I.5.3 IEC 62109

This standard covers the safety of inverters for photovoltaic systems.

Table I.3: Standards of inverters for photovoltaic systems.

Safety requirements	The standard establishes safety criteria for inverters, including protection against electric shock, overcurrent, overvoltage and other electrical hazards.
Safety testing	This specifies tests designed to assess inverter compliance with safety requirements. These tests may include overvoltage resistance tests, fault protection tests, thermal stability tests, etc.
Overvoltage protection	The standard defines requirements for the protection of inverters against overvoltage, in order to minimize risk to the user and ensure equipment reliability.
Insulation	This includes specifications for the electrical insulation of inverters to ensure adequate protection against electric shock.
Mechanical tests	The standard may also include mechanical tests to assess the physical robustness of inverters.

I.5.4 IEC 61724

deals with the characteristics of photovoltaic systems in terms of monitoring, maintenance and diagnostics. This includes recommendations on performance monitoring, preventive maintenance and fault detection.

Table I.4: Standards of monitoring.

Monitoring parameters	The standard lists the essential parameters to be monitored in a photovoltaic plant, such as energy production, module temperature, weather conditions, etc.
Measurement methods	It provides recommendations on the appropriate measurement methods for each parameter, ensuring accurate assessment of system performance.
Performance reports	Provides guidelines on how to generate performance reports based on monitoring data, facilitating analysis and understanding of system performance.
Maintenance and calibration	The standard includes recommendations on the regular maintenance of measurement equipment to ensure its accuracy over time.

I.5.5 IEC 61646

this standard concerns photovoltaic modules (solar panels) and specifies test methods for assessing their performance. However, it is important to note that standards may be

updated, and it is advisable to check with standards bodies or official sources to obtain the most recent version of the standard.

Table I.5: Standard photovoltaic modules.

Performance testing	The standard establishes test methods for evaluating the performance of photovoltaic modules, including criteria such as energy yield, long-term stability, and resistance to environmental conditions.
Electrical testing	It specifies procedures for evaluating the electrical performance of modules, including voltage and current characteristics.
Mechanical tests	The standard may include mechanical tests to assess module resistance to mechanical stresses, such as snow and wind loads.
Environmental tests	The standard defines climatic tests to assess the resistance of modules to environmental conditions such as exposure to heat, humidity, frost, etc.
Module classification	The standard may also include criteria for classifying modules according to their characteristics.

I.6 Algerian standards for photovoltaic energy

Algeria has adopted a number of standards concerning photovoltaic energy, with the aim of guaranteeing the safety and efficiency of installations. These standards are developed by the Renewable Energy Development Center (CDER), in collaboration with international standards bodies.
The main Algerian standards for photovoltaic energy are as follows:

I.6.1 NA 02-004-14

Is an Algerian standard that defines the technical requirements and test procedures for photovoltaic systems. It was published by the National Agency for Renewable Energy and Energy Efficiency (ANRE) in 2014.
This standard is mandatory for all photovoltaic systems installed in Algeria. It is important to ensure the safety and performance of photovoltaic systems.
NA 02-004-14 covers the following aspects of photovoltaic systems:

I.6.2 NA 02-005-14

Is an Algerian standard that defines the technical requirements and test procedures for roof photovoltaic systems. It was published by the National Agency for Renewable Energy

Table I.6: Aspects of photovoltaic systems.

Materials and components	The standard defines requirements for materials and components used in photovoltaic systems, such as photovoltaic cells, photovoltaic modules, inverters and brackets.
Design and Installation	The standard defines requirements for the design and installation of photovoltaic systems, such as component selection, module layout, and installation procedures.
Testing	The standard defines the test procedures for photovoltaic systems, such as performance testing, safety testing and durability testing.

and Energy Efficiency (ANRE) in 2014.

NA 02-005-14 covers the following aspects of roof photovoltaic systems:

Table I.7: Aspects of roof photovoltaic systems.

Materials and components	The standard defines the requirements for materials and components used in photovoltaic roofing systems, such as photovoltaic cells, photovoltaic modules, inverters and brackets. Photovoltaic modules used in roof photovoltaic systems must be designed to withstand corrosion and extreme weather conditions.
Design and installation	The standard defines requirements for the design and installation of roof photovoltaic systems, such as component selection, module layout, and installation procedures.
Testing	The standard defines test procedures for roof photovoltaic systems, such as performance testing, safety testing, and durability testing.

I.6.3 NA 02-007-14

This standard defines the technical requirements applicable to stand-alone photovoltaic installations. It specifies the electrical, mechanical and thermal characteristics of the installations, as well as the tests they must undergo to comply.

Example: A farmer in Algeria wants to install an autonomous photovoltaic installation to power his farm. He must choose photovoltaic modules that are designed to withstand extreme weather conditions. He must also install the installation in such a way as to meet the energy needs of the farm. Finally, he must subject the installation to performance tests to ensure that it produces the expected amount of energy.

Algeria has also adopted a number of European standards relating to PV energy. These standards are similar to IEC standards, but they are often more stringent.

I.6.4 EN 61215 (PV Modules)

This is a European standard that is part of the harmonized standards for photovoltaic modules (solar panels) and specifies the design and performance requirements of these modules. Specifically, EN 61215 covers crystalline modules used in solar installations.

I.6.5 EN 60253 (PV Controllers)

Defines safety and performance requirements photovoltaic (PV) controllers. It applies to PV controllers used to convert the DC voltage of PV modules into AC voltage compatible with the power grid.

I.6.6 EN 60364 (PV Cables)

This is an international standard that defines the electrical installation requirements for buildings. It is applicable to all types of electrical installations, including photovoltaic (PV) installations.
It defines the following requirements for PV cables:

Table I.8: Standard of electrical installation requirements(PV cables).

Insulation	The insulation of PV cables must be resistant to high temperatures and ultraviolet radiation.
Conductors	The conductors of PV cables must be made of copper or aluminum.
Cross section	The cross section of PV cables must be sufficient to carry the required electrical power.
Marking	PV cables should be marked with information such as rated voltage, frequency, cross section, and type of insulation. In Algeria, the EN 60364 standard is transposed into the CNE 60364 standard. This standard is mandatory for all electrical installations in Algeria.

I.6.7 EN 62548 (PV Installations)

It is an international standard that defines the safety and performance requirements for photovoltaic (PV) installations. It applies to all PV installations, whether connected to the network or not. The standard covers the following aspects of PV installations:

In addition to Algerian standards, photovoltaic installations must also comply with the provisions of the Electricity Code. This code defines the safety rules applicable to all electrical installations, including photovoltaic installations.
The adoption of these standards has contributed to the development of the photovoltaic energy sector in Algeria. Standards ensure the quality and safety of facilities, which contributes to investor and consumer confidence.

Table I.9: International standard photovoltaic (PV) installations.

Safety	The standard defines safety requirements to protect people, property and the environment. These requirements include protection against electric shock, over voltage, fire and explosion.
Performance	The standard defines performance requirements to ensure that PV installations operate efficiently and reliably. These requirements include output power, energy efficiency, service life and maintenance. The application of these standards is mandatory for all photovoltaic products and installations marketed in Algeria. Products and installations that do not comply with the standards may not be placed on the market or put into service.

I.6.8 Renewable Energy Development Center CDER

The company that adopts these standards is the Renewable Energy Development Center (CDER)(Centre de Développement des Energies Renouvelables).
The CDER is a public scientific and technical institution under the supervision of the Ministry of Energy. The CDER is responsible for the promotion of renewable energies in Algeria. One of its tasks is to develop standards and regulations in this area.
Algerian standards for photovoltaic energy are developed by the CDER in collaboration with international standards bodies. This collaboration ensures that Algerian standards are harmonized with international standards. This facilitates trade in photovoltaic products and installations between Algeria and other countries.

I.6.9 Standards for thermal panels

The standards applicable in France are the European technical standards put in place by the European Committee for Standardization (CEN).
Photovoltaic standards and regulations have been put in place to control quality of the solar installations presented above. It is a set of obligations and recommendations established by public authorities or associations whose objective is: