

# FLEX INDUSTRIES

D7.1 Report on standardization landscape and applicable standards

WP7 Replicability and scalability of the solutions - Task 7.4:  
Standardization pathways for FLEXIndustries methods and solutions

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## Technical references

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## Executive Summary

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This document is a deliverable of the FLEXIndustries project, funded under the European Union's Horizon Europe Framework programme (HORIZON) under grant agreement No 101058453.

The deliverable D7.1 is produced in the context of FLEXIndustries-WP7, Task 7.4 – Standardization pathways for FLEXIndustries methods and solutions, in particular with regard to the analysis of the applicable standardization landscape. This deliverable includes as main contribution the identification and analysis of the standardization technical committees (TCs) at European and International standardization level related with the FLEXIndustries project as well as the published standards (existing and under development) that can be relevant and useful for all the project activities. Using standards as a knowledge source in the earliest possible stages of research and innovation avoids duplication of work and provides the basis for future marketable products.

The Spanish Association for Standardisation (UNE), as a National Standardization Body, is partner in the FLEXIndustries project to provide support regarding all the standardization tasks included in the project. In order to fulfil this commitment, this deliverable has been prepared to guide the partners about the published standards and standards under development that can be applicable and are related to the FLEXIndustries/WP tasks.

This deliverable will also serve as source to identify, in the near future, the strategy for collaboration and communication with the relevant technical committees and the contribution to standardization, and also to recognize the standardisation gaps that can be covered by the results of the project.

# 1. Introduction

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The Deliverable D7.1 Report on the Standardization landscape and applicable standards contains a detailed study on the relevant Standardization Technical Committees on international and European level in the scope of the FLEXIndustries project activities as well as relevant standards developed in these committees.

The objective of including the standardization in the project is to facilitate the acceptance and utilization by the market of the developed solutions. Other objectives are to provide starting information for other WPs, ensure compatibility and interoperability with what already exists in the market through standards, as well as to use the standardization system as a tool for the dissemination of the project results and the interaction with the market stakeholders.

This document contains:

- an overview on the relevant international and European standardization system;
- a detailed list of the standards and normative documents as well as standards and normative documents under development relevant for FLEXIndustries.

## 2. The context: FLEXIndustries project

FLEXIndustries will develop a holistic multi-level (device, process and value-chain) and multi-scale (operating, tactical and strategic) approach to allow stakeholders select and deploy the most suitable Energy Efficiency Measures (EEMs) and Process Flexibility Methods for their industrial environments with a positive impact into the Energy System. Particular focus will be on the development of a comprehensive assessment methodology and Dynamic Energy & Process Management Platform to enable innovative implementations of energy storage and conversion assets, as well as novel market designs for enhanced Industrial Energy Flexibility.

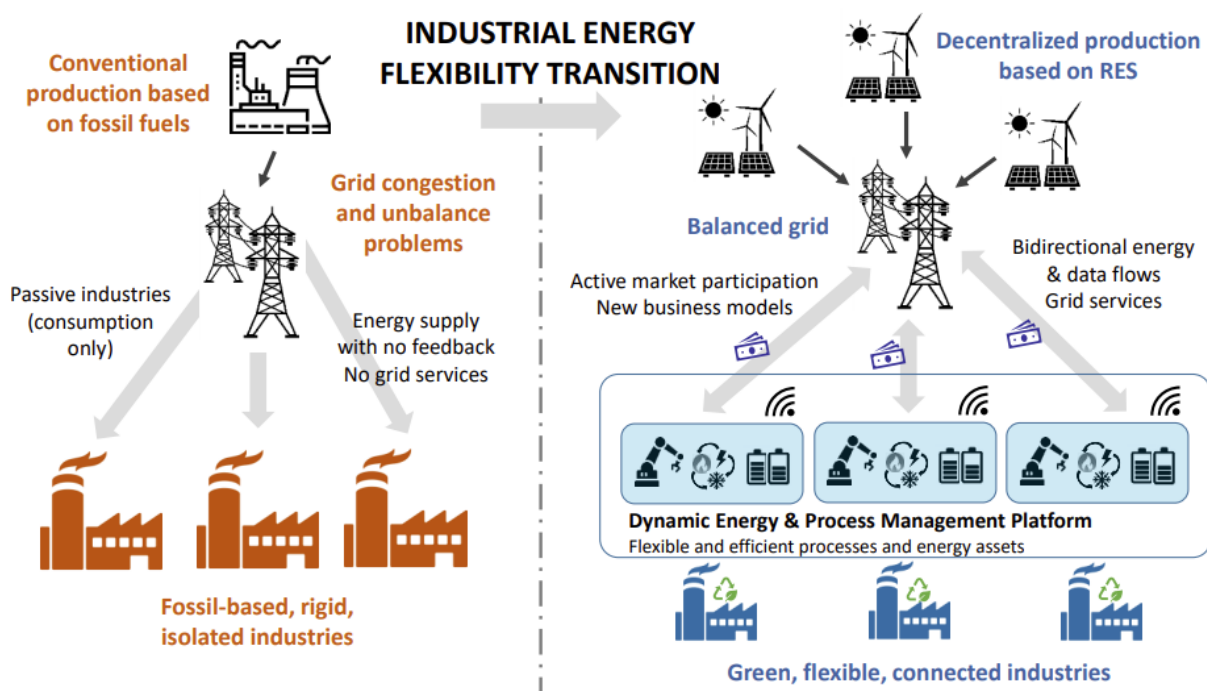


Figure 1: FLEXIndustries overall project vision.

In the FLEXIndustries project, standardization activities are employed to maximize the impact and to facilitate the acceptance and utilization by the market of the developed solutions. In order to provide starting information for other WPs, ensure compatibility and interoperability with what already exists in the market through standards, this document contains a list of standardization technical committees and standards relevant for the FLEXIndustries project. This document has been developed as result of subtask for the analysis of the applicable standardization landscape, corresponding to the WP7 “Replicability and scalability of the solutions”.

No official updates of this document are foreseen in the project plan, i.e. there will not be a deliverable corresponding to an update of this document. Nevertheless, a continuous follow-up of the activities of relevant Standardization Technical Committees and their standardization developments will be provided throughout the project lifetime.



## D7.1 Report on standardization landscape and applicable standards

Further activities within the scope of Task 7.4 “Standardization pathways for FLEXIndustries methods and solutions”, which extends to the end of the project in M48, will be documented by means of a final report (D7.10 “FLEXIndustries contribution to the standardization system”). The aim is to make the greatest possible contribution to standardization based on the results of the FLEXIndustries project.

## 3. Methodology of the document

### 3.1. Short introduction about standardization

Standards are voluntary technical documents that set out requirements for a specific item, material, component, system or service, or describes in detail a particular method, procedure or best practice. Standards are developed and defined through a process of sharing knowledge and building consensus among technical experts nominated by interested parties and other stakeholders - including businesses, consumers and environmental groups, among others. These experts are organized in Technical Committees (TCs), which are subdivided in Subcommittees (SCs) or Working Groups (WGs). These TCs are included in the structure of the Standardization Organizations (National, European and International, with the respective mirror committees) and work following their internal regulations.

The standardization bodies operate at National (UNE, AFNOR, BSI, DIN, etc.), Regional (CEN, CENELEC, ETSI) or International (ISO, IEC, ITU) level. Sometimes there are different standardization bodies at the same level but covering different fields. This is the case of ISO (general), IEC (electrical) and ITU (telecommunications) at International level, or CEN, CENELEC and ETSI at European level in the same way.

There are also different kinds of standardization documents. The most widespread is the standard, which has a different code depending on the organization under it was developed, e.g. EN for European Standards, ISO for International standards. Other types of documents are Technical Specifications (TS), Technical Reports (TR) and Workshop Agreements (CWA). Further Amendments to the standards are identified by adding A1, A2, etc. at the end of the standard code.

At European level, all the members of CEN shall adopt EN standards as national standards and have to withdraw any existing national standard which could conflict with them. A summary of the characteristics of the different standardization documents can be found in Table 1.

Table 1 Characteristics of different standardization documents

Type	International code	European code	National code	Main characteristics
Standard	ISO IEC	EN	UNE, NF, BS, DIN, UNI, etc. When adopting: UNE-EN, NF-EN, UNE-ISO, NF-ISO etc.	<ul style="list-style-type: none"> <li>• Elaboration: 3 years</li> <li>• 2 steps of member approval</li> <li>• European: compulsory national adoption</li> </ul> Review: every 5 years

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Type	International code	European code	National code	Main characteristics
				Revision: whenever needed and as result from a systematic review
Technical Specification	ISO/TS IEC/TS	CEN/TS CLC/TS	When adopting: UNE-CEN/TS, NF-CEN/TS, UNE-ISO/TS, NF-ISO/TS, etc.	<ul style="list-style-type: none"> <li>• Elaboration: 21 months</li> <li>• 1 step of member approval or internal approval in TC</li> <li>• European: optional national adoption</li> </ul> Review: after 3 years (upgrading to EN or deletion)
Technical Report	ISO/TR IEC/TR	CEN/TR CLC/TR	When adopting: UNE-CEN/TR, NF-CEN/TR, UNE-ISO/TR, NF-ISO/TR, etc.	<ul style="list-style-type: none"> <li>• Elaboration: free timeframe</li> <li>• Internal approval in TC</li> <li>• European: optional national adoption</li> </ul> No review required
Workshop Agreement	IWA	CWA	Variable	<ul style="list-style-type: none"> <li>• Elaboration: free timeframe (usually few months)</li> <li>• Internal approval in the Workshop</li> <li>• European: optional national adoption</li> </ul> Review: after 3 years (upgrading to EN or deletion)

There is also an agreement established between European and International Organizations (e.g. CEN and ISO, in this case is called Vienna Agreement) in order to avoid duplication of efforts and promote global relevance of standards, which allows to adopt or develop in parallel each other's standards with the same content and code.

National standards could also be proposed as a base for new European or International standards. Figure 2 shows possible tracks of standards adoption.

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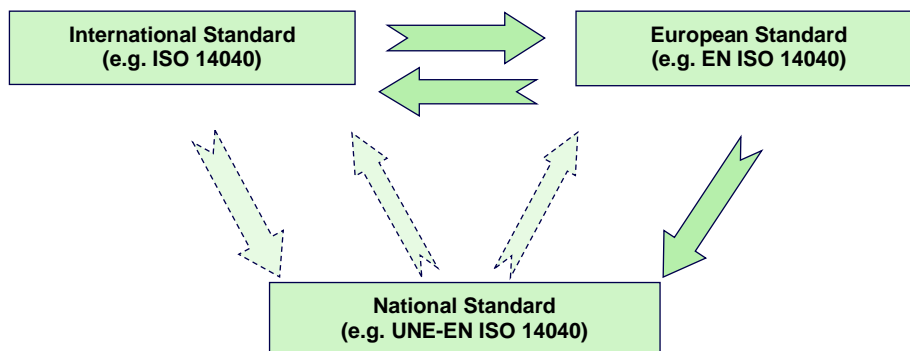


Figure 2. Possible tracks of standards adoption

Therefore, the code of any standard is the combination of the above mentioned issues, and could be explained as shown in Figure 3.

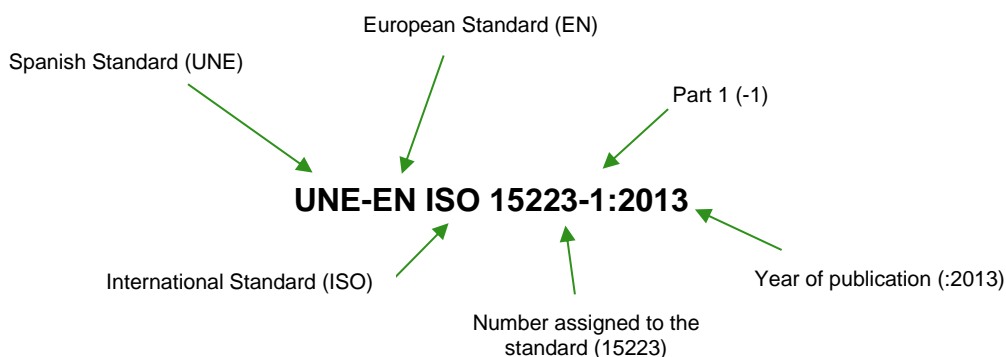


Figure 3. Example of identification of elements in the code of a standard

### 3.2. Methodology of the identification of relevant standardization areas

This document presents the standardization activity found relevant for the FLEXIndustries project. In order to structure the research, UNE and CARTIF jointly developed a list of key concepts, to act as a starting point for the identification of standardization areas. The list of topics was also shared with the technical leaders of WP2 for validation.

For the selection of the key concepts, the aims and goals of the project and the levels in which the project should integrate were taken into account. Also, the needs of the demonstration case studies were considered.

An extensive list of key concepts was obtained, which is shown, in **Annex I** to this document.

Standards and standards under development were identified for each standardization area, together with the technical committee responsible for the respective standards.

The standardization study covers European standardization developed by the European Committee for Standardization (CEN), the European Committee for electrotechnical

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Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI), and also the International standardization developed by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

The first result of the research carried out by UNE was shared with the WP7 leader CARTIF, the WP2 technical leaders and the RTO demo partners. They were asked to select the interesting documents and to add other interesting missing standards. The submitted feedback was compiled and the list of documents and technical committees was updated according to their expert contribution. The final result of the FLEXIndustries standardization landscape is described in the section 4 “Standardization related to FLEXIndustries project” of this deliverable.

## 4. Standardization related to FLEXIndustries project

For a better overview of this report, the study has been structured in main technical areas. The relevant standardization technical committees (TCs), the published standards and the standards under development have been clustered within each of these areas.

### 4.1. Standardization committees' overview

The standards search was carried out considering the agreed key concept list (see Annex I), and, as a result, several standardization committees were identified as responsible of the development of these standards. These technical committees were therefore selected as the main technical committees in relation to the FLEXIndustries Project, and they are shown in Table 2 clustered by technical area:

Table 2. Relevant standardization committees for FLEXIndustries

Technical area	Standardization Technical Committees
<b>Energy management &amp; Energy markets</b>	<p><b>ISO/TC 301</b> Energy management and energy savings</p> <p><b>CEN/CLC/JTC 14</b> Energy management and energy efficiency in the framework of energy transition</p> <p><b>IEC/TC 8</b> System aspects of electrical energy supply</p> <ul style="list-style-type: none"> <li>- IEC/TC SC 8A Grid Integration of Renewable Energy Generation</li> <li>- IEC/TC SC 8B Decentralized electrical energy systems</li> </ul> <p><b>IEC/TC 57</b> Power systems management and associated information exchange</p> <p><b>CLC/TC 57</b> Power systems management and associated information exchange</p>
<b>Metering (electricity and thermal)</b>	<p><b>IEC/TC 13</b> Electrical energy measurement and control</p> <p><b>CLC/TC 13</b> Electrical energy measurement and control</p> <p><b>CEN/TC 176</b> Thermal energy meters</p>
<b>Industrial automation &amp; IT</b>	<p><b>IEC/TC 65</b> Industrial-process measurement, control and automation</p> <p><b>ISO/TC 184</b> Automation systems and integration</p> <p><b>ISO/IEC JTC 1/SC 7</b> Software and systems engineering</p> <p><b>ISO/IEC JTC 1/SC 41</b> Internet of things and digital twin</p>

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	<b>ISO/IEC JTC 1/SC 42</b> Artificial intelligence
<b>Energy storage &amp; EV</b>	<b>IEC/TC 120</b> Electrical Energy Storage (EES) systems <b>IEC/TC 21</b> Secondary cells and batteries <b>CLC/TC 21X</b> Secondary cells and batteries <b>IEC/TC 69</b> Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks <b>ISO/TC 22/SC 37</b> Electrically propelled vehicles
<b>Renewable energy sources (RES)</b>	<b>IEC/TC 82</b> Solar photovoltaic energy systems <b>CLC/TC 82</b> Solar photovoltaic energy systems <b>ISO/TC 180</b> Solar energy <b>CEN/TC 312</b> Thermal solar systems and components <b>ISO/TC 255</b> Biogas
<b>Heat recovery system</b>	<b>ISO/TC 86</b> Refrigeration and air-conditioning <b>CEN/TC 113</b> Heat pumps and air conditioning units <b>CEN/TC 110</b> Heat exchangers <b>CEN/TC 182</b> Refrigerating systems, safety and environmental requirements

## 4.2. Standardization on Energy management & Energy markets

### **Technical committees**

#### **ISO/TC 301 Energy management and energy savings**

Standardization in the field of energy management and energy savings.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### **CEN/CLC/JTC 14 Energy management and energy efficiency in the framework of energy transition**

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Standardization in the field of energy management within the energy transition framework in close coordination with CEN/CENELEC sectorial strategy including, but not limited to, subjects such as:

- Energy management systems
- Energy audits
- Energy efficiency and energy performance improvement
- Energy and savings calculation methodologies
- Energy efficiency improvement financing (For example: Valuation of Energy Related Investments, Energy Performance Contracting minimum requirements, etc.)
- Energy services providers
- Energy measurement and monitoring
- Role of enabling technologies and RES within the energy management and energy efficiency framework

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **IEC/TC 8 System aspects of electrical energy supply**

Standardization with emphasis on overall system aspects of electricity supply systems and acceptable balance between cost and quality for the users of electrical energy. Electricity supply system encompasses transmission and distribution networks, generators and loads with their network interfaces.

This scope includes, but is not limited to, standardization in the field of:

- Terminology for the electricity supply sector;
- Characteristics of electricity supplied by public networks;
- Network management from a system perspective;
- Connection of network users (generators and loads) and grid integration;
- Design and management of de-centralized electricity supply systems (e.g. microgrids, systems for rural electrification).

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### - **IEC/TC SC 8A Grid Integration of Renewable Energy Generation**

Standardization for grid integration of variable power generation from renewables such as PV, wind energy with emphasis on overall system aspects of electricity supply systems (grids). SC 8A focuses on the impact of a high percentage of renewables connected to the grid, considering that their variability and predictability impact the functioning of the whole electricity grid. It covers grid integration standards for renewable energy, aggregating contributions of all grid users and prescribing interaction modes between the grid and power plants. This includes requirements for interconnection and related tests for grid code compliance, as well as standards or best practice documents for planning, modeling,



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forecasting, assessment, control and protection, scheduling and dispatching of renewables with a grid level perspective.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### - *IEC/TC SC 8B Decentralized electrical energy systems*

Standardization enabling the development of secure, reliable and cost-effective systems with decentralized management for electrical energy supply, which are alternative, complement or precursor to traditional large interconnected and highly centralized systems. This includes but is not limited to AC, DC, AC/DC hybrid decentralized electrical energy system, such as distributed generation, distributed energy storage, virtual power plants and electrical energy systems having interaction with multiple types of distributed energy resources.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### *IEC/TC 57 Power systems management and associated information exchange*

and

### *CLC/TC 57 Power systems management and associated information exchange*

Standardization for power systems control equipment and systems including EMS (Energy Management Systems), SCADA (Supervisory Control And Data Acquisition), distribution automation, teleprotection, and associated information exchange for real-time and non-real-time information, used in the planning, operation and maintenance of power systems.

The homepage of IEC/TC 57 technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

The homepage of CLC/TC 57 technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

## **Standards to be considered**

Table 3. Standards to be considered: Energy management & Energy markets

Reference	Title
ISO/IEC 13273-1:2015	Energy efficiency and renewable energy sources — Common international terminology — Part 1: Energy efficiency
ISO/IEC 13273-2:2015	Energy efficiency and renewable energy sources — Common international terminology — Part 2: Renewable energy sources
ISO 17741:2016	General technical rules for measurement, calculation and verification of energy savings of projects
ISO 17742:2015	Energy efficiency and savings calculation for countries, regions and cities

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ISO 17743:2016	Energy savings — Definition of a methodological framework applicable to calculation and reporting on energy savings
ISO 50001:2018	Energy management systems — Requirements with guidance for use
ISO 50002:2014	Energy audits — Requirements with guidance for use
ISO 50003:2021	Energy management systems — Requirements for bodies providing audit and certification of energy management systems
ISO 50004:2020	Energy management systems — Guidance for the implementation, maintenance and improvement of an ISO 50001 energy management system
ISO 50005:2021	Energy management systems — Guidelines for a phased implementation
ISO 50006:2014	Energy management systems — Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) — General principles and guidance
ISO 50009:2021	Energy management systems — Guidance for implementing a common energy management system in multiple organizations
ISO/TS 50011:2023	Energy management systems — Assessing energy management using ISO 50001:2018
ISO 50015:2014	Energy management systems — Measurement and verification of energy performance of organizations — General principles and guidance
ISO 50021:2019	Energy management and energy savings — General guidelines for selecting energy savings evaluators
ISO/TS 50044:2019	Energy saving projects (EnSPs) — Guidelines for economic and financial evaluation
ISO 50045:2019	Technical guidelines for the evaluation of energy savings of thermal power plants
ISO 50046:2019	General methods for predicting energy savings
ISO 50047:2016	Energy savings — Determination of energy savings in organizations
ISO 50049:2020	Calculation methods for energy efficiency and energy consumption variations at country, region and city levels
EN 17463:2021	Valuation of Energy Related Investments (VALERI)
EN 17267:2019	Energy measurement and monitoring plan - Design and implementation - Principles for energy data collection
EN 16325:2013+A1:2015	Guarantees of Origin related to energy - Guarantees of Origin for Electricity
EN 16247-5:2015	Energy audits - Part 5: Competence of energy auditors
EN 16247-3:2022	Energy audits - Part 3: Processes
EN 16247-1:2022	Energy audits - Part 1: General requirements
IEC TS 62786:2017	Distributed energy resources connection with the grid
IEC TR 63043:2020	Renewable energy power forecasting technology
IEC TR 63410:2023	Decentralized electrical energy systems roadmap
IEC 60870	Telecontrol equipment and systems
IEC TS 60870	Telecontrol equipment and systems
IEC TR 60870	Telecontrol equipment and systems
IEC 61850	Communication networks and systems for power utility automation - ALL PARTS

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IEC TR 61850	Communication networks and systems for power utility automation
IEC TS 61850	Communication networks and systems for power utility automation
IEC 62351:2023 SER	Power systems management and associated information exchange - Data and communications security - ALL PARTS
IEC TR 62351	Power systems management and associated information exchange - Data and communications security
IEC TS 62351	Power systems management and associated information exchange - Data and communications security
IEC TR 62357-1:2016	Power systems management and associated information exchange - Part 1: Reference architecture
IEC TR 62357-200:2015	Power systems management and associated information exchange - Part 200: Guidelines for migration from Internet Protocol version 4 (IPv4) to Internet Protocol version 6 (IPv6)
IEC 62361-2:2013	Power systems management and associated information exchange - Interoperability in the long term - Part 2: End to end quality codes for supervisory control and data acquisition (SCADA)
IEC 62361-100:2016	Power systems management and associated information exchange - Interoperability in the long term - Part 100: CIM profiles to XML schema mapping
IEC TS 62361-102:2018	Power systems management and associated information exchange - Interoperability in the long term - Part 102: CIM - IEC 61850 harmonization
IEC TR 62361-103:2018	Power systems management and associated information exchange - Interoperability in the long term - Part 103: Standard profiling
IEC 61000-6	Electromagnetic compatibility (EMC)

### **Standards under development to be considered**

Table 4. Standards under development to be considered: Energy management & Energy markets

Reference	Title
ISO/CD 50002-3	Energy audits — Requirements with guidance for use — Part 3: Processes
ISO 50006	Energy management systems — Evaluating energy performance using energy performance indicators and energy baselines
prEN 16325	Guarantees of Origin related to energy - Guarantees of Origin for Electricity, gaseous hydrocarbons, Hydrogen, and heating & cooling
PWI 8-6	IEC TS 62786-xx Distributed Energy Resources connection with the Grid - Regional profiles
IEC TS 62786-1 ED1	Distributed energy resources connection with the grid - Part 1: General requirements
IEC TS 62786-2 ED1	Distributed energy resources connection with the grid – Part 2 Additional requirements for PV generation
IEC TS 62786-3 ED1	Distributed energy resources connection with the grid – Part 3 Additional requirements for Stationary Battery Energy Storage System
PNW TS 8B-166 ED1	Microgrids – Technical requirements – Testing for Microgrid Monitoring, Control, and Energy Management Systems
IEC TS 62898-3-2 ED1	Microgrids &ndash; Part 3-2: Technical requirements - Energy management systems

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IEC TS 62898-3-4 ED1	Part 3-4: Microgrids – Technical requirements – Microgrid monitoring and control systems
IEC 61850-6 ED3	Communication networks and systems for power utility automation - Part 6: Configuration description language for communication in electrical substations related to IEDs
IEC TR 61850-90-23 ED1	Communication networks and systems for power utility automation - Part 90-23: Use of IEC 61850 for microgrid systems
IEC TR 61850-90-27 ED1	Communication networks and systems for power utility automation - Part 90-27: Use of IEC 61850 for thermal energy systems connected to electric power grid

### 4.3. Standardization on Metering (electricity and thermal)

#### **Technical committees**

##### **IEC/TC 13 Electrical energy measurement and control**

Standardization in the field of a.c. and d.c. electrical energy measurement and control, for smart metering equipment and systems forming part of smart grids, used in power stations, along the network, and at energy users and producers, as well as to prepare international standards for meter test equipment and methods.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

##### **CLC/TC 13 Electrical energy measurement and control**

Standardization in the field for metering equipment and systems (using whenever possible IEC standards), including smart metering systems, for electrical energy measurement, tariff- and load control, customer information and payment, for use in power stations, along the network and at energy end users, as well as to prepare international standards for meter test equipment and methods.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

##### **CEN/TC 176 Thermal energy meters**

Standardization in the field of heat meters, including requirements for accuracy, construction and testing. The scope includes recommendations for installation, commissioning and operation. All types, sizes and working principles are included.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### **Standards to be considered**

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Table 5. Standards to be considered: Metering (electricity and thermal)

Reference	Title
IEC TR 62051	Electricity metering
IEC 62052	Electricity metering equipment - General requirements, tests and test conditions
IEC 62053	Electricity metering equipment (a.c.) - Particular requirements
IEC 62054	Electricity metering (a.c.) - Tariff and load control
IEC 62055	Electricity metering - Payment systems
IEC TS 62056	Electricity metering data exchange - The DLMS/COSEM suite
IEC 62058	Electricity metering equipment (AC) - Acceptance inspection
CLC/TS 50590:2015	Electricity metering data exchange - Lower layer PLC profile using Adaptive Multi Carrier Spread-Spectrum (AMC-SS) modulation
CLC/TS 50586:2019	Open Smart Grid Protocol (OSGP)
CLC/TS 50568-8:2015	Electricity metering data exchange - The DLMS/COSEM suite - Part 8: SMITP B-PSK PLC communication profile for neighbourhood networks - Including: The Original-SMITP PLC B-PSK communication profile, The Original-SMITP Local data exchange profile and The Original-SMITP IP communication profile
EN 1434	Thermal energy meters
CEN/TR 16911:2015	Heat meters - Recommendations for circulation water in industrial and district heating systems and their operation
CEN/TR 13582:2021	Installation of thermal energy meters - Guidelines for the selection, installation and operation of thermal energy meters

### **Standards under development to be considered**

Table 6. Standards under development to be considered: Metering (electricity and thermal)

Reference	Title
IEC 62052-31 ED2	Electricity metering equipment (AC) - General requirements, tests and test conditions - Part 31: Product safety requirements and tests
IEC 62057-3 ED1	IEC 62057-3 ED1 Test equipment, techniques and procedures for electrical energy meters - Part 3: Automatic Meter Testing System (AMTS)

## 4.4. Standardization on Industrial automation & IT

### **Technical committees**

#### **IEC/TC 65 Industrial-process measurement, control and automation**

Standardization for systems and elements used for industrial process measurement, control and automation. To coordinate standardization activities which affect integration of components and functions into such systems including safety and security aspects. This work of standardization is to be carried out in the international fields for equipment and systems.

## D7.1 Report on standardization landscape and applicable standards

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **ISO/TC 184 Automation systems and integration**

Standardization in the field of automation systems and their integration for design, sourcing, manufacturing, production and delivery, support, maintenance and disposal of products and their associated services. Areas of standardization include information systems, automation and control systems and integration technologies.

The substructure of ISO/TC 184 “Automation systems and integration” is:

- ISO/TC 184/SC 1 Industrial cyber and physical device control
- ISO/TC 184/SC 4 Industrial data
- ISO/TC 184/SC 5 Interoperability, integration, and architectures for enterprise systems and automation applications

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **ISO/IEC JTC 1/SC 7 Software and systems engineering**

Standardization of processes, supporting tools and supporting technologies for the engineering of software products and systems.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **ISO/IEC JTC 1/SC 41 Internet of things and digital twin**

Standardization in the area of Internet of Things and Digital Twin, including their related technologies.

- Serve as the focus and proponent for JTC 1's standardization programme on the Internet of Things and Digital Twin, including their related technologies.
- Provide guidance to JTC 1, IEC, ISO and other entities developing Internet of Things and Digital Twin related applications.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **ISO/IEC JTC 1/SC 42 Artificial intelligence**

Standardization in the area of Artificial Intelligence:

- Serve as the focus and proponent for JTC 1's standardization program on Artificial Intelligence

## D7.1 Report on standardization landscape and applicable standards

- Provide guidance to JTC 1, IEC, and ISO committees developing Artificial Intelligence applications

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **Standards to be considered**

Table 7. Standards to be considered: Industrial automation & IT

Reference	Title
IEC 61506:1997	Industrial-process measurement and control - Documentation of application software
IEC 62424:2016	Representation of process control engineering - Requests in P&I diagrams and data exchange between P&ID tools and PCE-CAE tools
IEC 62832-1:2020	Industrial-process measurement, control and automation - Digital factory framework - Part 1: General principles
IEC 62832-2:2020	Industrial-process measurement, control and automation - Digital factory framework - Part 2: Model elements
IEC 62832-3:2020	Industrial-process measurement, control and automation - Digital factory framework - Part 3: Application of Digital Factory for life cycle management of production systems
IEC TR 62837:2013	Energy efficiency through automation systems
IEC TS 62872-1:2019	Industrial-process measurement, control and automation - Part 1: System interface between industrial facilities and the smart grid
IEC 62872-2:2022	Industrial-process measurement, control and automation - Part 2: Internet of Things (IoT) - Application framework for industrial facility demand response energy management
IEC 62890:2020	Industrial-process measurement, control and automation - Life-cycle-management for systems and components
IEC PAS 63088:2017	Smart manufacturing - Reference architecture model industry 4.0 (RAMI4.0)
IEC PAS 63131:2017	System control diagram
IEC TR 63283-1:2022	Industrial-process measurement, control and automation - Smart manufacturing - Part 1: Terms and definitions
IEC TR 63283-2:2022	Industrial-process measurement, control and automation - Smart manufacturing - Part 2: Use cases
IEC PAS 63441:2022	Functional architecture of industrial internet system for industrial automation applications
ISO 8000	Data quality
ISO/TS 8000	Data quality
ISO/IEC/IEEE 42010:2022	Software, systems and enterprise — Architecture description
ISO/IEC 20005:2013	Information technology — Sensor networks — Services and interfaces supporting collaborative information processing in intelligent sensor networks
ISO/IEC 20924:2021	Information technology — Internet of Things (IoT) — Vocabulary
ISO/IEC 21823-1:2019	Internet of things (IoT) — Interoperability for IoT systems — Part 1: Framework



## D7.1 Report on standardization landscape and applicable standards

ISO/IEC 21823-2:2020	Internet of things (IoT) — Interoperability for IoT systems — Part 2: Transport interoperability
ISO/IEC 21823-3:2021	Internet of things (IoT) — Interoperability for IoT systems — Part 3: Semantic interoperability
ISO/IEC 21823-4:2022	Internet of things (IoT) — Interoperability for IoT systems — Part 4: Syntactic interoperability
ISO/IEC TR 22417:2017	Information technology — Internet of things (IoT) use cases
ISO/IEC 30141:2018	Internet of Things (IoT) — Reference Architecture
ISO/IEC 30141:2018/Cor 1:2020	Internet of Things (IoT) — Reference Architecture — Technical Corrigendum 1
ISO/IEC 30161-1:2020	Internet of Things (IoT) — Requirements of IoT data exchange platform for various IoT services — Part 1: General requirements and architecture
ISO/IEC TR 30166:2020	Internet of things (IoT) — Industrial IoT

### **Standards under development to be considered**

Table 8. Standards under development to be considered: Industrial automation & IT

Reference	Title
IEC TR 63283-5 ED1	Industrial-process measurement, control and automation – Smart manufacturing – Part 5: Market and innovation trends analysis
IEC TR 63319 ED1	A meta-modelling analysis approach to smart manufacturing reference models
IEC 63376 ED1	INDUSTRIAL FACILITY ENERGY MANAGEMENT SYSTEM (FEMS) – Functions and Information Flows
ISO 20140-5 ED2	Automation systems and integration - Evaluating energy efficiency and other factors of manufacturing systems that influence the environment - Part 5: Environmental performance evaluation data
ISO/CD 20140-5.2	Automation systems and integration — Evaluating energy efficiency and other factors of manufacturing systems that influence the environment — Part 5: Environmental performance evaluation data
ISO/IEC AWI 30172	Digital Twin — Use cases
ISO/IEC AWI 30173	Digital twin — Concepts and terminology
ISO/IEC FDIS 24029-2	Artificial intelligence (AI) — Assessment of the robustness of neural networks — Part 2: Methodology for the use of formal methods
ISO/IEC CD TR 24030	Information technology — Artificial intelligence (AI) — Use cases
ISO/IEC DIS 42001	Information technology — Artificial intelligence — Management system
ISO/IEC CD 42006	Information technology — Artificial intelligence — Requirements for bodies providing audit and certification of artificial intelligence management systems

## 4.5. Standardization on Energy storage & EV

### **Technical committees**

#### **IEC/TC 120 Electrical Energy Storage (EES) systems**



## D7.1 Report on standardization landscape and applicable standards

Standardization in the field of grid integrated EES systems in order to support grid requirements.

- TC 120 focuses on system aspects on EES systems rather than energy storage devices.
- TC 120 investigates system aspects and the need for new standards for EES systems.
- TC 120 also focuses on the interaction between EES systems and Electric Power Systems (EPS).

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **IEC/TC 21 Secondary cells and batteries**

To provide standards for all types of secondary i.e. rechargeable cells and batteries as related to their chemistry, product dimensions, marking and performances, the intrinsic safety of the design, the qualification tests for selected applications and the safety rules for installation, operation, maintenance and disposal.

All commercially maturing or matured electrochemical energy storage technologies and batteries made thereof, such as Lead-acid, Nickel-Cadmium, Nickel-Metal hydride, Lithium-ion as also specialized ones such as Na-S (Sodium-Sulphur), Na-NiCl (Sodium-nickel chloride) High temperature couples and assorted Flow-Batteries are included in the scope of the technical committee and subcommittee.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **CLC/TC 21X Secondary cells and batteries**

To execute the following standardization activities for secondary cells and batteries: - to implement IEC/TC 21/SC 21A documents into CENELEC standards; - to prepare Product Standards, general requirements and methods of testing included; - to prepare Safety Standards and associated Codes of Practice; - to consider Environmental Requirements (EC Rules) for the products.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **IEC/TC 69 Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks**

Standardization on electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks (hereafter EV) drawing current from a rechargeable energy storage system (RESS). Possibilities to transfer power/energy include conductive power/energy transfer, wireless power/energy transfer and battery swap.

## D7.1 Report on standardization landscape and applicable standards

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **ISO/TC 22/SC 37 Electrically propelled vehicles**

Specific aspects of electrically propelled road vehicles, electric propulsion systems, related components and their vehicle integration.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **Standards to be considered**

Table 9. Standards to be considered: Energy storage & EV

Reference	Title
IEC 62933	Electrical energy storage (EES) systems
IEC TS 62933	Electrical energy storage (EES) systems
IEC TR 62933	Electrical energy storage (EES) systems
IEC 61427-1:2013	Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application
IEC 61427-2:2015	Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 2: On-grid applications
IEC 62619:2022 ED2	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications
IEC 62660	Secondary lithium-ion cells for the propulsion of electric road vehicles
IEC 62485-3:2014 ED2	Safety requirements for secondary batteries and battery installations - Part 3: Traction batteries
EN 50604-1:2016/A1:2021	Secondary lithium batteries for light EV (electric vehicle) applications - Part 1: General safety requirements and test methods
EN 50604-1:2016	Secondary lithium batteries for light EV (electric vehicle) applications - Part 1: General safety requirements and test methods
IEC 61851	Electric vehicle conductive charging system
IEC PAS 61851	Electric vehicle conductive charging system
IEC 63110-1:2022	Protocol for management of electric vehicles charging and discharging infrastructures - Part 1: Basic definitions, use cases and architectures
IEC 62477-1:2022 ED2	Safety requirements for power electronic converter systems and equipment - Part 1: General
IEC 60204-1:2016 ED6	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

## D7.1 Report on standardization landscape and applicable standards

### Standards under development to be considered

Table 10. Standards under development to be considered: Energy storage & EV

Reference	Title
IEC TS 62933-2-3 ED1	Electric Energy Storage (EES) Systems - Part 2-3: Unit parameters and testing methods - Performance assessment test after site operation
IEC 62933-3-1 ED1	Electrical energy storage (EES) systems - Part 3-1: Planning and performance assessment of electrical energy storage systems - General specification
IEC TR 62933-4-200 ED1	Electrical Energy Storage (EES) Systems - Part 4-200: Guidance on environmental issues - Greenhouse gas (GHG) emission assessment by electrical energy storage (EES) systems
IEC 62933-5-1 ED1	Electrical energy storage (EES) systems - Part 5-1: Safety considerations for grid-integrated EES systems - General specification
IEC 62933-5-2 ED2	Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid-integrated EES systems - Electrochemical-based systems
IEC 62933-5-4 ED1	<p>Electrical energy storage(EES) systems Part 5-4 – Safety test methods and procedures for grid integrated EES systems – Lithium ion battery-based systems</p>
IEC 62933-4-2 ED1	Electric Energy Storage Systems - Part 4-2- Assessment of the environmental impact of battery failure in an electrochemical based storage system
IEC 62933-4-3 ED1	Electrical energy storage(EES) systems - Part 4-3: The protection requirements of BESS according to the environmental conditions and location types
IEC 61427-2 ED2	Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 2: On-grid applications
IEC 61851-1 ED4	Electric vehicle conductive charging system - Part 1: General requirements
IEC TS 61851-3-1 ED1	Electric Vehicles conductive power supply system - Part 3-1: DC EV supply equipment where protection relies on double or reinforced insulation - General rules and requirements for stationary equipment
IEC 63380-1 ED1	<p>Local Charging station management systems and Local Energy Management Systems network connectivity and information exchange - Part -1 General Requirements, Use Cases and abstract Messages</p>
IEC 63380-2 ED1	<p>Local Charging station management systems and Local Energy Management Systems network connectivity and information exchange - Part 2 Specific Data Model Mapping</p>
IEC 63380-3 ED1	<p>Local Charging station management systems and Local Energy Management Systems network connectivity and information exchange - Part 3 Communication Protocol and Cybersecurity Specific Aspects</p>
IEC 63380-4 ED1	<p>Local Charging station management systems and Local Energy Management Systems network connectivity and information exchange - Part-4 Test Specifications</p>

ISO/SAE CD 12906	Road vehicles — Test procedures for electrical vehicles to determine charging performance
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## 4.6. Standardization on Renewable energy sources (RES)

### **Technical committees**

#### **IEC/TC 82 Solar photovoltaic energy systems**

Standardization for systems of photovoltaic conversion of solar energy into electrical energy and for all the elements in the entire photovoltaic energy system. In this context, the concept "photovoltaic energy system" includes the entire field from light input to a photovoltaic cell to and including the interface with the electrical system(s) to which energy is supplied.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### **CLC/TC 82 Solar photovoltaic energy systems**

To prepare European Standards for systems of and components for photovoltaic conversion of solar energy into electrical energy and for all elements in the entire photovoltaic energy system. The standards will deal with EMC, Machine, CPD and LVD directives. The CLC/TC 82 will especially develop standards in areas where there are special European concerns.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### **ISO/TC 180 Solar energy**

Standardization in the field of solar energy utilization in space and water heating, cooling, industrial process heating and air conditioning. This includes developing standards on the instrumentation and procedures used for measuring solar energy and solar measurement.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### **CEN/TC 312 Thermal solar systems and components**

Preparation of European Standards to cover terminology, general requirements, characteristics, test methods, conformity evaluation and labelling of thermal solar systems and components.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### **ISO/TC 255 Biogas**

Standardization in the field of biogas produced by anaerobic digestion, gasification from biomass and power to gas from biomass sources.

## D7.1 Report on standardization landscape and applicable standards

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **Standards to be considered**

Table 11. Standards to be considered: Renewable energy sources (RES)

Reference	Title
IEC 60904:2023 SER	Photovoltaic devices - ALL PARTS
IEC 61215	Terrestrial photovoltaic (PV) modules - Design qualification and type approval
IEC 61683:1999	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
IEC 61724	Photovoltaic system performance
IEC 61853-1:2011	Photovoltaic (PV) module performance testing and energy rating
IEC 62446	Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance inspection
IEC 62093:2022	Photovoltaic system power conversion equipment - Design qualification and type approval
IEC 62116:2014	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IEC 62124:2004	Photovoltaic (PV) stand alone systems - Design verification
IEC TS 62257-100:2022	Renewable energy off-grid systems - Part 100: Overview of the IEC 62257 series
IEC 62509:2010	Battery charge controllers for photovoltaic systems - Performance and functioning
IEC 62548:2016	Photovoltaic (PV) arrays - Design requirements
IEC 62891:2020	Maximum power point tracking efficiency of grid connected photovoltaic inverters
IEC 62920:2017+AMD1:2021 CSV	Photovoltaic power generating systems - EMC requirements and test methods for power conversion equipment
IEC TS 62994:2019	Photovoltaic (PV) modules through the life cycle - Environmental health and safety (EH&S) risk assessment - General principles and nomenclature
IEC TS 63019:2019	Photovoltaic power systems (PVPS) - Information model for availability
IEC 63092-1:2020	Photovoltaics in buildings - Part 1: Requirements for building-integrated photovoltaic modules
IEC 63112:2021	Photovoltaic (PV) arrays - Earth fault protection equipment - Safety and safety-related functionality
IEC TS 63156:2021	Photovoltaic systems - Power conversion equipment performance - Energy evaluation method
EN 50530:2010/A1:2013	Overall efficiency of grid connected photovoltaic inverters
EN 50530:2010	Overall efficiency of grid connected photovoltaic inverters
ISO 9806:2017	Solar energy — Solar thermal collectors — Test methods
ISO 22975	Solar energy — Collector components and materials — Part 1: Evacuated tubes — Durability and performance
EN 12975:2022	Solar collectors - General requirements

## D7.1 Report on standardization landscape and applicable standards

ISO 20675:2018	Biogas — Biogas production, conditioning, upgrading and utilization — Terms, definitions and classification scheme
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### **Standards under development to be considered**

Table 12. Standards under development to be considered: Renewable energy sources (RES)

Reference	Title
IEC 61730-1 ED3	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
IEC 61730-2 ED3	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
IEC 61853-1/AMD1 ED1	Amendment 1 - Photovoltaic (PV) module performance testing and energy rating - Part 1: Irradiance and temperature performance measurements and power rating
IEC 61853-3/AMD1 ED1	Amendment 1 - Photovoltaic (PV) module performance testing and energy rating - Part 3: Energy rating of PV modules
IEC 61853-4/AMD1 ED1	Amendment 1 - Photovoltaic (PV) module performance testing and energy rating - Part 4: Standard reference climatic profiles
IEC TS 62257-301 ED1	Renewable energy off-grid systems - Part 301: Generators - Integration of solar with other forms of power generation within hybrid power systems
IEC TS 62257-341 ED1	Renewable energy off-grid systems - Part 341: Selection of batteries and battery management systems for stand-alone electrification systems - Specific case of automotive flooded lead-acid batteries available in developing countries
IEC TS 62257-350 ED1	Renewable energy off-grid systems - Part 350: Recommendations for selection of inverters
IEC 62446-1 ED2	Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 1: Grid connected systems - Documentation, commissioning tests and inspection
IEC TS 62446-3 ED2	Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 3: Photovoltaic modules and plants - Outdoor infrared thermography
IEC 62509 ED2	Battery charge controllers for photovoltaic systems - Performance and functioning
IEC 63409-1 ED1	Photovoltaic power generating systems connection with grid - Conformity assessment for power conversion equipment - Part 1: Overall description of conformity assessment for grid connection
IEC 63409-2 ED1	Photovoltaic power generating systems connection with grid - Testing of power conversion equipment - Part 2: Testing environment
IEC 63409-3 ED1	Photovoltaic power generating systems connection with grid - Testing of power conversion equipment - Part 3: Basic operations
IEC 63409-4 ED1	Photovoltaic power generating systems connection with grid - Conformity assessment for power conversion equipment - Part 4: Interface protection and fault ride through
IEC 63409-5 ED1	Photovoltaic power generating systems connection with grid - Testing of power conversion equipment - Part 5: Power Quality and EMC
IEC 63409-6 ED1	Photovoltaic power generating systems connection with grid - Conformity assessment for power conversion equipment - Part 6: Power control functions and grid support



## D7.1 Report on standardization landscape and applicable standards

IEC 63409-7 ED1	Photovoltaic power generating systems connection with grid - Testing of power conversion equipment - Part 7: Information exchange
ISO/AWI 9806	Solar energy — Solar thermal collectors — Test methods
ISO/FDIS 22975-4	Solar energy — Collector components and materials — Part 4: Glazing material durability and performance
ISO/DTR 23585	Safety and environment information for biogas plants, biogas transportation and biogas use

## 4.7. Standardization on Heat recovery system

### **Technical committees**

#### **ISO/TC 86 Refrigeration and air-conditioning**

Standardization in the fields of refrigeration and air-conditioning, including terminology, mechanical safety, methods of testing and rating equipment, measurement of sound levels, refrigerant and refrigeration lubricant chemistry, with consideration given to environmental protection. The scope includes factory-assembled air-conditioners (cooling), heat pumps, dehumidifiers, refrigerants, and refrigerant reclaiming and recycling equipment as well as other devices, components and equipment such as humidifiers, ventilation equipment and automatic controls used in air-conditioning and refrigeration systems that are not covered by other ISO technical committees.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### **CEN/TC 113 Heat pumps and air conditioning units**

Standardization of testing and requirements for the performance of factory assembled heat pumps, air conditioning units (ducted and non ducted), hydronic room fan coil units, and liquid chilling packages whether vapour compression or sorption, regardless of energy used, for domestic or commercial purposes excluding industrial processes and also excluding the rational use of gas energy which is within the scope of CEN/TC 299. Also the standardization of rating conditions, performance testing and the presentation of data of refrigerant compressors and condensing units.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

#### **CEN/TC 110 Heat exchangers**

Series produced heat exchangers that utilize any combination of refrigerants, steam, water and air as their working fluid and are used for heating and/or heat recovery for hot sanitary water and/or space heating and/or cooling purposes, when installed in private, public or industrial buildings. CEN/TC 110 will also prepare a standard for test methods and acceptance conditions for the thermal, hydraulic and acoustic performance of natural draught wet cooling towers.

## D7.1 Report on standardization landscape and applicable standards

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **CEN/TC 182 Refrigerating systems, safety and environmental requirements**

Standardization of requirements in the field of safety and environment for the design, construction, installation, testing, operation, maintenance, repair and disposal of refrigerating systems used for cooling and/or heating.

The homepage of technical committee with further information on, for example, the Business Plan of the TC can be found [here](#).

### **Standards to be considered**

Table 13. Standards to be considered: Heat recovery system

Reference	Title
ISO 16345:2014	Water-cooling towers — Testing and rating of thermal performance
ISO 16494-1:2022	Heat recovery ventilators and energy recovery ventilators — Method of test for performance — Part 1: Development of metrics for evaluation of energy related performance
ISO/TR 16494-2:2019	Heat recovery ventilators and energy recovery ventilators — Method of test for performance — Part 2: Assessment of measurement uncertainty of performance parameters
ISO 19967-1:2019	Heat pump water heaters — Testing and rating for performance — Part 1: Heat pump water heater for hot water supply
ISO 19967-2:2019	Heat pump water heaters — Testing and rating for performance — Part 2: Heat pump water heaters for space heating
ISO 21773:2021	Methods of test and characterization of performance for energy recovery components
ISO 21978:2021	Heat pump water heater — Testing and rating at part load conditions and calculation of seasonal coefficient of performance for space heating
ISO 817:2014	Refrigerants — Designation and safety classification
ISO 817:2014/Amd 2:2021	Refrigerants — Designation and safety classification — Amendment 2
ISO 11650:1999	Performance of refrigerant recovery and/or recycling equipment
EN 16147:2017/AC:2017	Heat pumps with electrically driven compressors - Testing, performance rating and requirements for marking of domestic hot water units
EN 1397:2021	Heat exchangers - Hydronic room fan coil units - Test procedures for establishing the performance
EN 15879-1:2011	Testing and rating of direct exchange ground coupled heat pumps with electrically driven compressors for space heating and/or cooling - Part 1: Direct exchange-to-water heat pumps
EN 16147:2017+A1:2022	Heat pumps with electrically driven compressors - Testing, performance rating and requirements for marking of domestic hot water units
EN 13771-2:2017	Compressors and condensing units for refrigeration - Performance testing and test methods - Part 2: Condensing units



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EN 13771-1:2016	Compressors and condensing units for refrigeration - Performance testing and test methods - Part 1: Refrigerant compressors
EN 1117:1998/A1:2002	Heat exchangers - Liquid cooled refrigerant condensers - Test procedures for establishing the performance
EN 1216:1998/A1:2002	Heat exchangers - Forced circulation air-cooling and air-heating coils - Test procedures for establishing the performance
EN 1148:1998/A1:2005	Heat exchangers - Water to water heat exchangers for district heating - Test procedures for establishing the performance data
EN 328:2014	Heat exchangers - Forced convection unit air coolers for refrigeration - Test procedures for establishing the performance
EN 1118:1998	Heat exchangers - Refrigerant cooled liquid coolers - Test procedures for establishing the performance
EN 305:1997	Heat exchangers - Definitions of performance of heat exchangers and the general test procedure for establishing performance of all heat exchangers
EN 14705:2005	Heat exchangers - Method of measurement and evaluation of thermal performances of wet cooling towers
EN 13741:2003	Thermal performance acceptance testing of mechanical draught series wet cooling towers
EN 1118:1998/A1:2002	Heat exchangers - Refrigerant cooled liquid coolers - Test procedure for establishing the performance
EN 306:1997	Heat exchangers - Methods of measuring the parameters necessary for establishing the performance
EN 327:2014	Heat exchangers - Forced convection air cooled refrigerant condensers - Test procedures for establishing performance
EN 307:1998	Heat exchangers - Guidelines to prepare installation, operating and maintenance instructions required to maintain the performance of each type of heat exchangers
EN 1048:2014	Heat exchangers - Air cooled liquid coolers ('dry coolers') - Test procedures for establishing the performance
EN 1117:1998	Heat exchangers - Liquid cooled refrigerant condensers - Test procedures for establishing the performance
EN 308:2022	Heat exchangers - Test procedures for establishing performance of air to air heat recovery components
EN 1216:1998	Heat exchangers - Forced circulation air-cooling and air-heating coils - Test procedures for establishing the performance
EN 1148:1998	Heat exchangers - Water to water heat exchangers for district heating - Test procedures for establishing the performance data
EN 378-2:2016	Refrigerating systems and heat pumps - Safety and environmental requirements - Part 2: Design, construction, testing, marking and documentation
EN 13136:2013+A1:2018	Refrigerating systems and heat pumps - Pressure relief devices and their associated piping - Methods for calculation

### **Standards under development to be considered**

Table 14. Standards under development to be considered: Heat recovery system

Reference	Title
ISO/FDIS 5222-1	Heat recovery ventilators and energy recovery ventilators — Testing and calculating methods for seasonal performance factor — Part 1: Sensible heating recovery seasonal performance factors of heat recovery ventilators (HRV)

## D7.1 Report on standardization landscape and applicable standards

ISO/CD 5222-2	Heat recovery ventilators and energy recovery ventilators — Testing and calculating methods for seasonal performance factor — Part 2: Sensible cooling recovery seasonal performance factors of HRV
ISO/CD 5222-3	Heat recovery ventilators and energy recovery ventilators — Testing and calculating methods for annual performance factor — Part 3: Sensible recovery annual performance factors of HRV
ISO 16494-1:2022/DAmendment 1	Heat recovery ventilators and energy recovery ventilators — Method of test for performance — Part 1: Development of metrics for evaluation of energy related performance — Amendment 1
ISO/CD 817	Refrigerants — Designation and safety classification
prEN 12900 rev	Refrigerant compressors — Rating conditions, tolerances and presentation of performance data
prEN 378-2 rev	Refrigerating systems and heat pumps - Safety and environmental requirements - Part 2: Design, construction, testing, marking and documentation

## 5. Conclusions and perspectives

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This report brings together the technical standardization committees of interest for the FLEXIndustries project at European and international level on the basis of a detailed analysis carried out with input from WP7 leader CARTIF, the WP2 technical leaders (CARTIF, LINKS, CIRCE and STAM) and the RTO demo partners (CARTIF, CIRCE, CERTH, UoP and FBK). By making this report available, the awareness of all partners in the project is raised that there is an extensive basis of potentially relevant standards. This can also prevent any duplication of work.

This document D7.1 forms the basis for the upcoming activities of Task 7.4 on FLEXIndustries contribution to the ongoing and future standardization developments until the end of the project. The developments within the relevant technical committees will be monitored and reported to the project partners. This information will be produced at different times throughout the project and will be collected in the final deliverable D7.10 “FLEXIndustries contribution to the standardization system” at M48.

Task 7.4 will now aim to investigate the standardization potential of the results being generated in FLEXIndustries, enabling the project to interact with the related technical standardization committees, assessing to what extent the relationships with the committees should be and using the standardization system as a rapid and much more focused dissemination tool to market stakeholders.

Based on the above results, FLEXIndustries will seek if there is an option to contribute to the development of new standards on specific topics, related to the project objectives. In case the inclusion of the project results in new or future standards that can be easily used by European or international industry and research is achieved, it will increase the impact of the project and contribute positively to the transfer of the knowledge generated in the framework of the project to industry and society.

In order to be able to use the standardization system as a tool for dissemination of project results and interaction with market actors, it will be necessary to decide on the type of interaction with the technical standardization committees relevant to FLEXIndustries (see Table 2). UNE will provide the necessary technical support for such interaction.

Specific tasks may be performed in relation with the standardization works of the identified TCs. Depending on the assessment by FLEXIndustries partners of the impact of the identified standardization TCs on their tasks and the level of contribution that their results can represent for these committees, several actions can be performed, for example:

- the follow up of the standardization activity through updates reported by UNE, supported by the technical partners;
- the dissemination of the FLEXIndustries project progress by delivering reports to the relevant TCs Secretaries or by attending relevant technical committees' meetings;
- the proposal of standardization activities to relevant TCs, e.g. revision or modification of existing standards, participation in the development of ongoing standards, proposals of new standards, etc. In the case of new standards, the most appropriate

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option in the framework of a Horizon Europe project is the development of fast-track standards, such as CEN-CENELEC Workshop Agreements (CWA).

Consequently, the following objectives have been achieved with the production of this deliverable:

- Identification of documents (Standards, Technical Specifications and Technical Reports) that can be directly applied in the FLEXIndustries activities, or/and that can be used as valuable information source.
- Identification of relevant standardization Technical Committees for FLEXIndustries project, allowing the monitorization of their future activities.
- Awareness of the present standardization framework around the FLEXIndustries knowledge areas, that will allow in the next steps to identify possible contributions of the FLEXIndustries project to the on-going and future standardization developments.
- Insight into the state of the art, that will be the base for the specification of a FLEXIndustries strategy concerning its interaction with the European standardisation system.

## 6. References

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- CEN Website ([www.cen.eu](http://www.cen.eu))
- CENELEC Website ([www.cenelec.eu](http://www.cenelec.eu))
- CEN/CENELEC Projex Online database ([projex.cen.eu](http://projex.cen.eu)) (restricted to authorized users)
- ISO Website ([www.iso.org](http://www.iso.org))
- ISO Project Portal ([isotc.iso.org](http://isotc.iso.org)) (restricted to authorized users)
- IEC Website ([www.iec.ch](http://www.iec.ch))

## 7. Annex I – List of key topics for the identification of standards

This annex shows the list of key concepts used for the identification of the relevant standards for FLEXIndustries.

A preliminary list has been proposed by UNE (see 7.1). CARTIF, as technical expert and WP7 leader, has worked on it and proposed an extensive list of topics organized according to demo case studies and other general subjects (see 7.2).

### 7.1. Preliminary list of key topics proposed by UNE.

**List of topics of interest:**

1	DISTRIBUTED ENERGY
2	ENERGY STORAGE
3	RENEWABLE ENERGY SOURCES
4	INDUSTRIAL WASTE HEAT RECOVERY SYSTEM
5	METERING INFRASTRUCTURE/ ELECTRICAL ENERGY MEASUREMENT AND CONTROL
6	ENERGY MANAGEMENT/ INDUSTRIAL NETWORKS/SMART GRIDS
7	ENERGY MARKETS
8	INDUSTRIAL AUTOMATION
9	FLEXIBLE MANUFACTURING
10	ELECTRIC VEHICLE CHARGING
11	COOMUNICATION INFRASTRUCTURE
12	ARTIFICIAL INTELLIGENCE
13	DATA SCIENCE/TRACEABILITY OF DATA

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### 7.2. Key topics elaborated by CARTIF.

#### 7.2.1. Project overall analysis

Num	Subject	Key Words
1	General	Decarbonisation
2	General	Electrical Energy Consumed / Generated
3	General	Thermal Energy Generated
4	General	Primary Energy Consumed
5	General	tCO2 Emissions
6	General	Process Plan
7	General	Energy Cost
8	General	Energy-Intensive Industries
9	General	Demand Management Strategy
10	General	Flexibility Potential
11	General	Carbon Dioxide Emissions In Tco2
12	General	Electric Energy Grid Operators
13	General	Electric Energy Grid Platforms
14	General	TSO (Transport System Operators)
15	General	Wholesale Electricity Market
16	General	Market Clearing Price
17	General	Charging Station For EV
18	General	Day-Ahead Model
19	General	Intra-Day Model
20	General	Paper Mill
21	General	Electrical Fixed Tariff
22	General	Demand Side Flexibility
23	General	Balancing Market Providing Ancillary Services
24	General	Voltage, Frequency And Power Of The Line

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Num	Subject	Key Words
25	General	Power Containment Reserve
26	General	Power Generation From Different Countries
27	General	Storage Elements
28	General	Self-Dispatch Model (Germany)
29	General	Central Dispatching System / Model
30	General	(Italy, Greece, Poland)
31	General	FCR Primary Reserve
32	General	Afrr Secondary Reserve
33	General	Mfrr Terciary Reserve
34	General	Possible Replacement Reserve (RR)
35	General	Link: <a href="https://Emissions-Euets.Com/Internal-Electricity-Market-Glossary">Https://Emissions-Euets.Com/Internal-Electricity-Market-Glossary</a>
36	General	Demand Side Flexibility
37	General	Prosumer
38	General	Implicit Energy Remuneration Mechanism
39	General	Explicit Energy Remuneration Mechanism
40	General	Interconnected Electricity Market
41	General	The Ramp Rate
42	General	Cyclic Operations
43	General	Start-Up Time
44	General	Combinated Heat Power
45	General	CCHP Turbine
46	General	Steam Turbine
47	General	Organic Rankine Cycle (ORC
48	MIL Y KFL	Gas Engines
49	General	Manageable Loads
50	General	Load Shedding Estrategy



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Num	Subject	Key Words
51	General	Peak Shaving
52	General	Electric Boilers
53	SUAM	Heat Pump
54	FORD	Electrical Grid Unbalance
55	FORD	Frequency Regulation
56	FORD	Grid Back-Up Services
57	General	Second Life Batteries
58	General	Precharging From Grid To Battery (G2B)
59	General	Battery-To-Grid Discharge (B2G)
60	SUAN, FORD	Electrical Storage
61	SUAN	CCHP (Tri-Generation System)
62	General	Charge Levelling
63	General	Self-Production Ratio
64	General	Self-Consumption Ratio
65	General	Gas Trader
66	General	Natural Gas Market Characterization
67	General	DH
68	General	EV Charging Cycle-Time
69	General	Power / VE
70	General	Peak Simultaneous Power Demand
71	General	Simultaneous Demand In One Hour (Kwh)
72	General	Simultaneous Demand In A Day (Kwh)
73	General	Kpis For Energy Flexibility Potential
74	General	Process Flow Chart
75	General	Oil Boilers

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Num	Subject	Key Words
76	General	Store Thermal Energy
77	General	Digital Twin
78	FORD	Stationary Battery Energy Storage System (BESS).
79	SUANFARMA	Extra Energy Sold
80	General	Sale Of Thermal Energy To The Heat Network (DHN Of Rovereto, Italy)
81	General	Electric Arc Furnace
82	STOMANA	Ladle Furnace (LF).
83	STOMANA	CCM. Casting Continuous Machine
84	STOMANA	Vacuum Degasser
85	STOMANA	Rolling Line
86	TITAN	Kiln
87	General	Heat Recovery In Kiln
88	SUAN	Waste Water Treatment Plant (WWTP)
89	FORD	Monocrystalline PERC PV Cells Module
90	SUAN	DSS Module
91	SUAN	EMS: Energy Management System
92	SRI	SCADA System
93	SRI	Anti-Pollution Systems
94	SRI	Centralized Dehumidification System For Plastic Injection
95	FORD	Solar Wall
96	General	Shell-And-Tube Evaporator
97	General	Solar Air-Heating Technology
98	General	Bare Plate Solar Collectors
99	General	Back-Pass Solar Collectors
100	General	Single Pass Solar Collectors

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Num	Subject	Key Words
101	General	Double Pass Solar Collectors
102	General	Compact Plate Condenser
103	General	Refrigerant Tank
104	General	Two-Stage Back To Back Centripetal Turbine
105	TITAN	Thermoelectric Modules
106	General	Thermal Storages: Sensible Insulated Hot Water Storage Reservoir
107	General	Thermal Storages: Latent
108	General	Thermochemical Storages
109	General	Sortion Storage
110	KFL	Fluidized Bed (FB) Gasification
111	KFL	Circulating Fluidized Bed Gasification
112	KFL	Bubbling Fluidized Bed Gasification
113	FORD	Reduction In Electricity Consumption
114	FORD	Reduction In Natural Gas Consumption
115	FORD	2nd Life Li-Ion Batteries
116	FORD	Increase In RES Production
117	FORD	Annual Energy Cost Reduction
118	General	Energy Balancing Service Provider (BSP)
119	General	Energy Balancing Market (BM)
120	PRO	Natural Gas Boilers
121	General	Self Consumption
122	General	Electricity Price Forecasting
123	FORD	Ancillary Services
124	FORD	Charging Ramp Of Charging Station
125	FORD	Peak Simultaneous Power Demand

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Num	Subject	Key Words
126	General	Charge The Battery
127	MIL	Potentially Interruptible Loads
128	TITAN	Waste Heat Recovery
129	General	Fixed Tariff
130	STN	Day Ahead Market
131	STN	Intra Day Market
132	STOMANA	Deviated Energy Consumption Forecasting
133	SUANFARMA	100% Certified Green Energy Electricity Consumed From The Grid;
134	SUANFARMA	Distributed Electricity Resources (DER)
135	SUANFARMA	TRIGENERATION
136	KLF	Wood Pellets

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**7.2.2. List of demos and possible related keywords for standards**

<b>PRO (Pulp &amp; Paper factory; Actions on the attached RDF-fired CHP plant: Germany)</b>		
<b>EXISTING / NEW</b>	<b>TECHNOLOGY /SYSTEM</b>	<b>POSSIBLE KEY WORDS</b>
Existing	STEAM TURBINES (moved by RDF steam boiler)	Refuse-Derived fuel definition Cogeneration Efficiency
Existing	SHELL BOILERS (Fuel-oil → Natural gas)	Boilers efficiency
New	0,5 MW PV system	Photovoltaic systems Green certificates
New	PCM Heat Storage (6,67MWh)	Thermal storage Phase Change Materials Steam-Pressurized systems

<b>FORD (Commercial Vehicle factory; Paint shop and EV Charging; Turkey)</b>		
<b>EXISTING / NEW</b>	<b>TECHNOLOGY /SYSTEM</b>	<b>POSSIBLE KEY WORDS</b>
Existing	SOLARWALL	Energy Building efficiency HVAC Building Management Systems
New	0,5 MW PV system	Same as other PV Plants
New	2 additional SOLARWALL	Same as other SOLARWALL
New	100 kWh Battery Energy Source	Electric security Battery efficiency
New	Use of the Manufactured EV Initial charging process as a manageable load (flexibility purposes)	EV charging efficiency EV charging protocols

<b>KFL (K-FLEX) (Elastomeric insulation materials manufacturing; Energy (electric and thermal) self-generation, extruder waste heat recovery; Poland)</b>		
<b>EXISTING / NEW</b>	<b>TECHNOLOGY /SYSTEM</b>	<b>POSSIBLE KEY WORDS</b>
New	426 kWth (peak power) solar plant	Solar thermal generation

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		Solar thermal efficiency
New	Sensible heat storage water tank	Thermal Storage
New	21 kWel Organic Rankine Cycle to recover waste energy from the vulcanization process (technical problem with polluted hot air)	Refrigerant / working fluids Heat exchangers for polluted air ORC efficiency Cooling towers
New	Gasifier + CHP Module	Wood pellets feedstock Gas synthesis CHP efficiency
New	Use of the Manufactured EV Initial charging process as a manageable load (flexibility purposes)	EV charging efficiency EV charging protocols

**MIL OIL (Biodiesel and Biogas production; Energy (electric and thermal) self-generation, extruder waste heat recovery; Poland)**

<b>EXISTING / NEW</b>	<b>TECHNOLOGY /SYSTEM</b>	<b>POSSIBLE KEY WORDS</b>
Existing	3 CHP (1,1+1,1+15MWel) powered by self-produced biogas	CHP efficiency Biogas definition Biogas treatment Electricity grid injection
New	150 kWel Organic Rankine Cycle to recover waste energy from the v3 CHPs (hot water)	Heat exchangers Refrigerant / working fluids ORC efficiency Cooling towers
New	Use the total electricity generation potential (up to 3,65MWel) to be injected into the grid as a “flexibility tool” in electric grid market	Balance service providers Quality of service in the national electricity grid

**TITAN (Cement manufacturing; Waste energy heat recovery from the Kiln; Greece)**

<b>EXISTING / NEW</b>	<b>TECHNOLOGY /SYSTEM</b>	<b>POSSIBLE KEY WORDS</b>
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New	TEG (ThermoElectric Generator) modules that convert heat recovered from the kiln surface to be converted into electricity (250 kWel)	Heat exchangers Termoelectric energy efficiency Refrigerant fluids Cooling towers
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<b>STOMANA (Steel manufacturing; Load interruption mechanisms; Bulgary)</b>		
<b>EXISTING / NEW</b>	<b>TECHNOLOGY /SYSTEM</b>	<b>POSSIBLE KEY WORDS</b>
Existing	Study and identification of the possible manufacturing processes that could be halt and/or delayed in order to optimize energy costs. A digital tool that take into account as input: hourly production schedule, planned stops, hourly-and-product energy consumption, energy prices,... And returns: a quarter consumption forecast, calculated quarter energy consumption, programming of planed stops,...	Electricity market Day-ahead and intra-day markets Digital twin Manufacturing planning Energy monitoring

<b>SUAN (Active Pharmaceutical Ingredients production; Energy (electric and thermal) self-generation utilities; Italy)</b>		
<b>EXISTING / NEW</b>	<b>TECHNOLOGY /SYSTEM</b>	<b>POSSIBLE KEY WORDS</b>
Existing	2 Trigeneration Units (4500 KkWel) powered by NATURAL GAS: Reciprocating engine that turns an alternator (electricity production mostly for self-consumption) Engine Cooling is derived through Absorption Chiller (cold production) Exhaust Gases are used to produce steam (hot production)	Trigeneration efficiency ICE efficiency and maintenance Absorption chillers
Existing	CHP (526kWel) powered by biogas (Self-produced?) Reciprocating engine that turns an alternator (electricity production all injected into the grid with incentives) Engine cooling and exhaust gases are used to produce water	CHP efficiency Biogas definition Biogas treatment Electricity grid injection

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New	New Trigeneneration Unit	Same comments as the existing Trigeneneration Units
New	560 kWel (peak) PV system for self-consumption	Same as other PV Plants
New	1 MWth heat pump to produce cold water (10°C) for cooling purposes and hot water (90°C) to be sold to a DHN	Heat Pumps efficiency DHN connection Thermal energy market
New	490 kWh Battery Energy Source	Electric security Battery efficiency