D1.1 – Report on Standardization, activities and regulatory requirements

WP1 – Requirements, Use Cases, Specifications

T1.1 – Analyze the regulatory requirements and existing standards

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DISCLAIMER

ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CENELEC	Comité Européen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)
CIM	Common Information Model
DER	Distributed Energy Resource
EESS	Electrical Energy Storage System
EMC	Electromagnetic Compatibility
EMS	Energy management system
ETSI	European Telecommunications Standards Institute
EV	Electric Vehicle
GDPR	General Data Protection Regulation
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
RED	Renewable Energy Directive
SC	Subcommittee
TC	Technical Committee
VPP	Virtual Power Plant
WG	Working Group

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EXECUTIVE SUMMARY

This report reviews standardization and regulation related to InterSTORE, specifically in the field of electrical energy storage systems (EESS) with main focus on interoperability and new generation EMS enabling the EESS digitalization. The report includes a list of standardization projects and their relevance in the Appendix.

In the standardization section, an introduction to standardization organizations such as IEC, CENELEC, and IEEE is provided. Additionally, relevant standardization expert groups and projects are discussed. These include various projects under IEC/TC 120, IEC/TC 21, IEC/TC 57, IEC/TC 8, IEC/TC 8 SC 8A, IEC/TC 8 SC 8B, IEC/TC 8 SC 8C, and IEC/TC 69. Similar expert groups and projects under CENELEC and IEEE and their relation to the project are also analyzed. As IEEE 2030.5 is the main focus of the project this standard is reviewed and set into context with IEC 61850 and IEC 61968.

The regulation section explores the role of regulation for InterSTORE, specifically in the context of energy transition, data protection and security, and cybersecurity. Various directives, acts and strategies are discussed, including the Digitalisation of Energy Action Plan, Energy Efficiency Directive, Directive (EU) 2019/944 on common rules for the internal market for electricity, Energy performance of buildings directive, System Integration Strategy, Sustainable and smart mobility strategy, Implementing Acts on interoperability requirements and transparent procedures for access to data RED I and III, ENTSO-E Network Codes, Digital Markets Act, Data Governance Act, E-Privacy Regulation, European Data Strategy, European Digital Identity (EUid Regulation, eIDAS Revision), Role of ENISA (EU Agency for Cybersecurity), European Cybersecurity Strategy, Network Code on Cybersecurity, EU Security Union Strategy, and NIS 2 Directive.

In conclusion, the report highlights the importance of standardization and regulation in the field of InterSTORE and provides an overview of the key organizations, expert groups, projects, and directives involved in this domain. Based on this overview and the feedback of the project partners as the project progresses the D6.3 "Exploitation Strategy, Plan and IPR Report" will be created.

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1 STANDARDIZATION

Standardization is the process of developing and implementing standard rules, guidelines, and requirements that ensure products, services, and processes meet a set of established specifications or criteria. These specifications are typically designed to enhance safety, quality, reliability, and efficiency.

The use of standards is essential for businesses, governments, and other organizations to operate effectively and efficiently in today's globalized world. Standardization allows for the development of interoperable systems and products, facilitating communication and trade across borders. It also promotes consumer protection, reduces waste and duplication, and creates a level playing field for all parties involved.

1.1 Introduction to standardization organizations

The relevant standardization organizations covered in this report are CENELEC on the European and IEC on the global level. IEEE standards are also used, e.g. in the US and Australian markets.

Using and creating CENELEC standards has the following advantages:

- European standards ensure that products, services, and systems are safe, reliable, and of high quality. Compliance with European standards is often mandatory for companies operating in the European market, which helps to ensure that products are safe and reliable for consumers.
- European standards promote interoperability between products and systems. This means that products from different manufacturers can work together seamlessly, which reduces the risk of compatibility issues and improves efficiency.
- CENELEC standards reduce trade barriers within the European market of 34 countries. By adopting common technical standards, companies can operate across borders with greater ease, which encourages competition and innovation.
- CENELEC standards are developed through a consensus-based process that involves stakeholders from industry, government, and civil society. This ensures that standards are developed in a transparent and inclusive manner, and that they reflect the needs of all stakeholders.
- CENELEC standards can help to support sustainability and environmental goals. Standards can be used to promote the use of sustainable materials and production methods, and to reduce the environmental impact of products and services.

Overall, the use of European standards has many advantages for businesses, consumers, and society as a whole. By promoting safety, interoperability, trade, and sustainability, European standards help to create a level playing field for companies and ensure that products and services meet the needs of consumers and society in one of the globally largest markets giving access to 34 countries (see figure 1).

On a global level European experts from CENELEC promote European ideas and technology at IEC. So, experts from 34 European countries deliver an impact to international standardization.

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Figure 1: Why standards?

1.1.1 IEC

The International Electrotechnical Commission (IEC) is a global organization that develops and publishes international standards for electrical and electronic technologies. Founded in 1906, the IEC works with industry experts and stakeholders from around the world to establish standards that ensure safety, interoperability, and efficiency of electrical and electronic products and systems. The IEC also provides conformity assessment services to ensure that products and systems meet these standards. Its work covers a wide range of areas, including energy, telecommunications, medical devices, and renewable energy.

1.1.2 CENELEC

The European Committee for Electrotechnical Standardization (CENELEC) is a non-profit organization that develops and publishes harmonized standards for electrical and electronic products and systems across the European Union. Founded in 1973, CENELEC works closely with industry stakeholders and national standardization bodies to ensure that its standards are safe, reliable, and compatible with international standards. The organization's work covers a wide range of areas, including energy, telecommunications, transportation, and medical devices. Compliance with CENELEC standards is often required by EU legislation and is necessary for manufacturers to sell their products in the European market.

1.1.3 IEEE

The Institute of Electrical and Electronics Engineers (IEEE) is a professional association of electrical, electronics, and computer engineers, as well as other technology professionals. Established in 1963, the IEEE is the world's largest technical professional organization, with over 400,000 members in more than 160 countries. The IEEE fosters innovation in technology by developing and promoting technical standards, organizing conferences and events, and publishing journals and other technical content. The IEEE's standards cover a wide range of areas, including power and energy, communications, aerospace, and computing.

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1.2 Relevant standardization expert groups and projects

The following IEC Technical Committees (IEC/TC) are evaluated as relevant for InterSTORE. Key factors for the selection were that the TC are working in the area of storage technology, communication or IT security. Criteria for identifying TC and projects relevant for InterSTORE are relations to:

- Hybrid Storage systems
- Storage technology
- Communication
- Cybersecurity
- Systems integration
- Interoperable Distributed energy resources

Tables with relevant projects can be found in the Appendix.

1.2.1 IEC

1.2.1.1 Electrical Energy Storage (EES) systems (IEC/TC 120)

This expert group focuses on the development of international standards for electrical energy storage systems (EESS) from a systems view. EESS as a system are critical components of the modern electrical grid, enabling the integration of renewable energy sources, increasing grid stability, and providing backup power during outages.

The committee's work includes developing standards related to safety, performance, and interoperability of EESS components and systems.

Focus however is the system role of EESS for grid stabilization, as a service or an emergency, as a market participant and as part of new applications like virtual powerplants, microgrids etc.

E.g. in the emergency role EESS can improve grid stability and also provide backup power during outages. This is particularly important in areas that are prone to natural disasters or other events that can disrupt the electrical grid. By providing backup power, EESS can help to ensure that critical infrastructure, such as hospitals and emergency services, remain operational during outages.

In a market role EESS can provide backup capacity when maintenance breaks need to be compensated.

So, from InterSTORE perspective this expert group offers EESS applications from a systems view.

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1.2.1.2 Secondary cells and batteries (IEC/TC 21)

The scope of this expert group focuses developing international standards for the technology of secondary cells and batteries in terms of their performance, safety, environmental compatibility, labeling, and transportation. Its work is aimed at ensuring the safety, reliability, and performance of batteries across different applications, including electric vehicles, portable devices, and stationary energy storage systems. This also involves the development of test methods, performance criteria, and safety requirements that ensure the safe operation of batteries throughout their lifecycle.

In the context of electrical storage systems the work of this expert group is particularly relevant in setting standards for battery performance, safety, and compatibility with other system components. This includes developing standards for battery management systems, which are critical in maintaining the health and safety of battery systems, ensuring their reliable operation, and extending their lifespan.

1.2.1.3 Power systems mgmt. and associated information exchange (IEC/TC 57)

IEC/TC 57 is a technical committee of the International Electrotechnical Commission (IEC), which develops international standards related to electrical energy systems. The committee is responsible for the development of standards for the exchange of information between electrical utilities and their customers, as well as for the integration of renewable energy sources, distributed energy resources, and electrical energy storage systems into the power grid.

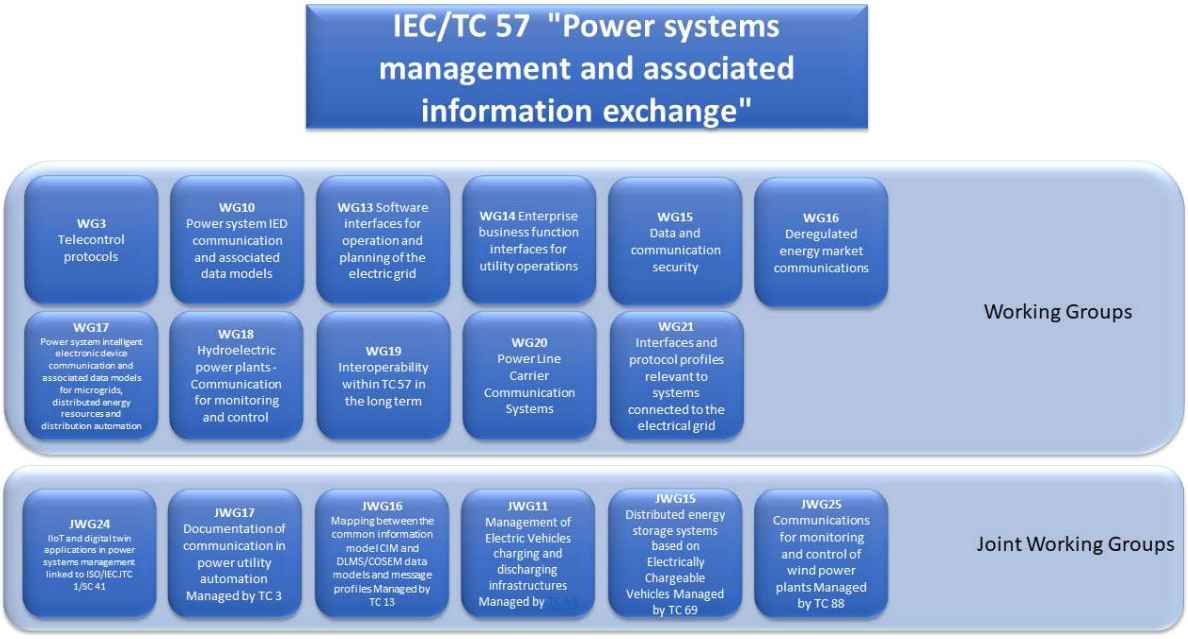

Figure 2: Working groups IEC/TC 57

Electrical energy storage systems (EESS) are a critical component of modern energy systems, helping to balance the supply and demand of electricity in real-time. EESS technologies include batteries, flywheels, pumped hydro, compressed air, and thermal storage systems, among others. EESS can be used for a variety of applications, including peak shaving, load shifting, frequency regulation, and grid stabilization. However, the

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integration of EESS into the power grid requires standardized communication protocols, which is where IEC/TC 57 comes in.

IEC/TC 57 has developed a number of standards related to EESS, including the IEC 61850 series of standards for substation automation and communication, the IEC 61968 and IEC 61970 series of standards for utility application integration.

The IEC 61850 series of standards provides a framework for the communication and control of substation automation systems. This framework includes a common data model, communication services, and system configuration tools. The standard is designed to support interoperability between different substation automation systems, which is important for the integration of EESS into the power grid.

The IEC 61968 and IEC 61970 series of standards provide a framework for the integration of utility applications, such as outage management, distribution management, and metering, into the power grid. The standards provide a common language for the exchange of information between different utility applications, which is important for the integration of EESS into the power grid.

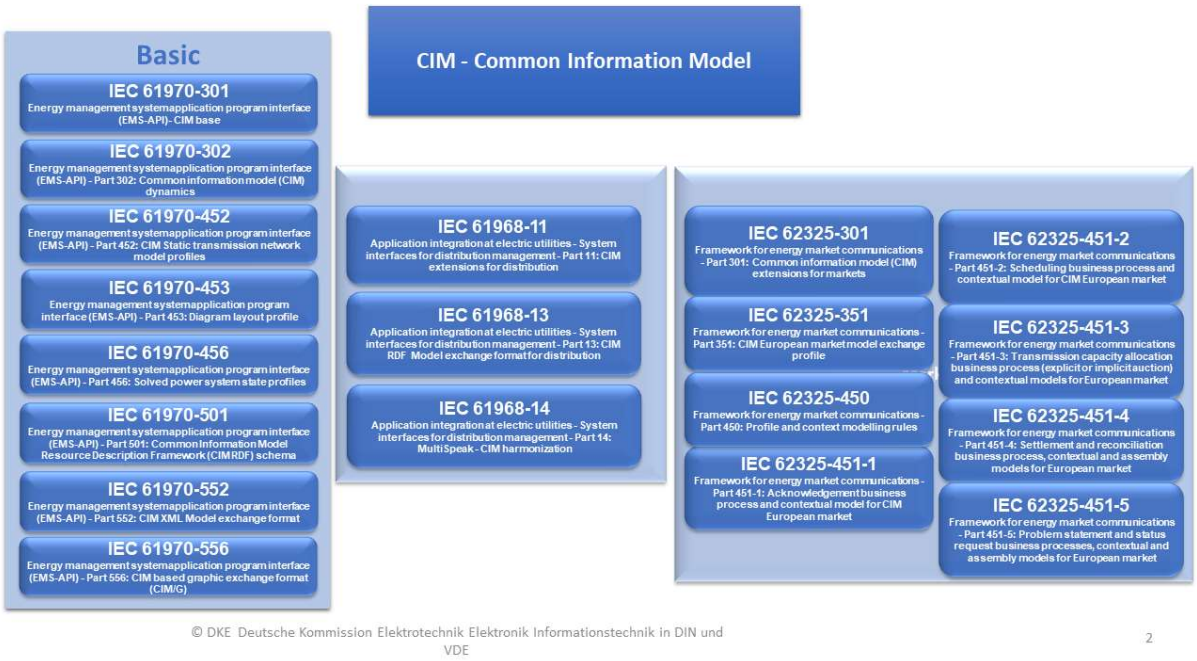

Figure 3: IEC 61970 CIM structure

In addition to developing standards, IEC/TC 57 also collaborates with other international organizations, such as the International Renewable Energy Agency (IRENA) and the International Energy Agency (IEA), to promote the integration of renewable energy and EESS into the power grid. For example, IEC/TC 57 participated in the development of the IRENA Global Atlas for Renewable Energy, which provides maps and data on renewable energy resources around the world.

Cybersecurity is handled by IEC/TC 57 WG15 "Data and communication security". WG15 created and continuously improves a cybersecurity architecture which promotes concepts like end2end-security, security by design and standards for conformity assessments of these

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cybersecurity standards. Typically for standardization TC future trends are also analyzed today e.g. the effects on quantum computing.

Overall, the work of IEC/TC 57 is critical for the integration of EESS into the power grid. Standardized communication protocols enable the seamless integration of EESS into the grid, which can help to increase the reliability and resiliency of the power system, as well as enable the efficient use of renewable energy resources.

1.2.1.4 System aspects of electrical energy supply (IEC/TC 8)

The main objective of TC 8 is to develop international standards and other deliverables in collaboration with other TC/SCs, focusing on the overall system aspects of electricity supply systems. This includes finding a suitable balance between cost and quality for the users of electrical energy. The scope of TC 8 covers various components of the electricity supply system, such as transmission and distribution networks, generators, loads, and their interfaces with the network.

The following scope is especially interesting for the integration of EESS:

- 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)

This expert group has also established three subcommittees to cover grid integration of renewables, applications of renewables and grid stabilization.

Figure 4: Structure of IEC/TC 8

Reviewing and using the established terminology and characteristics will facilitate the integration of EESS in general. Especially the connection requirements will be relevant to integrate the EESS not only into the standard power grid but also into sophisticated applications like microgrids and virtual powerplants.

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1.2.1.5 Grid Integration of Renewable Energy Generation (IEC/TC 8 SC 8A)

This subcommittee is responsible for developing international standards and other deliverables for the grid integration of variable power generation from renewable sources such as photovoltaic (PV) and wind energy. The emphasis is on the overall system aspects of electricity supply systems, specifically the grids, as defined in the scope of TC 8. It's important to note that SC 8A does not cover issues typically regulated, such as renewable energy policies like infeed tariff schemes.

The focus on grid code compliance on the international level is especially relevant for the integration of EESS. This includes connection rules but also applications which are relevant for InterSTORE, e.g. the use of EESS in microgrids and/or in virtual powerplants.

1.2.1.6 Decentralized electrical energy systems (IEC/TC 8 SC 8B)

SC 8B's scope is to develop IEC publications 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. These new systems include but are not limited to AC, DC, AC/DC hybrid decentralized electrical energy systems and influence distributed generation, distributed energy storage, virtual power plants and electrical energy management systems.

A popular concept is currently the “microgrid” defined as a group of interconnected loads and distributed energy resources with defined electrical boundaries that acts as a single controllable entity and is able to operate in both grid-connected and island mode.

Decentralized electrical energy systems have applications for developing countries (focussing on access to electricity) as well as for developed countries (focusing on high reliability, black-out recovery and services). Interactions within decentralized multi energy systems should also be considered.

1.2.1.7 Network mgmt. in Interconnected Electric Power Syst. (IEC/TC 8 SC 8C)

The focus of this expert group is in the field of network management in interconnected electric power systems, including functions with different time horizons, e.g. design, planning, operation, control and market integration.

SC 8C is planning to cover issues contributing to the resilience, reliability, security, stability of the interconnected electric power systems.
The current focus ensuring a stable grid operation however the current projects are still in a preliminary phase.

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1.2.1.8 Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks (IEC/TC 69)

The objective of this expert group is to develop standards concerning the power and energy transfer systems for electrically propelled road vehicles and industrial trucks, commonly referred to as EVs. These vehicles draw power from rechargeable energy storage systems (RESS). The publications cover various methods of power and energy transfer, including conductive transfer, wireless transfer, and battery swapping.

From the EESS perspective especially the charging process as interface to the grid and using EV as "mobile EESS" is interesting as option. IEC/ISO 15118 describes the vehicle to grid communication interface. As the communication parts of this generic equipment are the Electric Vehicle Communication Controller (EVCC) and the Supply Equipment Communication Controller (SECC), ISO 15118 describes the communication between these components. The different parts of this standard specify terms and definitions, general requirements and use cases as the basis for the other parts of ISO 15118. It provides a general overview and a common understanding of aspects influencing the charge process, payment and load levelling.
ISO 15118 does not specify the vehicle internal communication between battery and charging equipment and the communication of the SECC to other actors and equipment (beside some dedicated message elements related to the charging). All connections beyond the SECC, and the method of message exchanging are out of the scope as specific use cases.

1.2.2 CENELEC

In the energy sector CENELEC TC not only mirror the IEC activities but also creates new and adapts existing international standards for the European market. CENELEC TC also introduce European concepts, like the connection requirements, into IEC TCs.

1.2.2.1 System Aspects of Electrical Energy Supply (CLC/TC 8x)

CENELEC TC 8x primary objective is to develop European standards that promote the safe and efficient use of electrical energy in power systems from a systems view. The scope of this committee encompasses all aspects of electrical energy supply, including generation, transmission, distribution, and consumption. CENELEC TC 8x aims to establish technical specifications that ensure the proper functioning of the power system, with a high emphasis on the integration of renewable energy sources like PV and special solutions like Microgrids and virtual power plants (VPP) including energy storage systems. A special focus is on the connection requirements (EN 50549-Series) which describes the requirements for the connections and a grid stabilization including the ENTSO-E Network Codes.
From the InterSTORE perspective TC 8x is especially interesting since they cover connection requirements, but also new system solutions like microgrids and VPP.

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1.2.3 IEEE

The Institute of Electrical and Electronics Engineers (IEEE) follows a systematic process to create standards. This process involves several stages and involves collaboration among experts, stakeholders, and interested parties.

1.2.3.1 Smart Energy Profile Application Protocol (IEEE 2030.5)

As InterSTORE assumed using IEEE 2030.5 as a fundamental starting point of the project it is essential to understand it's role in comparison within the international standards from CENELEC and IEC.
In the US, Australia, Canada, Japan and many other countries (figure 6), distributed energy resource (DER) integration applications employ the IEEE 2030.5 standard, formerly known as Smart Energy Profile 2 (SEP 2) as the communications protocol. As far as the IEEE 2030.5 structure and content is concerned the IEC 61968 data model is used for the majority of the semantics in the IP-based IEEE 2030.5 standard, which is independent of the underlying physical transport (Wi-Fi, ZigBee, etc.). The IEC 61850-7-420 logical node classes for DER components are adopted by the IEEE 2030.5 standard. The IEEE authorized an update to IEEE 2030.5 in 2018 that adopted changes to bring it into compliance with IEC 61850 extensions for DER.

Figure 5: IEEE 2030.5

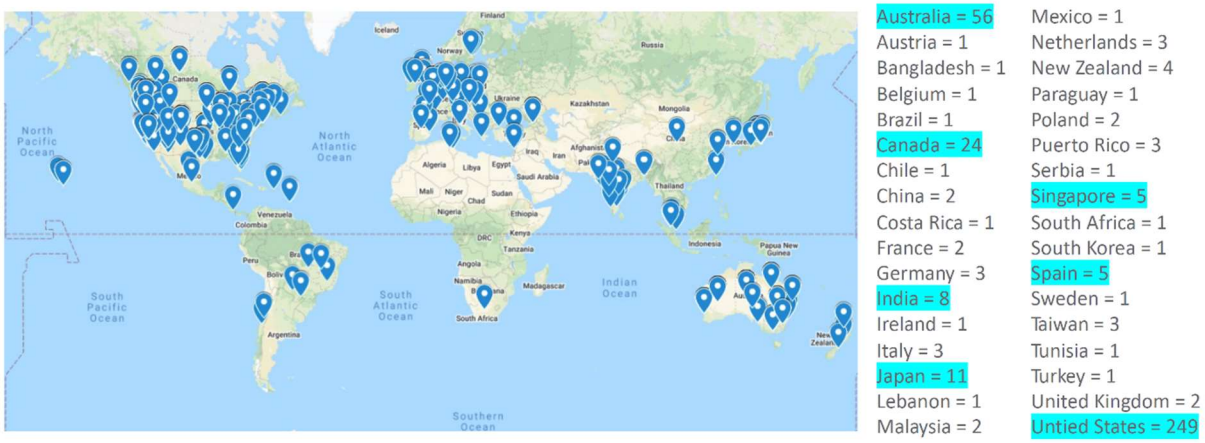

Figure 6: Global interest in IEEE 2030.5 as of May 2021

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So, IEEE 2030.5, also known as the Smart Energy Profile (SEP) standard, focuses on the interoperability of energy management systems (EMS) and devices within a smart grid environment. It defines the communication protocols and data models for exchanging information between various components, such as smart meters, renewable energy systems, electric vehicles, and energy management systems. IEEE 2030.5 provides a framework for secure, reliable, and efficient communication and control within smart grid infrastructures.

1.2.3.2 Comparison IEEE 2030.5 with IEC 61850

IEEE 2030.5 and IEC 61850 have overlaps: Both standards address communication protocols and data models but focus on different aspects. IEEE 2030.5 primarily deals with the interoperability of energy management systems within a smart grid context, while IEC 61850 specifically targets substation automation systems. However, there may be instances where these standards can complement each other, such as when integrating smart grid devices and substation automation systems.

From the ESS perspective IEEE 2030.5 and IEC 61850 overlaps are:

- **Interoperability:** IEEE 2030.5 focuses on the interoperability of energy management systems (EMS) within a smart grid environment, while IEC 61850 addresses the interoperability of intelligent electronic devices (IEDs) in substations. When it comes to electrical storage devices, both standards can facilitate interoperability by defining common communication protocols, data models, and interfaces.
- **Integration:** Electrical storage devices, such as batteries or energy storage systems, play a crucial role in enabling renewable energy integration and grid stability. IEEE 2030.5 can provide a framework for integrating these storage devices into the energy management system, enabling effective monitoring, control, and management. IEC 61850, with its focus on substation automation systems, can support the integration of storage devices within the substation environment, ensuring seamless communication and interoperability between the storage system and other intelligent devices.

1.2.3.3 Comparison IEEE 2030.5 with IEC 61968 (CIM)

The overlaps of IEEE 2030.5 and IEC 61968 are of course different: IEEE 2030.5 focuses on the communication and interoperability of energy management systems, including smart meters and distributed energy resources. IEC 61968, on the other hand, provides a standardized framework for integrating utility enterprise systems. While their focus areas differ, there can be interactions between these standards when integrating utility applications with energy management systems, enabling efficient data exchange and coordination.

From the ESS perspective the overlaps between IEEE 2030.5 and IEC 61968 are:

- **Data Exchange:** IEC 61968, also known as CIM, defines data models and interfaces for utility enterprise systems. IEEE 2030.5 can complement IEC 61968 by providing standardized protocols and communication frameworks for exchanging information related to electrical storage devices within the utility enterprise systems. This enables efficient data exchange, coordination, and management of storage devices, including status, capacity, charging/discharging schedules, and performance data.

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- **Energy Management:** IEEE 2030.5 focuses on the interoperability of energy management systems, which can include functions related to energy storage management. IEC 61968, with its focus on utility enterprise systems, can support the integration of energy storage management functions, such as asset management, scheduling, and optimization, within the overall utility infrastructure.

As IEC 61850 series and IEC 61968 series are further developed at high speed, the challenge for IEEE 2030.5 will need to be updated with the related contents with these two IEC standard series.

1.2.3.4 Advantages using IEEE 2030.5, compared with IEC 61850

Using IEEE 2030.5 instead of IEC 61850 offers several advantages. Here are some of the key advantages in detail:

Flexibility and Scalability: IEEE 2030.5 provides a flexible and scalable framework for integrating electrical storage devices into energy management systems (EMS) within smart grid environments. It allows for seamless integration of a wide range of devices, including storage systems of different capacities and technologies. This flexibility enables easier adoption of diverse storage devices and promotes interoperability across various manufacturers and vendors.

Application Focus: IEEE 2030.5 specifically addresses the needs of energy management systems, including functions related to storage device management. This focus ensures that the standard covers essential aspects such as monitoring, control, and optimization of storage systems within the energy management context. It provides dedicated features and protocols to efficiently manage storage devices and enables their effective participation in grid operations and energy market interactions.

Data Exchange and Interoperability: IEEE 2030.5 defines standardized data models and communication protocols, enabling seamless data exchange and interoperability between energy management systems and electrical storage devices. This facilitates efficient monitoring, control, and coordination of storage systems, allowing for real-time visibility of their status, performance, and capacity. The standardized data exchange promotes interoperability between different EMS platforms and enhances overall grid management.

Integration with Renewable Energy: Electrical storage devices play a vital role in integrating renewable energy sources into the grid. IEEE 2030.5 offers specific features and capabilities to support the integration and management of storage systems in renewable energy scenarios. It enables coordination between renewable generation, storage, and grid operations, facilitating optimal utilization of renewable energy and improved grid stability.

Interoperability with other Smart Grid Components: IEEE 2030.5 provides a framework for interoperability not only with storage devices but also with other smart grid components such as smart meters, electric vehicle charging infrastructure, and demand response systems. This interoperability allows for seamless communication and coordination among these components, enabling advanced energy management, grid optimization, and enhanced customer services.

Industry Adoption and Support: IEEE 2030.5 has gained significant industry adoption and support, with many utilities, vendors, and manufacturers implementing and utilizing the standard

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in their energy management systems. This widespread adoption ensures a broader ecosystem of compatible devices and solutions, offering more choices and options for integrating electrical storage devices into the grid.

So, in general IEC 61850 is primarily focused on substation automation systems and has a broader scope covering various devices and functions within the substation. While it can support certain aspects of storage device integration, IEEE 2030.5 offers a more targeted approach specifically designed for energy management systems and their interactions with distributed storage devices. However, the decision depends on the specific requirements, context, and compatibility with existing systems in a given smart grid application.

1.2.3.5 Advantages using IEEE 2030.5, compared with IEC 61968

When considering the advantages of using IEEE 2030.5 for electrical storage devices instead of IEC 61968, several key benefits stand out. In detail the advantages are:

Specific Focus on Energy Management: IEEE 2030.5 is specifically designed to address the needs of energy management systems (EMS) within smart grid environments. It provides a dedicated framework for managing electrical storage devices within the context of energy management, including functions such as monitoring, control, optimization, and coordination. This specific focus ensures that IEEE 2030.5 covers the essential aspects of storage device management required for efficient grid integration and energy optimization.

Standardized Communication Protocols: IEEE 2030.5 defines standardized communication protocols and data models for exchanging information between energy management systems and electrical storage devices. This standardization enables seamless interoperability and communication, ensuring compatibility between different storage devices and energy management systems from various manufacturers. It facilitates efficient data exchange, control signals, and monitoring parameters, streamlining the integration of storage devices into energy management systems.

Scalability and Flexibility: IEEE 2030.5 provides a scalable and flexible framework for integrating electrical storage devices into energy management systems. This flexibility allows for the integration of storage systems of varying capacities, technologies, and configurations. The standardized approach of IEEE 2030.5 ensures that storage devices from different vendors can be easily integrated, promoting interoperability and offering more options for system configuration and expansion.

Enhanced Grid Integration: Electrical storage devices play a crucial role in grid integration, especially in managing renewable energy sources and addressing grid stability challenges. IEEE 2030.5 includes features and protocols specifically designed to support the integration and management of storage devices in renewable energy scenarios. It enables effective coordination between renewable generation, storage, and grid operations, facilitating enhanced grid integration and renewable energy utilization.

Interoperability with Other Smart Grid Components: IEEE 2030.5 provides interoperability not only with storage devices but also with other smart grid components such as smart meters, electric vehicle charging infrastructure, and demand response systems. This interoperability allows for seamless communication and coordination among these components, enabling advanced energy management, grid optimization, and enhanced integration of various smart grid functionalities.

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Industry Adoption and Support: IEEE 2030.5 has gained significant industry adoption and support, with many utilities, vendors, and manufacturers implementing and utilizing the standard in their energy management systems. This widespread adoption ensures a broader ecosystem of compatible devices and solutions, offering more choices and options for integrating electrical storage devices into energy management systems.

While IEC 61968, known as the Common Information Model (CIM), provides a framework for utility enterprise systems and data management, it has a broader scope beyond energy management. IEEE 2030.5, on the other hand, is specifically tailored for energy management systems and their interactions with distributed storage devices, making it more focused and aligned with the specific needs of electrical storage integration in smart grids.

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2 REGULATION

2.1 Role of regulation for InterSTORE

European regulation sets the framework, while standardization handles the technical challenges within this framework.

The EU "New Approach" is a regulatory framework that was introduced in the 1980s to promote the free movement of goods within the European Union by harmonizing technical standards and regulations across member states.

Under the New Approach, the EU sets broad objectives and essential requirements for products, but leaves it European standardization organizations CEN, CENELEC and ETSI and their experts to develop and implement technical specifications and standards. This allows for greater flexibility and higher innovation speed in the European marketplace, while ensuring that products meet safety, quality and sustainability standards.

The New Approach covers a wide range of products, including machinery, electronics, medical devices, toys, and construction products. It has been successful in promoting cross-border trade within the EU and reducing barriers to entry for small and medium-sized enterprises.

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2.1.1 Energy transition

The EU energy transition strategy refers to the comprehensive plan and set of policies aimed at transforming the EU's energy system from one heavily reliant on fossil fuels to one characterized by renewable energy sources, increased energy efficiency, and reduced greenhouse gas emissions. The strategy encompasses various initiatives, targets, and regulations implemented by the EU and its member states to achieve a more sustainable and resilient energy sector.

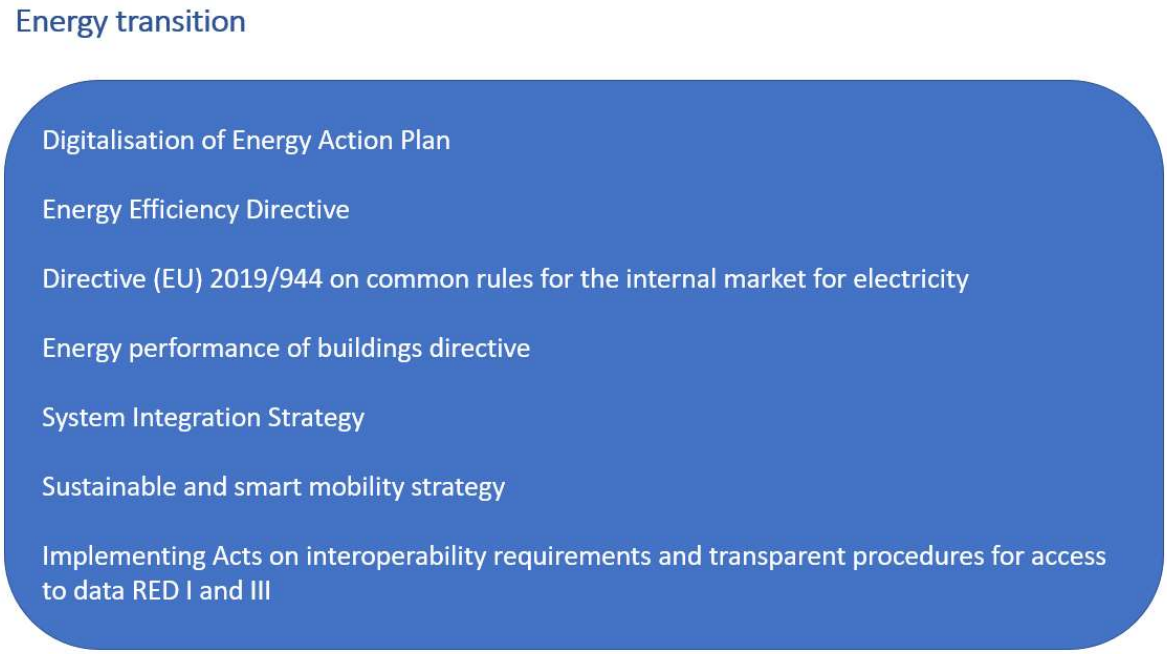

Figure 7: Energy transition

The EU's energy transition strategy is driven by several key objectives, including:

Decarbonization: The EU aims to reduce its greenhouse gas emissions, contributing to global efforts to mitigate climate change. The overarching target is to achieve climate neutrality by 2050, which involves balancing carbon emissions with removals or offsets.

Renewable Energy Deployment: The EU seeks to increase the share of renewable energy in its overall energy mix. The target is to reach a 32% renewable energy share by 2030, with individual national targets reflecting varying starting points and potential for renewables.

Energy Efficiency: The EU focuses on improving energy efficiency across all sectors to reduce energy consumption and minimize waste. The target is to achieve a 32.5% improvement in energy efficiency by 2030.

Electrification and Clean Mobility: The EU aims to promote the electrification of transport, reducing dependence on fossil fuel-powered vehicles. This includes supporting the deployment of electric vehicles and establishing charging infrastructure networks.

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2.1.1.1 Digitalisation of Energy Action Plan

The European Union (EU) Digitalisation of Energy Action Plan is a comprehensive framework that aims to accelerate the deployment of digital technologies in the energy sector. The plan outlines a set of policy measures and initiatives aimed at leveraging digitalisation to enhance the energy efficiency, security, and sustainability of the European energy system. One of the key elements of the plan is the integration of electrical storage systems (EESS) into the energy grid.

EESS are a crucial component of the transition towards a more sustainable energy system, as they enable the integration of intermittent renewable energy sources, such as solar and wind power, into the grid. They also provide energy security and stability by storing excess energy generated during times of low demand and releasing it during peak hours. The integration of EESS into the grid is expected to increase the flexibility and reliability of the energy system, reduce greenhouse gas emissions, and decrease the cost of energy.

The Digitalisation of Energy Action Plan aims to support the deployment of EESS through various measures. One of the key initiatives is the creation of a European battery innovation and manufacturing ecosystem. The EU plans to invest heavily in research and development (R&D) activities aimed at developing advanced battery technologies that are more efficient, cost-effective, and sustainable. The goal is to ensure that the EU becomes a leading global player in the battery industry, with a focus on developing a circular economy for batteries.

Another key initiative is the development of a regulatory framework that supports the deployment of EESS. The EU plans to review and update its existing energy regulations to ensure that they are adapted to the needs of a digital and decarbonized energy system. The regulatory framework will aim to create a level playing field for EESS operators, facilitate the integration of EESS into the grid, and ensure that the benefits of EESS are shared across all stakeholders.

The Digitalisation of Energy Action Plan also aims to leverage digital technologies to optimize the operation of EESS. The plan advocates for the use of artificial intelligence (AI), blockchain, and other digital tools to enhance the performance and efficiency of EESS. For example, AI can be used to optimize the charging and discharging of EESS based on weather forecasts and energy demand patterns. Blockchain can be used to create a transparent and secure marketplace for energy trading and storage.

The integration of EESS into the energy grid also presents new opportunities for the development of smart grids. Smart grids are energy systems that use digital technologies to monitor and control energy production, consumption, and storage in real-time. The integration of EESS into smart grids can increase the efficiency, reliability, and resilience of the energy system, while also enabling the integration of electric vehicles (EVs) and other distributed energy resources (DERs) into the grid.

In conclusion, the EU Digitalisation of Energy Action Plan is a comprehensive framework that aims to leverage digital technologies to accelerate the transition towards a more sustainable energy system. The plan recognizes the crucial role of EESS in this transition and outlines a set of policy measures and initiatives aimed at supporting the deployment of EESS. The integration of EESS into the grid is expected to increase the flexibility and reliability of the energy system, reduce greenhouse gas emissions, and decrease the cost of energy. The plan aims to create a regulatory framework that supports the deployment of EESS, develop advanced battery technologies, and leverage digital tools to optimize the operation of EESS.

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The integration of EESS into the grid also presents new opportunities for the development of smart grids. Overall, the Digitalisation of Energy Action Plan is a significant step towards a more sustainable and digitalized energy system.

2.1.1.2 Energy Efficiency Directive

The European Union (EU) has taken a proactive approach to reducing energy consumption through the introduction of the Energy Efficiency Directive (EED) in 2012. The directive is a crucial part of the EU's plan to achieve a 20% improvement in energy efficiency by 2020. The EED is designed to encourage energy efficiency measures across a range of sectors, including buildings, transport, and industry. The directive's primary focus is to reduce energy consumption by promoting energy-efficient practices and technologies while ensuring that the EU remains competitive and that its energy supplies are secure.

The 2018 amending directive, part of the "Clean energy for all Europeans package", updated the policy framework for energy efficiency in the EU. Its main objective is to achieve a headline energy efficiency target of at least 32.5% by 2030, collectively across the EU. This target is based on 2007 modelling projections for 2030.

The amending directive also extends the energy savings obligation in end use introduced in the 2012 directive. EU countries must achieve new energy savings of 0.8% each year of final energy consumption for the 2021-2030 period, except for Cyprus and Malta, which have a lower target of 0.24% each year.

The amending directive also includes provisions such as stronger rules on metering and billing of thermal energy, transparent national rules on cost allocation in multi-apartment buildings, monitoring efficiency levels in new energy generation capacities, an updated primary energy factor for electricity generation, and a general review of the Energy Efficiency Directive required by 2024.

From the EESS perspective the EED includes a range of measures aimed at reducing energy consumption, including energy audits, energy management systems, and energy-saving obligations for energy companies. However, one of the most significant impacts of the EED has been the promotion of energy storage systems, especially electrical storage systems.

Energy storage systems have the potential to play a critical role in supporting the transition to a low-carbon energy system, by enabling the integration of variable renewable energy sources like solar and wind into the grid. Electrical storage systems can store surplus energy when supply exceeds demand and release it when demand exceeds supply. This makes it possible to smooth out the variability of renewable energy sources and to balance the grid's supply and demand.

The EED has recognized the potential of electrical storage systems and has included measures to encourage their deployment. The directive stipulates that member states should take steps to remove barriers to the deployment of energy storage systems. Member states are also required to assess their potential for energy storage and to develop plans to deploy storage systems where appropriate.

One of the most significant impacts of the EED has been the promotion of energy storage systems in the building sector. The directive requires member states to encourage the use of energy-efficient heating and cooling systems and to promote the use of energy-efficient

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lighting. Energy storage systems can be used in conjunction with these measures to reduce energy consumption further. For example, an electrical storage system can be used to store energy generated by a solar panel during the day and use it to power the building in the evening.

Another area where the EED has had an impact is in the promotion of electrical storage systems in the transport sector. The directive requires member states to encourage the use of alternative fuels in transport, including electricity. Electrical storage systems can be used to power electric vehicles, enabling them to travel longer distances without the need for recharging.

Overall, the EED has played a crucial role in promoting the deployment of electrical storage systems across Europe. It has encouraged member states to remove barriers to the deployment of storage systems and to assess their potential for energy storage. This has helped to create a more favourable environment for the development of storage systems, which are essential for supporting the transition to a low-carbon energy system.

In conclusion, the EU's Energy Efficiency Directive is a crucial piece of legislation designed to promote energy efficiency across a range of sectors. The directive recognizes the potential of electrical storage systems to support the transition to a low-carbon energy system and includes measures to encourage their deployment. Electrical storage systems have the potential to play a critical role in enabling the integration of variable renewable energy sources into the grid, smoothing out their variability and balancing supply and demand. The EED has played a vital role in promoting the deployment of electrical storage systems, creating a more favourable environment for their development, and helping to ensure that Europe remains competitive, and its energy supplies are secure.

2.1.1.3 Directive (EU) 2019/944 on cmn. rules for the internal mkt. for electricity

Directive (EU) 2019/944 on common rules for the internal market for electricity is a legal framework established by the European Union to promote the efficient and effective functioning of the electricity market across the European Union. This Directive lays down common rules to ensure the optimal operation of the internal market for electricity, which includes provisions on market design, network operation, and interconnection.

In particular, this directive emphasizes the role of energy storage systems in the transition to a more sustainable energy system. Energy storage systems play a crucial role in balancing the grid, ensuring the stability and reliability of electricity supply, and integrating renewable energy sources into the grid. The Directive therefore includes provisions to support the deployment of energy storage systems, with the aim of facilitating their integration into the electricity market.

One of the key provisions of the Directive is the requirement for Member States to remove any regulatory barriers that prevent the participation of energy storage systems in the electricity market. This includes the removal of any unjustified restrictions on energy storage systems, such as requirements for double licensing or discriminatory pricing, which may discourage their deployment. The Directive also requires that energy storage systems be treated equally to other resources in terms of market access, network connection, and system operation.

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To facilitate the deployment of energy storage systems, the Directive also introduces a number of technical and operational requirements. For example, it requires that storage system operators provide transparent information on the technical capabilities and characteristics of their systems, as well as on their availability and response times. It also requires that energy storage systems comply with relevant safety and environmental standards, and that they are subject to adequate monitoring and control.

The Directive also promotes the use of storage systems in the provision of ancillary services, such as frequency regulation and reserve capacity, which are critical for maintaining the stability and reliability of the electricity grid. To facilitate the participation of storage systems in these services, the Directive requires that market rules be designed to ensure that they are able to compete on a level playing field with other resources.

Finally, the Directive promotes the use of energy storage systems to support the integration of renewable energy sources into the grid. This includes the use of storage systems to smooth out fluctuations in renewable energy production, as well as to provide backup power during periods of low renewable energy output. The Directive requires that energy storage systems be integrated into the planning and operation of the grid, and that they be subject to the same rules as other resources in terms of grid connection and system operation.

In summary, Directive (EU) 2019/944 on common rules for the internal market for electricity promotes the deployment of energy storage systems as a key element of the transition to a more sustainable and efficient energy system in the European Union. By removing regulatory barriers and promoting technical and operational requirements, the Directive aims to ensure that energy storage systems are able to compete on a level playing field with other resources in the electricity market. This will facilitate the integration of renewable energy sources into the grid, while ensuring the stability and reliability of electricity supply for consumers.

2.1.1.4 Energy performance of buildings directive

The Energy Performance of Buildings Directive (EPBD) is a European Union (EU) directive aimed at improving the energy efficiency of buildings across the EU. The directive sets minimum energy performance requirements for new and existing buildings, with a focus on reducing the energy consumption of heating, cooling, ventilation, and lighting systems. It also requires member states to establish energy performance certification schemes for buildings, and to regularly inspect and monitor the energy performance of buildings. The EPBD aims to help reduce greenhouse gas emissions, combat climate change, and improve the energy security of the EU.

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2.1.1.5 Integration Strategy

The System Integration Strategy is a policy framework of the European Union aimed at facilitating the integration of renewable energy sources, energy storage, and other new technologies into the EU's energy systems. The strategy seeks to promote a more flexible, resilient, and interconnected energy system, enabling the efficient use of renewable energy sources and the integration of emerging technologies such as energy storage and demand-side response. The strategy includes measures to support the deployment of renewable energy infrastructure, promote research and innovation in the energy sector, and promote the development of new business models for energy markets. The System Integration Strategy is an important component of the EU's broader efforts to transition to a clean, secure, and affordable energy system.

For EESS the system approach is especially important: EESS are part of system solutions, technically e.g. in a virtual power plant and/or in a market role e.g. as a service provider for frequency stabilization.

2.1.1.6 Sustainable and smart mobility strategy

The Sustainable and Smart Mobility Strategy is a policy framework of the European Union aimed at promoting sustainable and smart mobility solutions in the EU. The strategy seeks to promote the deployment of low-emission transport solutions, such as electric vehicles and alternative fuels, and to encourage the use of smart and shared mobility solutions. The strategy includes measures to support the development of clean and efficient transport infrastructure, promote research and innovation in the transport sector, and improve the connectivity and interoperability of transport services across the EU. The Sustainable and Smart Mobility Strategy is an important component of the EU's broader efforts to transition to a low-carbon and sustainable economy.
EESS, as part of a system, can be relevant for this approach, integrating EV into hybrid storage systems.

2.1.1.7 Implementing Acts on interoperability requirements and transparent procedures for access to data RED I and III

The Implementing Acts on interoperability requirements and transparent procedures for access to data RED I and III are regulatory frameworks established by the European Union to facilitate the implementation of the Renewable Energy Directive I and III. The acts set out technical requirements and procedures to ensure the interoperability of renewable energy systems across the EU, enabling the efficient exchange of energy data between member states. The acts also include provisions for the transparent and non-discriminatory access to energy data, ensuring that all market participants have equal access to energy information. The Implementing Acts on interoperability requirements and transparent procedures for access to data RED I and III are important components of the EU's broader efforts to promote the deployment of renewable energy and to transition to a clean, secure, and affordable energy system.
Especially the EESS data exchange with other market participants can be relevant for these concepts.

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2.1.1.8 ENTSO-E Network Codes

The ENTSO-E Network Codes are a set of rules and regulations developed by the European Network of Transmission System Operators for Electricity (ENTSO-E) to promote harmonization of the European electricity market. The codes cover various aspects of the electricity market, such as grid connection, capacity allocation, and balancing of the power system. The ENTSO-E Network Codes are designed to ensure the efficient and secure functioning of the electricity market, while also promoting competition and facilitating the integration of renewable energy sources. They are an important component of the European Union's efforts to create a single, integrated energy market, including EESS.

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2.1.2 Data protection and security

The primary legislation governing data protection and security in the EU is the General Data Protection Regulation (GDPR), which came into effect in May 2018. The GDPR establishes a set of rules and principles for the processing and protection of personal data within the EU.

Figure 8: Data protection and security

The EU's strategy on data protection and data security is focused on several key aspects:

GDPR Compliance: The EU emphasizes the importance of organizations, both within the EU and those processing personal data of EU residents, complying with the provisions of the GDPR. This includes obtaining informed consent for data processing, implementing appropriate security measures, and ensuring transparency and accountability in data handling practices.

Data Subject Rights: The EU promotes the protection of individuals' rights concerning their personal data. The GDPR grants data subjects various rights, such as the right to access their data, the right to rectification, the right to erasure (also known as the "right to be forgotten"), and the right to data portability. The EU encourages individuals to exercise these rights and ensures that organizations respect and facilitate them.

Cross-Border Data Transfers: The EU has established strict rules for transferring personal data outside the EU to ensure an adequate level of protection. The GDPR allows data transfers to countries that have been deemed to provide an adequate level of protection, or through the use of specific safeguards such as Standard Contractual Clauses (SCCs) or Binding Corporate Rules (BCRs). The EU is actively involved in negotiations and discussions with other countries to facilitate secure cross-border data flows.

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Data Security and Breach Notification: The EU places a strong emphasis on data security and requires organizations to implement appropriate technical and organizational measures to protect personal data. The GDPR also mandates the notification of data breaches to the relevant supervisory authority and, in certain cases, to the affected individuals. This ensures that appropriate actions can be taken to mitigate the impact of data breaches and safeguard individuals' rights.

Cooperation and Enforcement: The EU promotes cooperation among its member states and supervisory authorities to ensure consistent application and enforcement of data protection rules. The GDPR establishes a "one-stop shop" mechanism, where organizations dealing with cross-border data processing have a lead supervisory authority responsible for their regulation.

2.1.2.1 Digital Markets Act

The Digital Markets Act (DMA) is a legislative proposal of the European Union aimed at regulating digital platforms that act as gatekeepers to the online market. The DMA seeks to establish a level playing field for smaller competitors by imposing new obligations on large tech companies such as Amazon, Google, and Facebook. These obligations include the sharing of data, the prohibition of self-preferencing, and the requirement for interoperability. The DMA also provides for substantial fines for non-compliance. The proposal is part of the EU's efforts to ensure fair competition in the digital sector and to protect consumers from potential abuses of market power by large tech companies.

2.1.2.2 Data Governance Act

The Data Governance Act (DGA) is a legislative proposal of the European Union aimed at establishing a framework for the cross-border sharing of non-personal data. The DGA seeks to create a system of rules and standards for the safe and secure sharing of data, with the goal of promoting innovation and increasing the availability of data for businesses and public authorities. The act also establishes a European Data Innovation Board to provide guidance and support for data-driven innovation. The proposal is part of the EU's broader strategy to create a single market for data and to promote the digital transformation of the European economy.

2.1.2.3 E-Privacy Regulation

The e-Privacy Regulation is a legislative proposal of the European Union aimed at updating and replacing the existing e-Privacy Directive. The regulation seeks to establish rules and standards for the protection of personal data in electronic communications, including the use of cookies and other tracking technologies. The e-Privacy Regulation also provides for substantial fines for non-compliance, in line with the EU's General Data Protection Regulation (GDPR). The proposal is part of the EU's broader efforts to strengthen data protection and privacy rights for individuals in the digital age.

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2.1.2.4 European Data Strategy

The European Data Strategy is a comprehensive framework developed by the European Commission to promote the responsible and innovative use of data within the European Union (EU). It was introduced as part of the European Commission's broader digital strategy aimed at harnessing the potential of digital technologies for economic growth and societal benefits.

2.1.2.5 European Digital Identity (EUid Regulation, eIDAS Revision)

The EUid Regulation is a legislative proposal of the European Union aimed at establishing a single, interoperable system for the identification and authentication of citizens across the EU. The regulation seeks to simplify and streamline the process of accessing public services, such as healthcare and social security, by allowing citizens to use their electronic identification (eID) across borders. The EUid Regulation also includes provisions for the protection of personal data, including the requirement for strong security measures and the right to access, rectify, and erase personal data. The proposal is part of the EU's broader efforts to create a Digital Single Market and to improve cross-border digital services for citizens.

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2.1.3 Cybersecurity

The EU cybersecurity strategy recognizes the growing threat landscape due to the digital transformation and aims to provide adapted and innovative responses to address cybersecurity challenges.

The EU aims to lead efforts in secure digitalization, setting norms and standards for cybersecurity while driving the development and application of new technologies. The strategy emphasizes the shared responsibility of governments, businesses, and citizens in ensuring a cyber-secure digital transformation.

The strategy focuses on achieving technological sovereignty and resilience in connected services and products. It emphasizes the need for collaboration among the different cybercommunities, including those involved in the internal market, law enforcement, diplomacy, and defense, to collectively respond to cyber threats.

Figure 9: Cybersecurity

2.1.3.1 Role of ENISA (EU Agency for Cybersecurity)

The European Union Agency for Cybersecurity (ENISA) is a specialized agency of the EU tasked with promoting cybersecurity across the EU. ENISA's role is to support EU member states in the development and implementation of their cybersecurity strategies and to promote cooperation between member states on cybersecurity issues. ENISA also provides advice and guidance on cybersecurity to businesses, public authorities, and other organizations across the EU. Additionally, ENISA is responsible for coordinating the EU's response to cybersecurity incidents and for promoting the development of cybersecurity standards and best practices.

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2.1.3.2 European Cybersecurity Strategy

The European Cybersecurity Strategy is a policy framework of the European Union aimed at enhancing cybersecurity across the EU. The strategy seeks to improve the EU's resilience to cyber threats, promote cooperation and information sharing between member states, and strengthen the EU's cybersecurity industry. The strategy includes measures to enhance the cybersecurity of critical infrastructure, establish a certification framework for cybersecurity products and services, and promote research and development in the field of cybersecurity. The European Cybersecurity Strategy is an important component of the EU's broader efforts to promote a safe and secure digital environment for citizens and businesses across the EU.

2.1.3.3 Network Code on Cybersecurity

The Network Code on Cybersecurity is a set of technical rules and standards developed by the European Network of Transmission System Operators for Electricity (ENTSO-E) to ensure the cybersecurity of Europe's electricity networks. The code sets out requirements for transmission system operators to implement robust cybersecurity measures, including risk assessments, incident reporting, and information sharing. The code also requires operators to establish secure communication channels for critical infrastructure and to regularly test their cybersecurity systems. The Network Code on Cybersecurity is an important component of the EU's broader efforts to improve the cybersecurity of critical infrastructure and to ensure the resilience of Europe's energy networks.

2.1.3.4 EU Security Union Strategy

The EU Security Union Strategy is a policy framework of the European Union aimed at strengthening the EU's collective response to security threats. The strategy seeks to promote cooperation between member states on a range of security issues, including terrorism, cybercrime, and organized crime. It also includes measures to enhance border security, improve the exchange of information and intelligence, and support the development of new security technologies. The EU Security Union Strategy is an important component of the EU's broader efforts to ensure the safety and security of its citizens and to promote stability and security across the region.

2.1.3.5 NIS 2 Directive

The NIS 2 Directive is a legislative proposal of the European Union aimed at updating and strengthening the existing Network and Information Security (NIS) Directive. The NIS 2 Directive seeks to establish a more comprehensive and coordinated approach to cybersecurity across the EU, with a particular focus on critical infrastructure, such as energy, transport, and health sectors. The directive sets out requirements for member states to establish cybersecurity strategies, to identify and assess cyber risks, and to establish reporting mechanisms for cybersecurity incidents. The NIS 2 Directive is part of the EU's broader efforts to improve cybersecurity and resilience in the face of growing cyber threats.

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3 CONCLUSION

The purpose of this report is to provide a starting point for the InterSTORE project. This report will provide the project partners with relevant information about activities in standardization and regulation. Due to the rapid technical developments (e.g. cybersecurity, A.I.) the activities of the standardization expert groups are especially interesting.

Also due to these fast developments this report is supposed only to be a kick-off. As InterSTORE progresses, the recommended standards and regulations, as well as the continuously provided information (e.g. by newsletter etc.) will be adapted.

Further activities will include technology exchange between the project partners. This technology transfer will provide continuous updates and, together with the project partners, fine-tune the requirements and network with others.

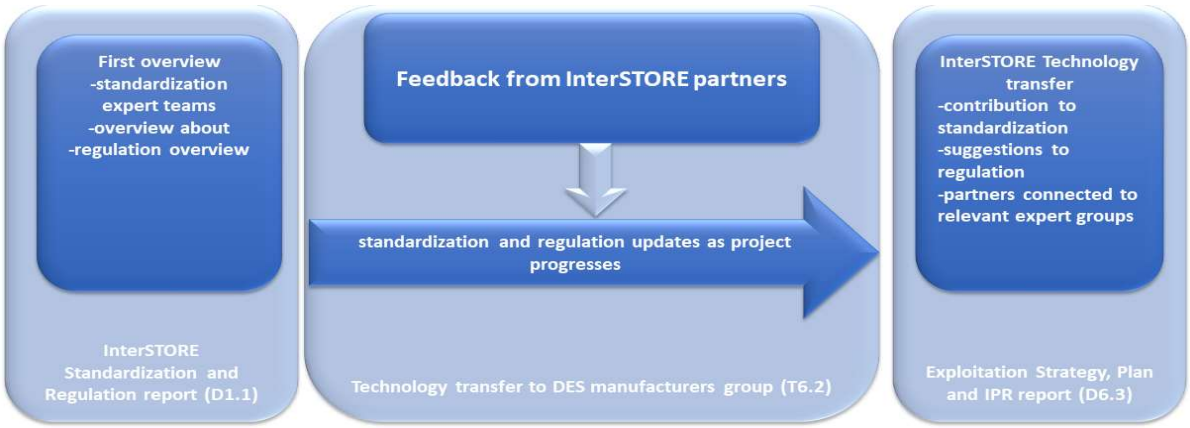

Figure 10: Interaction of T1.1 (D1.1) with T6.2 (D6.3)

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4 REFERENCES

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1.1.2	CENELEC	www.cenelec.eu/aboutcenelec/index.html
1.1.3	IEEE	www.ieee.org/about/index.html
1.2.1.1	Electrical Energy Storage (EES) systems (IEC/TC 120)	www.iec.ch/tc120
1.2.1.2	Secondary cells and batteries (IEC/TC 21)	www.iec.ch/tc21
1.2.1.3	Power systems management and associated information exchange (IEC/TC 57)	www.iec.ch/tc57
1.2.1.4	System aspects of electrical energy supply (IEC/TC 8)	www.iec.ch/tc8
1.2.1.5	Grid Integration of Renewable Energy Generation (IEC/TC 8 SC 8A)	www.iec.ch/tc8a
1.2.1.6	Decentralized electrical energy systems (IEC/TC 8 SC 8B)	www.iec.ch/tc8b
1.2.1.7	Network Management in Interconnected Electric Power Systems (IEC/TC 8 SC 8C)	www.iec.ch/tc8c
1.2.1.8	Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks (IEC/TC 69)	www.iec.ch/tc69
1.2.2.1	System Aspects of Electrical Energy Supply (CLC/TC 8x)	www.cenelec.eu
1.2.3.1	Smart Energy Profile Application Protocol (IEEE 2030.5)	www.ieee.org/2030.5
1.2.3.1	Figure 6	https://www.qualitylogic.com/wp-content/uploads/2021/05/GEI-Mini-Forum-2030.5.pdf
2.1.1.1	Digitalisation of Energy Action Plan	European Commission (2020), Digitalisation of Energy Action Plan https://ec.europa.eu/energy/sites/ener/files/documents/communication_digitalisation_of_energy_system_2020_en.pdf

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		European Commission (2016), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Accelerating Clean Energy Innovation European Commission (2020), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Renovation Wave for Europe – Greening our Buildings, Creating Jobs, Improving Lives
2.1.1.2	Energy Efficiency Directive	European Commission (2012), Energy Efficiency Directive https://ec.europa.eu/energy/sites/ener/files/documents/2012_eed_en.pdf European Commission (2020), Energy Storage in the EU https://ec.europa.eu/info/publications/energy-storage-eu_en Eurostat (2021), Energy efficiency and energy consumption in Europe European Commission (2012), Energy Efficiency Directive https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32012L0027 European Commission (2021), Energy Storage https://ec.europa.eu/energy/topics/renewable-energy/energy-storage_en European Energy Storage Association (2021), Energy Storage for a Sustainable Future https://www.eurobat.org/wp-content/uploads/2021/04/EESA_Energy-Storage-for-a-Sustainable-Future_2019-2.pdf
2.1.1.3	Directive (EU) 2019/944 on common rules for the internal market for electricity	European Commission (2019), Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU European Commission (2021), Energy storage in the EU: Overview of current and future developments.

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		European Technology and Innovation Platform for Smart Networks for Energy Transition (2019), Energy Storage in the Clean Energy Package: Implementation Guidelines International Renewable Energy Agency (2017), Electricity Storage and Renewables: Costs and Markets to 2030
2.1.1.4	Energy performance of buildings directive	European Commission, "Energy Performance of Buildings Directive" 2021
2.1.1.5	System Integration Strategy	European Commission, "Energy System Integration Strategy" 2020
2.1.1.6	Sustainable and smart mobility strategy	European Commission, "Sustainable and Smart Mobility Strategy" 2020
2.1.1.7	Implementing Acts on interoperability requirements and transparent procedures for access to data RED I and III	European Commission, "Renewable Energy Directive" 2018
2.1.1.8	ENTSO-E Network Codes	ENTSO-E, "Network Codes" 2021
2.1.2.1	Digital Markets Act	European Commission: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/digital-markets-act-ensuring-fair-and-open-digital-markets_de
2.1.2.2	Data Governance Act	European Commission: https://digital-strategy.ec.europa.eu/en/policies/data-governance-act
2.1.2.3	E-Privacy Regulation	European Commission: https://digital-strategy.ec.europa.eu/en/policies/eprivacy-regulation
2.1.2.4	European Data Strategy	European Commission: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en
2.1.2.5	European Digital Identitiy (EUid Regulation, eIDAS Revision)	European Parliament: https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-eid
2.1.3.1	Role of ENISA (EU Agency for Cybersecurity)	European Commission, "European Union Agency for Cybersecurity (ENISA)" 2021
2.1.3.2	European Cybersecurity Strategy	European Commission, "European Cybersecurity Strategy" 2020
2.1.3.3	Network Code on Cybersecurity	ENTSO-E, "Network Code on Cybersecurity" 2021
2.1.3.4	EU Security Union Strategy	European Commission, "The EU Security Union Strategy for 2020-2025", 2020
2.1.3.5	NIS 2 Directive	European Commission, "Proposal for a Directive on measures for a high common level of cybersecurity across the Union" 2020

Table 1: List of references

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5 APPENDIXES

5.1 List of relevant projects

Appendix 1: List of relevant projects – Electrical Energy Storage (EES) systems (IEC/TC 120)

Project Reference	Title	Working Group	Fcst. Publ. Date	Relation to InterSTORE
IEC 62933-1 ED2	Electrical energy storage (EES) systems - Part 1: Vocabulary	WG 1	2024-05	Terms for ESS
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	WG 2	2025-03	Performance assessment
IEC 62933-3-1 ED1	Electrical energy storage (EES) systems - Part 3-1: Planning and performance assessment of electrical energy storage systems - General specification	WG 3	2025-11	Set-up of EESS
IEC TR 62933-3-200 ED1	Electrical Energy Storage (EES) Systems - Part 3-200: Design principles of electrochemical based EES systems		2024-03	Planning support
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	WG 4	2024-03	Planning support
IEC 62933-5-1 ED1	Electrical energy storage (EES) systems - Part 5-1: Safety considerations for grid-integrated EES systems - General specification	MT 8	2024-07	Safety guidelines
IEC 62933-5-2 ED2	Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid-integrated EES	MT 7	2024-07	Safety guidelines

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	systems - Electrochemical-based systems			
IEC 62933-5-4 ED1	Electrical energy storage (ESS) systems Part 5-4 – Safety test methods and procedures for grid integrated EES systems – Lithium-ion battery-based systems	WG 5	2024-05	Safety guidelines
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	WG 4	2024-07	Environmental considerations
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	WG 4	2024-07	Environmental considerations
IEC 62933-4-4 ED1	Electrical energy storage (EES) systems- Part 4-4: Standard on environmental issues battery-based energy storage systems (BESS) with reused batteries – requirements	WG 4	2024-03	Reused EESS
IEC 62933-5-3 ED1	Electrical energy storage (EES) systems Part 5-3: Safety requirements when performing unplanned modification of electrochemical based EES systems	WG 5	2024-03	Modifications of EESS

Table 2: Appendix 1 (IEC/TC 120)

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Appendix 2: List of relevant projects – Secondary cells and batteries (IEC/TC 21)

Project Reference	Title	Working Group	Fcst. Publ. Date	Relation to InterSTORE
IEC 61427-2/AMD1 ED1	Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 2: On-grid applications	JWG 82	2024-06	ESS grid related
IEC 63330 ED1	Requirements for reuse of secondary batteries	PT 63330	2024-09	Reuse of EESS

Table 3: Appendix 2 (IEC/TC 21)

Appendix 3: List of relevant projects – Power systems mgmt. and associated information exchange (IEC/TC 57)

Project Reference	Title	Working Group	Fcst. Publ. Date	Relation to InterSTORE
PWI TR 57-1002	IEC TR 61850-90-28: Specification for subscriber IED to validate GOOSE and SV messages			communication protocol for intelligent el. devices (IED), including EESS
IEC TR 63353 ED1	IIoT applications in power distribution systems management: Architecture and functional requirements	JWG 24	2024-02	IIoT related to EESS
IEC TR 61850-80-5 ED1	Communication networks and systems for power utility automation - Part 80-5: Guideline for mapping information between IEC 61850 and IEC 61158-6 (Modbus)	WG 10	2024-02	EESS Modbus applications
IEC 61968-9 ED3	Application integration at electric utilities - System interfaces for distribution management - Part 9: Interfaces for meter reading and control	WG 14	2024-04	EESS and Metering systems
PWI 62325-452-1 ED1	Day Ahead Market	WG 16		relevant to EESS in markets
PWI 62325-452-4 ED1	Weather data to support market operations	WG 16		relevant to EESS in markets
PWI 62325-452-5 ED1	Communications with Demand Response Systems	WG 16		data relevant to EESS in DR
IEC TR 61850-90-7 ED2	Communication networks and systems for power utility automation - Part 90-7: Object models for power converters in	WG 17	2023-12	communication protocol for DER including EESS

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	distributed energy resources (DER) systems			
IEC TR 61850-90-23 ED1	Communication networks and systems for power utility automation - Part 90-23: Use of IEC 61850 for microgrid systems	WG 17	2024-02	applicable for EESS in microgrids
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	WG 17	2023-09	EESS as part of hybrid system
PNW TS 57-2582 ED1	Communication networks and systems for power utility automation - IEC 61850-7-410 WG18 Use Cases for Dynamic Data model	WG 18	2024-12	dynamic data models for EESS
IEC TR 62746-2 ED2	Systems interface between customer energy management system and the power management system - Part 2: Use cases and requirements	WG 21	2025-09	Use Cases for CEM and EESS
IEC 62746-4 ED1	Systems interface between customer energy management system and the power management system - Part 4: Demand Side Resource Interface	WG 21	2025-06	System interface for DER including EESS

Table 4: Appendix 3 (IEC/TC 57)

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Appendix 4: List of relevant projects – Data and communication security (IEC/TC 57 WG 15)

Project Reference	Title	Working Group	Fcst. Publ. Date	Relation to InterSTORE
PNW TS 57-2575 ED1	Power systems management and associated information exchange - Data and Communication Security - Part 100-41: Conformance Testing for 62351-4 A-Profile.	WG 15	2026-06	Cyber security
PNW 57-2576 ED1	Power systems management and associated information exchange - Data and communications security - Part 16: Profiles for Ethernet security, MACsec (IEC 62351-16)	WG 15	2026-06	Cyber security
PNW TS 57-2586 ED1	Power systems management and associated information exchange - Data and communications security - Part 15: Deep Packet Inspection (DPI) of encrypted communications	WG 15	2026-10	Cyber security
IEC 62351-3 ED2	Power systems management and associated information exchange - Data and communications security - Part 3: Communication network and system security - Profiles including TCP/IP	WG 15	2023-06	Cyber security
IEC 62351-7 ED2	Power systems management and associated information exchange - Data and communications security - Part 7: Network and System Management (NSM) data object models	WG 15	2024-06	Cyber security
IEC 62351-9 ED2	Power systems management and associated information exchange - Data and communications security - Part 9: Cyber security key management for power system equipment	WG 15	2023-06	Cyber security
IEC 62351-14 ED1	Power systems management and associated information exchange - Data and communications security - Part 14: Cyber security event logging	WG 15	2024-05	Cyber security
IEC TS 62351-100-4 ED1	Power systems management and associated information exchange - Data and communication security - Part 100-4: Cybersecurity conformance testing for IEC 62351-4	WG 15	2023-09	Cyber security

Table 5: Appendix 4 (IEC/TC 57 WG 15)

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Appendix 5: List of relevant projects – System aspects of electr. energy supply (IEC/TC 8)

Project Reference	Title	Working Group	Fcst. Publ. Date	Relation to InterSTORE
PWI 8-6	IEC TS 62786-xx Distributed Energy Resources connection with the Grid - Regional profiles			connection of EESS to grid
PWI TR 8-9 ED1	IEC TR 63222-101 Power quality management – Part 101: Power quality data application			power quality for EESS
IEC 60050-601 ED2	International Electrotechnical Vocabulary (IEV) - Part 601: Generation, transmission and distribution of electricity - General	JWG 1	2024-06	terms and definitions for EESS
IEC 60050-617 ED2	International Electrotechnical Vocabulary (IEV) - Part 617: Organization/Market of electricity	JWG 1	2024-06	EESS in a market role
IEC 60050-691/AMD2 ED1	Amendment 2 - International Electrotechnical Vocabulary (IEV) - Part 691: Tariffs for electricity	JWG 1	2024-06	EESS in a market role
IEC TS 62786-1 ED1	Distributed energy resources connection with the grid - Part 1: General requirements	JWG 10	2024-01	el. connection rules, including EESS
IEC TS 62786-3 ED1	Distributed energy resources connection with the grid – Part 3 Additional requirements for Stationary Battery Energy Storage System	JWG 10	2024-05	el. connection rules, focus on EESS
IEC TS 62786-41 ED1	Distributed energy resources connection with the grid – Part 41 Requirements for frequency measurement used to control DER and loads	JWG 12	2023-10	DER and loads including EESS
IEC TS 62786-42 ED1	Distributed energy resources connection with the grid – Part 42 Requirements for voltage measurement used to control DER and loads	JWG 12	2024-05	DER and loads including EESS

Table 6: Appendix 5 (IEC/TC 8)

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Appendix 6: List of relevant projects – Grid Integration of Renewable Energy Generation (IEC/TC 8 SC 8A)

Project Reference	Title	Working Group	Fcst. Publ. Date	Relation to InterSTORE
PWI TR 8A-20 ED1	IEC TR 6XXXXX ED1: Integrating distributed PV into LVDC systems and use cases			possibly interesting for ESS in a buffer role
IEC TR 63401-3 ED1	Fast Frequency Response and Frequency Ride-Through from Inverter-Based Resources during Severe Frequency Disturbances	JWG 5	2024-03	emergency response, possibly interesting for ESS in a backup role

Table 7: Appendix 6 (IEC/TC 8 SC 8A)

Appendix 7: List of relevant projects – Syst. aspects of electrical energy supply (CLC/TC 8x)

Project Reference	Title	Working Group	Fcst. Publ. Date	Relation to InterSTORE
EN 50549-1:2019	Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network - Generating plants up to and including Type B			Connection requ. LV for EESS
EN 50549-2:2019	EN 50549-2 Requirements for generating plants to be connected in parallel with distribution networks - Part 2: Connection to a MV distribution network - Generating plants up to and including Type B			Connection requ. MV for EESS
EN 50549-10:2022	EN 505491-10 Requirements for generating plants to be connected in parallel with distribution networks - Part 10: Tests for conformity assessment of generating units			Testing requ. for EESS

Table 8: Appendix 7 (CLC/TC 8x)

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7 LIST OF FIGURES

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