Standarder og datakommunikation

Teknologisk institut i Århus
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- S-557 (TC57 Danish National Committe)
  - IEC TC57 WG17 (Distributed Energy Resources)
  - Project leader for TR61850-90-8 (TC57 WG17)
  - IEC TC57 WG15 (Security)
- S-454 (EV Danish National Committe)
  - IEC TC69 WG4 (EV Power supplies and chargers)
  - IEC/ISO JWG V2G Communication Interface (TF leader)
- CEN/CENELEC
  - Project leader for CEN/CENELEC EV Focus Group for ’EV Communication’
  - Raporteur between M468 and M490 (SG-CG steering group member)
  - Chairman for the new ’EM-AhG-SmartCharge’ under CEN/CENELEC

A standard is a **technical document designed to be used as a rule, guideline or definition**. It is a consensus-built, repeatable way of doing something.

Standards are created by bringing together all interested parties such as manufacturers, consumers and regulators of a particular material, product, process or service. All parties benefit from standardization through increased product safety and quality as well as lower transaction costs and prices.

cen
European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Avanceret energilagring 2015

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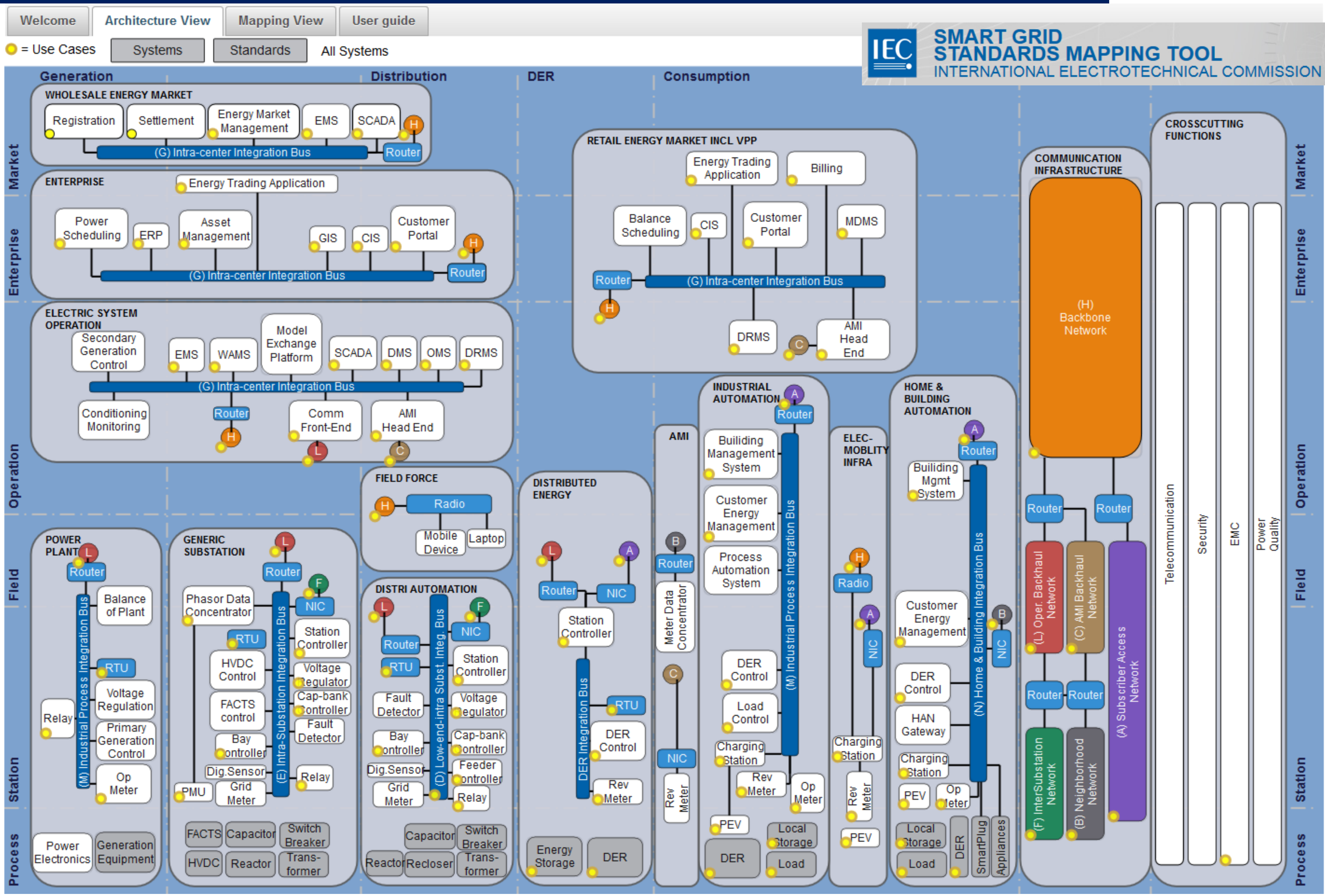

http://smartgridstandardsmap.com/

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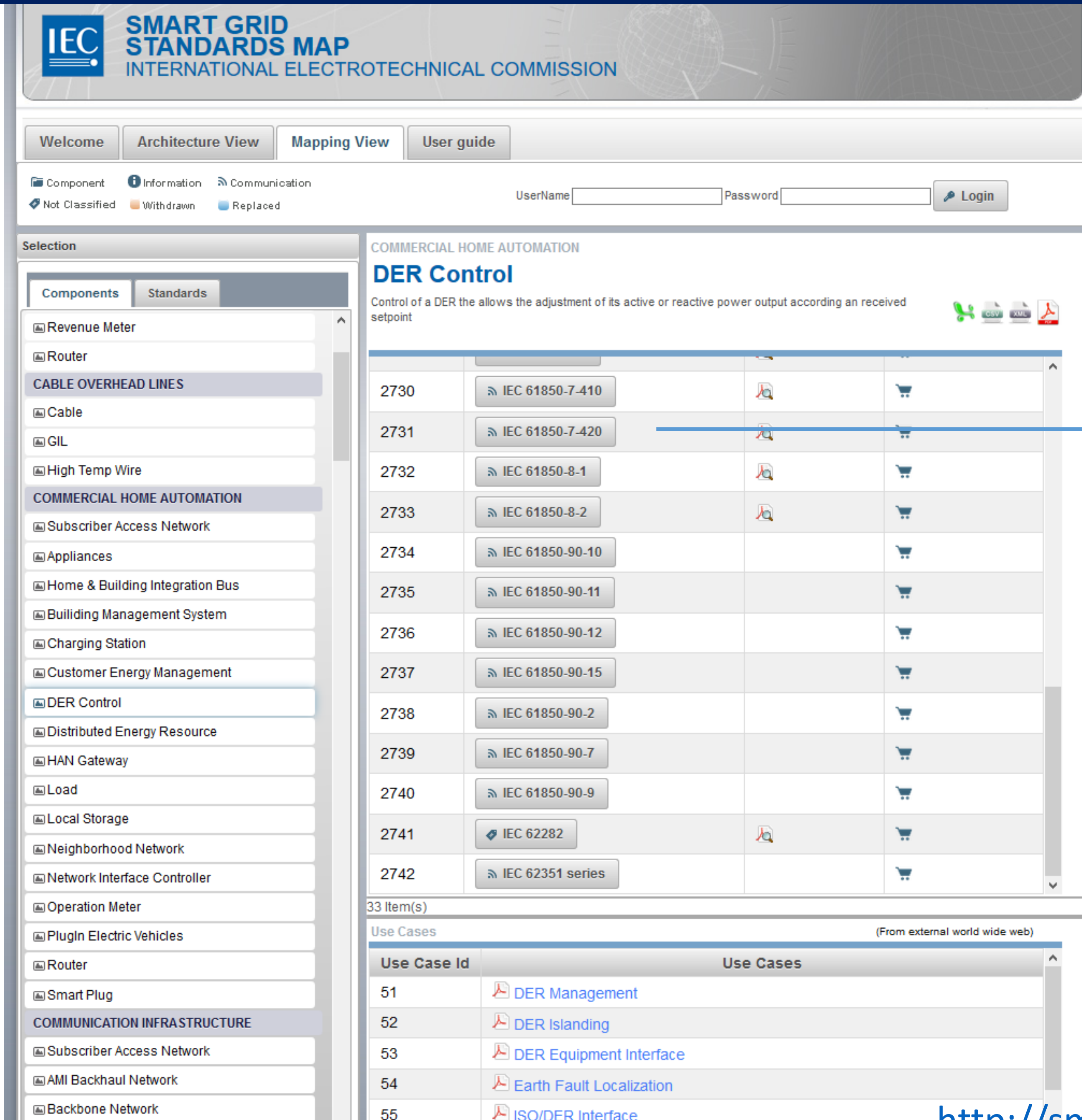

IEC 61850-7-420

IEC 61850-7-420:2009(E) defines IEC 61850 information models to be used in the exchange of information with distributed energy resources (DER); which comprise dispersed generation devices and dispersed storage devices; including reciprocating engines; fuel cells; microturbines; photovoltaics; combined heat and power; and energy storage. Utilizes existing IEC 61850-7-4 logical nodes where possible; but also defines DER-specific logical nodes where needed.

http://smartgridstandardsmap.com/

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Hvilke **muligheder** er der med internationale standarder?

- Implementeringer iht. ITU/ISO/IEC standarder① er som udgangspunkt 'Free of Charge'
- International harmonisering gennem nationalkomiteer (NC)
- Muligheder for interoperabilitet på tværs af fabrikater (second source)

① Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC

Hvilke **udfordringer** er der med internationale standarder?

- Bedste tekniske kompromis
- Harmonisering imellem forskellige standardiseringsorganisationer
- Konkurrence ift. 'industrispecifikationer'

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IEC TC57

Power systems management and associated information exchange

TC 57 Subcommittee(s) and/or Working Group(s)

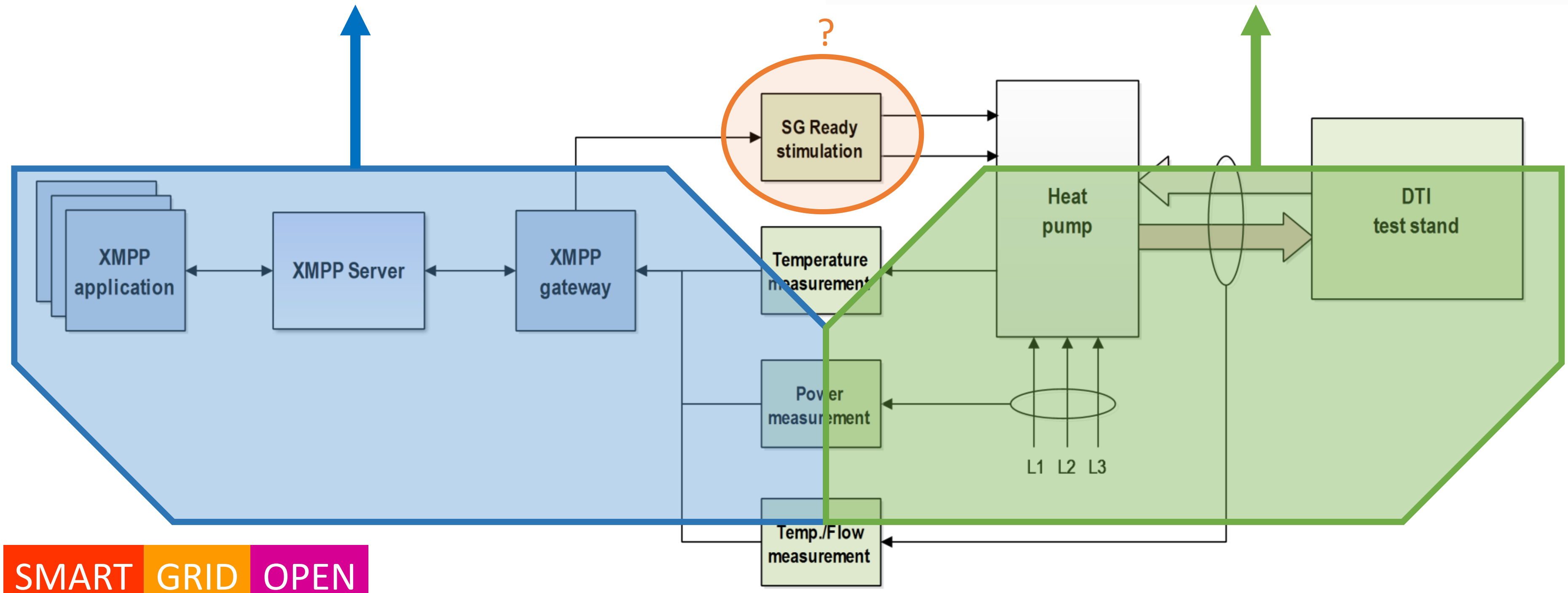
Label	Title
Working Groups	
WG 3	Telecontrol protocols
WG 9	Distribution automation using distribution line carrier systems
WG 10	Power system IED communication and associated data models
WG 13	Energy management system application program interface (EMS - API)
WG 14	System interfaces for distribution management (SIDM)
WG 15	Data and communication security
WG 16	Deregulated energy market communications
WG 17	Communications Systems for Distributed Energy Resources (DER)
WG 18	Hydroelectric power plants - Communication for monitoring and control
WG 19	Interoperability within TC 57 in the long term
WG 20	Planning of (single-sideband) power line carrier systems (IEC 60495) Planning of (single-sideband) power line carrier systems (IEC 60663)
WG 21	Interfaces and protocol profiles relevant to systems connected to the electrical grid

CEN/TC 113

Heat pumps and air conditioning units

CEN/TC 113 Subcommittees and Working Groups

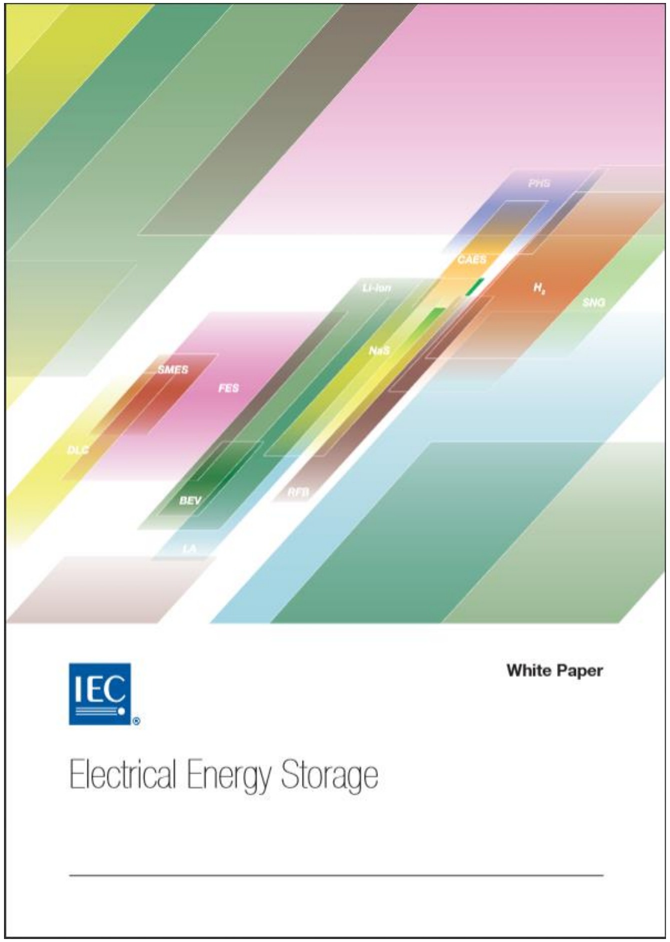
Working group	Title
CEN/TC 113/WG 1	Heat pumps for heating sanitary water
CEN/TC 113/WG 10	Heat pumps for domestic hot water production and revision of EN 16147
CEN/TC 113/WG 11	Direct expansion-to-water units
CEN/TC 113/WG 14	Revision of EN 1397
CEN/TC 113/WG 2	Measurement of sound power level
CEN/TC 113/WG 3	Requirements
CEN/TC 113/WG 4	Air conditioning units
CEN/TC 113/WG 6	Refrigerant compressors - Presentation of performance data
CEN/TC 113/WG 7	Heat Pumps, air conditioners and chilling liquid packages - testing and rating at part load conditions
CEN/TC 113/WG 8	Rating and testing for performance
CEN/TC 113/WG 9	Sound rating of heat pumps, air conditioners and liquid chilling packages



SMART GRID OPEN

http://www.iec.ch/whitepaper/pdf/iecWP-energystorage-LR-en.pdf

Eksempel på fokusarbejde fra standardiseringorganisationerne side



Standardisering af Elektrisk Energilagring
Electrical Energy Storage (EES)

- **The roles of electrical energy storage technologies in electricity use**
- **Types and features of energy storage systems**
- **Markets for EES**
- **Forecast of EES market potential by 2030**
- **Conclusions and recommendations**

Acknowledgments

This paper has been prepared by the Electrical Energy Storage project team, a part of the Special Working Group on technology and market watch, in the IEC Market Strategy Board, with a major contribution from the Fraunhofer Institut für Solare Energiesysteme.

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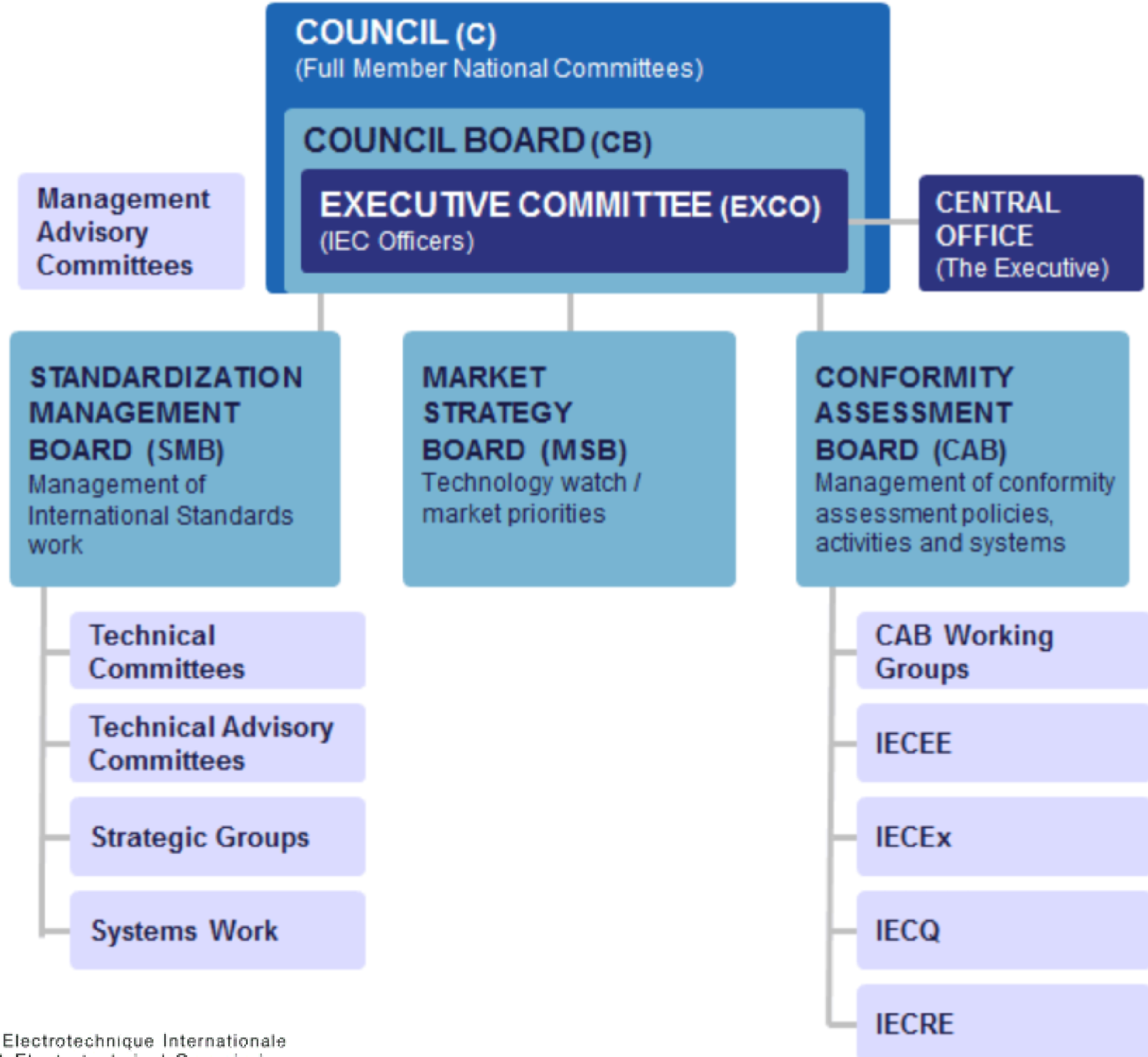

IEC
Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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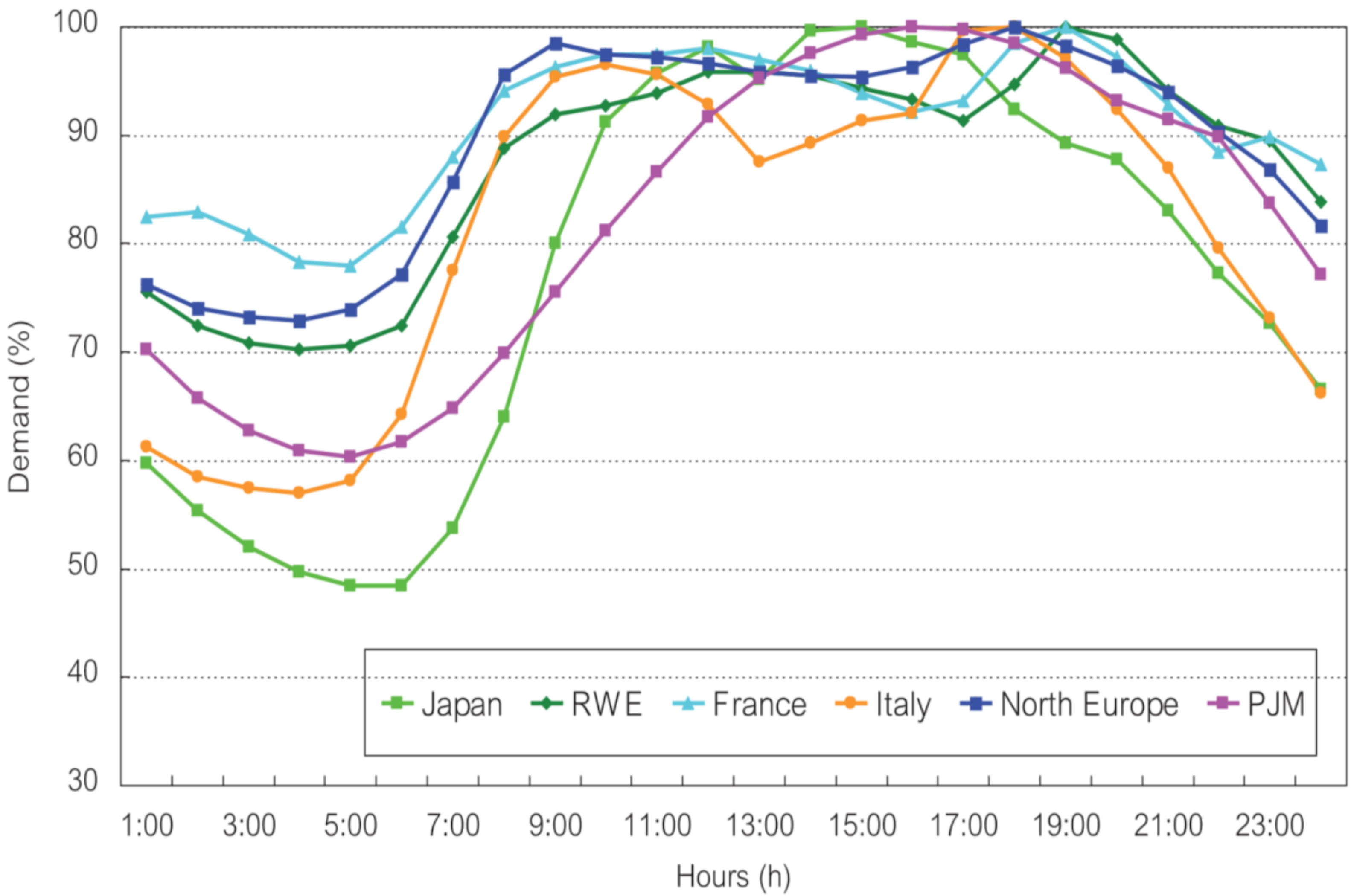
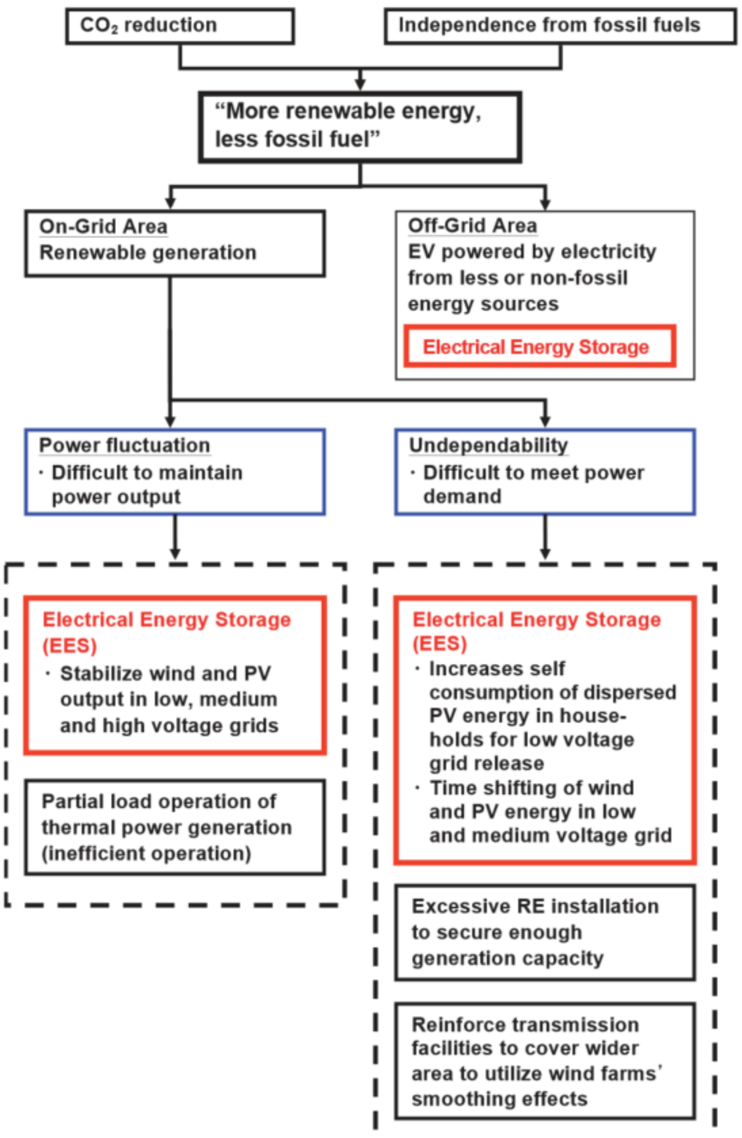
Indledende information omkring elsystem og VE



Comparison of daily load curves (IEEJ – The Institute of Energy Economics, Japan, Problems in renewable energy installation and possible solutions (TEPCO)



- Store fordele ved VE (miljø og forsyningssikkerhed)
- Store fluktueringer gør kontrollen af netfrekvensen (50 Hz) udfordrende
- Kompensering fra termiske værker betyder, at de skal køre dellast hvilket kan give ineffektiv drift
- Overproduktion af VE eller stor spredning af VE kilderne, forskellige VE teknologier mm., kan være nødvendigt for at sikre stabilitet
- Alternativt Electrical Energy Strorage

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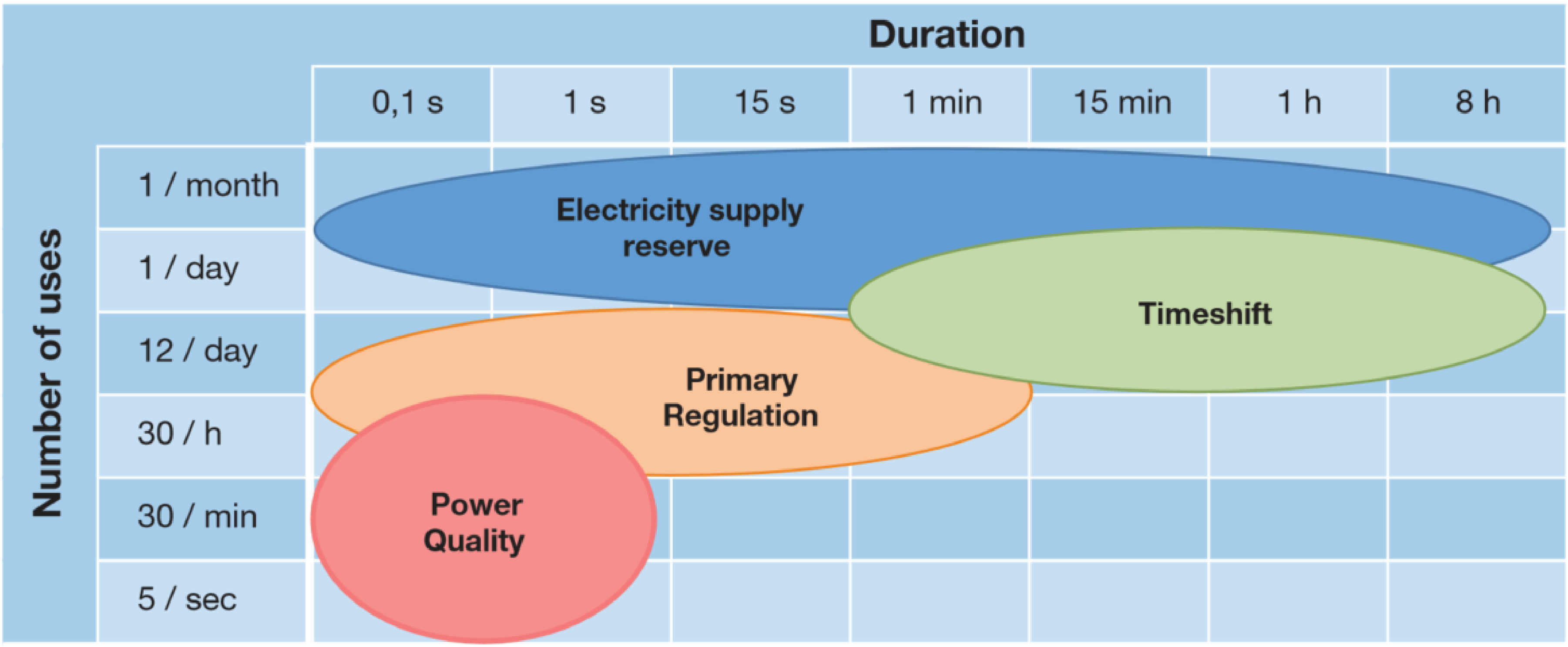
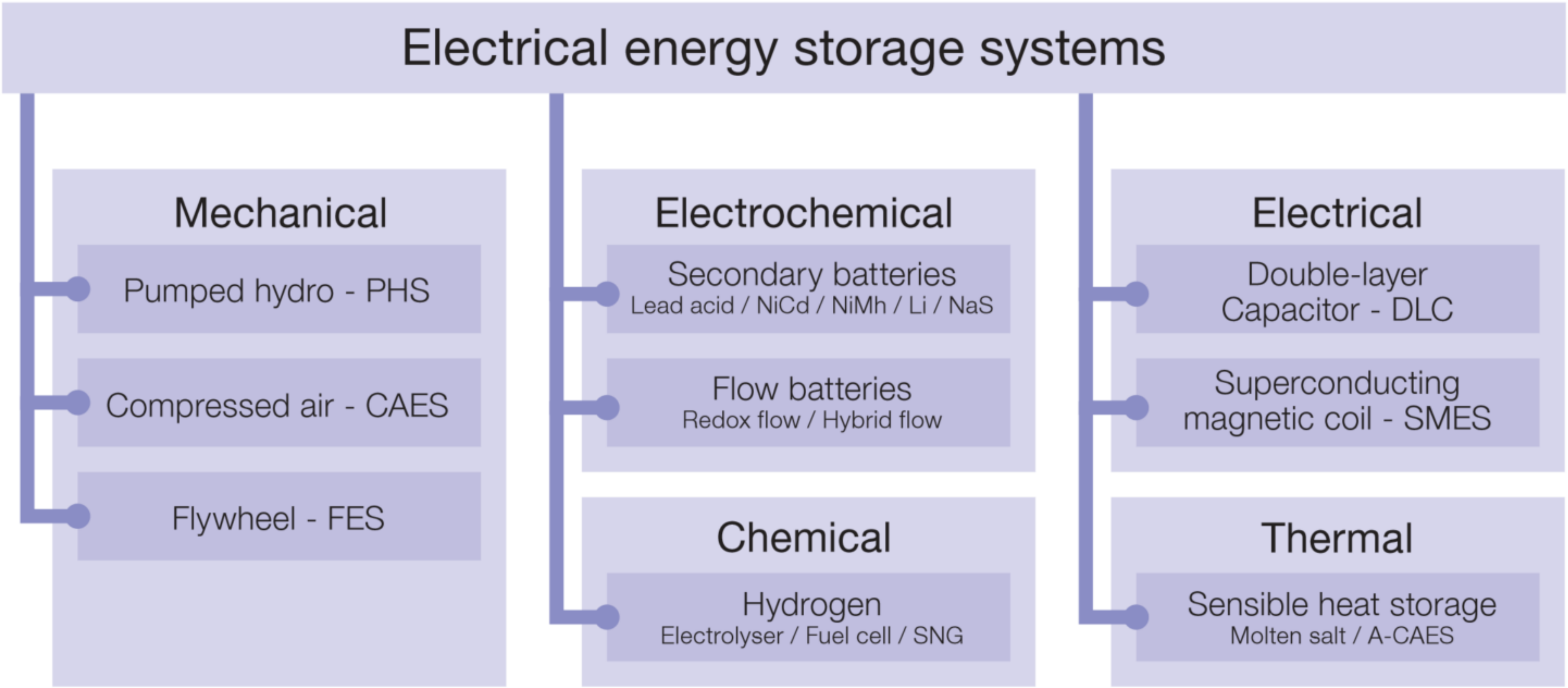
The roles of electrical energy storage technologies



Different uses of electrical energy storage in grids, depending on the frequency and duration of use

Types and features of energy storage systems



Classification of electrical energy storage systems according to energy form (Fraunhofer ISE)

Den mest brugte mekaniske energilagringssystemer er:

- **Pumped hydroelectric power plants (pumped hydro storage, PHS)**
- Compressed air energy storage (CAES)
- Flywheel energy storage (FES)

With over 120 GW, pumped hydro storage power plants (figure) represent nearly 99 % of world-wide installed electrical storage capacity , which is about 3 % of global generation capacity

Conventional pumped hydro storage systems use two water reservoirs at different elevations to pump water during off-peak hours from the lower to the upper reservoir (charging).

When required, the water flows back from the upper to the lower reservoir, powering a turbine with a generator to produce electricity (discharging)

The largest PHS plant in the world, with 2 100 MW peak power, is the Bath County hydroelectric pumped storage plant located in Virginia, USA

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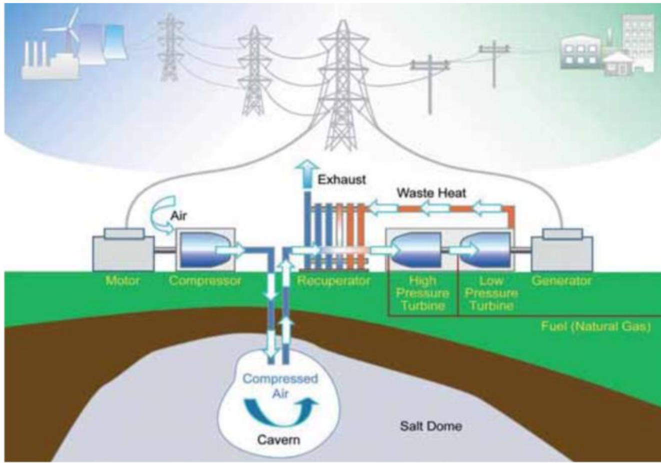
- Pumped hydroelectric power plants (pumped hydro storage, PHS)
- **Compressed air energy storage (CAES)**
- Flywheel energy storage (FES)

Compressed air (compressed gas) energy storage (figure) is a technology known and used since the 19th century for different industrial applications including mobile ones.

Air is used as storage medium due to its availability. Electricity is used to compress air and store it in either an underground structure or an above-ground system of vessels or pipes. When needed the compressed air is mixed with natural gas, burned and expanded in a modified gas turbine.
Typical underground storage options are caverns, aquifers or abandoned mines.

The advantage of CAES is its large capacity; disadvantages are low round-trip efficiency and geographic limitation of locations



Den mest brugte mekaniske energilagringssystemer er:

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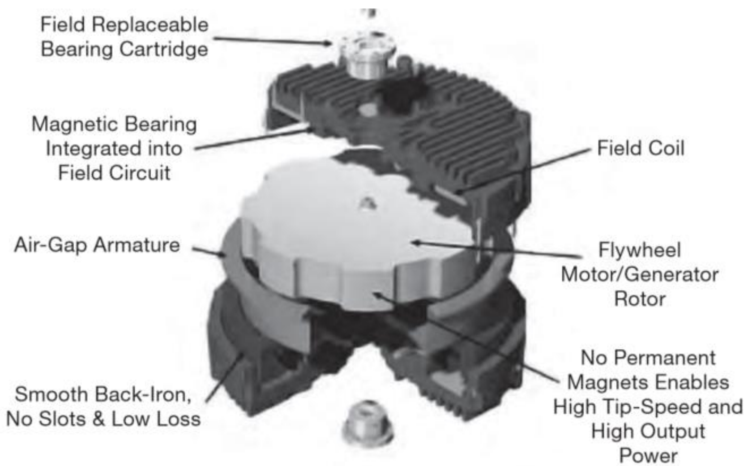
- **Flywheel energy storage (FES)**

In flywheel energy storage (figure) rotational energy is stored in an accelerated rotor, a massive rotating cylinder. The main components of a flywheel are the rotating body/cylinder (comprised of a rim attached to a shaft) in a compartment, the bearings and the transmission device (motor/generator mounted onto the stator).

The energy is maintained in the flywheel by keeping the rotating body at a constant speed. An increase in the speed results in a higher amount of energy stored.

Today flywheels are commercially deployed for power quality in industrial and UPS applications, mainly in a hybrid configuration.



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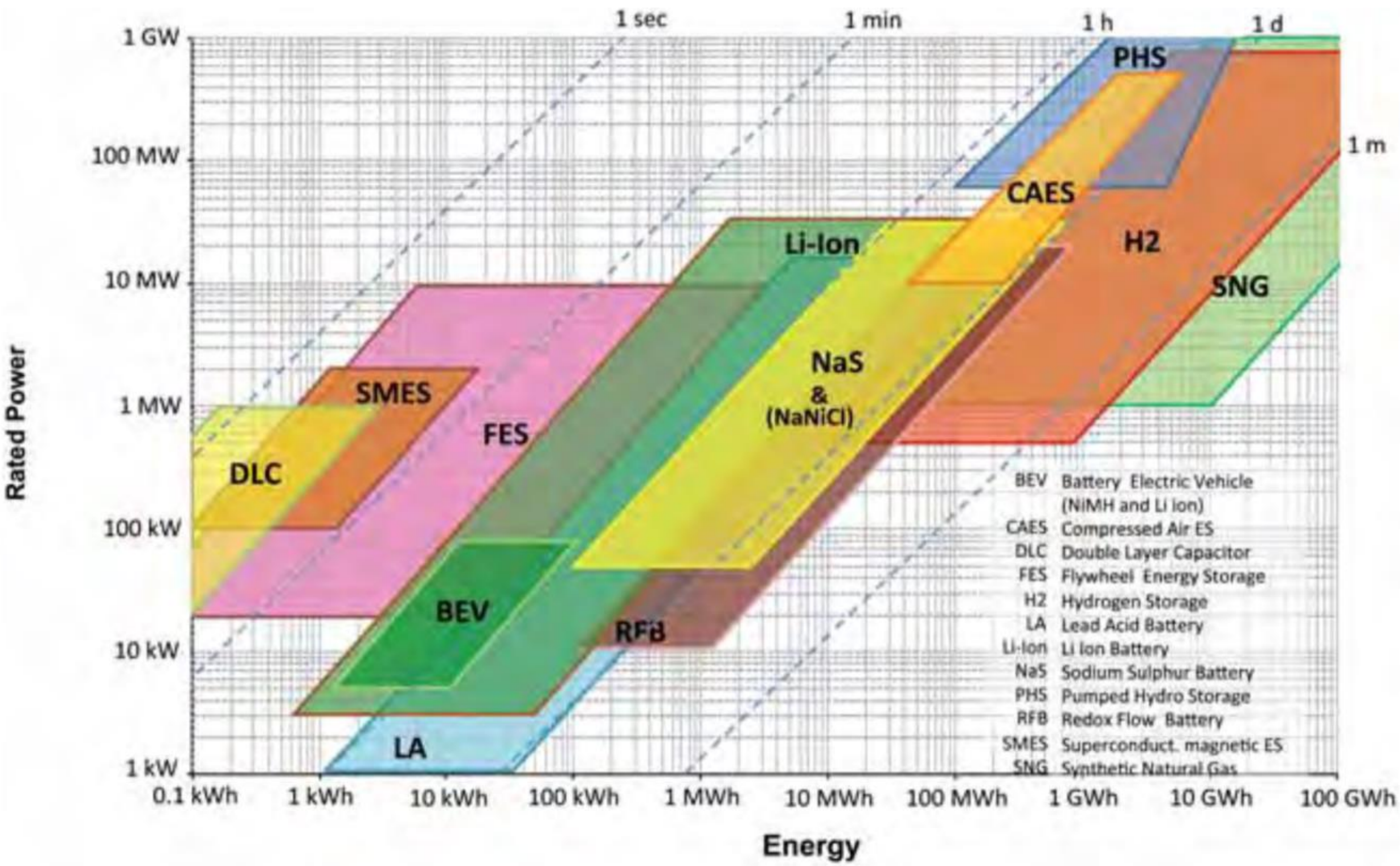
Mange forskellige typer af energilagringstyper beskrives i EES rapporten



Comparison of rated power, energy content and discharge time of different EES technologies (Fraunhofer ISE)

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Annex A
Technical overview of electrical energy storage technologies

Battery Technology	Nominal Voltage [V]	Capacity per cell [Ah]	Response Time	Energy Density [Wh/kg]	Energy Density [Wh/l]	Power Density W/l	Typical Discharge time	Energy-Efficiency ηWh [%]	Lifetime [a]	Typ. Cycle Lifetime [cycles]	Typical applications
PHS	-	-	min	0.2 – 2	0.2 – 2	0.1 – 0.2	hours	70 – 80	> 50	> 15 000	Time shifting, Power quality, Emergency supply
CAES	-	-	min	-	2 – 6	0.2 – 0.6	hours	41 – 75	> 25	> 10 000	Time shifting
Flywheel	-	0.7 – 1.7 MW	< sec	5 – 30	20 – 80	5 000	seconds	80 – 90	15 – 20	$2*10^4 – 10^7$	Power quality
Lead acid	2.0	1 – 4 000	< sec	30 – 45	50 – 80	90 – 700	hours	75 – 90	3 – 15	250 – 1 500	Off-Grid, Emergency supply, Time shifting, Power quality
NiCd Vented sealed	1.2	2 – 1 300 0.05 – 25	< sec	15 – 40 30 – 45	15 – 80 80 – 110	75 – 700 (vented)	hours	60 – 80 60 – 70	5 – 20 5 – 10	1 500 – 3 000 500 – 800	Off-Grid, Emergency supply, Time shifting, Power quality
NiMH sealed	1.2	0.05 – 110	< sec	40 – 80	80 – 200	500 – 3 000	hours	65 – 75	5 – 10	600 – 1 200	Electric vehicle
Li-ion	3.7	0.05 – 100	< sec	60 – 200	200 – 400	1 300 – 10 000	hours	85 – 98	5 – 15	$500 – 10^4$	Power Quality, Network efficiency, Off-Grid, Time shifting, Electric vehicle
Zinc air	1.0	1 – 100	< sec	130 – 200	130 – 200	50 – 100	hours	50 – 70	> 1	> 1 000	Off-Grid, Electric Vehicle
NaS	2.1	4 – 30	< sec	100 – 250	150 – 300	120 – 160	hours	70 – 85	10 – 15	2 500 – 4 500	Time shifting, Network efficiency, Off-Grid
NaNiCl	2.6	38	< sec	100 – 200	150 – 200	250 – 270	hours	80 – 90	10 – 15	~ 1 000	Time shifting, Electric vehicles
VRFB	1.6	-	sec	15 – 50	20 – 70	0.5 – 2	hours	60 – 75	5 – 20	> 10 000	Time shifting, Network efficiency, Off-Grid
HFB	1.8	-	sec	75 – 85	65	1 – 25	hours	65 – 75	5 – 10	1 000 – 3 650	Time shifting, Network efficiency, Off-Grid
Hydrogen central decentral	-	-	sec – min	33 330	600 (200 bar)	0.2 – 2 2.0 – 20	hours – weeks	34 – 44	10 – 30	$10^3 – 10^4$	Time Shifting
SNG	-	-	min	10 000	1 800 (200 bar)	0.2 – 2	hours – weeks	30 – 38	10 – 30	$10^3 – 10^4$	Time Shifting
DLC	2.5	0.1 – 1 500 F	< sec	1 – 15	10 – 20	40 000 – 120 000	seconds	85 – 98	4 – 12	$10^4 – 10^5$	Power Quality, Effective Connection
SMES	-	-	< sec	-	6	2 600	seconds	75 – 80	*)	*)	Time Shifting, Power Quality

Brug evt. EES rapporten som guideline for teknologier indenfor området, samt for referencerne til kildematerialet

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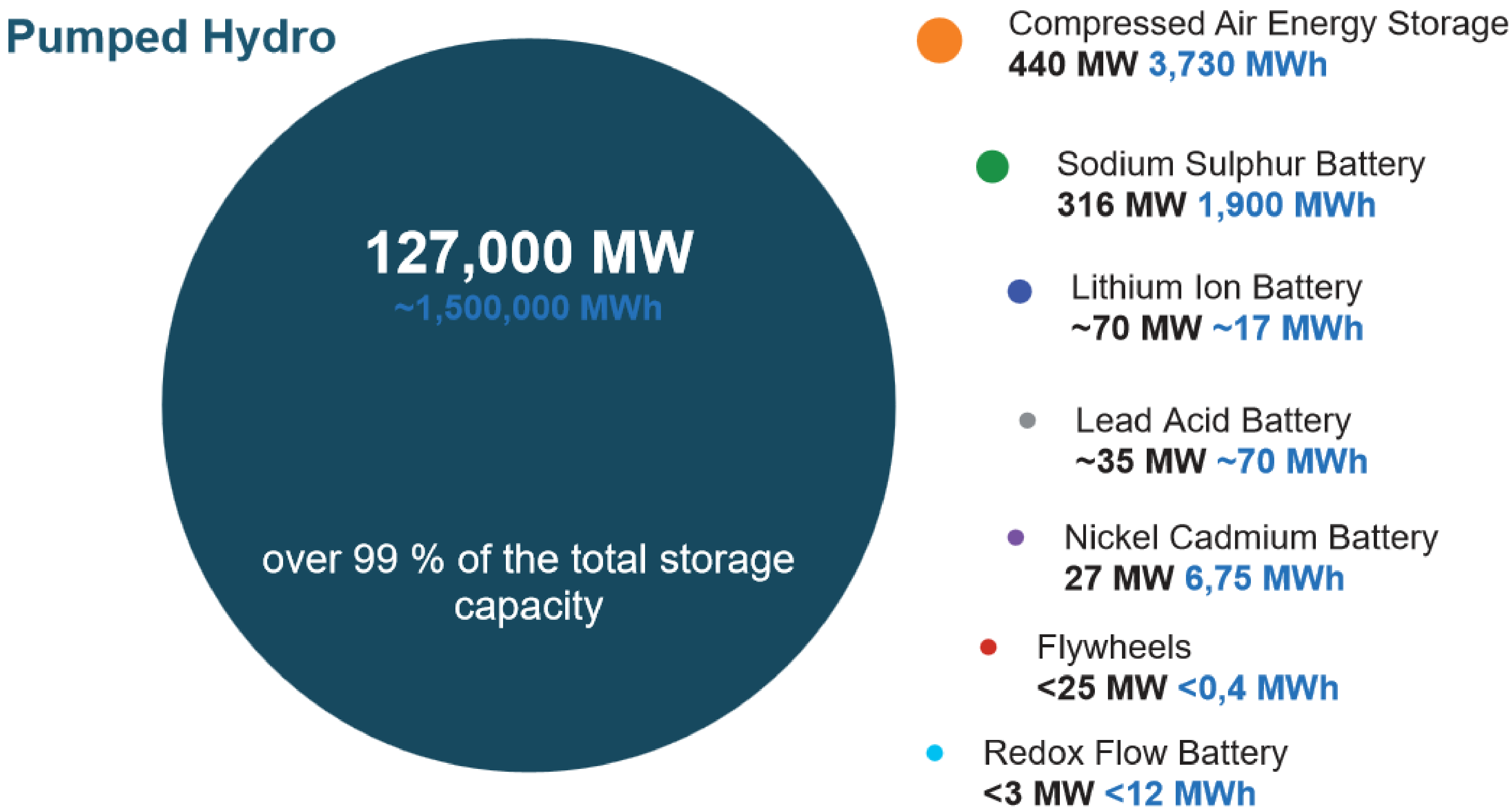
Markets for EES



Worldwide installed storage capacity for electrical energy

- Electric Power Research Institute: Electric Energy Storage Technology Options White Paper, 2010
- C. Dötsch: Electrical energy storage from 100 kW – State of the art technologies, fields of use. 2nd Int. Renewable Energy Storage Conference, Bonn/Germany, 22 Nov 2007.

Figure 3-1 | Variable-speed PHS operated by TEPCO *(TEPCO)*

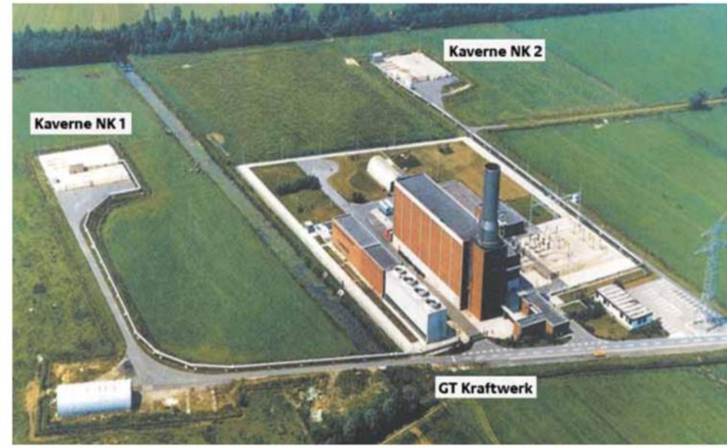


Figure 3-2 | CAES plant in Huntorf *(Vattenfall, IEC MSB/EES Workshop 2011)*

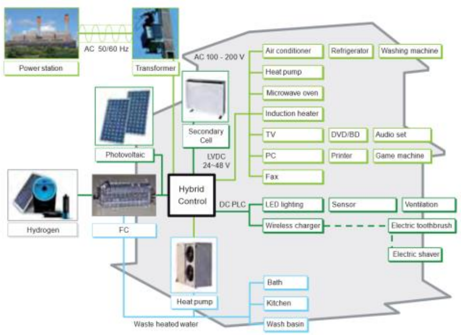


Figure 3-15 | Future home energy network in a smart house *(IEC White Paper 2010)*

Gode eksempler på EES anlæg fra drift til fremtidsscenarier

Figure 3-3 | Li-ion battery supplying up to 12 MW of power at Los Andes substation in Chile *(A123, 2009)*

Figure 3-9 | General view of the Futamata wind power plant *(Japan Wind Development Co.)*

Figure 3-10 | NaS battery units – 34 MW *(Japan Wind Development Co.)*

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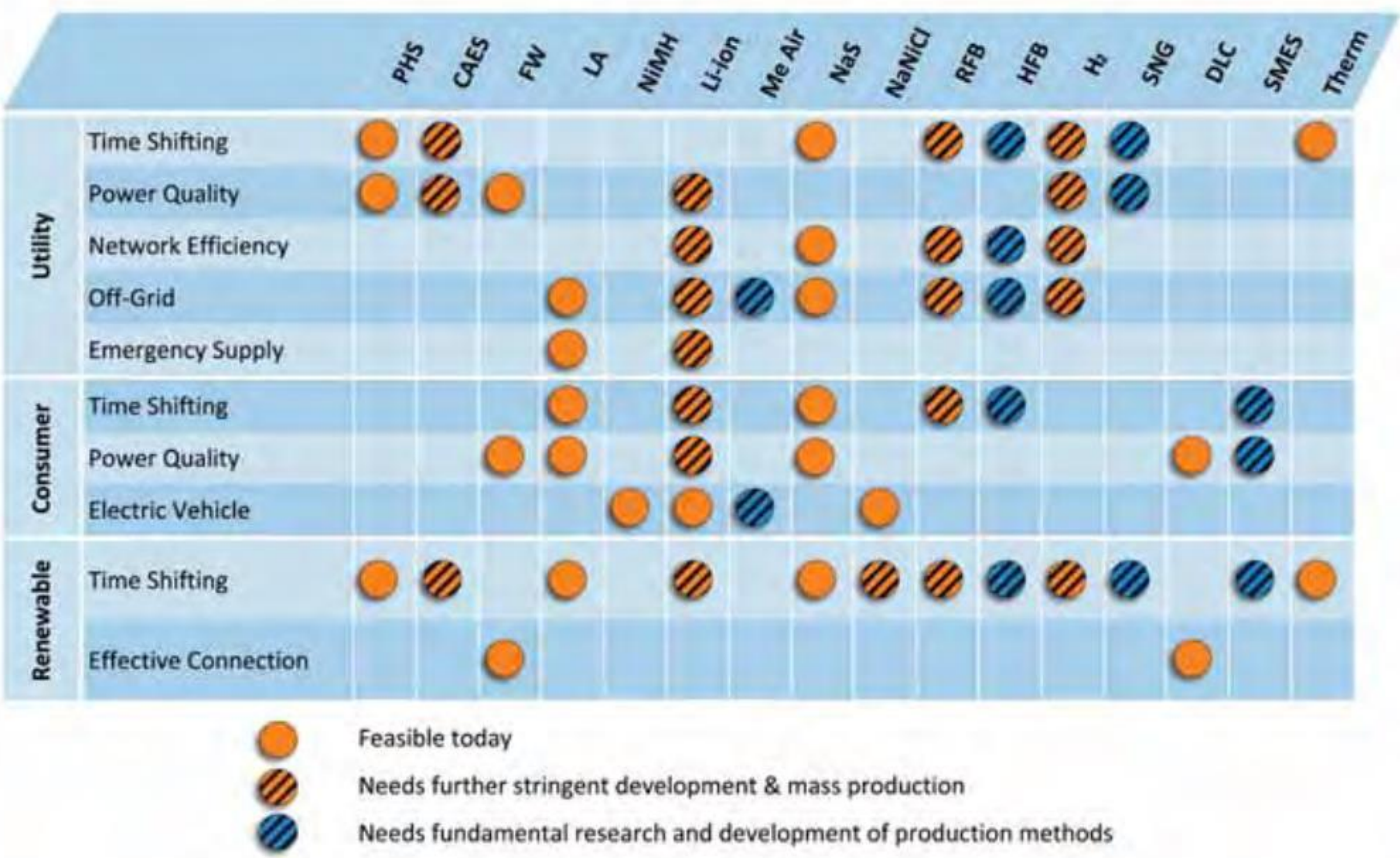
Forecast of EES market potential by 2030



EES present feasibility, future potential, need for further research and development (Fraunhofer ISE)

Conclusions and recommendations

Objectives
- CO_2 reduction
- More efficient and reliable electricity

Drivers
- Renewable energies
- Smart Grid
- Dispersed generation/Microgrid

Market forecasts
- Total EES market
- Conventional large-scale
- Long-term storage
- Dispersed storage

Technological and practical implications
- Batteries
- H_2/SNG (synthetic natural gas)
- Lifetime costs
- Control / interoperability

Recommendations
a) Policy recommendations
b) R&D recommendations
c) Standards recommendations

Recommendations addressed to the IEC and its committees

Recommendation 5.7.1 – Cooperation needed for hydrogen and SNG standards

The MSB recommends the IEC to work out future standardization solutions in the domain of hydrogen and synthetic natural gas (SNG) storage in close collaboration with ISO and with industries, such as hydrogen, natural gas and petroleum, with which it has historically had few contacts.

Forbedret samarbejde imellem standardiseringsorganisationerne og industrien

Recommendation 5.7.2 – Architecture and structure of EES systems

The IEC study shows that a thorough, shared comprehension of the roles and functions of storage in all grid-related circumstances is currently not available. The MSB therefore recommends the IEC to develop an EES architecture and a fundamental standard on the structure of EES systems, upon which all the other standards needed may be based.

Udarbejde en arkitekturmodel for EES som kan skabe konsensus omkring alle standarder på området

Recommendations addressed to the IEC and its committees

Recommendation 5.7.3 – Users' guide on planning and installing storage

One of the determining factors in successful rollout of storage solutions will be the players' level of understanding of the cost and functionality of the different technologies. The MSB recommends the IEC to develop a users' guide containing suggested criteria to apply when planning and using each specific technology (type of product) for a specific application. In addition to data on storage technology behaviour and characteristics (speed, power, energy), it will probably also need to contain information on full lifecycle cost, disposal cost, regulatory considerations, and environmental advantages and disadvantages.

Udarbejde en brugermanual for udrulning af EES teknologier med specifikation af 'cost benefit'

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Recommendations addressed to the IEC and its committees

Recommendation 5.7.4 – Interface, control and data element standards

Several elements of the IEC study show a pressing need for the control and interconnection of EES installations: small-scale storage in microgrids and its connection to the grid, integration of storage systems with different technologies into a single virtual store, systems used jointly by different organizations (generation plant owner, grid operator, electricity seller) and for different applications, etc. Insofar as the relevant standards do not yet exist, the MSB therefore recommends the IEC to standardize rapidly the interfaces between storage and other grid elements, protocols for data exchange and control rules, and the data elements for the input, output and control information supplied by or to storage systems.

Fokus på hurtig udvikling af standarder for interfacet imellem EES og elsystemet (inkl. microgrid)

Recommendations addressed to the IEC and its committees

Recommendation 5.7.5 – Standards for systems to relieve transmission congestion

The introduction of large quantities of renewable energies will cause transmission system congestion, to which storage can be a solution. Some of the resulting integrated systems, for example a hybrid system consisting of storage combined with a wind farm, will require standards in order to function correctly. The MSB recommends the SMB to initiate the standards needed.

Fokus på hurtig udvikling af standarder for integration mellem EES og vedvarende energikilder (VE)

Recommendation 5.7.6 – Standards for unit size and other factors affecting costs

Reducing lifetime costs of storage requires, among many other things, a range of standards, such as standardized EES unit sizes and technical features to allow mass production of associated equipment. The MSB therefore recommends the SMB to launch such projects.

Fokus på hurtig udvikling af standarder for kostreduktion af EES produkter

Recommendations addressed to the IEC and its committees

Recommendation 5.7.7 – Safety of new storage technologies

The rapid growth and the new technologies involved in electrical energy storage in the near future, as well as their installation by consumers, will impose particular requirements for safety. At the same time, society and governments will need assurance of safety before the much-needed systems can be deployed. The MSB therefore recommends the SMB to set in motion rapidly the development of storage safety standards.

Fokus på hurtig udvikling af standarder for personsikkerhed

Recommendation 5.7.8 – Compatibility of EES with the environment

The scale, the impact and the materials of EES all represent potential challenges to the environment, especially when new technologies are involved. Without International Standards in place the regulatory requirements may be different in different regions, which would be an unnecessary burden on manufacturers and owners. The MSB consequently recommends that standards for EES compatible with the environment be developed as soon as possible.

Fokus på hurtig udvikling af standarder for sikring af miljøvenlige EES materialer

Spørgsmål?

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