IEA Technology Collaboration Programme

International Energy Agency

Technology Collaboration Programme on Energy Storage

(ES TCP)

Energy Storage Glossary

23 November 2026

Content

Abbreviations 4

Energy Storage Related Terminology 5

Aquifer thermal energy storage – ATES 5
Battery energy storage system – BESS 5
Borehole heat exchanger – BHE 5
Borehole system 5
Borehole thermal energy storage – BTES 5
Brayton battery 5
Capacity 5
Carnot battery 5
Charging 5
Chemical energy storage 5
Coefficient of performance – COP 6
Comfort and climate box 6
Compact thermal energy storage – CTES 6
Compressed air energy storage – CAES 6
Concentrated solar power – CSP 6
Cost of no storage 6
Curtailment 6
Demand-side flexibility 6
Demand-side management – DSM 6
Distributed energy storage – DES 6
Discharging 6
District heating 7
Electrical energy storage – EES 7
Energy autonomy 7
Energy density 7
Energy storage 7
Energy system flexibility 7
Flexibility service 7
Flexibility trading 7
Flexible sector coupling 7
Flywheel energy storage 7
Frequency containment reserve 7
Generation-integrated energy storage 8
Giga-TES 8
Grid-operated storage 8
Heat exchanger 8
Heat-integrated Carnot battery 8
High-temperature thermal energy storage 8
Hybrid energy storage 8
Island solution/island grid 8
Key performance indicator – KPI 8
Liquid air energy storage – LAES 8
Latent heat storage 8
Lead-acid battery 9
Lithium-ion battery 9
Load shifting 9
Long-duration energy storage – LDES 9
Large thermal energy storage – LTES 9
Material-component interaction 9
Medium-duration energy storage – MDES 9

Mechanical energy storage 9
Mine thermal energy storage – MTES 9
Operating strategy 9
Peak shaving 9
Phase-change material – PCM 10
Pit thermal energy storage – PTES 10
Power 10
Power-to-gas – P2G 10
Power-to-heat – P2H 10
Power-to-power – P2P 10
Pumped hydroelectric energy storage – PHES 10
Rankine battery 10
Reactor 10
Redox-flow battery – RFB 10
Renewable-energy integration 10
Resilience 11
Round-robin test 11
Round-trip efficiency – RTE 11
Seasonal thermal energy storage 11
Sector coupling 11
Self-consumption 11
Sensible-heat storage 11
Service life 11
Short-duration energy storage – SDES 11
Sodium-ion battery 11
Solar-assisted heating 11
Sorption storage 12
State of charge – SoC 12
Storage duration 12
Storage efficiency 12
Storage medium 12
Supercapacitor 12
Tank thermal energy storage – TTES 12
Techno-economic assessment 12
Thermal energy storage – TES 12
Thermal energy storage material 12
Thermally activated building mass – TAB 12
Thermochemical energy storage – TCES 13
Thermochemical material – TCM 13
Underground thermal energy storage – UTES 13
Variable renewable energy – VRE 13
Virtual storage 13
Waste heat 13

IEA/Energy Storage TCP Terminology 13

Annex 13
ECES – Energy Conservation through Energy Storage 13
Enerstock 13
Task 13
Technology Collaboration Programme – TCP 13

ABBREVIATIONS

ATES	Aquifer thermal energy storage
BESS	Battery energy storage system
BHE	Borehole heat exchanger
BTES	Borehole thermal energy storage
CAES	Compressed air energy storage
COP	Coefficient of performance
CSP	Concentrated solar power
CTES	Compact thermal energy storage
DES	Distributed energy storage
DSM	Demand-side management
EES	Electrical energy storage
KPI	Key performance indicator
LAES	Liquid air energy storage
LDES	Long-duration energy storage
LTES	Large thermal energy storage
MDES	Medium-duration energy storage
MTES	Mine thermal energy storage
P2G	Power-to-gas
P2H	Power-to-heat
P2P	Power-to-power
PCM	Phase-change material
PHES	Pumped hydroelectric energy storage
PTES	Pit thermal energy storage
RFB	Redox-flow battery
RTE	Round-trip efficiency
SDES	Short-duration energy storage
SoC	State of charge
TAB	Thermally activated building mass
TCES	Thermochemical energy storage
TCM	Thermochemical material
TCP	Technology collaboration programme
TES	Thermal energy storage
TTES	Tank thermal energy storage
UTES	Underground thermal energy storage
VRE	Variable renewable energy

ENERGY STORAGE RELATED TERMINOLOGY

Aquifer thermal energy storage – ATES

Thermal energy storage that uses groundwater in a natural aquifer as the storage medium. Water is extracted and injected through wells, typically one warm and one cold well, to store and recover heat or cold. Mainly used for seasonal heating and cooling of buildings.

Battery energy storage system – BESS

Storage in which electrical energy is converted into electrochemical energy during charging and converted back into electricity during discharge. Technologies include lithium-ion, sodium-ion, lead-acid and redox-flow batteries.

Borehole heat exchanger – BHE

A heat exchanger installed vertically or sometimes horizontally in the ground to exchange heat with soil or rock. BHEs are central components of borehole thermal energy storage and ground-source heat-pump systems. Commonly also called a geothermal probe.

Borehole system

A ground-coupled thermal system containing one or more boreholes equipped with heat exchangers. Earlier Energy Storage TCP work addressed quality management throughout design, drilling, construction, operation, and monitoring.

Borehole thermal energy storage – BTES

A thermal storage system using an array of borehole heat exchangers to store and recover heat in soil or rock. BTES is particularly suitable for seasonal thermal storage.

Brayton battery

A Carnot-battery concept based on a Brayton or Joule thermodynamic cycle. Electricity is converted into thermal energy and later recovered using compression and expansion processes.

Capacity

The amount of energy that can be stored and subsequently delivered by a storage system, generally expressed in kWh, MWh or GWh.

Carnot battery

An electricity-storage technology that converts electricity into thermal energy, stores the thermal energy, and later converts it back into electricity. Several thermodynamic cycle concepts can be used for charging and discharging.

Charging

The process of transferring energy into a storage system. The charging energy may undergo conversion before it is stored.

Chemical energy storage

Storage in which energy is retained in chemical bonds, for example in hydrogen or synthetic fuels. The stored carrier can subsequently provide heat, electricity, mechanical energy, or another chemical product.

Coefficient of performance – COP

The ratio between useful heating or cooling supplied by a heat pump and the energy used to operate it. The COP strongly depends on source and sink temperatures.

Comfort and climate box

An integrated concept combining a heat pump, thermal energy storage, and controls. Task 34 investigated such systems for heating, cooling, and domestic hot water.

Compact thermal energy storage – CTES

Thermal energy storage designed to achieve comparatively high storage density at compact system dimensions. PCM and thermochemical storage are important CTES approaches.

Compressed air energy storage – CAES

A storage technology in which electricity is used to compress air for storage in a vessel or underground cavern. The compressed air is subsequently expanded to produce mechanical power and electricity.

Concentrated solar power – CSP

Solar-energy technology using mirrors or lenses to concentrate solar radiation and produce high-temperature heat. Thermal storage can extend CSP operation beyond periods of direct solar irradiation.

Cost of no storage

The cost associated with operating an energy system without storage in comparison with a system including storage. Examples can include additional generation, curtailment, grid reinforcement, or reduced resilience.

Curtailment

A deliberate reduction of energy generation, particularly from wind or photovoltaics, when electricity cannot be used or transported at the time. Energy storage can reduce curtailment by shifting consumption to a later period.

Demand-side flexibility

The ability of consumers to influence the timing or level of their demand. Storage, heat pumps, and thermally activated buildings can all contribute to demand-side flexibility.

Demand-side management – DSM

The systematic management of energy demand in response to system conditions, prices, or control signals. Storage allows demand to be shifted without changing the final energy service.

Distributed energy storage – DES

Energy storage located close to generation or consumption rather than at centralised grid level. Annex 28 investigated how DES can support the integration of renewable energy.

Discharging

The process of extracting useful energy from a storage system. The form of energy delivered depends on the type of storage.

District heating

A system distributing heat from central or distributed sources to multiple buildings through a thermal network. The integration of thermal storage can increase renewable and waste-heat utilisation and improve operational flexibility.

Electrical energy storage – EES

Storage that accepts and normally returns electrical energy, although intermediate energy forms may be chemical, electrochemical, mechanical, or thermal. Chemical batteries, pumped hydro, and Carnot batteries are examples.

Energy autonomy

The degree to which a consumer, building, community, or energy system can meet its own energy requirements from locally available resources. Storage can increase autonomy by shifting locally generated energy to periods when it is needed.

Energy density

The amount of stored energy per unit of mass or volume. Higher energy density generally allows a smaller or lighter storage system.

Energy storage

The capture of energy so that it can be used at a later time. Stored energy can take electrical, thermal, mechanical or chemical forms.

Energy system flexibility

The ability of an energy system to adapt to variations in generation, demand and network conditions. Storage provides flexibility by separating the timing of energy supply from energy use.

Flexibility service

A service that adjusts energy production, consumption, or storage operation in response to system needs. Examples include peak shaving, grid balancing, and shifting renewable electricity to different times or sectors.

Flexibility trading

Market-based exchange of the ability to increase, reduce, or shift energy consumption or generation. Thermally activated buildings and storage systems can potentially participate in such markets.

Flexible sector coupling

The coordinated connection of electricity, heating, cooling, mobility, and other energy sectors in a way that adds temporal and operational flexibility. Energy storage makes renewable electricity available to other sectors when needed in such systems.

Flywheel energy storage

Mechanical storage of kinetic energy in a spinning rotor. Charging and discharging through a motor-generator. High power, fast response, but limited to short-duration storage. Used in grid services and for short-term very high energy requirements.

Frequency containment reserve

A fast-acting electricity-system service used to stabilise grid frequency in case of imbalance between generation and demand. Aggregated distributed storage can provide such a service.

Generation-integrated energy storage

Energy storage physically or operationally integrated with an energy-generation asset. Integration can reduce infrastructure requirements or improve the combined generation-storage output profile.

Giga-TES

Very large thermal energy stores with gigawatt hours of capacity. Particularly relevant to seasonal storage and district heating.

Grid-operated storage

Storage controlled primarily to provide grid services, such as balancing and frequency control, to the electricity network rather than only serve a local consumer.

Heat exchanger

A component that transfers thermal energy between fluids or between a fluid and a storage medium without necessarily mixing them. Heat-exchanger design is often critical for storage charging and discharging power.

Heat-integrated Carnot battery

A Carnot battery that exchanges thermal energy with an external process or heating system. Integration can enable the utilisation of waste heat or simultaneous provision of heat and electricity storage.

High-temperature thermal energy storage

Thermal energy storage operating at elevated temperatures, particularly for industrial processes and power-generation applications. Suitable materials include molten salts, solids, and high-temperature PCMs.

Hybrid energy storage

A system combining two or more storage technologies or mechanisms. Hybridisation can combine complementary characteristics such as high power, high capacity, or different operating timescales.

Island solution/island grid

An energy system operating independently from larger electricity networks. Storage is especially valuable in such systems for balancing local renewable generation and demand.

Key performance indicator – KPI

A measurable parameter used to evaluate a storage technology, component, application or project. KPIs can describe technical, economic, environmental or system-level performance.

Liquid air energy storage – LAES

A technology that stores energy by cooling air until it liquefies. For discharging, the liquid air is warmed and expanded to produce mechanical power and electricity.

Latent heat storage

Thermal storage based on the enthalpy associated with a phase transition. Latent heat storages provide high storage density over a relatively narrow temperature interval.

Lead-acid battery
A rechargeable electrochemical battery based on lead electrodes and a sulphuric-acid electrolyte. It is technologically mature but generally has lower energy density than lithium-ion batteries.

Lithium-ion battery
A rechargeable electrochemical battery in which lithium ions move between electrodes during charging and discharging. It combines relatively high energy density and efficiency with a quick response speed.

Load shifting
Moving energy consumption or supply from one time period to another, usually through energy storage.

Long-duration energy storage – LDES
Storage intended for durations of 8 hours or longer.

Large thermal energy storage – LTES
Thermal energy storage with very high energy capacity, particularly used in district heating, and seasonal energy shifting. Common technologies are hot-water tank and pit storages and underground storages.

Material-component interaction
The influence of a storage material on its surrounding component and vice versa. Relevant phenomena include heat and mass transfer, wall-material interaction, corrosion, and mechanical effects.

Medium-duration energy storage – MDES
Storage designed to bridge the gap between short-duration storage and very long-duration technologies. Task 42 provisionally considers a range of roughly 4 to 200 hours, while recognising that technological and economic boundaries are not absolute.

Mechanical energy storage
Storage in physical forms such as gravitational energy, compressed gases, or rotational energy, e.g. in pumped hydropower, compressed-air storage, or flywheels.

Mine thermal energy storage – MTES
Thermal energy storage in flooded underground mine workings. Water and the surrounding rock act as the storage medium, while the water also acts as a heat carrier for charging and discharging. Enables seasonal heat storage that reuses existing infrastructure.

Operating strategy
The rules determining when and how a storage system charges and discharges. The operating strategy can strongly affect storage economics, efficiency, lifetime, and system benefit.

Peak shaving
Mitigation of peaks in power or energy demand through supplying energy from storage.

Phase-change material – PCM
A material that stores and releases latent heat during a phase transition, most commonly melting and crystallisation. PCMs can provide high thermal storage density within a comparatively narrow temperature interval.

Pit thermal energy storage – PTES
A large water-based TES system constructed as an excavated, insulated pit. Used for seasonal heat storage in district-heating systems.

Power
The rate at which a storage can be charged or discharged, generally expressed in kW, MW, or GW.

Power-to-gas – P2G
Conversion of electricity into a gaseous energy carrier, typically hydrogen, methane, or ammonia. The resulting gas can be stored, transported through existing infrastructure, or provide energy to a different sector.

Power-to-heat – P2H
Conversion of electricity into useful thermal energy using technologies such as resistance heaters or heat pumps. Combining P2H with TES enables temporal shifting and electricity–heat sector coupling.

Power-to-power – P2P
Storage pathway in which the input and final output are both electricity. Intermediate storage may nevertheless be electrochemical, mechanical, thermal, or chemical.

Pumped hydroelectric energy storage – PHES
Energy storage based on electrically pumping water to an elevated reservoir and later recovering electricity through turbines when the water flows back downhill.

Rankine battery
A Carnot-battery configuration in which the electricity-generation stage employs a Rankine-type vapour power cycle. Task 36 assessed Rankine and Brayton battery concepts.

Reactor
The component in which thermochemical storage reactions or sorption processes take place. Reactor design must address heat and mass transfer as well as material behaviour.

Redox-flow battery – RFB
An electrochemical battery which stores energy through reversible redox reactions in liquid electrolytes. Electrolyte tank volume determines energy capacity, while the size of the electrochemical reaction stack determines power.

Renewable-energy integration
The incorporation of renewable sources into the wider energy system while maintaining reliability and balancing supply and demand. Energy storage can reduce curtailment and compensate for temporal variations in renewable generation.

Resilience
The ability of an energy system to maintain or rapidly restore essential services during disturbances or interruptions. Storage can improve resilience through backup supply and operational flexibility.

Round-robin test
A coordinated exercise in which different laboratories evaluate the same material, component, or procedure. Its purpose is to assess reproducibility of outcomes and identify methodological differences.

Round-trip efficiency – RTE
The ratio between energy supplied during charging and useful energy recovered from a complete storage cycle.

Seasonal thermal energy storage
Thermal storage operating over periods of several months, typically storing summer heat for winter use or winter cold for summer cooling. ATES, BTES, PTES and large tanks can provide seasonal storage.

Sector coupling
Integration of energy sectors such as electricity, heating, cooling, and transport. Storage and conversion technologies allow energy to be shifted both between sectors and over time.

Self-consumption
The share of locally generated energy that is consumed on site rather than fed into the grid. Batteries or thermal storage can increase self-consumption by shifting surplus generation.

Sensible-heat storage
Thermal storage based on increasing or decreasing the temperature of a storage medium in an insulated vessel. Water, rocks, concrete, and molten salts are common examples for storage media.

Service life
The period or number of operating cycles over which a storage technology remains capable of meeting specified performance requirements. Materials, operating conditions, and degradation mechanisms strongly influence lifetime.

Short-duration energy storage – SDES
Storage optimised for relatively short discharge periods ranging from milliseconds to several hours. Mostly provided by batteries, pumped hydroelectric storage, flywheels, or supercapacitors and used for grid services.

Sodium-ion battery
A rechargeable battery in which sodium ions carry charge between electrodes. Its operating principle resembles lithium-ion technology while using different raw materials.

Solar-assisted heating
Heating systems in which solar energy supplies part of the thermal demand. Seasonal TES helps shift solar heat from periods of high availability to periods of heating demand for such systems.

Sorption storage
Thermochemical storage in which energy is stored through reversible ad- or absorption processes.

State of charge – SoC
A measure of the energy presently stored relative to a defined usable storage capacity. In TES systems, SoC may need to be inferred from temperatures, phase fractions, or reaction states.

Storage duration
The time span between charging and discharging of a storage system. Governed by the technological properties of the storage.

Storage efficiency
The ratio between energy supplied during charging and useful energy delivered during discharge over a defined storage cycle. It can include conversion, standby, and auxiliary-energy losses depending on the system and boundary conditions.

Storage medium
The material or substance in which energy is stored. The choice of medium determines a storage technology's energy density, round-trip efficiency, self-discharge rate, discharge duration, and suitable scale of application.

Supercapacitor
Capacitor that stores energy electrostatically in the electric double layer at the electrode-electrolyte interface. Very fast charging and discharging, capable of high power delivery. Used for short-term power buffering and grid stabilisation.

Tank thermal energy storage – TTES
Large-scale sensible heat storage using an insulated tank, commonly filled with water. Temperature stratification can preserve useful temperature differences inside the tank.

Techno-economic assessment
An analysis combining technical performance and economic factors. Typical inputs include efficiency, power, capacity, lifetime, investment cost, operating cost, revenues and market conditions.

Thermal energy storage – TES
Storage of heat or cold for later use. The principal categories are sensible, latent, and thermochemical storage.

Thermal energy storage material
A material capable of storing thermal energy by sensible heating, phase change, or reversible thermochemical processes.

Thermally activated building mass – TAB
Structural parts of a building, e.g., concrete floor slabs, walls, or ceilings, that are thermally charged and discharged via embedded heat-transfer systems. Provides thermal comfort, storage capacity, and grid flexibility.

Thermochemical energy storage – TCES
Thermal storage based on reversible chemical reactions or sorption processes. They often feature very small standby losses because the reaction products can be kept separated.

Thermochemical material – TCM
A material storing heat through reversible chemical reactions, adsorption, or absorption. TCM can provide high storage density and very low losses during long storage periods when reaction products are separated.

Underground thermal energy storage – UTES
Thermal energy storage that uses the ground or groundwater as a medium. Different designs use different methods in detail.

Variable renewable energy – VRE
Renewable generation whose output varies with weather conditions, particularly wind and photovoltaics. Energy storage helps to integrate these into the system by shifting energy between periods of surplus and deficit.

Virtual storage
A coordinated set of spatially distributed storage systems that behaves like one larger storage asset from the perspective of the electricity system.

Waste heat
Thermal energy generated as a by-product of an industrial or energy-conversion process that would otherwise be released to the environment. Thermal energy storage can retain waste heat and make it available again on demand.

IEA/ENERGY STORAGE TCP TERMINOLOGY

Annex
The former term for a Task in the Energy Storage TCP. Still found in older documents and publications.

ECES – Energy Conservation through Energy Storage
The historical name of the IEA programme now called the Energy Storage TCP. The abbreviation ECES appears in older Annual Reports and was progressively replaced by Energy Storage TCP.

Enerstock
The Energy Storage TCP's triennial international energy-storage conference.

Task
A time-limited, topic-specific collaborative research project within the Energy Storage TCP, run under the programme's overarching agreement.

Technology Collaboration Programme – TCP
The International Energy Agency's international framework in which member and partner countries cooperate on specific energy technologies through research, development, and information exchange in thematic programmes, such as the Energy Storage TCP.