ECES

Annex 26

Electric Energy Storage:
Future Energy Storage Demand - FESD

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Future Energy Storage Demand

Introduction

The future of electricity network involves a massive penetration of unpredictable renewable energies. For insuring network stability as well as for maximizing the energy efficiency of such networks, storage is a key issue. Up to now, the integration of renewable energies did not take into account the demand side and was performed in a “fit and forget” way. The optimum evolution in an economic perspective is in the future to have an integration that is respecting the needs. One solution – beneath demand side management and grid extension – is the use of energy storages. The main purpose of adding energy storage systems in the electricity grid is to collect and store overproduced, unused energy and be able to reuse it during times when it is actually needed. Essentially the system will balance the disparity between energy supply and energy demand. Worldwide between 2% and 7% of the installed power plants are backed up by energy storage systems (99% pumped hydro systems). The future demand of energy storage devices is actually unknown. Only the main influence factors on this demand are known.

	Installed storage capacity [GW]	**Installed generation capacity [GW]**	**Relative ratio**
North America	**26**	**1200**	**2,2%**
Europe	**46**	**700**	**6,6%**
East Asia	**25**	**875**	**2,9%**

Installed capacity of energy storage:
The installed capacity of energy storage amounts to 46 MW in Europe. This is both, in absolute and relative terms with 6.6% the highest global amount. The most significant differences emerge from different power plant parks and regional restrictions of electricity grids.

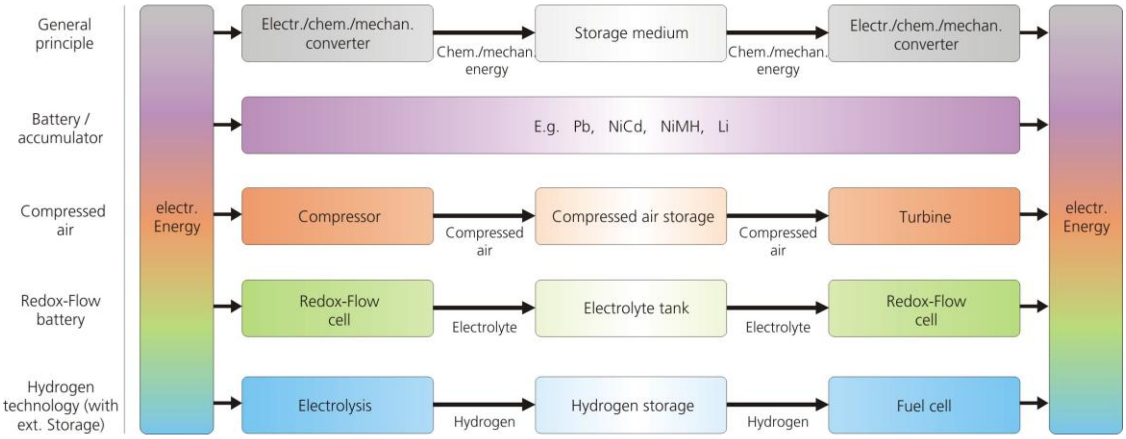
1 Description of the technology

Energy production and energy demand can be balanced by different means:

- Demand side management / demand response
- Energy import/export or transportation to other regions (HVDC)
- Control power plants
- Electric energy storages

All means are working in different ways and have different costs but the result is nearly the same: Balancing energy production and demand.
While demand side management tries to balance the demand through increased or decreased consumption, control power plants working vice versa: they balance the energy production side. Typically these are gas turbines. Energy import and export use the opportunities to minimize the need to balance by creating bigger grid systems.

Excess energy in one area will be transferred to an area with a lack of energy. But if there is a big surplus of energy production which can not be transported or exported this energy must be stored. Later the energy has to be fed back into the grid, if there is a lack of energy. Therefore different energy storage devices can be installed. Today only pumped hydro systems are widely spread because of economic reasons. Other technologies are only established in niches or special island grids.



Electrical energy storage

Energy storage occurs in three steps. Initially the electrical power is transformed into a form which can be stored. Then the storage medium (e.g. compressed air, hydrogen) will retain the stored energy. Finally when the energy is needed the storage medium will discharge and retransform the stored energy back into electrical energy

It is obvious that the different storage devices are in competition with each other and in competition with other balancing strategies mentioned above. Additionally balancing demand is influenced by the share of PV and wind energy, the dynamic of existing conventional power plant, the fluctuation of demand etc.

2 Objective and scope

Objective

The overall objective of this task is to develop a method or approach to calculate the regional energy balancing demand and to derive regional storage demand rasterizing the area and taking into account that there are competitive technical solutions. This objective can be subdivided into ten specific objectives:

- To rasterize the whole area to typical small self-similar elements,
- to identify and characterize typical fluctuating energy demand for different elements which stands for different regions and grid situations (e.g. intermeshing),
- to identify and characterize typical fluctuating energy production (wind, pv) for different elements which stand for different regions and renewable energy potential (e.g. wind velocity),
- to identify and characterize typical conventional energy production (gas turbine, nuclear power plant) for different elements which stand for different regions and conventional energy production,

- to reduce different grid structures to a fistful typical systems and to simulate their inner intermeshing and their exterior connectivity (transport, import, export),
- to derive balancing demand for each typical region,
- to derive energy storage demand as a share of the total balancing demand, taken into account that the most successful economic solution will be realized,
- to develop a method or model to transfer these results to other countries and regions,
- to assess the technical and economical impact of energy storages on the performance of the energy system, and
- to disseminate the knowledge and experience acquired in this task.

A secondary objective of this task is to create an active and effective research network in which researchers and industry working in the field of electric energy storage can collaborate.

Scope

This task deals with electric energy storages to balance the electric grid; demand side management, export/import, HVDC and balancing power plants are included as competitive technologies but they are not in the technical focus of these task. The task deals with electric energy storages on three different scales:

- Large scale storages at central locations or nearby wind farms,
- medium scale storages at weak grid points,
- small decentralized energy storages (stationary or mobile like electric cars).

There are also three different storage durations:

- Short term storages for seconds or minutes,
- medium term storages for minutes or some hours (e.g. UPS),
- long term storages for days or months (seasonal).

And there are three different possible operating company types:

- Energy producer (e.g. wind farms) which want to level or secure their production,
- energy consumer (e.g. big industrial plant) which want to level their demand or to realize an uninterruptable power supply,
- grid companies which are forced to balance their grid

And last but not least two different technical applications and key numbers: Storing energy (charging) or putting energy to the grid (discharging) and the appropriate full load hours for every demand are of interest. These figures are the base for any economic calculation.