MEXICAN-DANISH ENERGY COOPERATION

TECHNOLOGY CATALOGUE ON GRID-SCALE ELECTRICITY STORAGE

The technology catalogue provides up-to-date and objective data

INECC and the Danish Energy Agency have developed a Technology Catalogue (TC) on utility scale electricity storage technologies which provides up-to-date and country specific data for energy system modeling. The data covers both technical and economic data for nine selected technologies and it includes current representative data from today (2020) with projections to 2050.

The TC is developed in close cooperation and with a very large engagement from Mexican stakeholders throughout numerous workshops and working group meetings. This process has led to a TC which is both of high quality and well anchored in Mexico. The broad knowledge and recognition of the TC is especially important since it allows it to be a common point of reference for technology data for the whole energy sector. The TC is publicly available on INECC's website.

The Danish Energy Agency has more than 30 years of experience developing TCs in an open process and aimed for providing high quality technology data for governmental energy planning. This experience has been the foundation of the development of the Mexican TC allowing Mexico to benefit from this experience and conduct their own Technology Catalogue.

The selected technologies are:

- Pumped Hydro Energy Storage (PHES)
- Li-ion batteries (Li-Ion)
- Lead-acid batteries
- Sodium-sulphur batteries (NaS)
- Vanadium Redox Flow batteries
- Molten Salt
- Compressed air energy storage (CAES)
- Supercapacitors
- Flywheels

The competitiveness of the storage technologies depends on the service they provide. Various grid services are exemplified by different operational and load patterns, and the ability either to react quickly or to provide bulk power for longer periods makes certain technologies more suitable for some services than others. The Levelized Cost of Storage (LCoS) for the service of storing solar PV energy during peak production and providing it later the same day is shown below in Figure 1.

Comparing the data for the selected technologies on the long term shows that Li-ion batteries are expected to be among the cheapest technologies for consuming excess renewable energy and providing it during low power supply, while other battery types are also under steady development and will become competitive to more mature technologies. Other technologies might however be more suitable for power provision. That is the case for flywheels, which are less competitive for energy storage and thus excluded from the figure. Therefore, it is important to assess the technology mix based on specific service needs in local power systems.

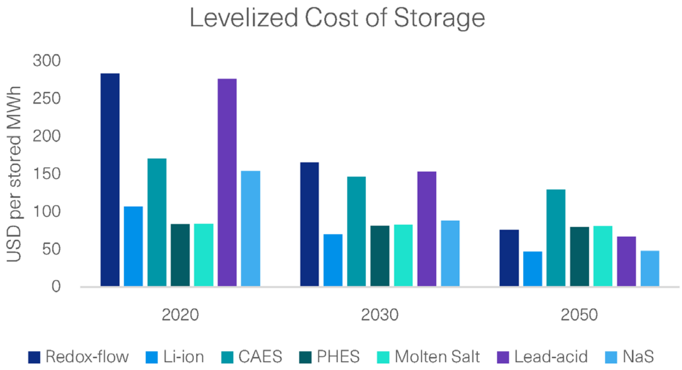

Figure 1: Levelized Cost of Storage for various technologies from 2020 and projected to 2050 for the grid service of PV storage. Calculations are based on technical and financial data from the Storage Technology Catalogue implemented in an internal LCoS model by the Danish Energy Agency.

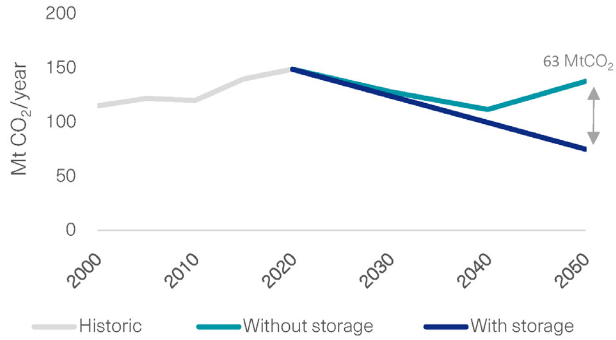

Figure 2: CO_2-emssions in two scenarios with and without electricity storage

Energy storage has a large mitigation potential

The TC has been used to determine the mitigation potential of storage technologies. By providing key technological and financial data as input to energy system analysis, the TC helps to illuminate the potential CO_2 reduction from introducing storage facilities. The analysis was carried out with the energy system optimization tool, Balmorel, which is able to simultaneously optimize investment in power plants, transmission lines, storage facilities and hourly dispatch.

The analysis shows that storage technologies can contribute to a reduction of 63 million tons CO_2 in 2050 (Figure 2), compared to a scenario without storage. This corresponds to a reduction of 45% of CO_2 emissions from the Mexican energy system by 2050 compared to a scenario without storage.

Energy system analysis is a well-known methodology within governmental energy planning. It demonstrates the cost-optimal pathway of integrating renewable energy into the energy system, while maintaining a high level of security of supply. Denmark has a decade-long experience with such approaches, which has supported the record-high 50% share of wind- and solar power in electricity production.

Regulatory barriers can challenge a smooth integration of storage

Regulatory barriers are often seen as one of the main obstacles for investments in storage technologies. To achieve the full mitigation potential from storage, such barriers must be identified and addressed at political level. The main barriers identified in cooperation between INECC and the Danish Energy Agency are:

- **Grid tariff design** currently encumber costs on stored energy both for charging and discharging
- **Market barriers** include inadequate requirements or lack of definitions for storage to deliver capacity and ancillary services
- **High financial risk** caused by short-term markets for services provided by storage as compared to longer term markets for conventional generation technologies

Background

The TC and associated activities were developed in cooperation between INECC and the Danish Energy Agency under the Danish Energy Partnership Programme 2017-2020.