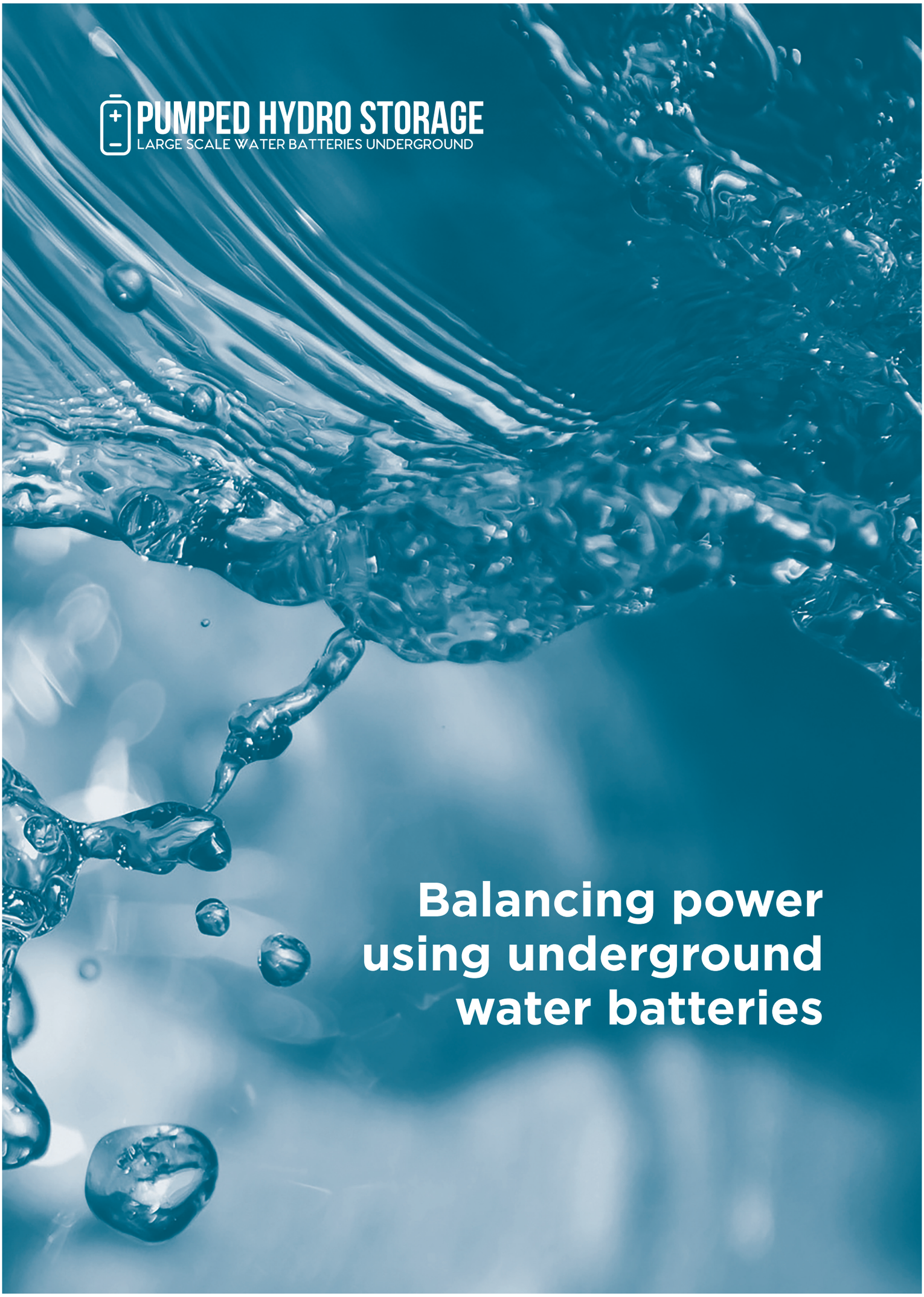


PUMPED HYDRO STORAGE

LARGE SCALE WATER BATTERIES UNDERGROUND

Balancing power using underground water batteries

THE PROBLEM

The amount of energy produced by renewable energy alternatives is heavily increasing as fossil sources are phased out.

Renewable energy, such as wind and solar power, are often unreliable with far too great variation in the amount of electricity produced compared to consumer usage. This implies challenges to maintain stability in the electric grid.

These challenges are increasing as the entire society is transitioning toward electrification; electric cars can be viewed as one driving force behind this trend. This calls for innovations that can facilitate the stabilization of the electric grid in the long term.

OUR SOLUTION

To overcome the challenges in the electric grid, we develop pumped-storage plants in abandoned mines. By doing this, we can provide power storage facilities with drastically lower investment costs, technological risks, and environmental impacts compared to alternative methods.

This is achievable primarily due to the minimization of the construction work needed to transform the mine into a storage facility.

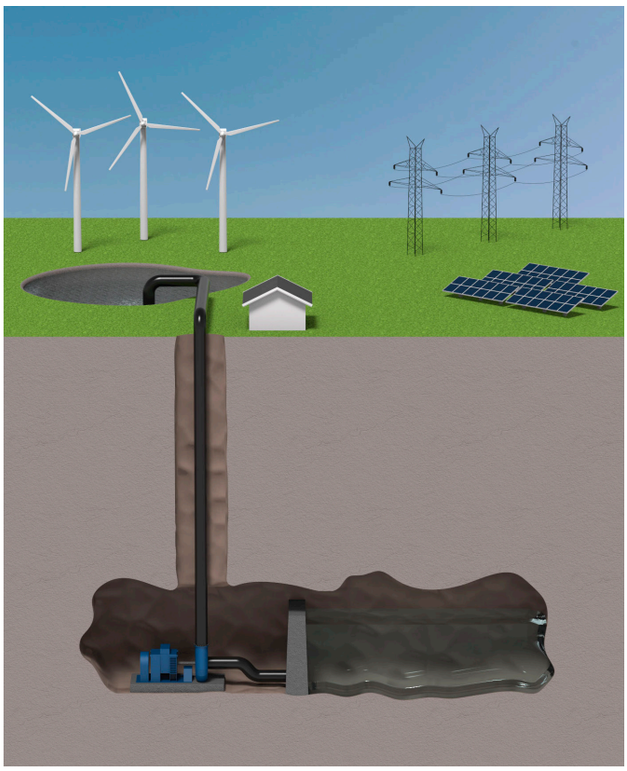
HOW WE STORE ENERGY IN OUR PUMPED-STORAGE PLANTS

Excess energy in the electric grid is used to pump water to an upper reservoir.

1

When an energy deficiency arises, the water is channeled back through the turbine that sends energy back out to the electric grid.

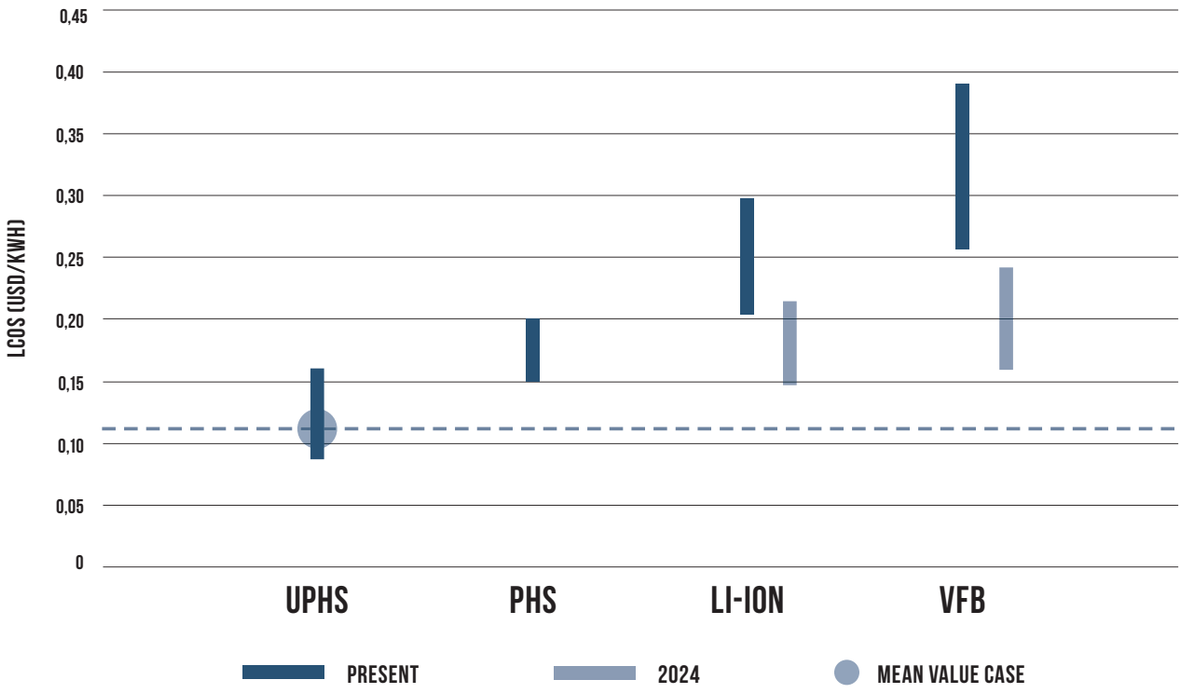
2



WHY US

We are pioneering the field of pumped-storage plants focusing on identifying the best locations to build plants and bring the projects into completion. To ensure that the usage of the facilities is optimized, we are also focusing on developing software that will determine the timing of pumping and generation of electricity. This creates a unique opportunity to channel investments into circular economy activities.

COST OF STORAGE



The graph shows the span of levelized cost of storage, i.e total cost per kWh of energy stored. The technologies displayed are Underground Pumped Hydro Storage (UPHS), traditional Pumped Hydro Storage (PHS), Lithium-Ion (Li-Ion), and Vanadium-Flow batteries (VFB).*

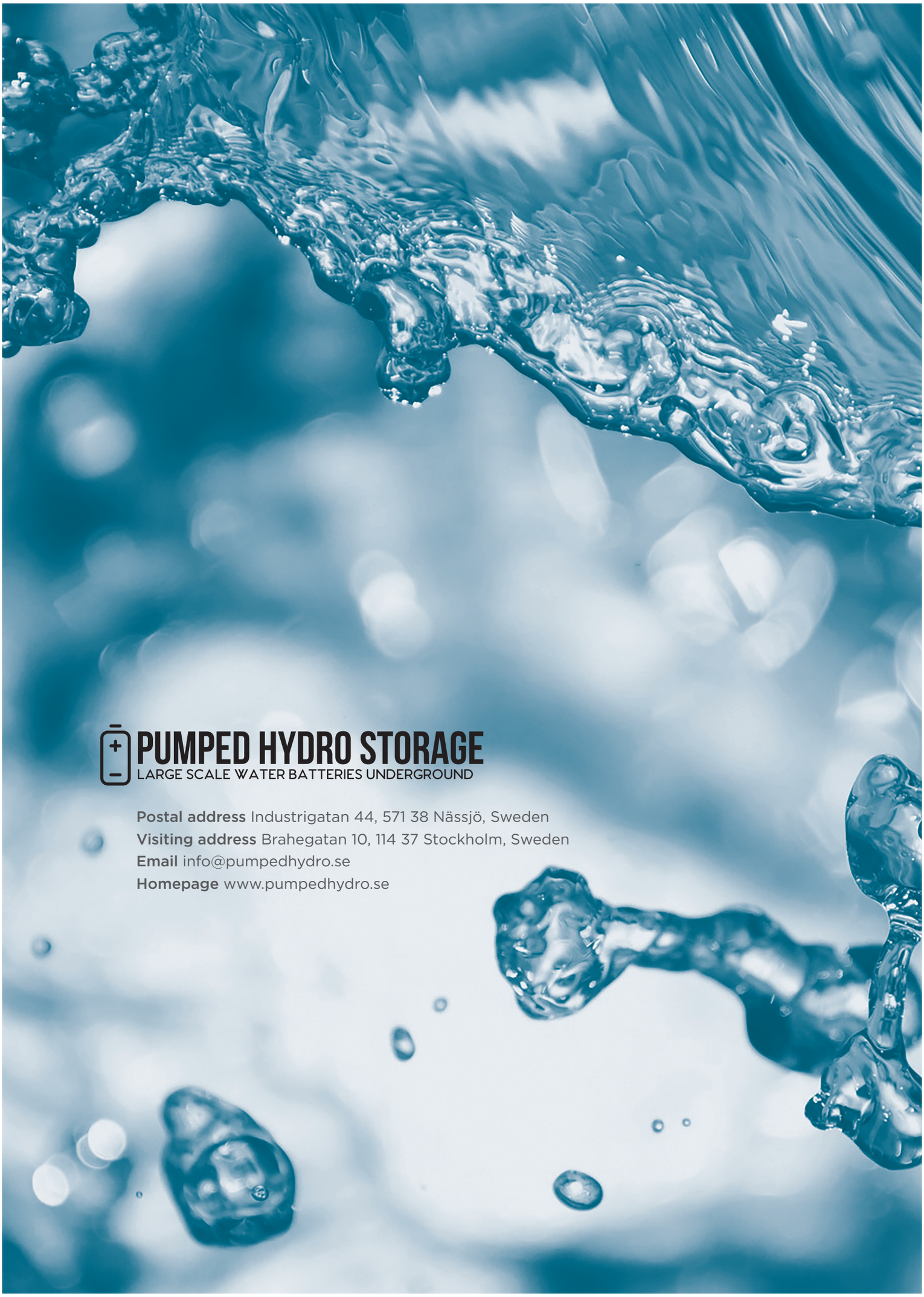
The financial advisory Lazard has developed a measure - Levelized Cost of Storage (LCOS) - to compare cost of storage across different technologies. The measure is a ratio of total costs per kWh of energy stored.

The numbers for PHS, Li-Ion, and VFB have been derived from LCOS analysis reports published by Lazard. The calculations for UPHS is based on on-going development projects that utilise old-mines or quarries as reservoirs. The methodology developed by Lazard was applied.

Projections of levelized cost of storage for the year 2024 has been made for Li-Ion and VFB based on Lazard's estimate of a decrease in CAPEX by 28% for Li-Ion and 38% for VFB. Since traditional PHS is a mature technology, no major improvements of costs or efficiencies are anticipated.

What we see is that the underground pumped hydro storage will likely remain the most cost-efficient form of large-scale energy storage for the foreseeable future.

* General assumptions applied are a discount rate of 11.2% and a charging cost of 0.03USD/kWh.



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