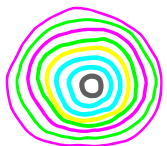


Innovation on Hydro Pump Storage

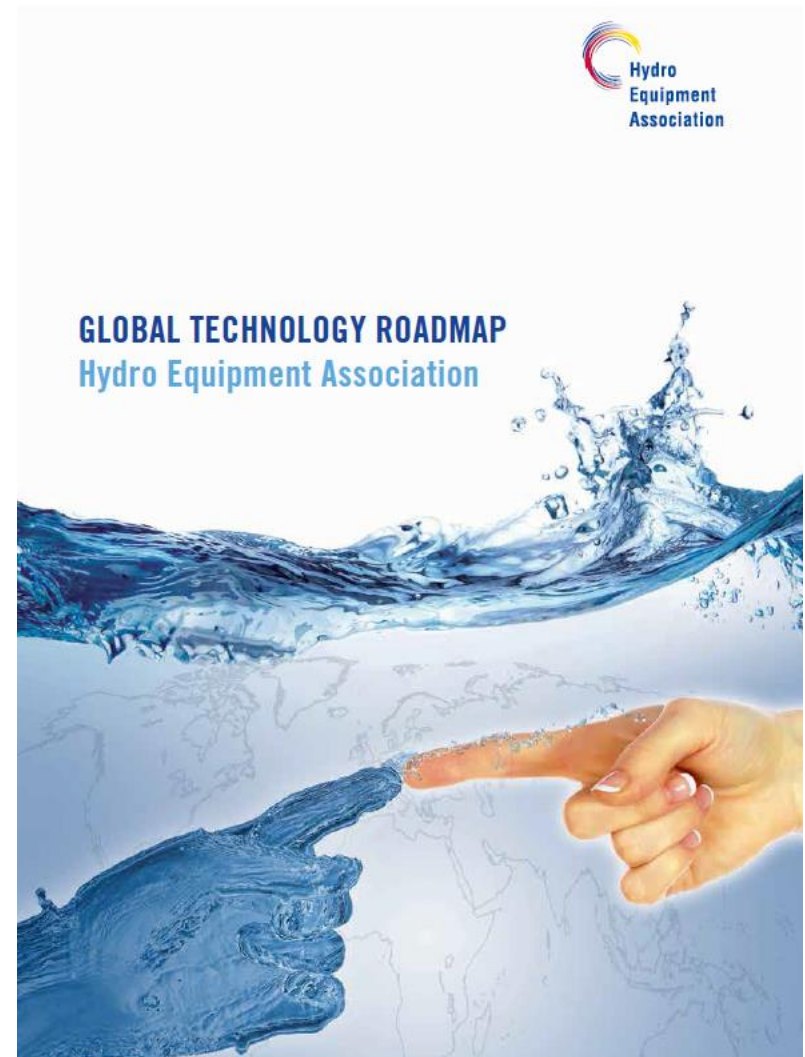
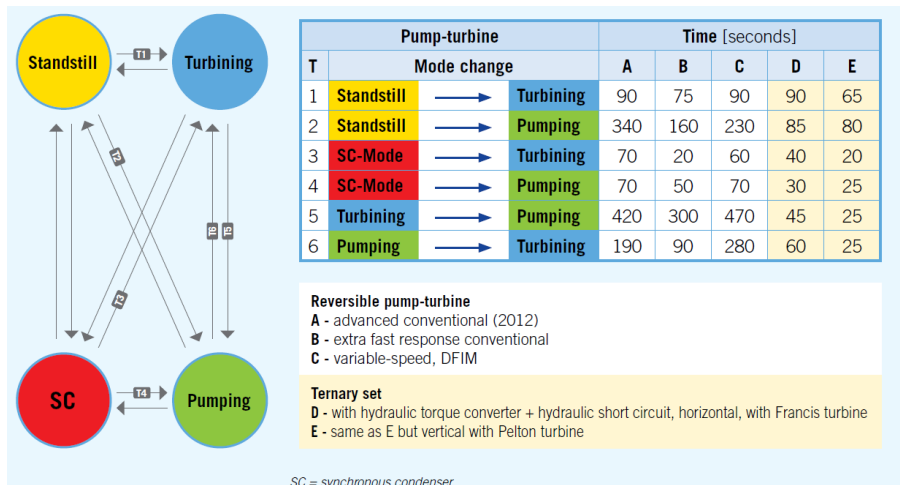
Brussels , 2017-04-06



Welcome
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150 Years

Innovation on Hydro Pump Storage HEA Roadmap

Hydro Equipment Manufacturers
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GLOBAL TECHNOLOGY ROADMAP

One complete Chapter is dealing with needed innovations on Pumped Hydro

Pumped storage plants for efficient and cost-effective energy storage from hours to months

PUMPED STORAGE PLANTS

Pumped storage plants (PSP) were first deployed in the 1930s. They pump water from a lower reservoir to an upper reservoir when electricity prices are low, and regenerate electricity from the water flowing back downhill when prices are higher (Figure 26). Where neither reservoir receives natural inflow of water from a watercourse, the PSP is said to be "closed loop" (all the rest are "open systems"). Closed loop systems, which are initially charged from a nearby water body, are almost completely isolated from an ecosystem by being built underground, which simplifies their environmental permitting.

PSP achieves a round-trip efficiency of 80%. This compares favourably with other storage technologies especially when PSP's high power and storage capacity is considered (Figure 27).

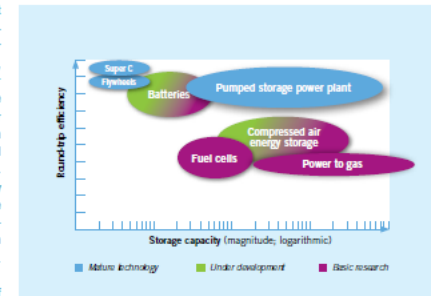


Figure 27: Comparison of electricity storage technologies. PSP is the only form of bulk electricity storage technology that today offers high efficiency and high capacity at low cost. Round-trip efficiency is the electrical efficiency of the whole storage cycle from electricity to electricity at the grid connection point.

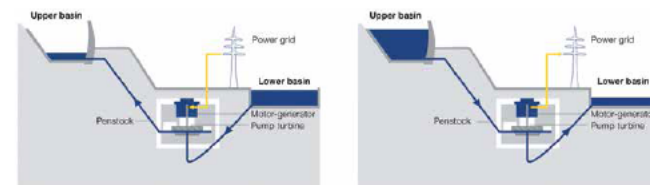
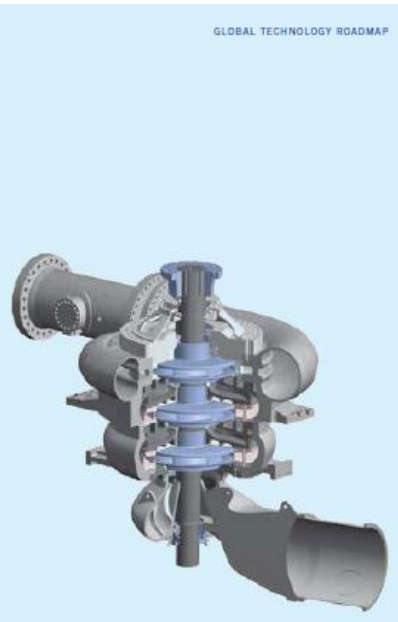


Figure 26: Principle of operation of a pumped storage plant (PSP): left: pumping (electricity storage), right: turbining (electricity generation)

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Technology outlook

PSP will need to start and stop more often and faster. By 2030, the target is to have increased the lifetime of turbine runners and critical rotor parts from 10,000 stop-starts to 100,000.

The use of variable-speed technology supports this trend. Variable-speed technologies come in two flavors: the **Double Fed Induction Motor-generator (DFIM)** and the **Synchronous Motorgenerator with Full-power Converter (SMFC)**. Efficiency will increase from

98% today to 99% by 2030. Novel forms of PSP, some of them facilitated by variable-speed technology, are under consideration. These include:

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Technology outlook

- > PSP built in or along the sea and that use the sea as a reservoir (to be situated close to wind farms and minimise offshore grid extension costs)
- > PSP using underground reservoirs (such as dis-used mines)
- > PSP using heavy masses (lifting a body of water on top of which rests a denser material, like sand).

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The Voith logo consists of the word "VOITH" in a bold, blue, sans-serif typeface. The letters are closely spaced and have a consistent weight throughout.

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