Role of Hydrogen for large Scale Energy Storage

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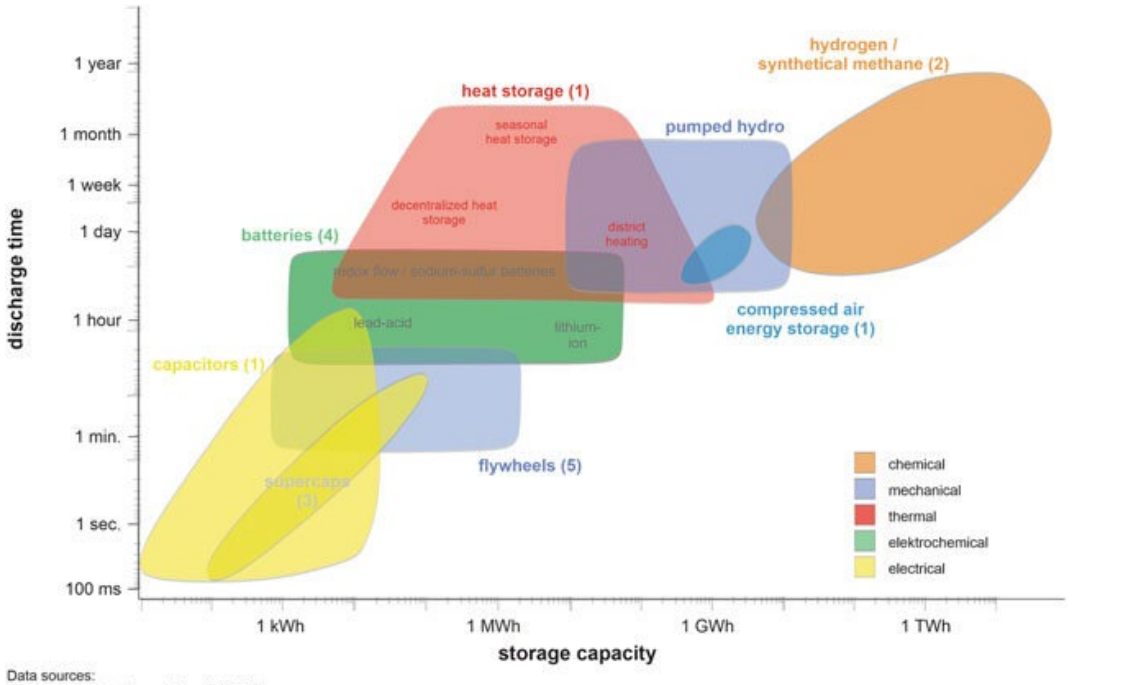
Beyond its traditional industrial use (for refining and fertilizers) massively relying on fossile-based hydrogen, hydrogen is anticipated to play a key role in new applications within the context of the energy transition: In the industrial sector, to decarbonize "hard-to-abate" sectors; As fuel for heavy-duty or long-distance transport (e.g., trucks, ships, or aircraft), either through direct use in fuel cells/engines/turbines, or indirectly to produce e-fuels when combined with CO_2; Lastly, when produced via electrolysis, hydrogen offers a means to store renewable electricity. Indeed, the global increase of renewable energies, particularly wind and solar, is creating an urgent need for large-scale energy storage. Since these sources are variable and intermittent, effective storage solutions are essential to balance supply and demand, ensure grid stability, and make full use of renewable production. Hydrogen offers a unique answer to this challenge. First it can store surplus renewable electricity in large amounts over long periods (figure). Second, it can transport energy across regions, and finally it can be used flexibly in power generation, industry, mobility, and heating.

The use of hydrogen as a mean to store massively renewable energy has a strong impact on two segments of the value chain. First, it is needed to operate electrolysers in an actively flexible grid-stabilising mode. Second, it requires to implement hydrogen storage means compatible with large quantities and long duration storage.

The presentation will cover opportunities and challenges related to the flexible operation of electrolyzers, as well as for massive hydrogen storage, with a particular emphasis on underground storage.



Data sources:
(1) Own data, Fraunhofer UMSICHT
(2) Moore, Jason; Shabani, Bahman: A Critical Study of Stationary Energy Storage Polices in Australia in an International Context The Role of Hydrogen and Battery Technologies; School of Engineering, RMIT University, 2015
(3) Sterner, M.; Stadler, I.: Energiespeicher - Bedarf, Technologien, Integration; Springer, 2017
(4) Eigene Daten, Fraunhofer UMSICHT + Wang, Zhiwen et al.: A review of marine renewable energy storage; International Journal of Energy Research, Volume 43, Issue:12; DOI: (10.1002/er.4444)
(5) Bos, Martin: Storage of renewable electricity in methanol; ISBN: 978-90-365-4791-8; DOI: 10.3990/1.9789036547918
(6) Doetsch, Chr.,: Energiespeichertechnologien- & Anwendungen, Teil b – „Technologien". [Video] ORCA.nrw. ORCA OER: Energiespeicher_#01b.mp4, 00:07:50-00:09:32

Source of the picture: Schischke, E., et al. (2024). Overview of Energy Storage Technologies Besides Batteries. In: Passerini, S., et al. (eds) Emerging Battery Technologies to Boost the Clean Energy Transition. The Materials Research Society Series. Springer, Cham. https://doi.org/10.1007/978-3-031-48359-2_4