ON THE AMBIGUOUS MARKET PROSPECTS OF STORAGES FOR PROMOTING ELECTRICITY GENERATION FROM INTERMITTENT RENEWABLES

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Overview.

The European Commission has set ambitious targets for increasing the share of electricity from renewable energy sources (RES-E). In recent years especially electricity generation from intermittent sources like wind and solar has rised. To balance electricity supply over time calls for storages has been launched. Because intermittency also exists over longer periods – months, years, -- especially the need for long-term- electricity storages is discussed.
The core objective of this paper is to investigate the future market prospects of long-term electricity storages like hydro pump storages, and power-to-gas (PtG) technologies like hydrogen (H2) and methane (CH4).

Method

Our method of approach is based on simple levelized cost calculation of electricity storages. The most crucial parameter in this context are fullloadhours (FLH). To answer the core question of future prospects we use a dynamic framework to model supply from various quantities of intermittent RES- E and the load profiles based on Western European conditions. The analysis of future prospects it is based on technological learning (TL) regarding the future development of investment costs of long-term storages. This analysis is based on quantities for technologies described in IEA (2011). Note, that for hydro storages we do not consider further TL.
On the electricity market side we use a fundamental approach where the intersection of supply and demand at every point-of-time gives the corresponding electricity market price. It is important to note that the quantity of storage has a feedback on the market price for charging storages as well as discharging and, hence, on the price spread..

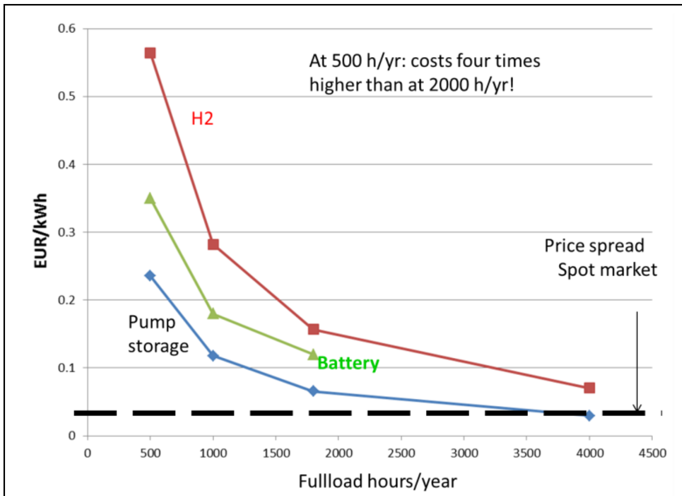

Figure 1. Costs of storing electricity for different technologies depending on the fullload hours

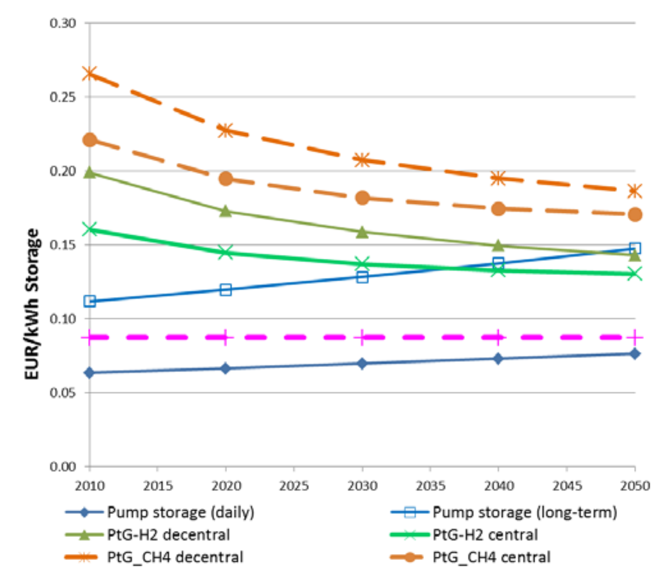

Figure 2. Development of costs of several technologies for long-term storage of electricity depending on Technological Learning over time up to 2050

Results

The major results of our Investigations are:
The first major problem of the economics of storages are their low FLH, see Fig.1. Currently, a figure of about 2000 hours per year is considered to be the minimum. As Fig. 1 shows costs are e.g. about four times higher if the FLH are reduced to 500 h/yr. Moreover, Fig. 1 shows that at current price spreads of about 3 to 5 cents/kWh in the German/French market no type of storage is economically attractive at FLH below 4000 h/yr. Also in the long run the economic prospects of storages do not look much brighter. Over the period up to 2050 decreases in the prices of PtG- technologies will take place mainly due to learning effects. For long-term hydro pump storages (over a year) further prices will rather increase mainly due to a lack of sites with reasonable costs and lack of

acceptance, see Fig. 2. In a dynamic market framework the costs of all centralized long-term storage technologies will finally be too high to become competitive. By 2030 under most favourable learning conditions the costs of hydrogen and methane for 2000 fullload hours per year will be between 0.15 EUR/kWh and 0.20 EUR/kWh. For the same FLH the price spread will be at the utmost about 0.08 EUR/kWh.

An additional reason for the unfavorable economic conditions of long-term storages is the self-cannibalism of storages in electricity markets. This means that every additional storage has lower FLH then the one before, see Fig. 3 and, in addition reduces the price spread and, hence, its own economic performance, Ehlers (2011).

Other reasons for limited attractiveness of long-term storages are competition with demand response options, demand–side management, and grid extention, see Fig. 4. Moreover, decentralized storages might also compete. The costs of the latter will not decline significantly faster but they will compete on end-user price level which is (and will remain) remarkably higher

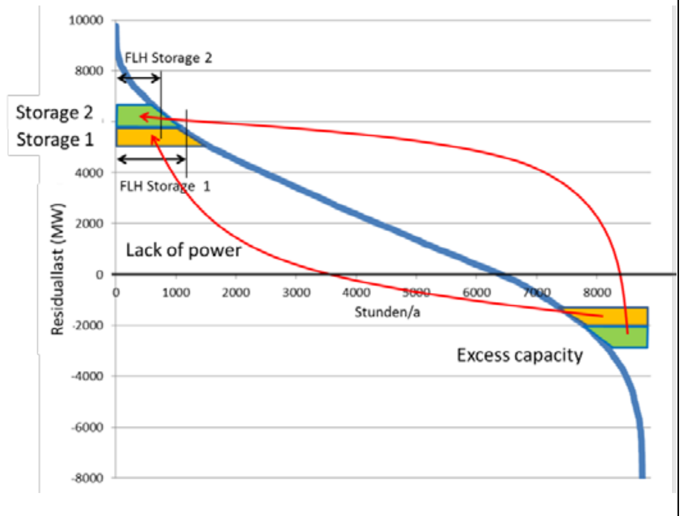

Figure 3. Fullloadhours of additional storages within a load duration curve with large shares of RES-E

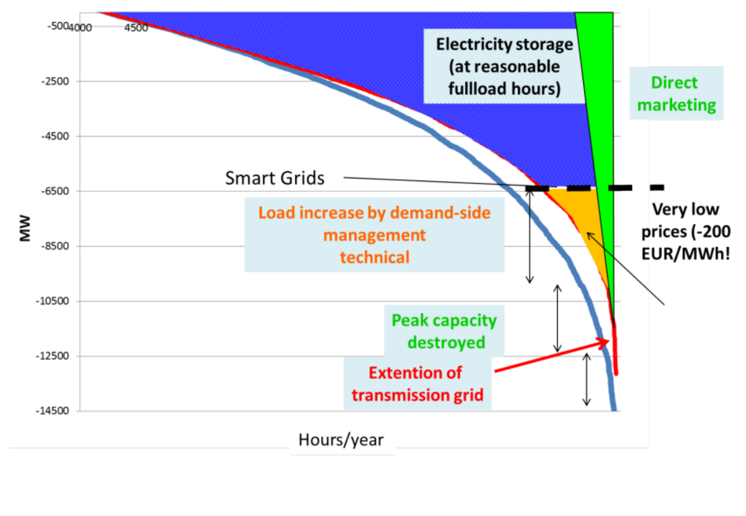

Figure 4. Options for flexible use of excess electricity competing with long-term storages

Conclusions

The major conclusions are: (i) Despite many calls for a prophylactic construction of new storage capacities with respect to all centralized long-term storage technologies the future perspectives will be much less promising than currently indicated in several papers and discussions; (ii) new long term hydro storages will not become economically attractive in general in the next decades; however, daily storages will remain the cheapest option and the most likely to be competitive; (iii) For PtG-technologies it will also become very hard to compete in the electricity markets despite a high technological learning potential. Yet, for hydrogen and methane there are prospects for use in the transport sector. Fuel prices in transport in recent years have rather increased compared to stagnation or decreases in electricity spot markets. Consequently, and given in addition the lack of environmentally benign fuels for mobility hydrogen and methane from renewable electricity might become an economically alternative for fueling passenger cars.

However, in any case new storages should be constructed only in a coordinated way and if there is a clear sign for new excess production, in this case of RES.

References

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Keywords: storages, electricity markets, power-to-gas, hydro pump storages, economics