Solution Mining Research Institute Fall 2011 Technical Conference
York, United Kingdom, 3–4 October 2011

PRESENT TRENDS IN COMPRESSED AIR ENERGY AND HYDROGEN STORAGE IN GERMANY

Jürgen Kepplinger, Fritz Crotogino, Sabine Donadei
KBB Underground Technologies GmbH, Hannover, Germany

Manfred Wohlers
IVG Caverns GmbH, Etzel, Germany

Abstract

As a consequence of the Fukushima power plant accident, Germany has decided to phase out nuclear energy generation within the next ten years. This will further accelerate the change-over from a fossil/nuclear energy economy to one based on renewable energy sources. The fluctuating availability of the predominant energy sources of wind and solar results in two key consequences and ultimately a high future demand for storage caverns. On the one hand it is anticipated that the shift away from nuclear energy will trigger a significant demand for new flexible gas fuelled power stations to provide short-term compensation of any lack of wind and solar energy. This will in turn trigger additional demand for extremely flexible gas storage capacities. On the other hand, the increase in direct generation of electrical power will also raise the need for capacities for electrical energy storage to allow for both short and long term equalization of power generation and load.

This *short-term* electrical energy reserve sector - in terms of minutes and hours - is the domain of pumped-hydro and (future) compressed air energy storages because of their high inherent efficiency. Whereas the further construction of pumped-hydro storage systems is extremely limited for environmental reasons, there is sufficient geological potential for compressed air energy storage caverns, especially in the windy areas of northwest Germany and the Netherlands.

If *larger energy quantities* are to be exploited, i.e. as arise after long periods with excess wind power - which can no longer be used within the grid - hydrogen storage facilities can step into the breach. The reason being that the volumetric energy storage density of hydrogen storages is higher by approximately two orders of magnitude. Moreover, salt caverns are almost ideally suited for the storage of hydrogen, as has been proven in several projects in England and the Southern USA.

Reflecting the low power-to-power efficiency of the hydrogen chain, maximum 40%, from wind turbine to generator in a combined cycle gas power station, alternative uses of wind hydrogen are currently under discussion and being investigated at demonstration and pilot plant scales. Current applications under consideration include the injection of hydrogen into the gas network at a level of initially 5 – 10 %; the substitution of hydrogen produced to date from natural gas using reformers for the chemical and petrochemical industries, and use as an energy source for a future fleet of fuel-cell powered vehicles.

All of the above applications have in common that demand is relatively constant throughout the year, whereas the generation of excess wind or solar power is extremely variable along various time scales. Gas storage caverns represent the principal choice in equalizing the above for safety and cost reasons, and have proven their outstanding capabilities in the gas economy for many decades.

Key words: Renewable energy, compressed air energy storage, CAES, hydrogen storage