Efficient Long Distance Hydrogen Transport Including DME as Hydrogen Vector and CO_2 Back-shipping

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Abstract

This contribution introduces the DME/CO_2 hydrogen storage cycle, designed for efficient long-distance transport of renewable hydrogen between specific harbor points. The process involves bonding renewable hydrogen with CO_2 to produce DME and water at a location rich in renewable energy (e.g. Australia). The liquefied DME holds excellent transport properties, making it easily feasible to use existing tanker and port technologies for shipment and handling. Upon arrival at the destination harbor in a rather energy scarce region (e.g. Europe), DME steam reforming is employed to release H_2 and CO_2. These two components are then separated, with H_2 being distributed through a domestic pipeline infrastructure, while the CO_2 is liquefied and transported back to the energy-rich location. This approach significantly reduces the need for costly DAC (Direct Air Capture) technology, as it is only required to make up for CO_2 losses that occur within the transport cycle.

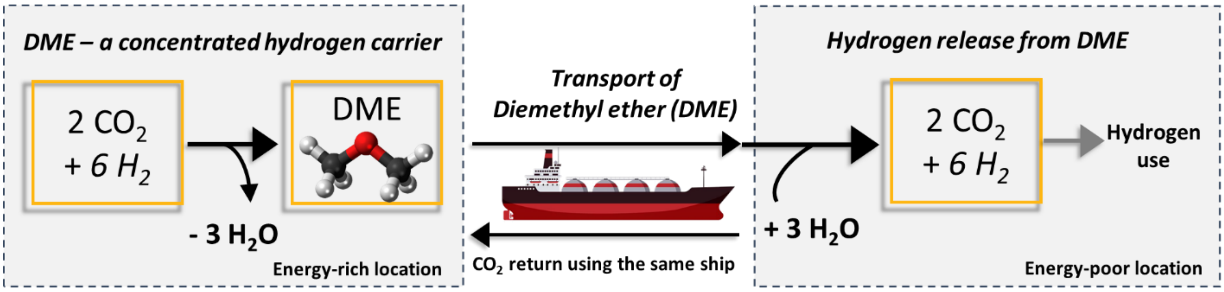

Figure 1: Sketch of the proposed hydrogen transport cycle using DME as vector and including CO_2 back-shipping.

The back-shipping of CO_2 is made possible due to the similarity in physico-chemical properties between DME and CO_2, which significantly enhances the economic competitiveness of this hydrogen logistics technology. Additionally, the DME/CO_2-cycle offers the advantage of efficient water management. The poster will explain that by utilizing DME as a hydrogen carrier, the need for costly and environmentally harmful seawater desalination at the hydrogen generation site can be reduced.

In a direct comparison with ammonia and methanol, which are currently among the most discussed hydrogen carrier molecules, DME exhibits superior technical hydrogen capacity, higher gravimetric energy density, and lower toxicity. The proposed DME/CO_2 cycle also stands out for its high energetic efficiency, as well as its relatively low heat demand and temperature level required for H_2 release, further solidifying the advantages of this new concept.