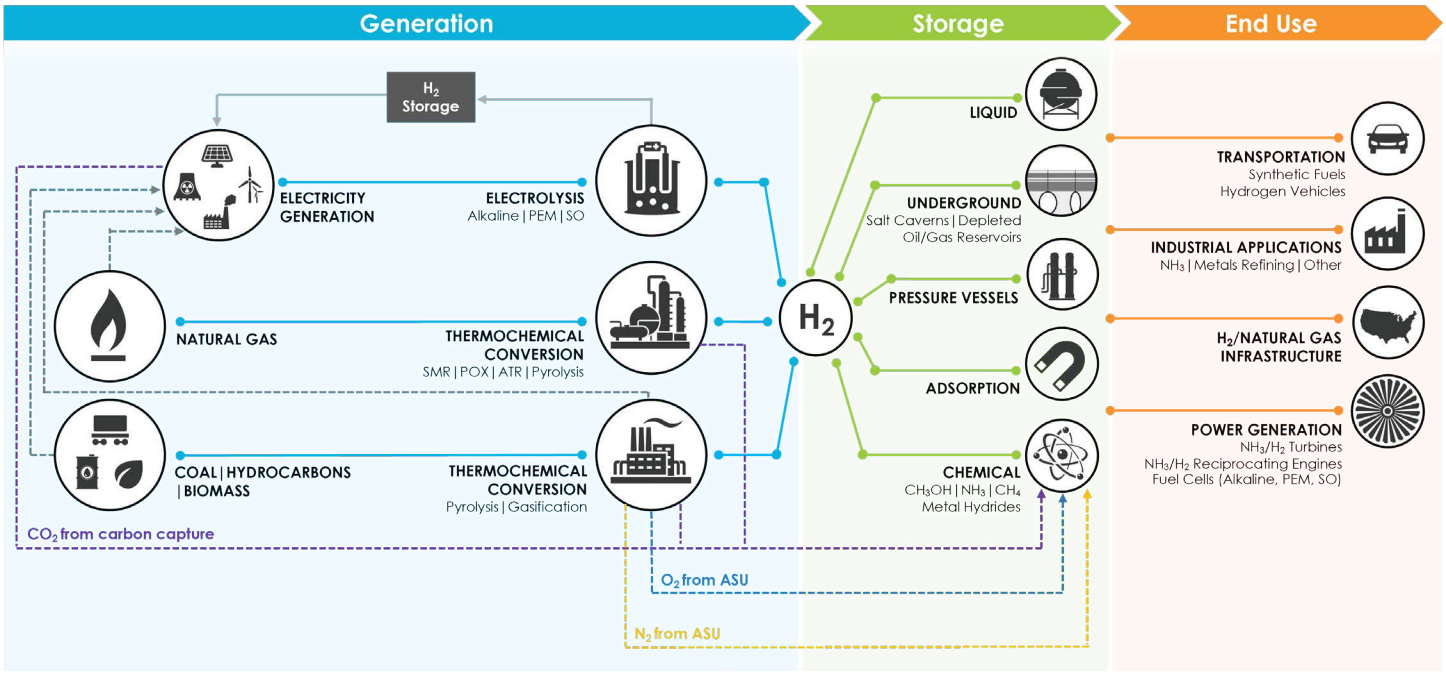
CHEMICAL ENERGY STORAGE

DEFINITION: Energy stored in the form of chemical fuels that can be readily converted to mechanical, thermal or electrical energy for industrial and grid applications.

Power generation systems can leverage chemical energy storage for enhanced flexibility. Excess electricity can be used to produce a variety of chemicals, which can be stored and later used to produce electricity or for a variety of other applications.

TECHNOLOGY EXAMPLES



METHANE

Methane has a larger volumetric energy density compared to hydrogen, and there is significant existing infrastructure for transportation and handling of methane. Hydrogen and captured CO_2 can be used to produce synthetic methane, which can be stored or used within the existing natural gas grid.

METHANOL

Methanol is formed through the hydrogenation of CO and CO_2 and, as a liquid chemical, can be easily stored and transported relative to other fuels. Methanol can be converted into a variety of other chemicals and may also have potential as a transportation fuel.

AMMONIA

Ammonia is another potential energy carrier and can be formed from hydrogen and nitrogen. Like methane, there is existing infrastructure for the transportation of ammonia (due to its widespread use as fertilizer). The use of ammonia directly as a fuel for power generation systems (combustion turbines, reciprocating engines, etc.) is a current area of research.

HYDROGEN

Hydrogen is commonly suggested for chemical energy storage due to the variety of low-carbon production methods and end-use applications.

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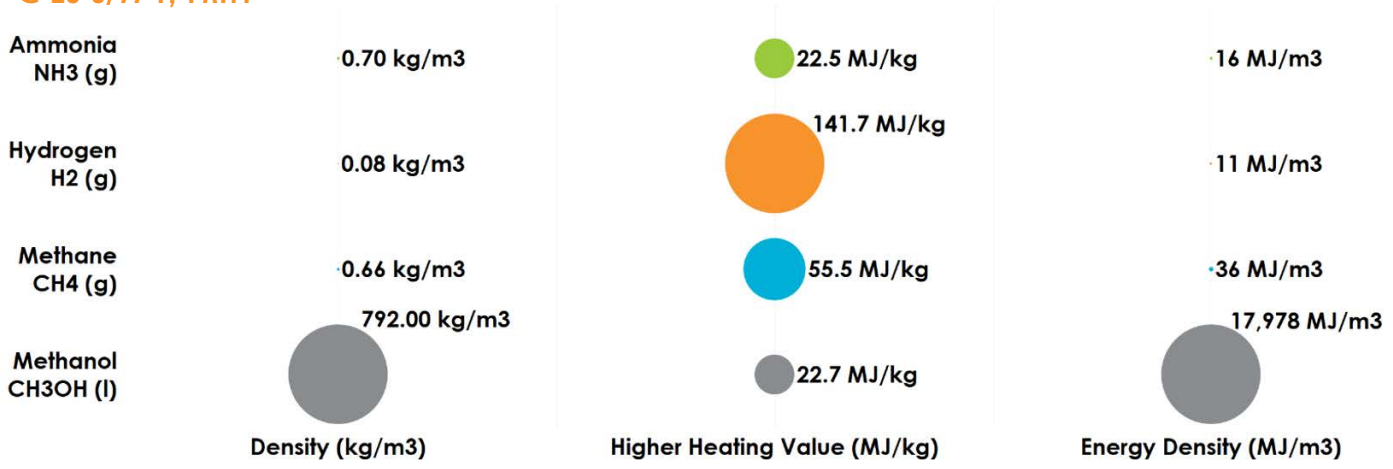
ADDITIONAL INFORMATION

CHEMICAL ENERGY STORAGE

Advantages of Chemical Energy Storage	Disadvantages and Challenges of Chemical Energy Storage
• Large storage capacities possible • Long discharge durations achievable (days-weeks-months) • Many pathways for production, storage and end use • Long lifetime • Provides the potential for alternate revenue streams outside of electricity sales • Extensive infrastructure for transportation and handling exists for some chemicals • Liquid chemicals (like methanol) may be easier to store and transport	• Some storage methods are dependent on regional geology aspects (i.e. underground storage) and may have large land requirements • Safety hazards associated with chemical physical properties • Chemicals with low volumetric energy densities require larger storage volumes which can be expensive • Lower round trip efficiency for electricity storage and recovery as compared to battery storage

PHYSICAL PROPERTIES OF SELECT CHEMICALS

@ 25°C/77°F, 1 ATM



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