



The paper offers a comprehensive analysis of the current state of hydrogen energy storage, its challenges, and the potential solutions to address these challenges. As the world increasingly seeks sustainable and low-carbon energy sources, hydrogen has emerged as a promising alternative.



Hydrogen is a versatile energy storage medium with significant potential for integration into the modernized grid. Advanced materials for hydrogen energy storage technologies including adsorbents, metal hydrides, and chemical carriers play a key role in bringing hydrogen to its full potential.



Hydrogen storage plays, featuring a suitable reservoir formation, a caprock that will retain the stored hydrogen and a trap structure which allows efficient reproduction, could provide a geographically more flexible solution for large-scale energy storage than salt ???



Advantages. Pipelines act as storage and transportation methods for gas. The storage of energy through a gas network experiences much less loss ( $<0.1\%$ ) than in a power network (8%). When blended with natural gas, the natural gas leakage rate reduces slightly due to the higher mobility of hydrogen molecules.



Hydrogen can be stored in a variety of physical and chemical methods. Each storage technique has its own advantages and disadvantages. It is the subject of this study to review the hydrogen storage strategies and to survey the recent developments in the field.



The U.S. Department of Energy Hydrogen Program, led by the Hydrogen and Fuel Cell Technologies Office (HFTO) within the Office of Energy Efficiency and Renewable Energy (EERE), conducts research and development in hydrogen production, delivery, infrastructure, storage, fuel cells, and multiple end uses across transportation, industrial, and stat



Hydrogen-rich compounds can serve as a storage medium for both mobile and stationary applications, but can also address the intermittency of renewable power sources where large-scale energy