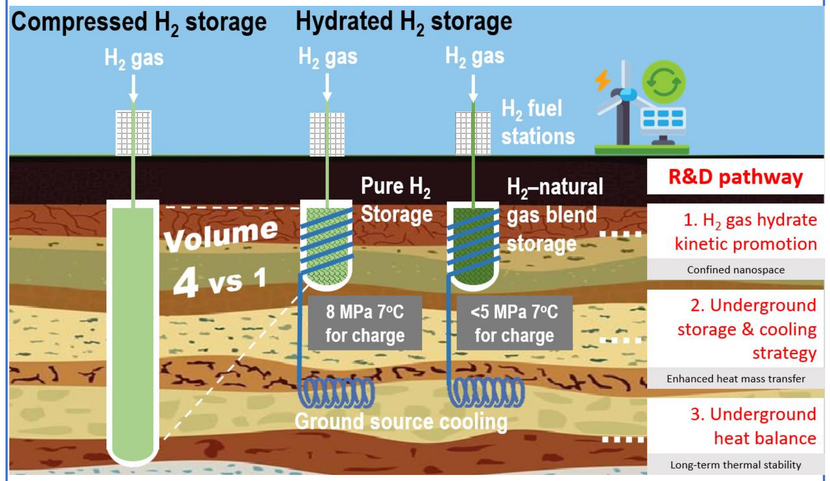
H_2 storage enabled by nano-scaffolded gas hydrate capsules with ground-source energy utilisation

This Project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Transformative Research Accelerating Commercialisation Program.

This project will develop technology for fully-scalable (from small to large size), safe (<**8 MPa**) and highly-efficient (>**4 wt%**) H_2 storage through clathrate hydrate-based hydrogen storage (CHHS) technology. It will replace expensive compressed storage at 70 MPa and cryogenic storage at -253°C. The combination of promising technological approaches including nano-scaffolding and encapsulation will bring significant mass transfer enhancement and promotion of H_2 hydrate formation kinetics so as to realise fast H_2 gas uptake in a few hours.



1. H_2 hydrate formation promotion through NANO-SCAFFOLDING and ENCAPSULATION
2. Reducing operational and capital cost through optimising H_2 STORAGE REACTORS and COOLING/HEATING STRATEGIES
3. Improving long-term thermal stability through SYSTEM INTEGRATION & OPTIMISATION

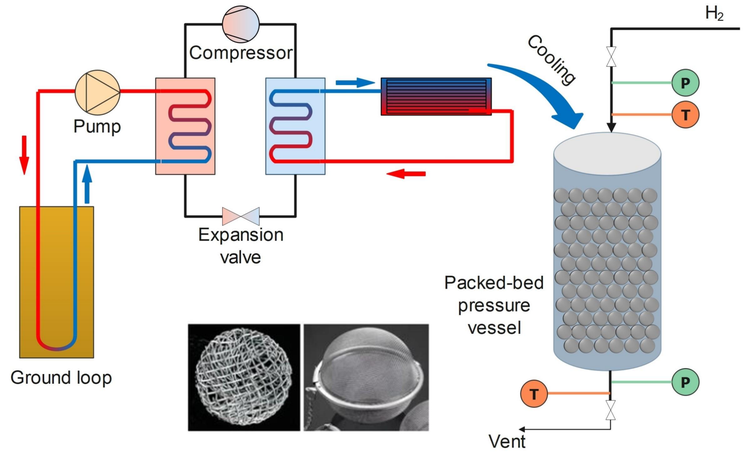
Phase 1
- Design of nano-scaffolding materials for H_2 hydrate formation promotion
- Evaluation of gas uptake rate and yield
- Modelling of optimised encapsulation structure for heat and mass transfer enhancement
- Evaluation of H_2 capsule cyclic performance

Phase 2
- Optimisation of packed-bed CHHS vessel structure
- CHHS system lab demonstration with performance assessment

Phase 3
- H_2 storage on-site performance assessment
- Design of ground-sourced heat pump system integrated with free geothermal cooling and heating
- Pilot-scale H_2 storage system integration
- Commercialisation strategy

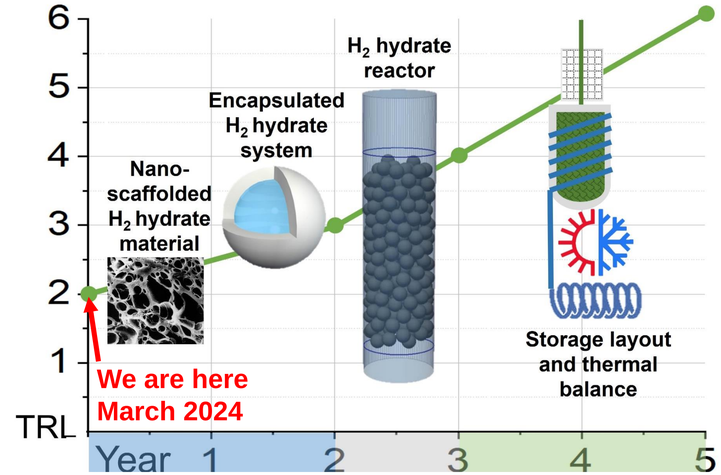
R&D Stage

Commercialisation Stage



Schematic of the pilot-scale CHHS system

- Fully scalable, safe (<8 MPa) and highly-efficient (>4 wt%) H_2 storage
- 3/4 reduction in footprint compared to that of compressed storage systems
- Low cost of USD$339/kg including vessels, site work and cooling systems
- Flexibility for H_2 storage aboveground, underground or in transport vehicles
- Improved competitiveness of the Australian H_2 industry globally



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