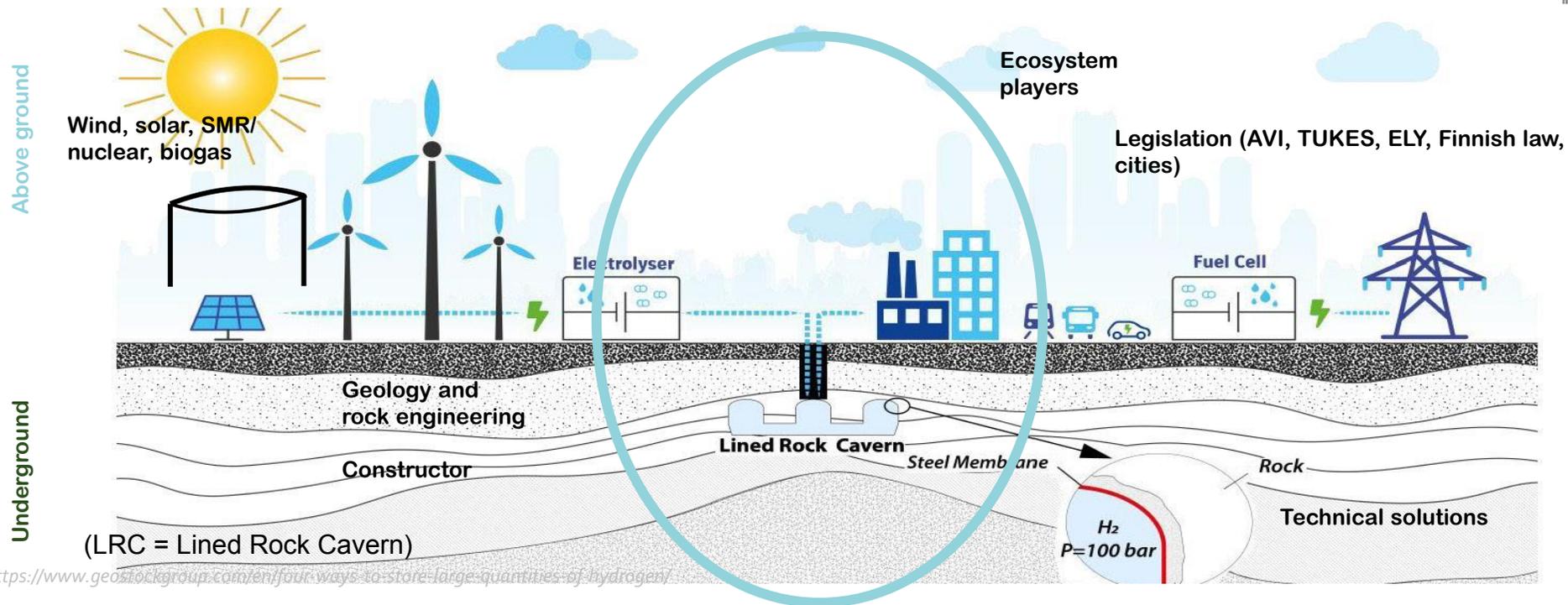
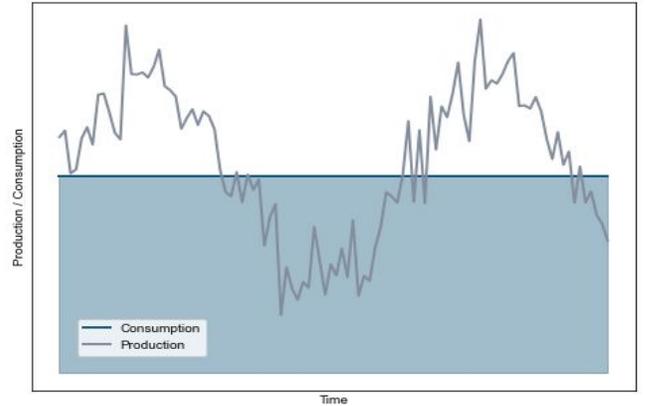


HUG HYDROGEN UNDERGROUND

BF CO-RESEARCH PROJECT
MAY 7TH 2025

HUG – Hydrogen UnderGround

Large scale Hydrogen underground storage is a key enabler of the hydrogen economy - it allows hydrogen production and consumption to be decoupled from each other, and thus stable H₂ distribution to its users.



Project volume:
2,572 M€

Project duration:
April 2024 –
March 2026

Questions we want to answer to

Ecosystems and business models

What are the reqs and models for viable value creation in the ecosystem?

Safety, sustainability and responsibility

How safety should be managed in the ecosystem and how new aspects affect the permitting process?

Green H2 value chain

Production

Supply

Storage
Operation

Distribution

P2X
Applications

Storage lifecycle

Commissioning +
Start-up

Excavation +
Construction

Design &
Engineering

Feasibility study

Dismantling +
Recycling

Maintenance
O&M

Lifecycles and Operations

How to design and ensure responsible operations, critical operator roles and responsibilities

How to ensure safe, resilient and reliable lifecycle

Design concepts and technology

What are the crucial site selection and investigations methods

What are the key design parameters for pressurized underground rock caverns

Feasible process technology and automation concepts

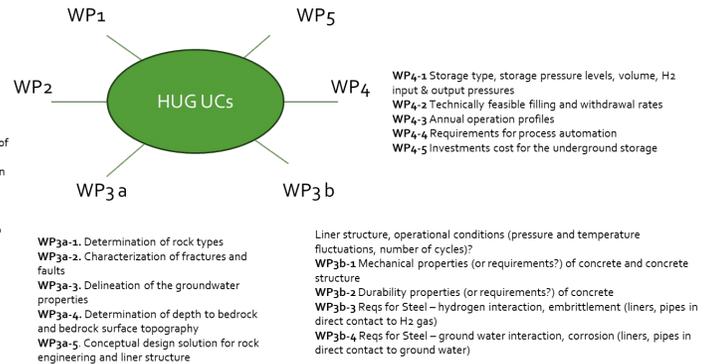
What are the cost of building and operations now and in the future

How simulation models support engineering of underground storages

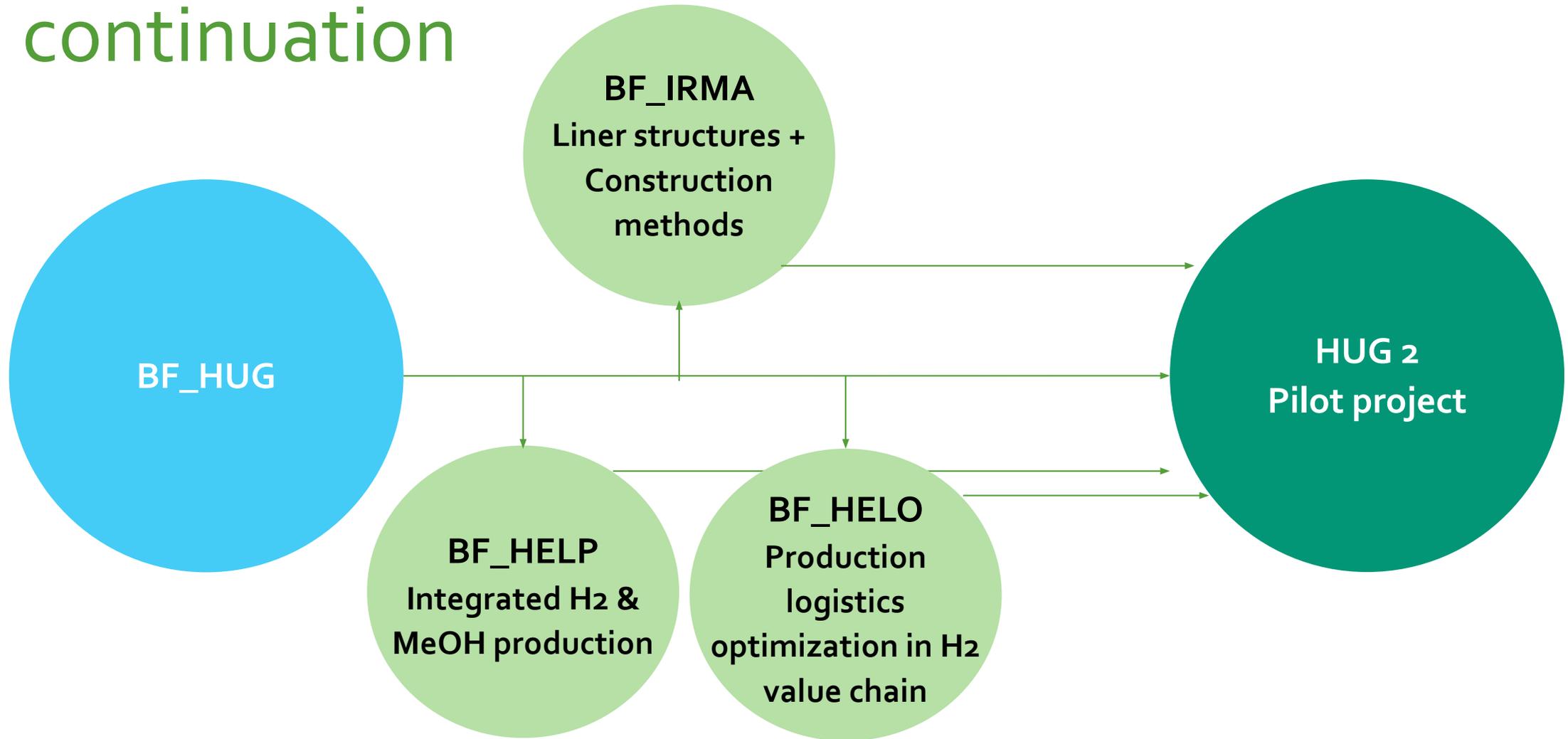
- WP1-1. High-level business model (including operation logic)
- WP1-2. Business across the lifecycle (including financial model (OPEX/CAPEX))
- WP1-3. Actors and their roles in the value chain and business ecosystem (customers/part of broader ecosystem/project partners from HUG)
- WP1-4. Uncertainties related to the concept realization

- Technical safety requirements:**
- WP2-1 LRC type of storage, single space, One large cavern
 - WP2-2 Pmax:
 - WP2-3 Connection pipe diameter:
 - WP2-4 Leakage detection principles; determination of the limit for an acceptable small leakage.
 - WP2-5 Emergency shutdown of surface connection in case of major failure.
 - WP2-6 Preventive and corrective maintenance of LRC.
 - WP2-7 Safety distance estimations for LRC with 10% of the surface connection pipe's cross-sectional area (Tukes requirement).
 - WP2-8 Heat radiation for the "10%" leakage.
- Organizational safety requirements**
- WP2-9 Responsibility for safety
 - WP2-10 Organizational capabilities and safety management system
 - WP2-11 Foster hydrogen safety culture and leadership

- WP5-1. Main operative function and length of the storage life cycle
- WP5-2. Physical storage as object of activity (Primary storage elements determining the operation, needed operator actions and key operative parameters for SA)
- WP5-3. Storage equipment for monitoring and control (CR concept and HMI for reliable operations, function allocation between op and auto, alarm concept)
- WP5-4. Storage related (work) process flows and world objects (Roles and responsibilities, skills and competence demands, operating strategies, decision-making process and operative procedures, training and development)

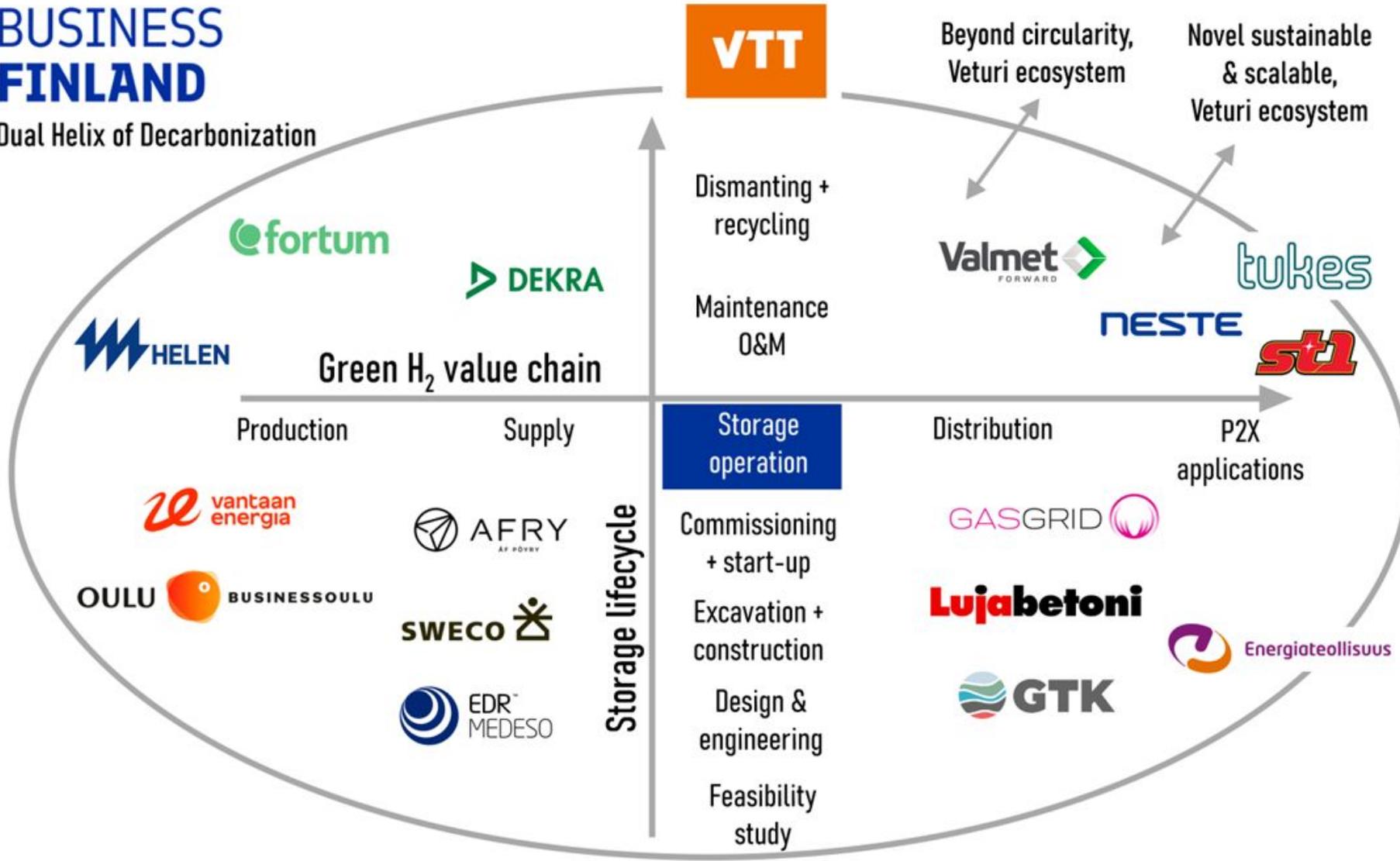


HUG continuation



BUSINESS FINLAND

Dual Helix of Decarbonization



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