Introduction of FME HyValue

Norwegian Centre for Hydrogen Value Chain Research

21.02.2023

Forskningssenter for miljøvennlig energi

The Research Council of Norway

Outline of this presentation

- Roadmap to Hydrogen in Norway
- What is a FME research center?
- HyValue - Organization, Numbers & Status 2022/2023
- HyValue - Objectives & WorkPackages

Roadmap to Hydrogen in Norway

H_2

Norge skal utvikle en verdikjede for produksjon, distribusjon og bruk av hydrogen produsert med ingen eller lave utslipp, og bidra til å utvikle hydrogenmarkedet i Europa.

Preliminary Illustration

The Norwegian Government's Hydrogen Strategy

Within 2025:

Five hydrogen-hubs for maritime/land-based transport awarded.

One-to-two industry projects facilitating hydrogen production established.

Five-to-ten pilot-projects for the development of cost-efficient hydrogen solutions.

Established a dedicated research center (FME) on hydrogen and ammonia.

Within 2030:

Network of hydrogen-hubs and realization of full-scale hydrogen projects in the industry.

Launched in 2022!

2x Norwegian Centre for Environment-Friendly Energy Research (FME) on Hydrogen and Ammonia

HyValue HYDROGENi

hosted by: NORCE (Bergen) hosted by: SINTEF (Trondheim)

Trondheim og Bergen får hvert sitt forskningssenter, og mottar til sammen 310 millioner kroner for å styrke Norges forskningsinnsats på hydrogen de neste åtte årene.

Olje- og energiminister Terje Aasland jubler i konfetti over tildelingen til Forskningsrådet på 310 millioner kroner for å styrke Norges forskningsinnsats på hydrogen de neste åtte årene. Foto: Margrete Løbben Hanssen/OED

Felles kickoff med HYDROGENi 4. oktober i Oslo

Teknisk kickoff, VilVite, Bergen, 17-18 oktober

What is a FME research center?

"FME research centers shall help solving key challenges in the energy sector, generate solutions for the low-emission society and enhance the innovation capacity of the business sector within hydrogen and ammonia."

Funding over 8 (5+3) years:

Maximum support RCN (HyValue): 120 MNOK
Partner-support: ≥ 120MNOK (cash/in-kind)

Success Criteria:

Long-term relevant research
Short-term industry projects (e.g., KSP/IPN..)
Innovation & value creation
Collaboration & Internationalisation
Researcher education & recruitment
Userpartners & financing
Organisation

Forskningssenter for miljøvennlig energi

HyValue

Norwegian Centre for Hydrogen Value Chain Research

NORCE

National Research Partners

NORCE · University of Bergen · University of Stavanger · Fridtjof Nansens Institutt / Fridtjof Nansen Institute · NHH · SNF Centre for Applied Research at NHH · TOI Transportøkonomisk institutt / Stiftelsen Norsk senter for samferdselsforskning · Western Norway University of Applied Sciences

International Research Partners

Jülich Forschungszentrum · MIT Massachusetts Institute of Technology · TNO innovation for life · Potsdam Institute for Climate Impact Research

Partners

EoneE · Elkem · equinor · EY · Alma · atheno · Kystverket · maritime cleantech · moreld · Shell · Energy Transition Norway · GAC · GASSCO · GCE NODE · Greenspot Mongstad · GREENSTAT · Å Energi · Sjøfartsdirektoratet Norwegian Maritime Authority · Arena Pro Ocean Hyway Cluster · pwc · Rogaland fylkeskommune · SEID · Statkraft · HJORT · HYDS Hydrogen Solutions · Justervesenet · Kongstein · Kristiansand kommune · SICK Sensor Intelligence. · Schjødt · TechnipFMC · Vestland County Council · VIA vital infrastruktur arena · VILVITE · ØYGARDEN · Corvus Energy · METCENTRE Marine Energy Test Centre, Norway · Wärtsilä · HY2GEN · Stavanger kommune · GEXCON US · TECO 2030 · westgass · HEXAGON PURUS · Hydro · Haugesund kommune

FME Forskningssenter for · Forskningsrådet

HyValue in Numbers

Project duration: 2022-2030
Total budget: 370 MNOK

Multidisiplinary research
technological, economical, social & political dimensions

8 national research partners
4 international research partners

~30 PhDs/Postdocs (2022-2030)
~10 Mscs per year
3 associated KSPs to date

47 unique userpartners !

Major energy companies, industry, vendors, operators, start-ups, trade org., law firms, public sector

HyValue organisation

How can we develop a sustainable hydrogen supply chain in/for Norway?

HyValue Objectives Short

#1 Produce hydrogen and ammonia with minimum energy loss and at lower cost.

#2 Create a safe and resilient transport and distribution system for hydrogen-based fuels.

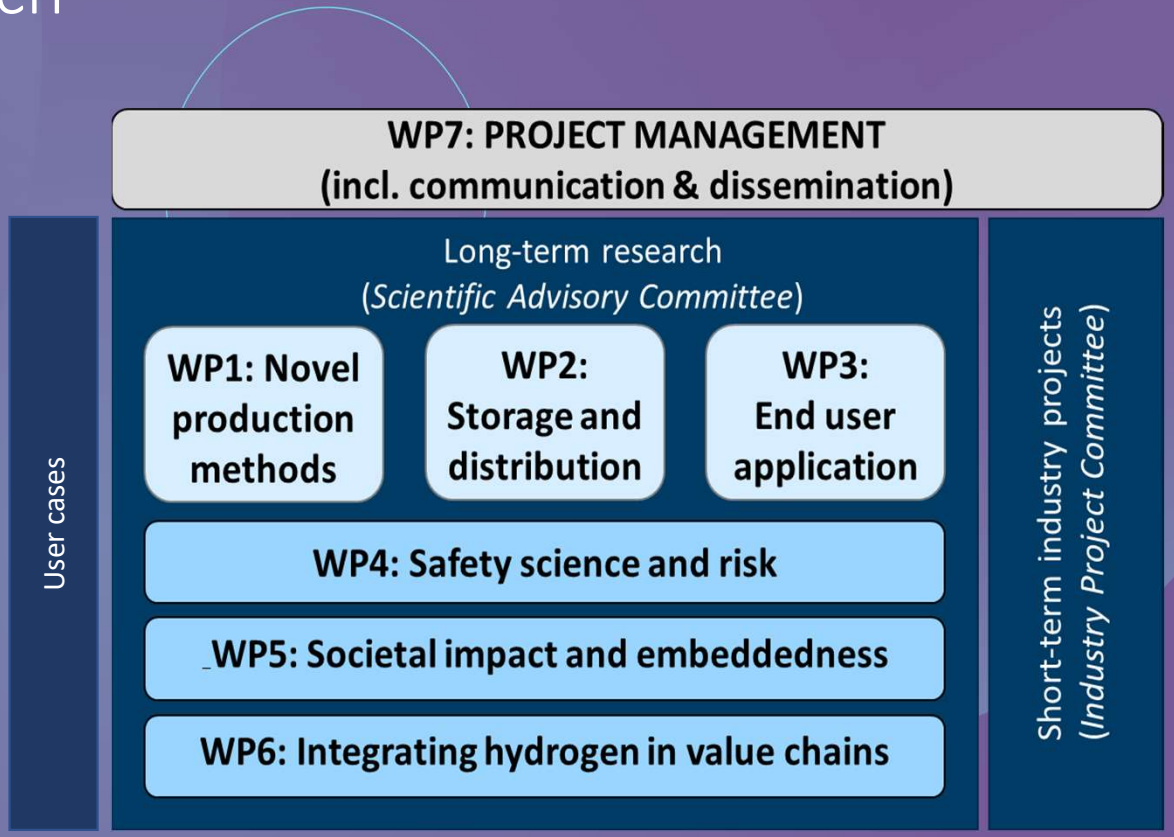
#3 Develop end-user applications for hydrogen-based energy carriers.

#4 Stimulate investments and build a system with acceptable risk for all stakeholders.

#5 Build public trust and confidence in a hydrogen society and economy.

FME HyValue – Norwegian Center for Hydrogen Value Chain Research

- Technical WPs 1-3
  - WP1: Mainly low TRL
  - WP2: Low to medium TRL
  - WP3: Medium to high TRL
- WPs 4-6: span and support the technical WPs
- User cases tie together WPs/activities



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WP1: Novel Production Methods

- Task 1.1: Materials for H_2 Purification and Catalysis

  Pascal D. C. Dietzel
  UiB

- Task 1.2: Green Hydrogen via Photocatalysis

  Dhayalan Velauthapillai
  HVL

- Task 1.3: Green Ammonia via Direct Electrocatalysis

  Vidar R. Jensen
  UiB

- Task 1.4: Green Hydrogen from Innovative PEM Electrolysis

  Jonathan Økland Torstensen
  HVL

- Task 1.5: Turquoise Hydrogen from Methane Cracking

  Zhixin Yu
  UiS

- Task 1.6: Feasibility Study: Offshore Wind-Based Production of Green Hydrogen and Ammonia

  Velaug Myrseth Oltedal
  HVL

WP2: Storage and distribution

Task
Task 2.1: Efficient transport and distribution systems
Task 2.2: Robust metering for supply chains
Task 2.3: Large scale and flexible storage systems
Task 2.4: Regulation and standardization of transport, storage, and custody transfer infrastructure

Our team:

Nicole Dopffel (NORCE) – WP lead, task 2.3
Kjetil Folgerø (NORCE) – WP deputy lead, task 2.2
Ignacio Herrera Anchustegui (UiB) – task 2.4
Antonie Oosterkamp (NORCE) – task 2.1
Remco Groenenberg (TNO) – task 2.3

NORCE

UNIVERSITAS BERGENSIS

TNO innovation for life

Geir Nævdal, NORCE
Task leader

Jonathan Ø. Torstensen, HVL
Deputy task leader

Tasks in WP 3

- 3.1 Cost-efficient hydrogen driven maritime operations (NORCE, MIT, NHH, SNF)
- 3.2 Achieving sustainable value chains in the industry (NORCE, HVL)
- 3.3 Maritime applications of hydrogen and hydrogen-carriers (HVL, NHH, SNF)

WP4: Safety Science and Risk

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WP4 management

- Jon Tømmerås Selvik and Ove Njå, UiS
- Trygve Skjold and Helene Hisken, UiB

Research partners involved in WP4

- UiS and UiB
- Forschungszentrum Jülich (FZJ)
- NORCE - Norwegian Research Centre
- Norwegian School of Economics (NHH)
- Centre for Applied Research at NHH (SNF)

Accidents shape the future

Hydrogen refuelling station, Sandvika, 10 June 2019.
After the explosion in Sandvika, all hydrogen refuelling stations in Norway closed down (most are still closed), plans for new stations were delayed/terminated, import of hydrogen cars stopped, etc., etc

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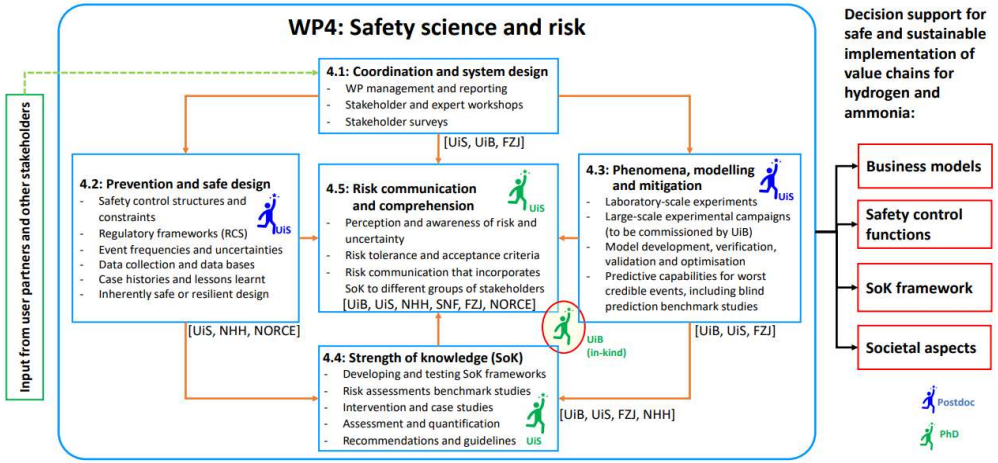
Research activities and relation to other WPs



Specific objectives

1. Characterise safety control structures and regulations, codes and standards (RCS) from a systems theoretical perspective.
2. Explore critical knowledge gaps concerning physical phenomena in laboratory experiments, large-scale experimental campaigns (commissioned) and blind-prediction benchmark studies.
3. Develop and test frameworks for Strength of Knowledge (SoK) through intervention and case studies, as well as risk assessment benchmark studies for hypothetical (or actual) systems.

WP5: Societal impact and embeddedness

Lead:

Lars Coenen

- professor in Innovation and Sustainability Transitions

- Mohn Centre for Innovation and Regional Development, HVL
- Regional Innovation, Clusters
- Sociotechnical system transitions
- Mission & Transformative Innovation Policies
- Previously in Lund & Melbourne

Co-lead:

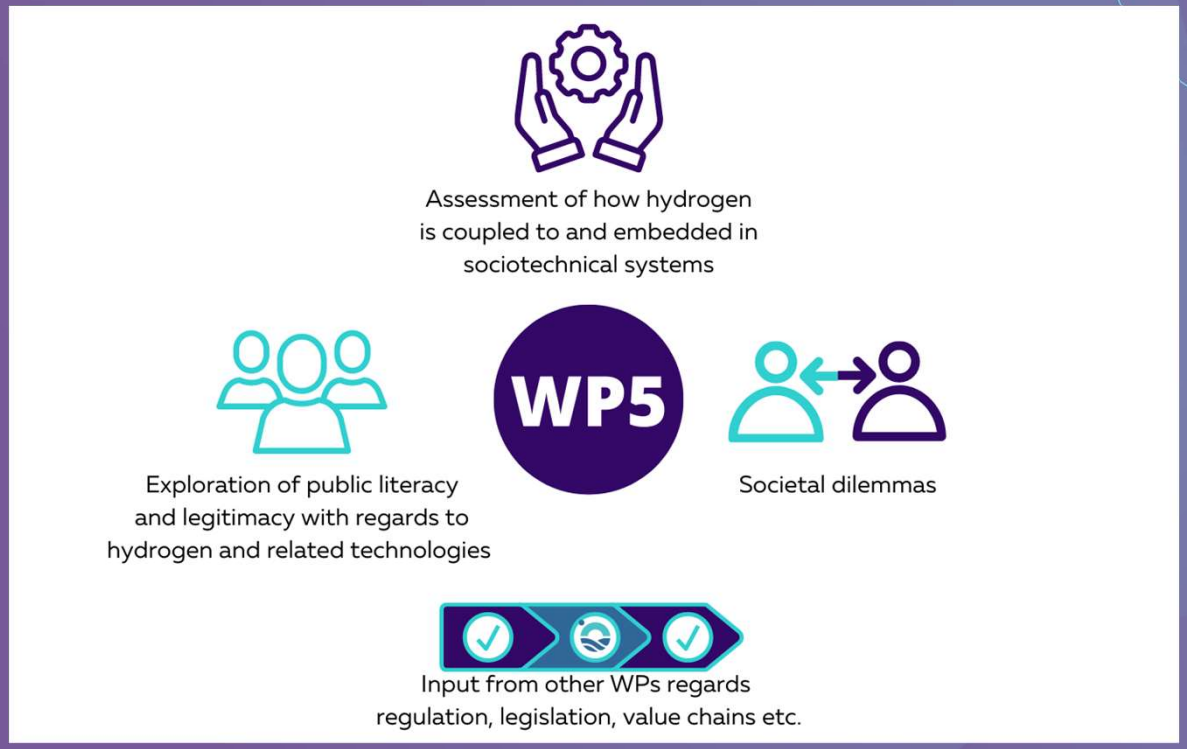
Kari Kjestveit

- senior researcher in Working life and Innovation

- NORCE Health and Society
- Sociotechnical system mechanisms in different industry trades
- Organizational complexity
- Public acceptance of liquid hydrogen in transport
  - Pilot E: Liquid hydrogen to decarbonize maritime transport in Norway (finished Spring 2022)

WP5: Societal impact and embeddedness

To explore synergies and dilemmas between economically viable, socially inclusive, and environmentally sustainable socio-technical systems for hydrogen



RQ5.1 What are the main narratives, networks and institutional logics behind production, storage, transportation, and use of hydrogen?

RQ5.2 How aligned are levels of public literacy and legitimacy about hydrogen with respect to political directions, international debate, and environmental engagement?

RQ5.3 How compatible are the levels of technology readiness and societal embeddedness for hydrogen production, storage, transportation, and use, and what are the main dilemmas and challenges?

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WP6: Integrating Hydrogen in Value Chains

A teaser

Gunnar Eskeland
NHH
WP lead

Ignacio H. Anchustegui
UiB
WP co-lead

WP6: Methods and focus

- *H* (H_2, NH_4) is an energy carrier:
  - a potential link in value chains
- Requiring costly conversions in energy form, time and location, a question is at what CO_2 price – or other sustainability paths – business models can lend *H* a role.
- WP6 focuses on regulatory, political, market and financial conditions, on market interactions, and on maritime transport with *H* for propulsion and in the logistics of *H*

Contact us:

hyvalue@norceresearch.no

FME HyValue

facilitating the safe and sustainable development of value chains for hydrogen and hydrogen-based fuels in industry and society