CCUS activities in Bergen

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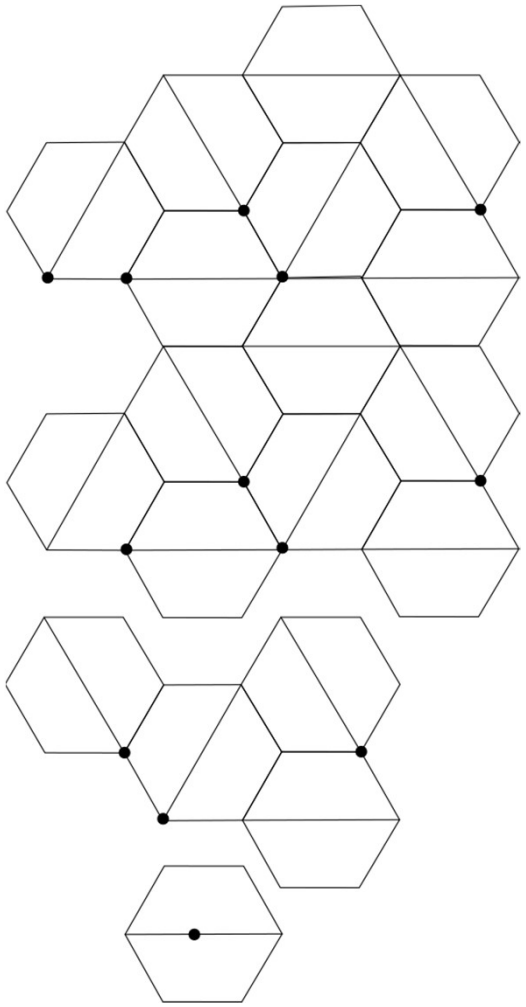
Energiomstilling VEST

- A newly formed knowledge-cluster
  - Internationally strong academic and HE organizations
  - Multidisciplinary

- Our mission
  - Generate and implement knowledge towards a low-emission society



The knowledge-cluster: ENERGY TRANSITION WEST

University of Bergen

16 900 students
&
3 700 employees

UNIVERSITETET I BERGEN

Western Norway Univ. of Applied Sciences

16 000 students
&
1680 employees

Høgskulen på Vestlandet

NHH
Norwegian School of Economics

3400 students &
400 employees

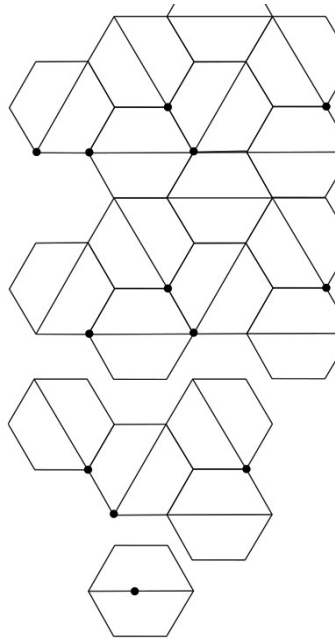
NHH

NORCE

1000 employees

NORCE

Why?



- Take out a higher potential through close & binding collaboration
  - Situated geographically close to eachother
  - Complementary
- Situated close to relevant industry, cluster organizations and public sector
  - Long tradition to collaborate with industry - industry advisory board established
- Visibility

Main research areas (1)

Natural Sciences and Technology

- Offshore Wind
- **CCUS**
- Other renewable energy sources
  - Sun, bio, wind, hydropower
- Energy systems
- Smart-house technology
- Robotics and AI
- Climate adaptation
- Geohazards
- Multifunctional areal-use
- etc.

Photo: Gunn Mangerud

Main research areas (2)

– a multidisciplinary perspectiv

- Social, economic and legal aspects
- Energy systems: Institutions, participant interactions, market incentives and decision making
- Energy efficiency
- Urban planning
- Policies and market instruments for integrating renewable energy technologies
- Energy and society
  - Implementation of Climate and Energy Action Plans in city-regions
- Health and psychological aspects of climate change and energy
- Environmentally friendly use of materials
- etc.

Why the Bergen region matters when it comes to CCUS

Main office location of four major research and educational facilities

- **University of Bergen** (>18000 students and 4000 faculty and staff)
- **NORCE** Norwegian Research Centre (1000 employees including subsidiaries)

- NHH Norwegian School of Economics (3,500 students and 400 faculty and staff)
- HVL Western University of Applied Sciences (16,000 students and 1,400 staff)

https://dribbble.com/shots/3550089-Bryggen

Why the Bergen region matters when it comes to CCUS

- Regional capabilities
  - Experience from decades of subsurface characterization, oil and gas, CCUS
    - Pore to field - unique CCUS upscaling
  - Transferable competencies
  - Multidisciplinary focus
  - International network & leading collaborative partners

Photo: Gunn Mangerud

Why the Bergen region matters when it comes to CCUS

- Education & training
  - New Energy master with CCUS
  - 120 CCUS PhD and master 2010-2019

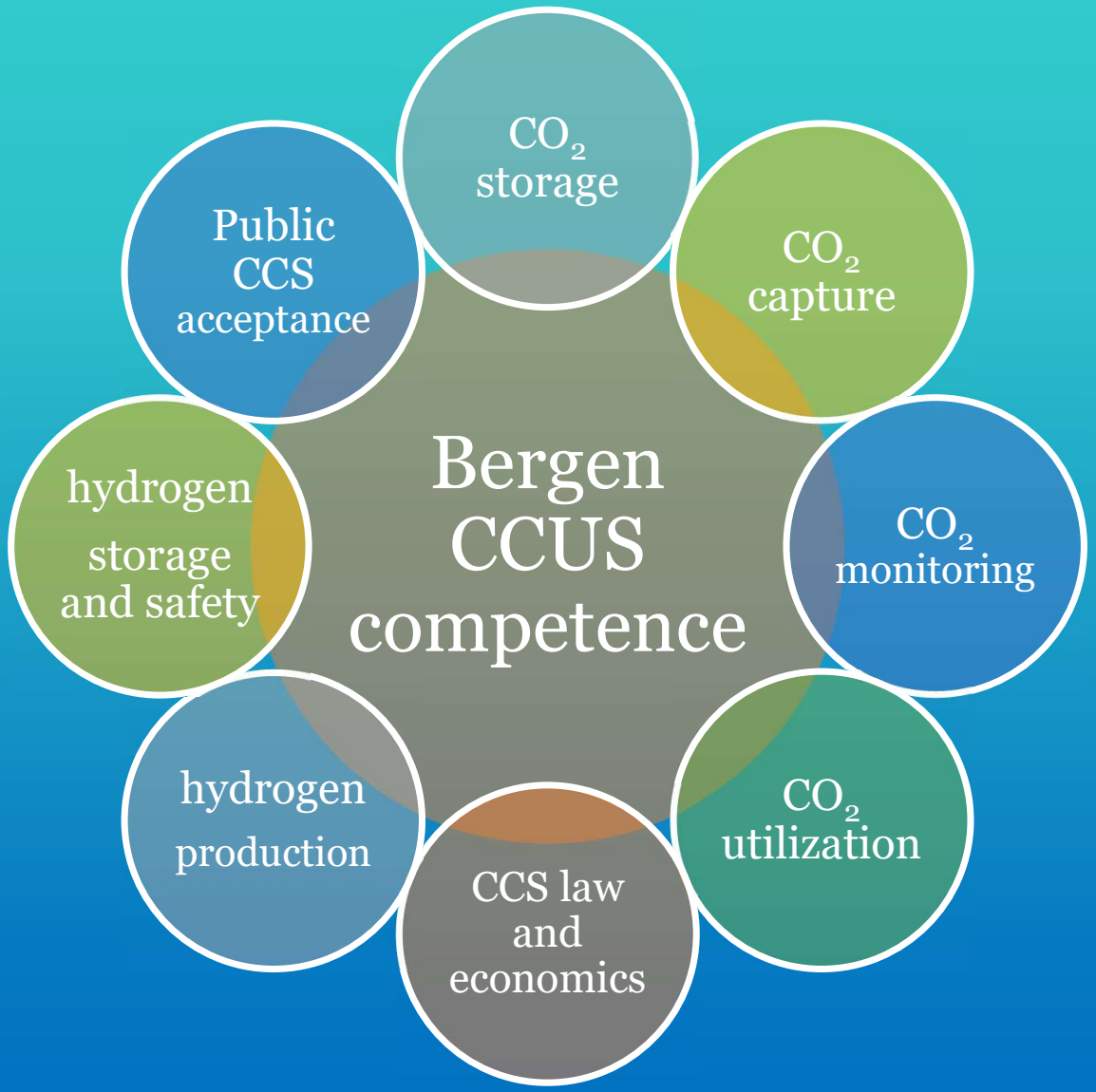
- Ambitions
  - Cross-disciplinary CCUS value chain education
  - EVU in CCUS and hydrogen
  - Expand CCUS + H_2 laboratories

Photo: Gunn Mangerud

Why the Bergen region matters when it comes to CCUS

- Immediate proximity to
  - Norwegian Northern Lights: first full-scale CCS project worldwide
  - Technology Centre Mongstad: facility for testing and development of carbon capture technologies
  - Industrial clusters with ambitious low-carbon targets
  - Equinor and other relevant industry partners

Photo: Gunn Mangerud



Slide credit: Martin Fernø

Selected regional projects funded by Norwegian Research Council on

CO2 Storage and Marine Monitoring

1. ACT on Offshore Monitoring (PI: Prof. Guttorm Alendal)
2. ACT on Digital Monitoring of CO2 storage DigiMon - (PI: Arvid Nøttvedt)
3. Subsurface Carbonate CO2 Storage and Security (PI: Prof. Martin Fernø)
4. Bayesian monitoring design (PI: Prof. Guttorm Alendal)
5. Efficient models for Microbially Induced CAlcite Precipitation as a Seal for CO2 Storage (PI: Svenn Tveit)
6. CO2 Storage in the North Sea: Quantification of Uncertainties and Error Reduction (PI: Per Pettersson)
7. Risk related to faults in reservoirs under consideration for CO2 storage (PI: Elin Skurtveit)

Slide credit: Martin Fernø

Selected regional projects funded by Norwegian Research Council on

CO_2 Utilization

1. Nanoparticles to Stabilize CO2-foam for Efficient CCUS in Challenging Reservoirs (PI: Prof. Martin Fernø)
2. CO2 Storage from Lab to On-Shore Field Pilots Using CO2-Foam for Mobility Control in CCUS (PI: Prof. Arne Graue)
3. Design of Green Catalysts for the Conversion of Renewable Resources into Polymers (PI: Assoc. Prof. Erwan Le Roux)
4. Establishing CO2 enhanced Oil recovery Business Advantages in South Eastern Europe (PI: Roman Berenblyum)
5. Understanding of CO2 dissolution in oil by convection-driven mixing and wettability alteration (PI: Ying Guo)
6. Fundamentals of CO2-Hydrocarbon Interactions for CO2 storage with EOR/EGR in offshore reservoirs: modeling, numerical methods and upscaling (PI: Sarah Gasda)

Slide credit: Martin Fernø

Selected regional projects on **Societal Acceptance**

1. Public Perceptions of Carbon Capture and Storage (NFR/CLIMIT project)
   (PI: Assoc. Prof. Endre Tvinnereim)

2. Legal aspects of property, jurisdiction and management of ocean areas
   (PI: Sigrid Eskeland Schutz)

3. Norwegian Citizen Panel -
   A web-based survey of Norwegians' opinions toward important societal matters.
   University of Bergen and NORCE

perCCSeptions

1. Onshore storage has limited public acceptance, but will offshore storage increase acceptance?

2. Most people reluctantly accept CCS - in Norway: 60% accept (Tvinnereim et al. 2016)

Research questions:

- Does acceptance of large-scale CCS storage depend on where the emissions come from (i.e., whether they are domestic or imported)?

- Does CCS acceptance depend on whether CO2 is stored onshore or offshore?
- Does the prospect of exporting CO2 to other jurisdictions (specifically: from Germany to Norway) reduce support for CCS (e.g., due to fairness concerns)?
- Does sector matter, notably energy vs. process emissions?

Stay TUNED!

Slide content credit: Endre Tvinnereim

Thank-you for your attention!