NTNU
Kunnskap for en bedre verden

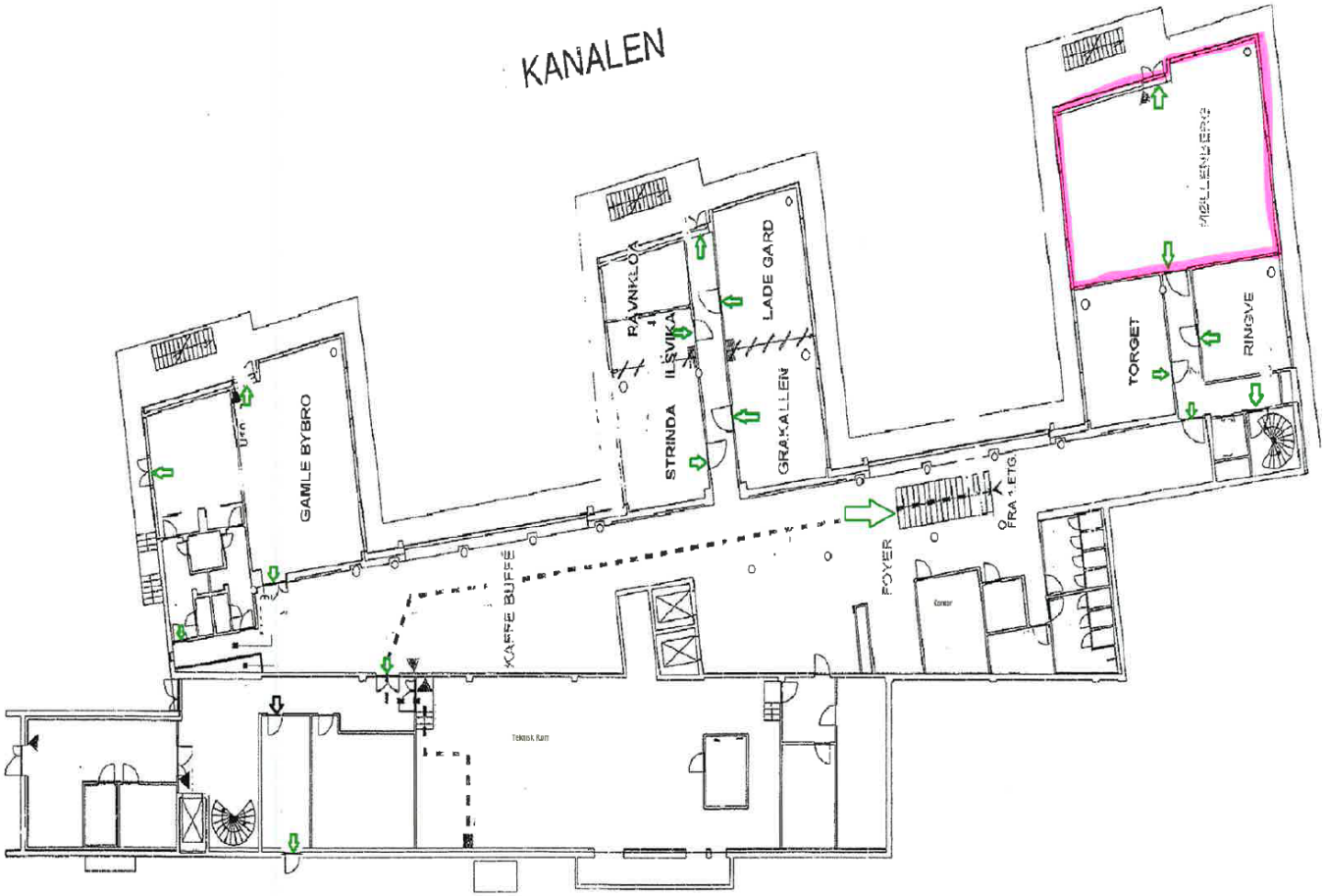
SINTEF

Seminar on hydrogen technology with Prof. J. Leachman

9 May, 2017, Scandic Nidelven Hotel

ENERSENSE

HMS



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Information about the day

- The schedule
- Introduction to ENERSENSE & NTNU, Prof. Burheim
- Projects within ENERSENSE.
- Hydrogen Projects @ SINTEF Energy, Prof. Wilhelmsen
- Introduction of Prof. Jacob Leachman

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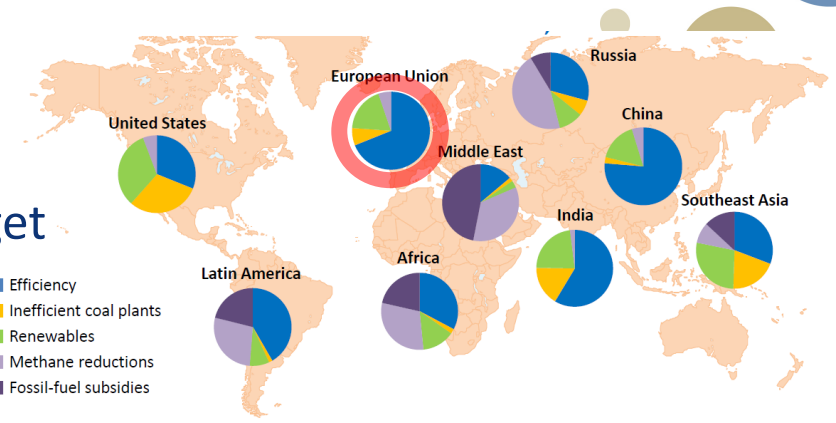
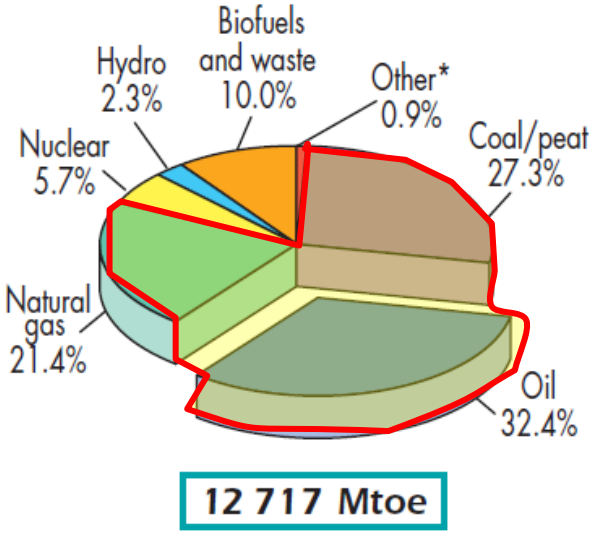
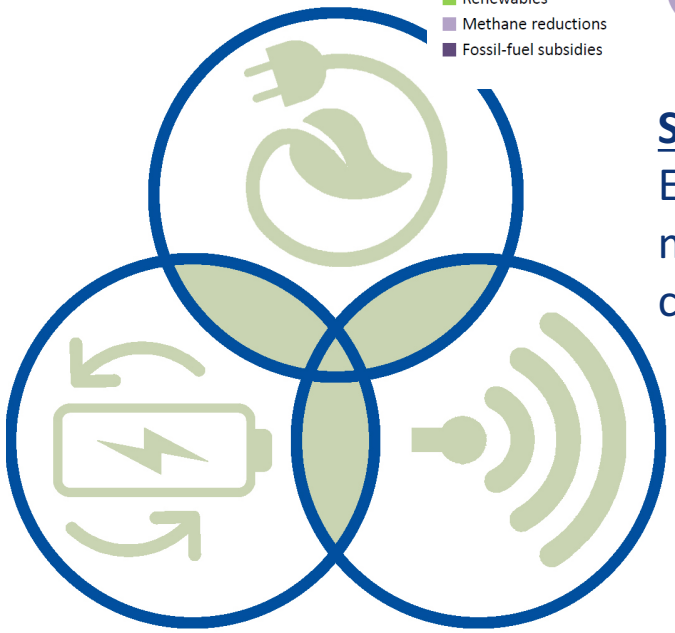
ENERSENSE and the trinity nexus

Energy efficiency

In Europe, 2/3 of the total efforts towards reaching the 2°-goal must target improvements of the energy efficiency

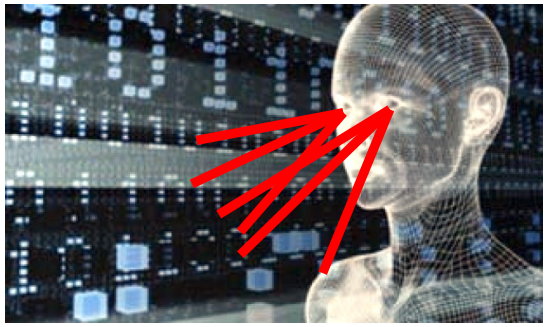






Sensor-instrumentation:

Experimental documentation to make reliable models and calculations - optical sensors

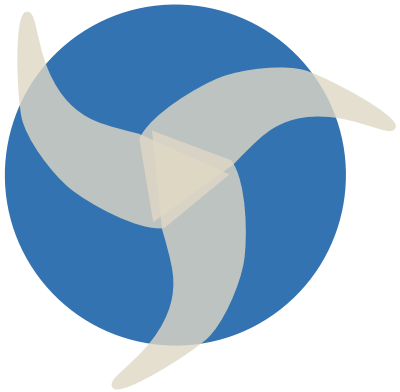


Energy storage

80% of currently used energy must be replaced by renewable energy that must be stored in some sense.

The trinity nexus

- The trinity nexus – new important ideas spin out!



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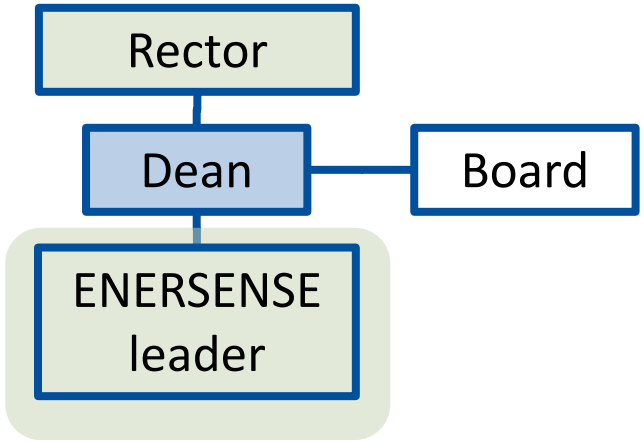
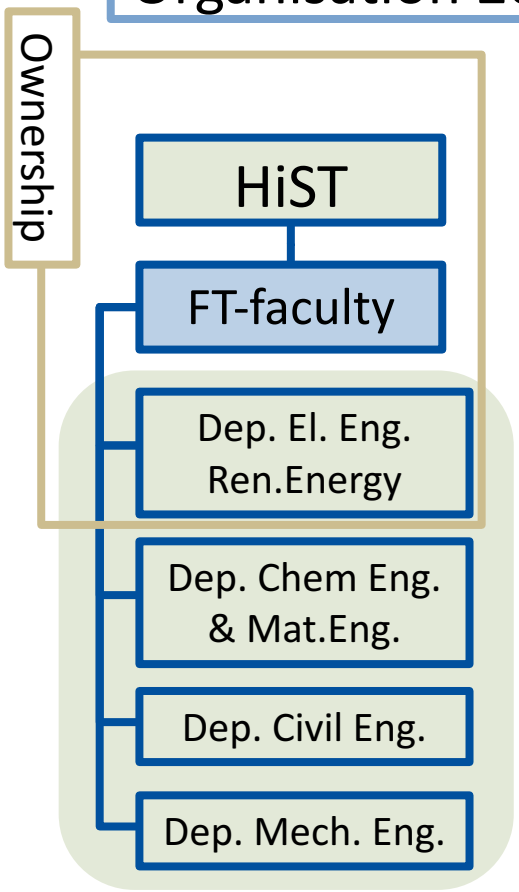
ORGANISATION HISTORY

Contract

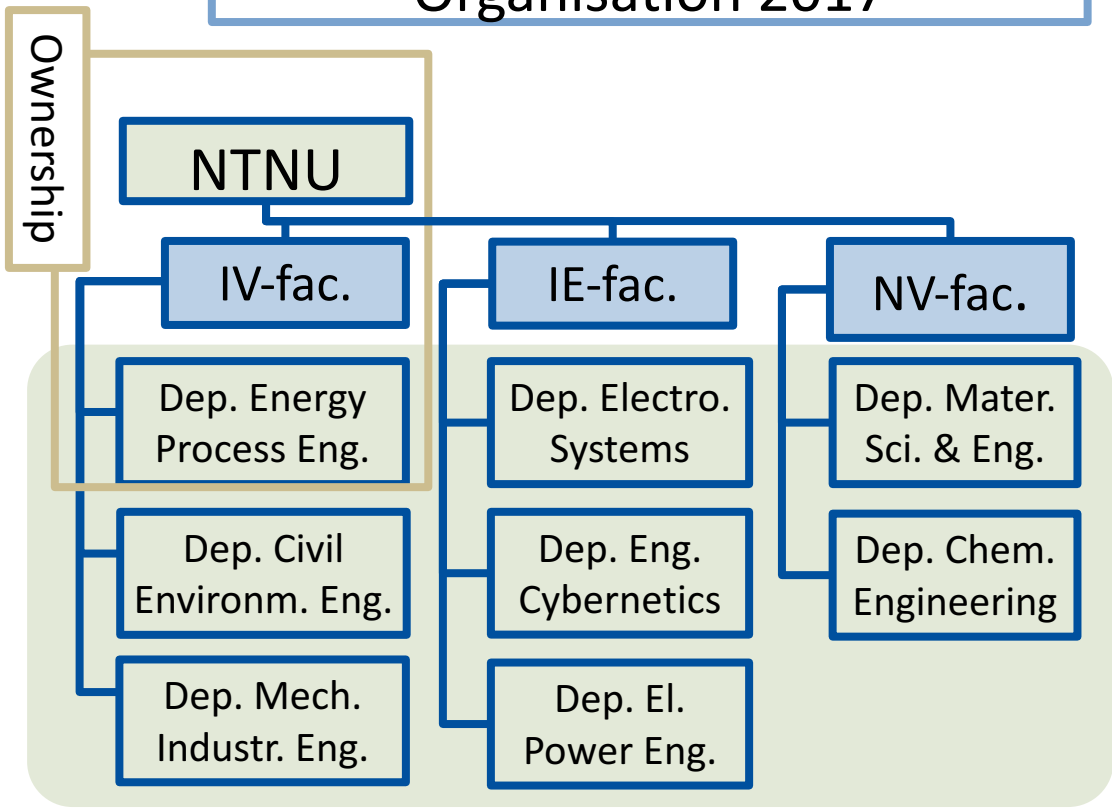
Structure



Organisation 2015



Organisation 2017



Why ENERSENSE @ NTNU?

1. *New and unique ideas*: We focus at the nexus between energy storage, sensor technology and energy efficiency
2. *Quality*: We aim to increase the general competence level of the group: Lector – Ass. Prof. – Prof
3. *Building bridges*: We want to bring scientists together: former HIST and old NTNU – and the world
4. *External funding*: ENERSENSE is support by rectors offica at NTNU and expanded by other external sources. (2017: 14 Mnok by RCN & others).

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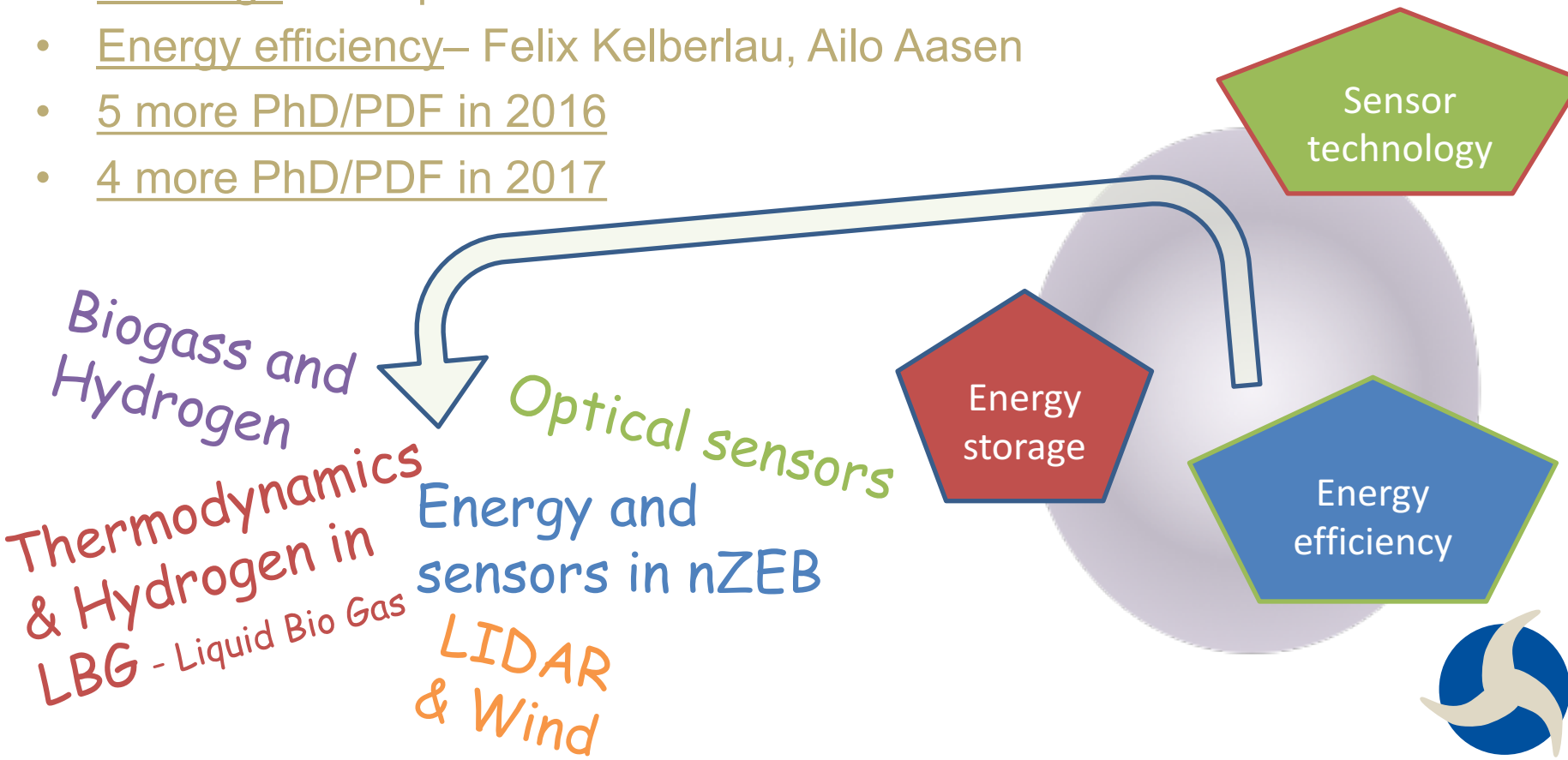
PhD og PDF

- Fuel cells– Robert Bock & Sigrid Lædre
- Batteries– F. Richter, K. Krakhella, Z. Jalili
- Sensors– Harald Ian Muri, Markus Wahl, Shiplu Sarker, Jacob Lamb
- Buildings– Joseph Schultz + Laurina Felius
- Energy efficiency– Felix Kelberlau, Ailo Aasen
- 5 more PhD/PDF in 2016
- 4 more PhD/PDF in 2017



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ENERSENSE - Energy storage examples

- Norwegian Fuel Cell and Hydrogen Centre (Sintef, IFE, HiST og NTNU)
- SafeLiLife – Safe, long-lived batteries for the shipping industry in Northern conditions (IFE, FFI, NTNU, HiST, Rolls-Royce Marin, ZEM A/S, FMC Kongsberg SUBSEA, DNV GL og ABB).

NORWEGIAN FUEL CELL AND HYDROGEN CENTRE

LOW TEMPERATURE FUEL CELLS & ELECTROLYSERS

FUEL CELL & ELECTROLYSER SYSTEMS

ENERSENSE - Energy efficiency examples

- **Industry / Transport:**
  - **Biogas**
    - ***Production optimization***
      - ***«Artificial Nose»***
      - ***Trending in H_2, VFA***
    - ***Biogas as «Hydrogen-carrier»***
    - Biogas hybrid. Buss, taxi, ferry, fish farming, supply.
    - **Collaborations:** Biokraft AS, Purac, Cambi, Ecopro, AtB, Avinor, STFK, NTFK, CENBIO / NUMB, Trønder-energi, NTE, Statkraft, AGA
  - **Hydrogen production and liquefaction**
- **Renewable energy in aquaculture**
  - Biofuel, electrification, wind (sun) & energy storage
- **Buildings:**
  - ***Plus houses*** *(Energy supply)*
    - Automation and sensor equipment

ENERSENSE – Sensor & instrumentation

- 80's => **PCs**
  - Computers became available for everybody
- 90's => **Internet**
  - Everybody became connected through a world-wide-web
- ……
- Now => Sensor equipment
  - The worlds electronic nervous system
    - Connect the Internet to the physical world we live in
  - Sensors monitor our surroundings in ways we can barely imagine
  - The digital organism

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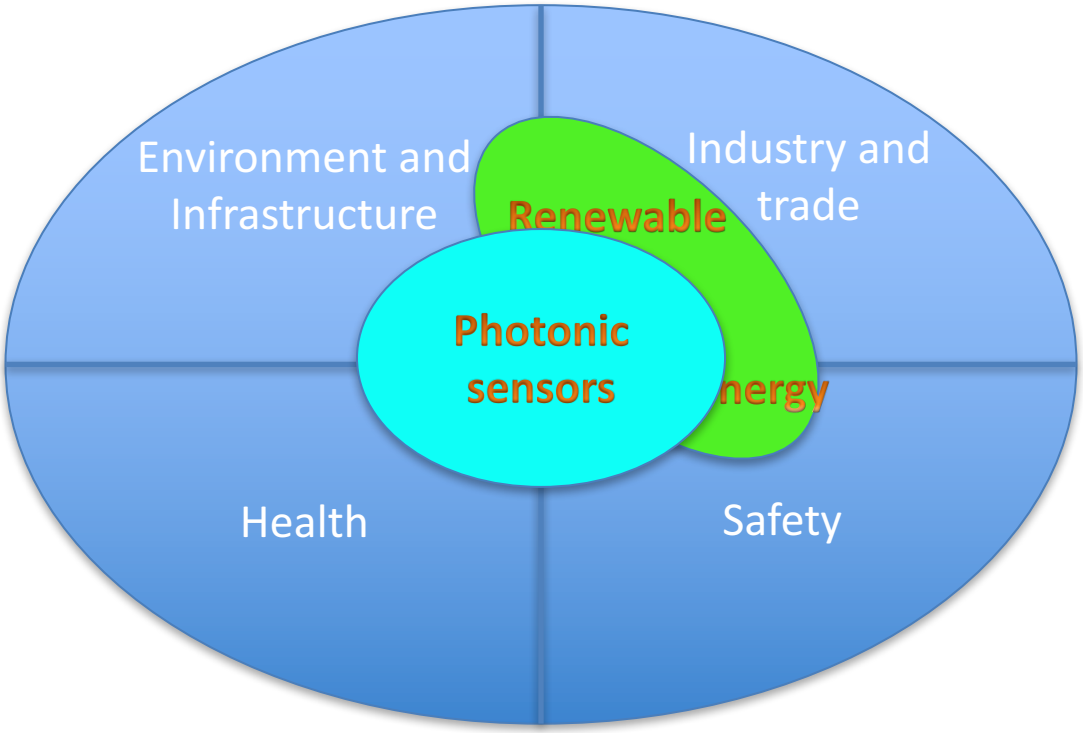
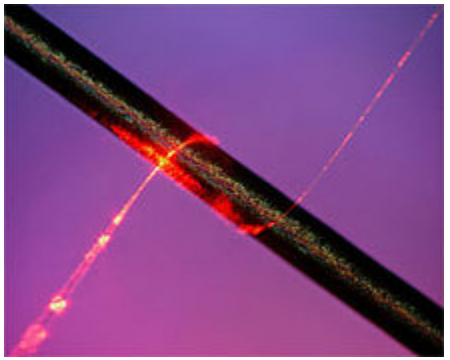
ENERSENSE – Sensor & instrumentation





Optical fiber surrounding a stain of hair

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The team:

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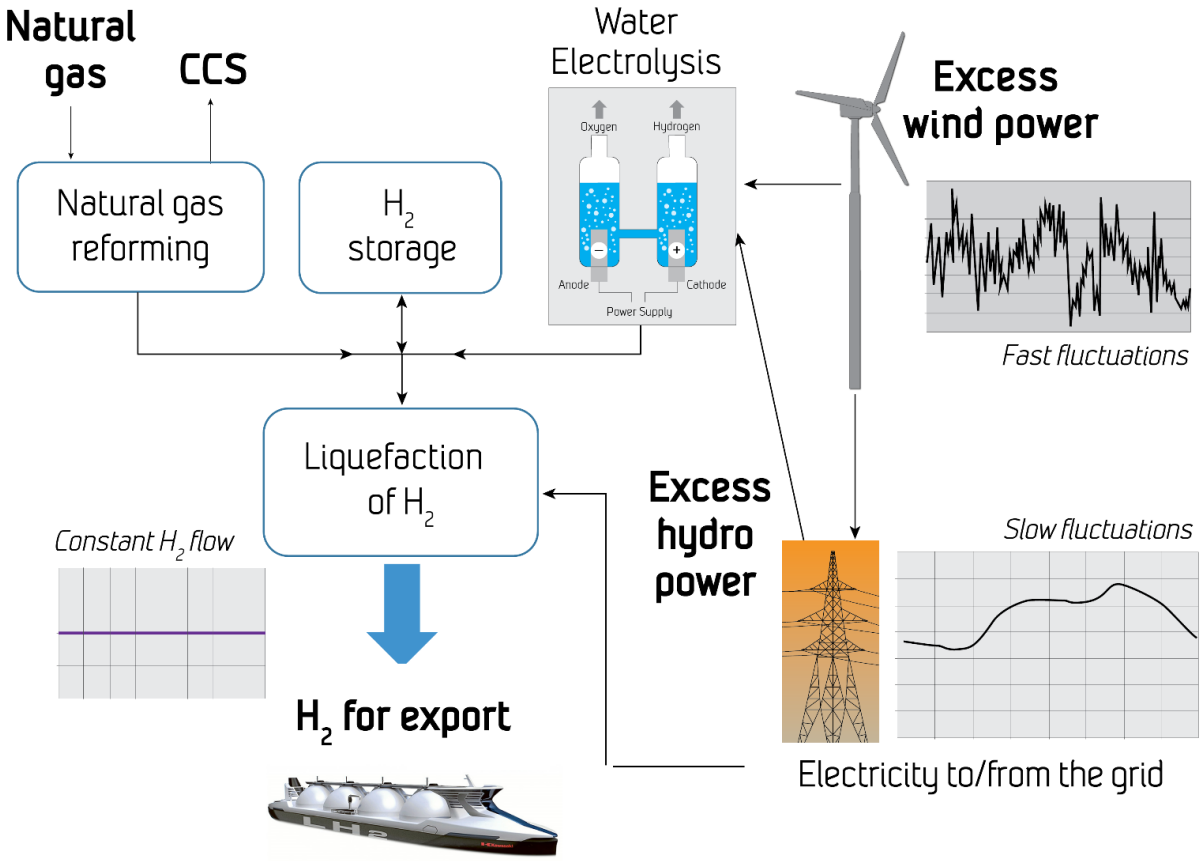
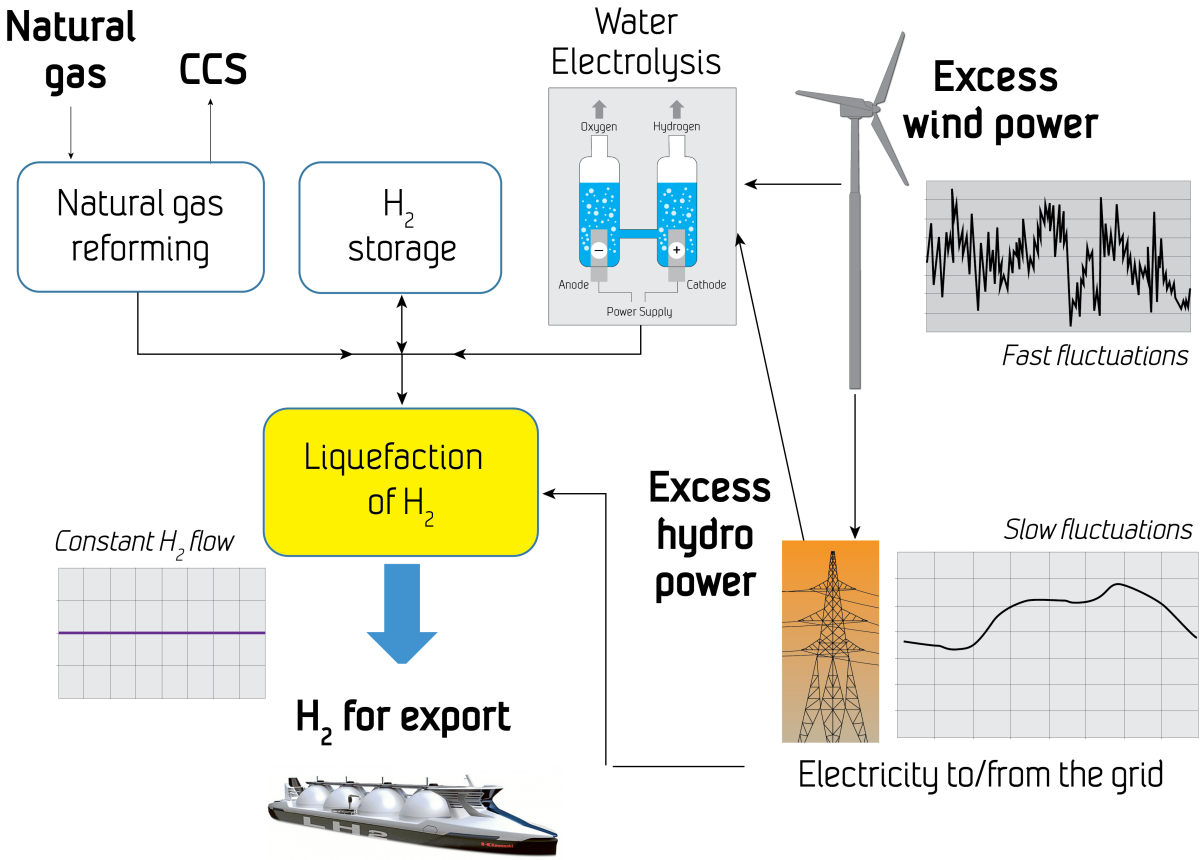
The HYPER project at SINTEF Energy



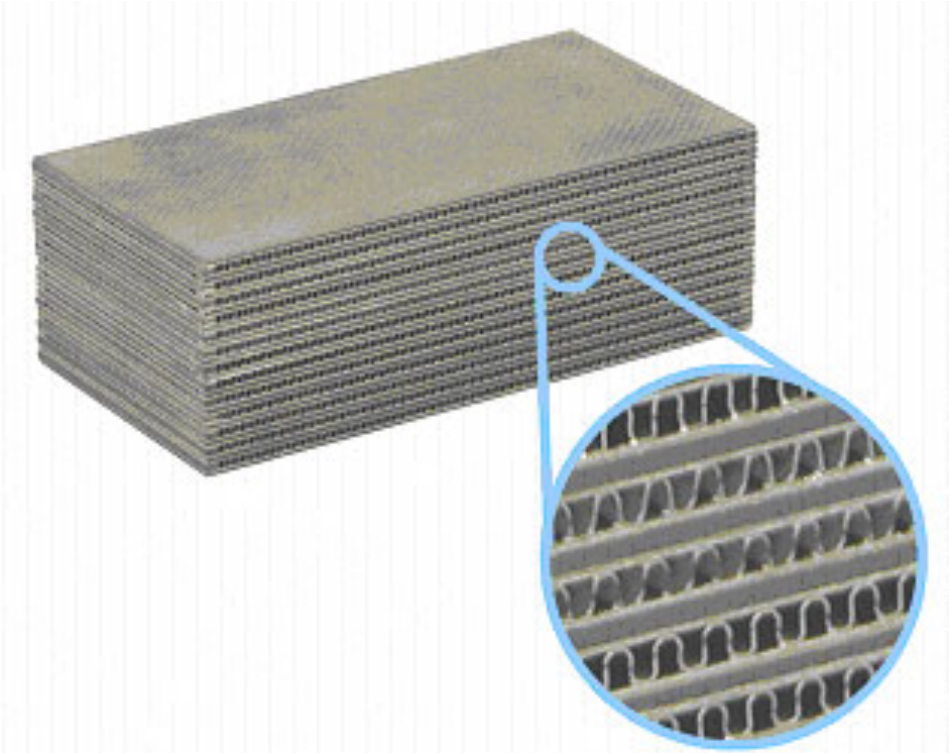
The HYPER project at SINTEF Energy



The HYPER project at SINTEF Energy

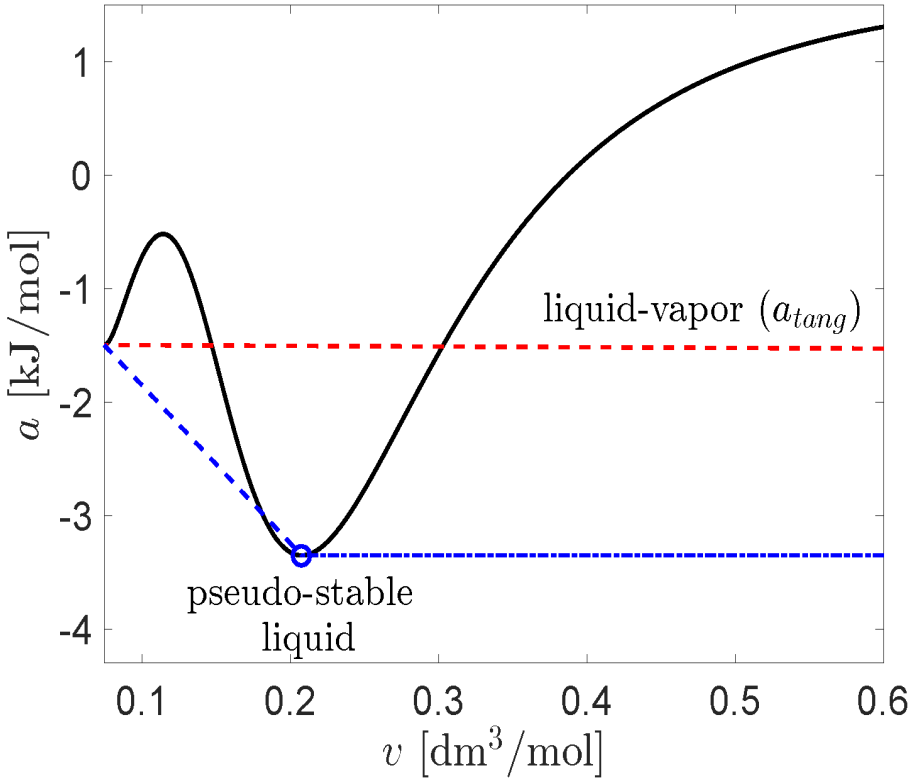
In present work, we study the influence of choosing Nelium as refrigerant on the performance of the heat exchangers in hydrogen liquefaction processes.

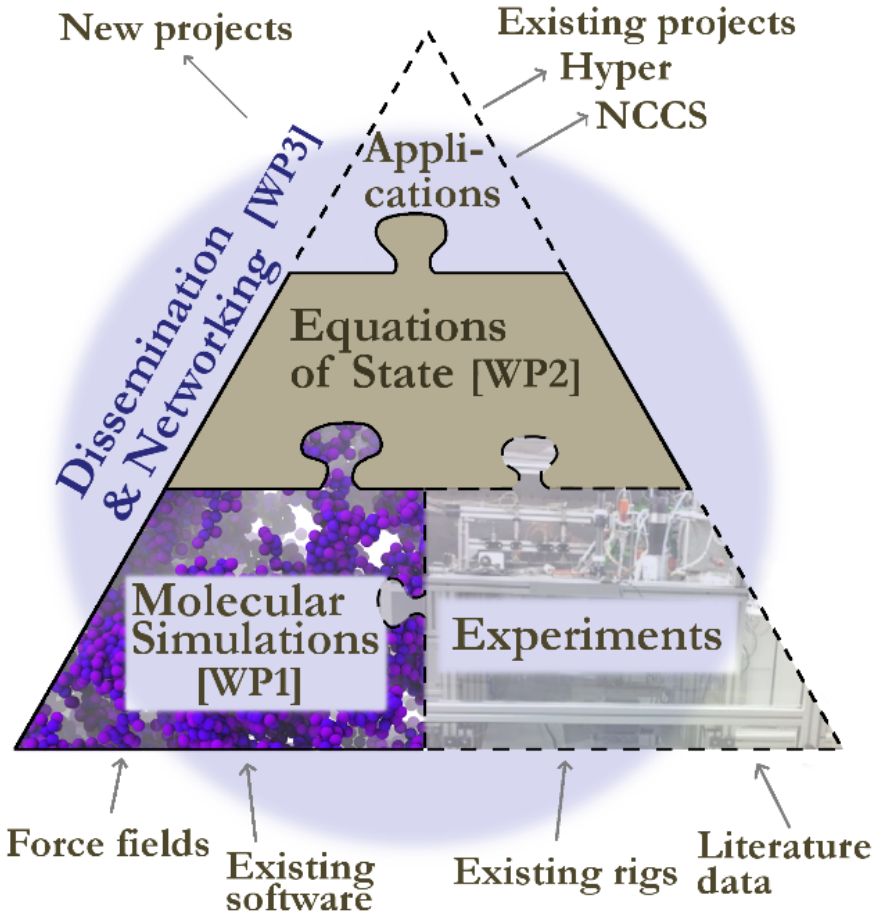
Many unresolved challenges to enable cost and energy efficient hydrogen liquefaction.



© Lytron Inc.: a plate-fin heat exchanger

The HYVA project at SINTEF Energy





Assoc. Prof. J Leachman

- Ass. Prof. at Mechanical and Materials Engineering at Washington State University.
- Director of the Hydrogen Properties for Energy Research (HYPER) Lab.
- Several research interests:
  - hydrogen properties,
  - hydrogen liquefier design,
  - thermophysical property modelling and measurement,
  - Rocket design,
  - cryogenics
  - ++

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