NTNU | Norwegian University of Science and Technology

Educational offer on hydrogen technologies at NTNU

HySchool Days 2025

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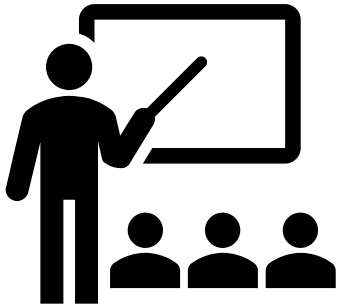
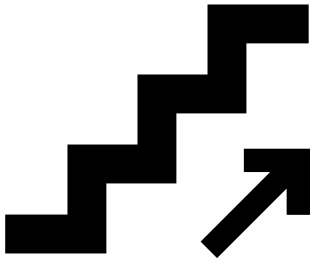




1. Motivation for hydrogen courses

The main motivation for the creation of new courses on H2 tech was:

1. Lack in educational offer on H2 tech
2. Increase number of PhD students focused on hydrogen-related topics
3. NTNU participation in education projects on H2 (e.g. HySchool, HySET)

2. NTNU educational offer on H2 tech.

The courses on hydrogen technologies currently offered at NTNU are:

PhD course:

1. PK8452 - Hydrogen energy technologies

Master courses:

1. TPK4254 - Hydrogen Energy Systems and Safety
2. TMT4287 - Hydrogen Technology, Fuel Cells And Batteries

2. NTNU educational offer on H2 tech.

Why presenting about master courses?

1. PhD students at NTNU can have 7.5 credits of master course in their plan
2. HySET students are attending HySchool days

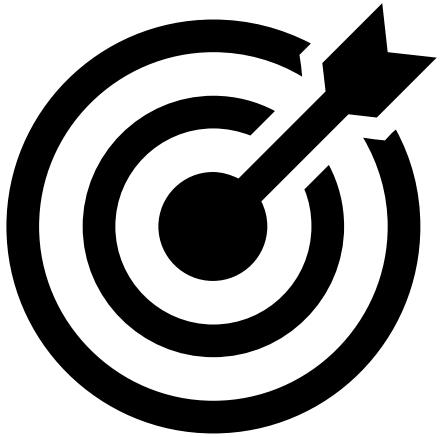
PK8452 course webpage

TPK4254 course webpage

3a. PK8452 - Course goals

The goals of the new PhD course:

1. Create an interdisciplinary PhD course on H2 tech that covers the entire H2 value chain
2. Have a mixed teaching approach: front lecture and self-teaching
3. Students should learn new topics beyond their PhD one
4. Enhance collaboration between students
5. Provide the opportunity to develop further PhD students' research



3b. PK8452 - Course format

The course has a hybrid format (online and in person) and divided in two parts:

1. **Seminars** (seven) where the students:
   a. Attend HySchool supervisors' presentations covering different topical areas
   b. Present the papers that are assigned to them (different than their PhD topic to increase interdisciplinary)
   c. Chair the discussion

Ass. Prof. Federico Ustolin

Ass. Prof. Xu Lu

Prof. Hilde Venvik

Prof. Knut Vågsæther

Prof. Sabrina Sartori

Supervisors contributing to PK8452

3b. PK8452 - Course format

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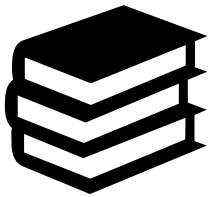
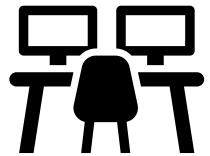
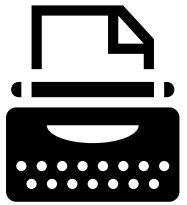




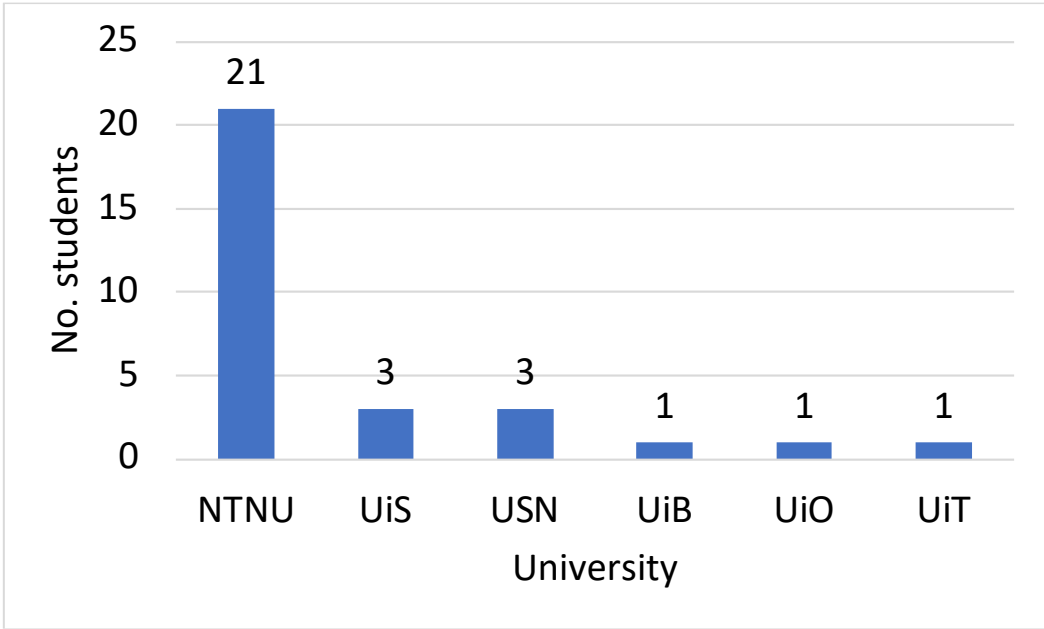


2. **Individual study**, where each student:
    d. Analyse the paper they are required to present
    e. and other two papers presented by other students to chair the discussion
    f. Select a topic related to their PhD for the final assignment. Students are encouraged to collaborate in a joint work

3c. PK8452 - Some statistics

After two years:

- 30 PhD students were enrolled in the course (22 in 2023, 8 in 2024, more 1/3 of HySchool students)
- Students came from six Norwegian universities
- 1 postdoc took the course
- 2 master students attended



3d. PK8452 - Students' presentations

The topics presented by the students and discussed in the course as part of the hydrogen value chain were:

- ✓ Production
- ✓ Storage
- ✓ Distribution
- ✓ Applications
- ✓ Society
- ✓ Environment
- ✓ Safety
- ✓ Regulations codes & standards
- ✓ Materials
- ✓ Modelling
- ✓ Education

3e. PK8452 - Feedback from students

"The course has provided a thorough and diverse introduction to hydrogen technologies, highlighting many challenges and opportunities associated with hydrogen. I was pleasantly surprised at how well it worked to participate in the course from different universities. In addition to providing an overview of hydrogen technologies, we have also gained insight into what other PhD students in the course are researching," says **Ingrid Marie Stuen**, a PhD student from UiB.

"The Hydrogen Energy Technologies course has been a really enriching experience that has allowed us to learn more about hydrogen in its different fields. Learning hydrogen disciplines that are more distant from my PhD-project has been especially easy thanks to the good dynamics in the seminars and the experts that were invited. It has also been a great opportunity to meet more PhD candidates and see how our projects can fit together in an interdisciplinary way," says **Alicia San Martin Rueda**, a PhD student from NTNU.

"What distinguishes this course is its innovative approach, motivating students to present papers beyond their immediate disciplines. It helped me expand my knowledge horizons and pushed me outside my comfort zone. It not only improved my presentation and communication skills but also culminated in a collaborative conference/journal-type paper closely aligned with my primary research," says **Petar Bosnic**, a PhD student from USN.

QR code and link to the HySchool article on PK8452

https://www.uib.no/en/hyschool/166607/hyschool-concludes-its-first-hydrogen-course

4. TPK4254 - Course description (1/2)

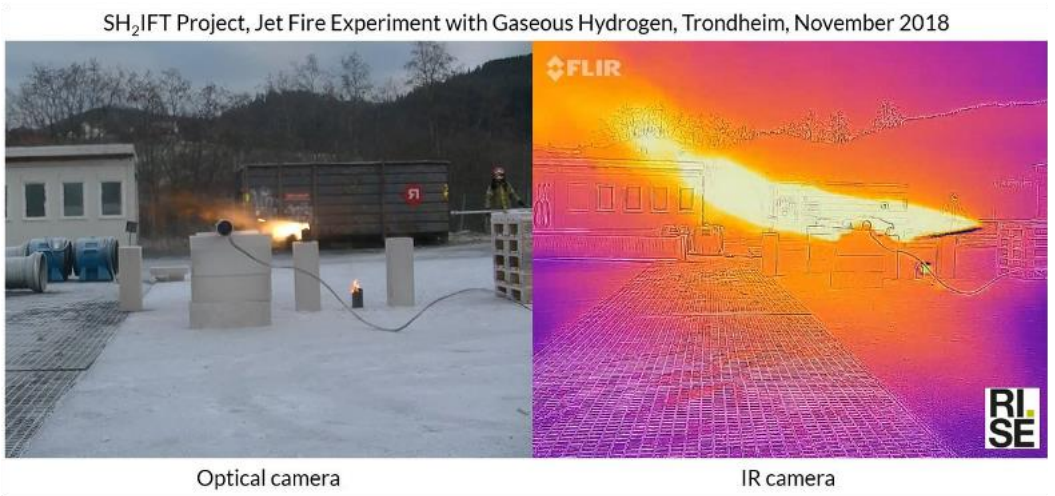
Part 1 – Hydrogen Energy Systems

- **Production**: electrolysers, steam methane reformers w/o CCS, compressors, liquefiers.
- **Storage**: compressed gaseous H2, cryogenic and liquid hydrogen, ammonia, liquid organic H2 carriers.
- **Transportation**: pipelines, road, shipping.
- **Utilization**: fuel cells, gas turbines, internal combustion engines.

4. TPK4254 - Course description (2/2)

Part 2 – Hydrogen Safety

- **Phenomena relevant to accidents**: H2 release, dispersion, ignition, combustion, explosions.
- **Consequences**: pressure effect, heat radiation, blast effects, physiological & environmental impact.
- Basic concepts of **risk assessment**.
- **Safety measures** and **safety barriers**.
- Technical **regulations, codes and standards** for hydrogen safety.



4. TPK4254 – Not only theory

Beyond frontal lecture, other activities are carried out during the course:

- Practice with real hydrogen systems (e.g. radio controlled H2 cars and small electrolyzers)
- Visit to the Norwegian Fuel Cell and Hydrogen lab in Trondheim
- Seminars given by experts including companies
- Learn how to use critical open-source tools, e.g. HyRAM+, e-laboratory

HyRAM+
Hydrogen Plus Other Alternative Fuels Risk Assessment Models

5. Conclusions

- Educational offer in H2 tech. was enhanced
- Two new interdisciplinary courses on H2 tech that covers the entire H2 value chain were created at NTNU
- Wide participation of 30 PhD students
- Very positive feedback were given by the students
- The course will be taught again in Fall 2026 semester

Photos: Merry H. Navjord

REMINDER!

You can apply for HySchool funding for:

1. Support for attending a PhD course
2. Support for attending an international conference or summer school
3. Support for a study stay abroad

HySchool webpage

More info is found on the HySchool website under Resources tab:

https://www.uib.no/en/node/163513/hyschool-travel-grants

Thanks for choosing the course, thanks to HySchool management for supporting it

Photo: Merry H. Navjord

PK8452 course webpage

Hope to meet many new PhD students in 2026 at the course

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