

# Mindre utdanningsprosjekt ved NV

## Rapport og erfaringsdeling

<b>Prosjektnavn:</b>	Learning about sustainability at IKP
<b>Prosjektleder:</b>	Hanna Knuutila
<b>Project team:</b>	Hanna Knuutila, Vanja Buvik and Maxime Francois
<b>Prosjektperiode:</b>	Autumn 2021 and Spring 2022
<b>Tildeling fra NV:</b>	30 000 NOK

### Summary of the performed work

Skills and knowledge related to sustainability within the chemical engineering education are much-discussed topics, that are hard to measure and quantify, particularly as the concept of sustainability is so wide-arching. Even though the various aspects of sustainability are part of many chemical engineering courses, there is a risk that the students connect the sustainability challenges and solutions only to the specific topics covered in the course, without the perspective to extend their knowledge onto other related topics. However, sustainability evaluations are part of all chemical engineering process development and working life. Their ability to perform sustainability assessments throughout their work life, as well as applying holistic thinking in their future careers will be important, both for them, and of course the environment. Our department wants to do as well as we can to provide the students with the skills and tools, they need in their work life.

We therefore organized two workshops with different objectives to better understand the current situation on our students' ability to evaluate sustainability. With these we wanted to both give the opportunity to the students to learn more about the topic and for us to have a chance to see what the students currently know, and hopefully identify if they are missing something in their chemical engineering education that we can provide.

#### *Workshop 1: CO<sub>2</sub> footprint*

In the first workshop, the students got an introduction to sustainability and ways to evaluate sustainability. Then, the participants got different tasks depending on their other courses. Most of the participating students were simultaneously taking TKP4170 Process design, where they work in small groups with specific chemical engineering processes. These students got a hands-on task to calculate the CO<sub>2</sub> footprint and evaluate the water use and emissions of the process they worked in the TKP4170. The students could then use the results in the report they wrote in TKP4170. Other students got a different hands-on task related to sustainability. These students evaluated the emissions and CO<sub>2</sub> footprints of processes described in scientific journal articles.

#### *Workshop 2: What do students think they have learned about sustainability?*

To better understand the need to strengthen students' learning on how chemical engineering can contribute to sustainability, we investigated students' awareness of how different courses and learning activities throughout their university studies connect to the 12 Principles of Green Chemistry (by Anastas and Warner, 1998). A workshop, open for all students at the Department of Chemical

Engineering, was organized. The workshop started with two industrial presentations addressing various aspects of sustainability, followed by a presentation related to the Green Chemistry and Engineering. After that, the students were given a sheet of paper listing the Green Chemistry Principles. In small groups, the students then discussed which courses and learning activities they had taken during their bachelor/master's studies addressed one or several Green Chemistry Principles. During the discussions, the students wrote down in which courses they had visited the various green chemistry principles and were encouraged to tell us where which principle could have been incorporated in a better way, throughout their studies.

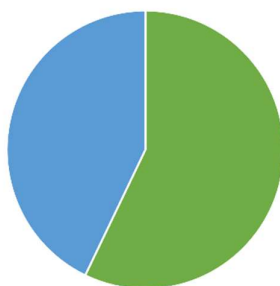
The results showed that while one group was able to identify specific activities (project work/lectures/lab activities) and courses addressing seven out of the 12 principles, other groups identified only three principles that they felt had been covered in their studies. Almost all students who participated thought they would like to have more activities that address sustainability in chemical engineering. The variation could be due to variations in the student mass, both because they come from different study programmes in different countries and because they are all different people.

The results indicate that our curriculum addresses many aspects of sustainability. However, the students need to be more aware of how they can use their chemical engineering skills to design and develop sustainable chemical engineering processes.

**Concluding remarks:**

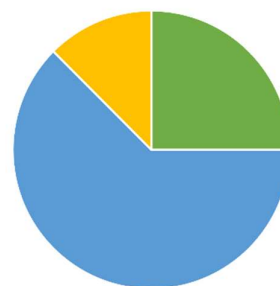
- The students experienced learning during the workshops and found the content of both workshops interesting and motivating, as illustrated in Figure 1. However, the workshops were voluntary, and it can be argued that this is most likely not a suitable format for years to come, as the number of participants can become relatively small (21 and 17 in these workshops, respectively).
- This project is just a part of the work at IKP. The calculation of CO<sub>2</sub> footprint and connecting this to course TKP4170 is a very concrete result from this project and will be implemented in TKP4170. This project gave us data on how students experience sustainability education during their chemical engineering studies, helping to develop different courses further.

**Sustainability of chemical processes**



■ I learned a lot      ■ I learned some  
■ I knew most of it      ■ I knew everything already

**Green chemistry & engineering**



■ I learned a lot      ■ I learned some  
■ I knew most of it      ■ I knew everything already

Figure 1: Summary of student survey responses after each of the two workshops.

**The project contributed to two conference publications:**

- *Knuutila, Hanna K; Francois, Maxime; Buvik, Vanja.:* Improving students' skills on sustainability through workshops. Læringsfestivalen, 9.-10. May 2022 (Oral)
- *Abtahi, Niloufar; Jäschke, Johannes; Knuutila, Hanna K.; Andreassen, Jens-Petter.:* Systematically developing a chemical engineering department education toward digitalization and sustainability at NTNU, European Society for Engineering Education (SEFI), Barcelona 19.-22. September 2022 (Submitted)

Only part of the funding was used. The funding covered snacks and food for the students participating in the two organized seminars.