METADATA (*)

TOPIC C – Training Unit 4: Renewable Energy Assisted Carbon Capture, Utilization and/or Storage (CCUS)

Source

Partner: SINTEF

Project: TRINEFLEX - Transformation of energy intensive process industries through integration of energy, process, and feedstock flexibility, Grant agreement ID: 101058174

The design figures of the lesson 1 “Design and installation of hybrid solar panel matrix loop” are obtained from the efforts of team responsible for the design and installation of the hybrid solar panel matrix loop.

The contents of the lesson 2 “Heat Pumps - Design, Construction, and Integration “ were developed using the following sources:

- R. de Boer, A. Marina, B. Zühlsdorf, C. Arpagaus, M. Bantle, V. Wik, B. Elmegaard, J. M. Corberan, J. Benson (2020). ”Strengthening Industrial Heat Pump Innovation: Decarbonizing Industrial Heat”. Available: https://www.sintef.no/globalassets/sintefenergi/industrial-heat-pump-whitepaper/2020-07-10-whitepaper-ihp-a4.pdf

- M. Bantle (2017). ”HeatUp: New high temperature heat pump prototype installed”. Available: https://blog.sintef.com/sintefenergy/new-high-temperature-heat-pumpprototype-installed/

- Eurostat. Energy Statistics - prices of natural gas and electricity. 2020.

Moreover, the figures listed below have been reused with permission from the Dutch Organization for Applied Scientific Research (TNO) and Robert de Boer: Strengthening Industrial Heat Pump Innovation Decarbonizing Industrial Heat, Boer, R. de et al. TNO, 2020, http://resolver.tudelft.nl/uuid:6094902d-a680-4861-82d9-3bf6e31a4548

- Fossil fuel driven industrial process schemes. (Figure 2, slide 5)
- Heat pump driven industrial process schemes. (Figure 3, slide 5)
- Technical process layout of a vapor compression heat pump with the energy flow depicted. (Figure 4, slide 7)
- Comparison of the electricity to gas price ratio in European countries for small scale industrial end-users. (Figure 11, slide 13)
- Breakdown of the final energy demand in European industry by broad application (left) and process heating demand by temperature level (centre) and energy source (right) (RES = renewable energy sources). (Figure 12, slide 14)

The contents of lesson 3 “The absorption of CO2 from flue gases. Carbon Capture Utilization and/or Storage (CCUS)” were developed using the following sources:

Funded by the European Union

This project has received funding from the European Union’s Horizon EUROPE research and innovation programme under Grant Agreement No 101058174 “TRINEFLEX”

- Hauger, S.O., Enaasen Flo, N., Kvamsdal, H., Gjertsen, F., Mejdell, T., Hillestad,M. “Demonstration of non-linear model predictive control of post-combustion CO2 capture processes”, Computers and Chemical Engineering 123 (2019), 184-185.

- Mejdell, T., Kvamsdal, H.M., Hauger, S.O., Gjertsen, F., Tobiesen, F.A., Hillestad, M., “Demonstration of non-linear model predictive control for optimal flexible operation of a CO2 control plant”, International Journal of Greenhouse Gas Control 117(2022).

- Mejdell et al.: “Pilot plant testing of HS-3 solvent”, Presentation at PCCC7 in Pittsbourgh, 2023 https://az659834.vo.msecnd.net/eventsairwesteuprod/production-ieaghg-public/68399cc3afdf47c4ba5d0624707302ec

Ownership

Lesson 1: Berhane Darsene Dimd – Research Scientist – SINTEF AS

Lesson 2: Bless, M., SINTEF Energy Research, 2024: Renewable Energy Assisted Carbon capture, utilization and/or storage: Heat Pumps - Design, Construction, and Integration.

Lesson 3: Thor Mejdell – SINTEF Industry

Abstract

This training unit explores the integration of a hybrid solar panel matrix and heat pump with SINTEF's solvent-based CO2 capture pilot plant in Tiller, Norway. Participants will gain insights into the design, installation, and operational aspects of this integration, understanding its potential for flexibility and energy optimization.

Structure

- Lesson1: Design and Installation of Hybrid Solar Panel Matrix Loop
  Concept, design, and installation process of the hybrid solar panel matrix, focusing on its role in optimizing energy capture and utilization.

- Lesson 2: Heat Pump: Design, Construction, and Integration
  Integration and application of high temperature heat pump for thermal energy boost in solar assisted CCS process.

- Lesson 3: The absorption of CO2 from flue gases. Carbon Capture Utilization and/or Storage (CCUS)

  Understand the CCS process, its flexibility, and its potential for both storage and utilization. Examine energy optimization potential and how waste heat integration impacts energy savings. Examine its integration within SINTEF's digital platform

Learning Outcomes

After this Training Unit, the trainees will be able to identify and describe the principles and concepts of solar energy conversion, the working principles of heat pumps and how carbon dioxide is captured and stored.

Funded by the European Union

This project has received funding from the European Union’s Horizon EUROPE research and innovation programme under Grant Agreement No 101058174 “TRINEFLEX”

Intended Audience Scientists, engineers, STEM university students and general audience with interest in renewable energy and technology.
Pre-requisites No pre-requisite knowledge necessary. Although background knowledge on the discussed topics is beneficial.
Language: English
Format: Video mp4, PDF
Expected workload Expected workload is 1 hour

(*) The structure of the Metadata for the Training Units derives from the training Metadata model developed within the Leonardo da Vinci project LINKVIT (2013-15, GA N. 2013-IT1-LEO05-04046)

Funded by the European Union

This project has received funding from the European Union's Horizon EUROPE research and innovation programme under Grant Agreement No 101058174 "TRINEFLEX"