Lecture of Professor Lars Nord from the Norwegian University of Science and Technology: Carbon capture and storage as a pathway to decarbonization in Europe?

Professor Lars Nord from the Department of Energy and Process Engineering at the Norwegian University of Science and Technology (NTNU) in Trondheim held the lecture: "Carbon capture and storage as a pathway to decarbonization in Europe?" at the University of Belgrade - Faculty of Mechanical Engineering on the 21th of March 2024.

He is a foreign member of the team working on the project financially supported by the Science Fund of the Republic of Serbia GRANT No. 3434, Improving operational flexibility of decarbonized thermal power plants with energy storage towards increased renewable sources utilization TPP-RSU, which is implemented by the Faculty of Mechanical Engineering, University of Belgrade, and the Innovation Center of the Faculty of Mechanical Engineering in Belgrade.

Professor Nord gave a short introduction of NTNU and the Department of Energy and Process Engineering. Then he gave a brief overview of the carbon capture and storage (CCS) technologies and explained how CCS can be a part of an energy system with a large portion of variable renewable energies both in the Norwegian and European context. In Norway, CO_2 could be extracted from the cement, aluminum and metal industry, waste incineration plants and gas fired combined heat and power (CHP) plants. The principle of operation and the overall impact of CCS on the operation of the plant, from which carbon dioxide is extracted from the flue gas, is explained on the example of their past and current research, in the test center Technology Centre Mongstad, as well as on the test plant on the thermal power plant Skawina, in Poland near Krakow, that burns coal. The focus was on thermal power plant flexibility and the effect from CCS on the plant's load following capabilities. CO_2 is extracted from the flue gas in the adsorber, in which the countercurrent flow of the flue gas and sorbent is obtained. Unrefined flue gas flows vertically upwards and sorbent flows downwards. Professor Nord mentioned the use of liquid absorbent and solid adsorbent. They research the use of activated carbon balls with a diameter of 1mm as the solid adsorbent. Refined flue gas needs to be fully cleaned of any solvent remains before it is released into the atmosphere. For now, only the small volumetric flow of unrefined flue gas was cleaned, and their conclusion is that huge amounts of sorbent are needed, and that CO_2 adsorber occupies a very large area. Professor Nord and his research team concluded that CCS can be very flexible but they also acknowledge problems that arise when using CCS, as follows: the investment cost, the sorbent cost, the overall size of the absorber/adsorber facility and negative impact on the plant efficiency. The energy is used to drive cooling water pumps, because adsorption takes place in lower temperature range, also the energy for sorbent transport is needed. The resorption process requires a certain amount of steam to heat the sorbent in order to regenerate it. The pressure drops in adsorber overcomes the flue gas fan. Energy is

also needed to drive compressors to compress extracted CO_2 from 1 bar to approximately 150 bars in order to be transported and stored.

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