Abstract

Poland is the 6th largest economy and the second largest emitter of greenhouse gases (GHG) in the European Union (EU). In 2019 Poland's energy sector is responsible for 46.9% of domestic GHG emissions, followed by transport (20.04%) and energy-intensive industry sectors such as iron&steel or cement production, which accounted for 9.7% share of total GHG emissions. Moreover, a share of fossil fuels in domestic Gross Electricity Production was about 84.02%. Furthermore, fuel combustion accounts for about 92.1% of CO_2 emissions in total net emissions (excluding LUC). The country's dependence on fossil fuels with the energy sector's major impact on domestic GHG emissions makes it an interesting case study country for the implementation of decarbonizing technologies such as Carbon Capture Utilisation and Storage (CCUS). CCUS technology is intended to capture CO_2 from industrial processes (such as power generation in power plants) and transport it to its final storage destination or to utilize it in manufacturing processes. CCUS is one of the key technologies in climate change mitigation, as it can significantly reduce CO_2 emissions and support the transition to a decarbonized economy. Life Cycle Assessment (LCA) analysis is a methodology characterized by a holistic, comprehensive approach to assessing the environmental impact of a product or service at all stages or throughout its life cycle. LCA provides an in-depth understanding of how environmental impacts are linked to and can change outcomes with the implementation of the CCUS supply chain. The purpose of this dissertation is to investigate, through the use of LCA analysis, the environmental benefits of a CCUS supply chain in the energy and cement industries, with a particular focus on the potential for utilization through the production of dimethyl ether (DME), methanol (MeOH) and carbonated concrete. Three case studies were selected: (1) a comparative analysis of power plants with and without CCS located in Poland, (2) a comparative analysis of power plants and cement plants with CCUS, (3) a comparative analysis of natural gas power plants in Italy and Poland, with and without CCUS. As proven in the study, there is potential to reduce the environmental impact of the studied facilities, although CO_2 storage technology offers greater environmental benefits than the selected CO_2 utilization technologies.