

## Sustainable process design and optimization: H<sub>2</sub> and CO<sub>2</sub>

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Hydrogen is in the spotlight as a new eco-friendly energy source. Hydrogen energy is divided into gray, blue, and green hydrogen according to the production and treatment of carbon dioxide, and carbon dioxide is essentially emitted in the entire process (production-storage-transport-distribution) to utilize hydrogen energy. In order to judge the usefulness of hydrogen energy, both economic and environmental aspects throughout the entire process must be considered, and for this, process design and analysis (technoeconomic and life-cycle assessment) of the hydrogen value chain and process optimization reflecting this are necessary. In this study, process design and optimization are performed for the main processes of hydrogen utilization, and the most economical and eco-friendly hydrogen utilization is explored. Specifically, through the case studies of 1) optimization of the hydrogen supply chain, 2) hydrogen liquefaction process, and 3) overseas transportation of large-capacity hydrogen, economic and environmental feasibility will be comprehensively analyzed. Furthermore, we will expand our study to discuss a new design methodology for sustainable process design.