Chapter 28
Techno-Economic Analysis of Green Hydrogen Production for Industrial Use

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ABSTRACT

This chapter will explore the role of green hydrogen as a sustainable energy source for the industrial sector. The will provide an overview of the importance of decarbonizing industry and the challenges associated with conventional energy sources. This will also explain the fundamentals of green hydrogen production through electrolysis, using renewable energy sources like solar, wind, and hydropower. It will compare green hydrogen with grey, blue, and other forms of hydrogen, discussing the environmental impact and energy efficiency. This also focuses on specific industrial applications where green hydrogen has the most potential like Steel Production, Chemical Industry, etc. We also focus on challenges associated with green hydrogen, such as the cost of production, transportation, and storage. At the same we will examine the role of governments in promoting green hydrogen, exploring policies, subsidies, and international agreements. It will also discuss the alignment of green hydrogen initiatives with the UN's Sustainable Development Goals (SDGs).

1. INTRODUCTION

The rise in global energy consumption has led to an increase in discourse around clean, inexpensive, and sustainable types of energy generation (Agyekum, 2020; Agyekum & Velkin,2020; Gyamfi et al., 2021). Exploiting these traditional fossil fuel resources will result in increased global warming and CO_2 emissions (Pour Azarm & Verma,2022). Power generation is critical to every country's industrial development. Renewable energy sources such as solar, wind, hydro, geothermal, ocean thermal energy conversion (OTEC), and biomass are among the most promising possibilities for fossil fuel replacement

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(Ishaq & Dincer, 2020). For this reason, among others, researchers and experts are researching alternative kinds of energy generation that have a zero or lower negative impact on the environment (Adebayo et al., 2021; Tarhan & Çil, 2021; Yaqoob et al., 2021; Xhao et al., 2021). **Figure 1** illustrates the proportion of the global energy supply. Coal accounts for 35% of global energy supply, followed by gas (23%), hydropower (16%), and nuclear (10%). Renewable energy sources account for approximately 13%, with 7% coming from wind energy, 4% from solar, about 2% from hydrogen, and the remainder coming from biomass and biogas. Coal, oil, and gas combustion account for most worldwide fossil fuel emissions. In 2022, coal will account for 40% of total global fossil fuel emissions, more than any other fossil fuel. Gas production ranks third with a 21% contribution, followed by cement production at 4% and oil at 32% of fossil CO_2. Biogas can be purified and used as a fuel, or it can be injected into the national gas grid if it meets the purity standards after upgrading (Jaiswal, 2018; Dwivedi et al., 2022). Hydrogen's current contribution to the energy industry is small, and when hydrogen is produced from renewable energy sources, the net CO_2 emissions are far lower than for other fuels. **Figure 2** shows the annual CO_2 emissions from various types of fuels. **Figures 1** and **2** show that oil, coal, and natural gas are traditional energy sources that account for most of the global energy supply, power generation, and CO_2 emissions.

Figure 1. Global share of energy sources 2021