Chapter 18
Towards a Sustainable Energy Future in the Arab World:
Opportunities and Challenges of Applying Green Hydrogen Technology

Ahmed Badran
https://orcid.org/0000-0002-9346-1927
Qatar University, Qatar

ABSTRACT

this chapter aims to shed light on green hydrogen energy and its varying uses in the Arab region. The study seeks to reveal the types of hydrogen energies and their effectiveness in reducing the volume of emissions resulting from fossil fuel production plants and plants. The study also aims to analyse the negative and positive effects of green hydrogen energy and the extent of its ability to reduce carbon emissions through investments in green hydrogen energy projects. Added to this, the chapter focuses on exploring the economic consequences of green hydrogen energy projects, including their impact on spending and investment rates in this field, and analysing the benefits and challenges that the Arab region may face in adopting this advanced technology.

1. INTRODUCTION

Over many decades, the discovery and exploitation of depleted energy sources such as coal, oil and gas, along with nuclear energy, have contributed to the development of industrial activities and the achievement of economic development and technological progress in multiple fields. Particular credit was given to energy derived from oil and natural gas, which facilitated transportation and trade over long distances. However, during the last three decades, the world has realized the danger of relying on these sources alone, as they are limited and will end one day. in addition, they negatively affect the environment in terms of water and air pollution, and the residues of industrial activities associated with them remaining stuck in the environment without They decompose, resulting in waste accumulation. For this reason, numerous experiments, research and studies have been conducted to test new systems for producing energy sustainably and without leaving harmful environmental impacts. These efforts resulted in the discovery of new sources of energy, such as solar energy and wind energy, in addition to

DOI: 10.4018/979-8-3693-7893-9.ch018

other sources that later proved efficient, such as ground energy, bioenergy, and gravitational energy, all of which are renewable and environmentally friendly energy sources.

Many governments around the world are also seeking to develop their energy policies to increase the proportion of renewable energy in the energy supply mix. In Europe, there is a vision to reach 0% dependence on fossil energy sources by 2050 (Majanne et al., 2024). The issue of climate change has increased interest in renewable energy, which led to the signing of the Paris Climate Agreement on December 12, 2015. This agreement aims to put an end to pollutants rising from factories, means of transportation, and other activities that have caused temperatures to rise and created environmental disasters that have affected vital systems. The agreement includes the commitment of participating countries to reduce carbon emissions during the current decade and to provide support from developed countries to developing countries to assist them in efforts to limit climate change.

In this context, green hydrogen technology emerges as one of the promising solutions for producing environmentally friendly energy. This technology has become the focus of attention of researchers in the fields of energy and environment, studying its future and its impact on the economic and environmental fields. Some countries have begun their first steps towards producing this type of energy, such as Chile, the United States, and Australia, in addition to the Kingdom of Saudi Arabia, which possesses the advantages required to produce hydrogen, including a suitable climate and large areas, in addition to the largest oil reserves in the world. It contains hydrocarbons that are considered a basis for hydrogen production.

The issue of clean and sustainable energy has recently attracted the attention of researchers and decision-makers in the field of energy policies in the Arab region. The motivation behind this is the desire of governments in the region to achieve sustainable development as a global challenge. In this context, climate change, which is mainly caused by the combustion of fossil fuels and the resulting greenhouse gases, poses a challenge to environmental systems and human well-being. This challenge requires a radical shift in energy systems towards renewable sources to reduce emissions and support economic growth (Badran, 2024).

The global energy sector is witnessing a pivotal shift as countries seek to adopt sustainable and renewable energy solutions to address climate change and reduce dependence on fossil fuels. Among the emerging technologies, green hydrogen technology has gained significant attention for its potential use as a clean energy source. Hydrogen is the most abundant element on planet Earth and therefore provides an ideal option to reduce carbon emissions and support environmental sustainability efforts. Green hydrogen is produced through the electrolysis of water using renewable energy sources, providing an emissions-free path to meet energy needs in various sectors including industry, transportation and power generation (Reda et al., 2024).

For Arab countries, green hydrogen represents both an opportunity and a challenge. The region has vast renewable energy resources, particularly solar and wind energy, which qualifies it to be a leader in the production and export of green hydrogen. This enhances the existing energy infrastructure capabilities and the strategic geographic location that connects major global markets in Europe, Asia and Africa. However, the development of a green hydrogen economy in Arab countries faces many challenges, including high production costs, infrastructure requirements and regulatory hurdles (Badran, 2022). This chapter examines the opportunities and challenges associated with the use of green hydrogen in Arab countries and examines how this technology can contribute to achieving a sustainable energy future. It also reviews the potential benefits of adopting green hydrogen, the obstacles that must be overcome, and the strategies that Arab countries can adopt to effectively integrate green hydrogen into their energy mix.