Chapter 5
Carbon Capture, Utilization, and Storage Technology:
A Key Strategy for Climate Change Mitigation

M. R. Namitha
https://orcid.org/0000-0003-2012-6316
KCAEFT, Tavanur, India

M. K. Shamin
https://orcid.org/0009-0006-6151-3135
KCAEFT, Tavanur, India

P. P. Afthab Saeed
https://orcid.org/0000-0002-8772-4022
KCAEFT, Tavanur, India

ABSTRACT

Climate change remains one of the most critical global issues of the 21st century, driven primarily by anthropogenic greenhouse gas emissions, particularly carbon dioxide (CO_2). Carbon Capture, Utilization and Storage (CCUS) has emerged as a vital technology stack, designed to reduce CO_2 emissions from major industrial sources and even directly from the atmosphere. This chapter presents a comprehensive overview of the CCUS framework, examining its role in achieving net-zero targets and supporting the transition to a low-carbon economy. The discussion encompasses the scientific principles, technological advancements, and deployment strategies of carbon capture, utilization and storage. The chapter also addresses

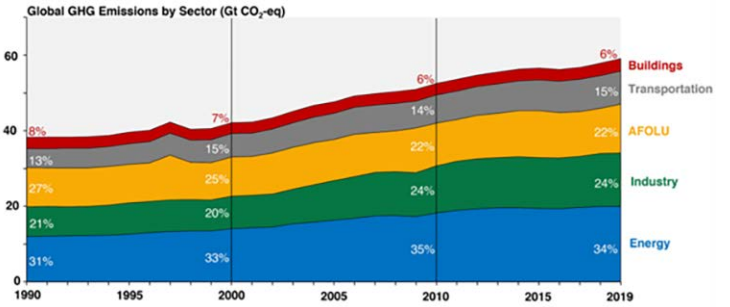
DOI: 10.4018/979-8-3373-3226-0.ch005

the socio-economic and environmental dimensions of CCUS deployment. Through an interdisciplinary approach, this chapter reinforces the integral role of CCUS as a bridging technology that complements the adoption of renewable energy and enhances the global efforts towards climate resilience and sustainable development.

INTRODUCTION

Climate change is one of the major issues of the present era, characterised by long-term shifts in temperature, weather patterns, and sea levels. Human activities, particularly the burning of fossil fuels, deforestation, and industrial practices, have significantly increased greenhouse gas emissions, leading to global warming (Min et al., 2011; Diffenbaugh and Field, 2013; Filonchyk et al., 2024). According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2022), global greenhouse gas (GHG) emissions reached approximately 59 Gt CO_2-eq in 2019, marking a 12% increase over 2010 levels and a 54% rise since 1990. The overall emissions by various sectors from 1990 to 2019 are depicted in Figure 1.

Figure 1. Global GHC emissions by various sectors from 1990 to 2019



(Sixth Assessment Report of the IPCC, 2022)

The emissions originate from key sectors including energy (34%), industry (24%), agriculture, forestry and other land use (AFOLU) (22%), transportation (15%), and buildings (6%). This results in extreme weather events, rising sea levels, and disruptions to ecosystems and agriculture. Climate change poses risks to health, food security, and biodiversity, affecting mostly the vulnerable populations. Immediate global action, including reducing emissions (Yin et al., 2025), transitioning to renewable energy (Ghorbani et al., 2024), and promoting sustainable practices, is critical in mitigating its impacts and securing a healthier, more stable future for the planet.

In the context of global climate change, Carbon Capture Utilisation and Storage (CCUS) technology has emerged as a core technique in climate change mitigation by

Adaptive Data Fusion for Energy Efficient Routing in Wireless Sensor Network

Priya Mohite (2015). *International Journal of Energy Optimization and Engineering (pp. 1-17).*
www.irma-international.org/article/adaptive-data-fusion-for-energy-efficient-routing-in-wireless-sensor-network/124743