

# Chapter 27: Alternative Fuels – Biofuels, Hydrogen, Syngas

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## Abstract

This chapter discusses the topic of alternative fuels and concentrates on biofuels, hydrogen, and syngas, their production, properties, their use in industry, and their importance to the environment. Biofuels are renewable energy sources that can be produced out of biomass, vegetable oils and waste products, and these fuels decrease reliance on fossil fuels. Hydrogen is offered as a clean carrier of energy, and the only by-product upon combustion is water, which makes it suitable for fuel cell and sustainable energy use. Syngas is a mixture of H<sub>2</sub> and CO, formed through the process of gasification of natural gas, biomass, or coal, and it is used as a flexible precursor in chemical production and energy production. It talks about methods of production, energy content, storage, handling and industrial use in the generation of power, transport and chemical manufacture. The positive environmental effects (such as the decreased emission of greenhouse gases and sustainable use of resources) are discussed, as well as such drawbacks as high costs of production, storage security, and technology. Using a combination of chemical principles, process engineering and industrial case studies, students can understand how to design and implement alternative fuel technology. Renewable energy, environmental engineering, sustainable transportation and chemical process development careers all depend on the knowledge of alternative fuels.

**Keywords:** Alternative fuels, Biofuels, Hydrogen, Syngas, Renewable energy, Fuel cells, Industrial applications.

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## 27.1. Introduction

Industrialization and increasing standards of living are causing the demand for energy in the world to increase at an alarming rate. Meanwhile, fossil fuel deposits such as coal, petroleum and natural gas are limited and are on their way out, potentially taking away energy security over the long term. Besides, burning such traditional fuels emits greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, NO<sub>x</sub>) and PM, contributing to air pollution, global warming, and climate change to a great extent. These obstacles have increased the rate of seeking alternative sources of energy, which are renewable, sustainable, or non-conventional sources. The alternative fuels are designed to decrease the reliance on fossil fuels, decrease the effects on the environment and create a sustained energy supply in the long term. They include biofuels (ethanol, biodiesel), hydrogen, synthetic fuels, biogas, and renewable sources of electricity. Scientific, technological and infrastructural inventions such as novel production techniques, engine design and distribution systems lead to the development and adoption of alternative fuel. These fuels are not only a source of cleaner energy but also can deliver economic and environmental resilience and thus are a part of the future energy environment.

## 27.2. Biofuels

Biofuels are renewable fuels that are derived from biological resources like plants, algae and organic waste. They are created as green substitutes to traditional fuels that are petroleum-based to be used in transportation, power generation and in industries. Biofuels are useful in minimizing greenhouse gas levels, curtailing reliance on nonrenewable fossil fuels and encouraging the use of renewable and domestically obtained biomass. They also contribute to rural development, generate job opportunities, and serve as a contributor to sustainable energy in the world because of their production and consumption. Biofuels can be available in liquid, gaseous and solid form depending on the source and the conversion method, hence they can be used to replace the conventional fuel in various sectors.