Chapter 3
Dynamic Interactions Between Economic Growth, Renewable Energy, and CO_2 Emissions in Norway Using a Fourier-Augmented ARDL Model

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ABSTRACT

This study investigates the relationship between renewable energy consumption, technological innovation, economic growth, and CO_2 emissions in Norway from 1990 to 2021 using the Fourier-Augmented ARDL model. The long-run results show that GDP growth increases emissions, while

DOI: 10.4018/979-8-3373-1077-0.ch003

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renewable energy and patent activity contribute to emissions reduction. In the short run, GDP significantly impacts emissions, whereas the effects of renewable energy and innovation are limited. These findings highlight the importance of sustained investments in green technologies and energy transition policies. The study provides new empirical evidence for the role of innovation and renewables in decarbonizing high-income economies

INTRODUCTION

Climate change represents a critical global concern, with carbon dioxide (CO_2) emissions playing a significant role in intensifying global warming. Nations across the globe are seeking to align their pursuit of economic growth with sustainable environmental practices, particularly by minimizing greenhouse gas emissions.

Norway stands out for its progressive stance on renewable energy and technological advancement, having set a bold objective of achieving carbon neutrality by 2030. Although the country has made commendable progress in transitioning its energy systems, the specific economic and technological factors influencing its CO_2 emissions remain insufficiently understood.

Previous studies have delved into the relationship between economic development and environmental degradation, often through the lens of the Environmental Kuznets Curve (EKC) hypothesis. This model implies a non-linear pattern in which emissions grow with rising income levels, only to decline as nations invest in cleaner technologies and adopt stringent environmental policies. Empirical results remain inconclusive, particularly in developed countries like Norway, where innovation and renewable energy adoption could significantly modify the expected trajectory (Kartal et al., 2024).

Notably, the role of innovation—commonly measured through patent activity—has been relatively overlooked in this context, despite Norway's leadership in green technology. Similarly, although renewable energy is increasingly recognized as a key strategy for reducing emissions, the

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