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Decarbonization Strategies for the Industrial Sector: Policy and Technology Perspectives

The industrial sector is a major contributor to global energy consumption and greenhouse gas emissions, particularly in energy-intensive industries such as steel, cement, chemicals, and heavy manufacturing. With global carbon neutrality targets emerging, achieving low-carbon transformation in industry has become a critical focus of energy and environmental policy. However, the complexity of industrial processes, high energy dependency, and diverse technological pathways make decarbonization a multifaceted challenge involving technical, economic, and policy considerations.

From a technological perspective, industrial decarbonization relies on energy efficiency improvements, clean energy substitution, and carbon capture, utilization, and storage (CCUS). Process optimization, waste heat recovery, and intelligent control can reduce energy consumption and emissions per unit of product. Replacing fossil fuels with renewable energy or green hydrogen enables process-level decarbonization, while CCUS provides an end-of-pipe solution for high-emission industries. Additionally, digitalization and industrial Internet technologies support process monitoring, energy optimization, and emission reduction potential assessment.

From a policy perspective, governments play a key role in guiding industrial decarbonization. Carbon trading schemes, energy efficiency standards, fiscal incentives, and green finance mechanisms combine regulatory constraints with economic incentives to encourage enterprises to adopt low-carbon technologies and optimize energy structures. Effective policy design must consider technological maturity, industry heterogeneity, and regional development to achieve both emission reduction and economic feasibility. The integration of policy and technology is central to achieving systemic decarbonization in industry.

This study aims to systematically analyze decarbonization strategies in the industrial sector from both policy and technology perspectives. It evaluates the emission reduction potential, economic feasibility, and practical applicability of different technological solutions, while exploring the interactions between policy incentives and technological innovation. The findings are expected to provide guidance for industrial enterprises in planning low-carbon transitions and support government decision-making in policy formulation, emission assessment, and the development of

green industries, thereby promoting sustainable, low-carbon industrial development.