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Climate Change Mitigation Strategies: A Comparative Global Analysis

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Abstract

Climate change mitigation remains one of the most pressing global challenges, with greenhouse gas (GHG) emissions continuing to drive unprecedented warming. This paper provides a comprehensive comparative analysis of mitigation strategies across major economies and regions, drawing on the latest 2025 data from the UNEP Emissions Gap Report, IEA World Energy Outlook, IPCC assessments, and the Climate Change Performance Index (CCPI) 2026. Key strategies examined include renewable energy deployment, energy efficiency, carbon pricing, nature-based solutions, and technological innovations such as carbon capture and storage (CCS). While advanced economies like the EU and US have made policy-driven progress through mechanisms like the EU Green Deal and Inflation Reduction Act, emerging powers such as China and India demonstrate rapid scale-up in renewables but face implementation gaps. Developing regions lag due to finance and technology barriers. Global projections indicate that current Nationally Determined Contributions (NDCs) lead to 2.3–2.5°C warming by 2100, far exceeding the Paris Agreement's 1.5–2°C goals, necessitating 35–55% emissions cuts by 2035. The analysis highlights synergies with adaptation, barriers like geopolitical tensions and fossil fuel lock-in, and policy recommendations for equitable international cooperation, scaled finance, and just transitions. Urgent, ambitious action can still limit overshoot and secure a sustainable future.

Keywods : finance , Determined, Contributions , Mitigation, Performance , Index, Denmark.

Introduction

Climate change, driven primarily by anthropogenic GHG emissions, poses existential risks to ecosystems, economies, and human societies. As of 2026, global temperatures have already risen approximately 1.3–1.4°C above pre-industrial levels, with 2025 recording record highs amid accelerating extreme weather events. Mitigation—reducing and avoiding emissions while enhancing sinks—has become central to international efforts under the UNFCCC and Paris Agreement. Yet progress remains insufficient, as evidenced by the UNEP Emissions Gap Report 2025, which projects 2.3–2.5°C warming under full NDC implementation and 2.8°C under current policies.

This paper conducts a comparative global analysis of mitigation strategies, evaluating their effectiveness, scalability, and equity implications across developed nations (EU, US), major emerging economies (China, India), and the Global South. It addresses core questions: Which strategies deliver the most emissions reductions? How do national contexts shape outcomes? What lessons emerge for closing the emissions gap? The analysis is grounded in 2025–2026 empirical data and reports, emphasizing the interplay between technology, policy, and finance. With COP30 approaching, this synthesis underscores the need for bolder ambition to align with 1.5°C pathways, which require transformative shifts in energy, land use, and industry. The structure proceeds from literature review to detailed strategies, regional comparisons, challenges, recommendations, and conclusions.

Literature Review Scholarly and institutional literature on climate mitigation has evolved from early focus on technological feasibility to integrated assessments of policy effectiveness, equity, and co-benefits. The IPCC's Sixth Assessment Report (AR6) Working Group III (2022) remains foundational, outlining that limiting warming to 1.5°C requires global GHG emissions to peak before 2025 and decline 45% by 2030 (relative to 2010), reaching net-zero around 2050. AR7 preparations (ongoing in 2026) incorporate updated scenarios emphasizing demand-side reductions and behavioral changes alongside supply-side decarbonization.

Recent reports refine these insights. The UNEP Emissions Gap Report 2025 highlights that new NDCs have only marginally narrowed the gap, with renewables "booming" but insufficient to offset fossil fuel persistence. It stresses the availability of low-carbon technologies while calling for massive support to developing countries. The IEA World Energy Outlook 2025 projects energy-related CO_2 emissions at record 38 Gt in 2024, with the Stated Policies Scenario (STEPS) showing declines to below 30 Gt by 2050 but still implying ~2.5°C warming; the Net-Zero Emissions (NZE) pathway demands accelerated efficiency, electrification, and low-emissions fuels.

Comparative studies, such as those in the Climate Change Performance Index (CCPI) 2026, rank 63 countries plus the EU on emissions, renewables, and policy. Denmark and the Netherlands lead, while the US ranks near the bottom (65th). Academic works (e.g., Fawzy et al., 2025 update) categorize strategies into conventional mitigation (renewables, efficiency), negative emissions technologies (NETs like BECCS, afforestation), and geoengineering, advocating synergies with adaptation.

Gaps persist in literature on Global South implementation barriers and geopolitical spillovers. This paper bridges these by integrating 2025 data into a multi-regional comparative framework, highlighting how strategies must be tailored to development levels for equitable outcomes

Key Climate Change Mitigation Strategies Mitigation strategies fall into five interconnected categories: (1) renewable energy transition, (2) energy efficiency and demand reduction, (3) carbon pricing and market mechanisms, (4) nature-based solutions and land-use change, and (5) emerging technologies like CCS and hydrogen.

Renewable energy deployment leads globally, with wind and solar costs plummeting 80–90% since 2010. The IEA notes tripling renewable capacity by 2030 (COP28 target) is nearly on track in STEPS, driven by China's dominance. Co-benefits include energy security and air quality improvements.

Energy efficiency offers the largest short-term gains, with the IEA estimating 4% annual improvements needed (vs. current 2%). Electrification of transport, buildings, and industry amplifies this when paired with clean power.

Carbon pricing—via taxes or emissions trading—internalizes externalities. The EU ETS covers 40% of emissions; China's national ETS (expanded 2025) targets power and industry. However, coverage remains low globally (~23% of emissions priced).

Nature-based solutions (NBS) like reforestation and wetland restoration provide cost-effective sinks. India's NDC commits to 2.5–3 $GtCO_2e$ additional carbon sink by 2030.

Emerging tech: CCS, direct air capture, and green hydrogen are scaling but remain expensive and energy-intensive. IPCC AR6 notes these are essential for hard-to-abate sectors but require policy support. Dual mitigation-adaptation approaches (e.g., climate-smart agriculture, resilient renewables) yield synergies, as per WRI analysis.

Effectiveness varies: Renewables and efficiency deliver immediate, scalable cuts; pricing ensures economy-wide signals; NBS offer biodiversity wins but face land competition. Integration is key for net-zero pathways.

Comparative Global Analysis Advanced Economies (EU and US): The EU exemplifies integrated policy via the Green Deal (55% net reduction by 2030) and Fit for 55 package, achieving high CCPI rankings through renewables (target 42.5% by 2030) and carbon border adjustments. Progress includes 22% emissions cut since 1990 despite growth. Challenges: energy security post-Russia and industrial competitiveness.

The US, under fluctuating federal policy, relies on the Inflation Reduction Act (2022) for $370B in clean incentives, boosting EVs and renewables. However, 2025 Paris withdrawal and state-level variations yield low CCPI performance (65th). Emissions fell ~15% since 2005 but remain high per capita.

Major Emerging Economies (China): China leads in absolute renewable additions (over 50% global solar/wind 2025) and EVs, with NDC updates targeting peak emissions pre-2030 and carbon neutrality 2060. Electrification rate exceeds 10% annually, positioning it as an "electrostate." Yet coal reliance persists (60%+ power), and emissions growth continues short-term. Strong industrial policy drives tech leadership but raises global supply chain concerns.

India (with Bihar Context): India's updated NDC (2022, with 2025 implementation) commits to 45% emission intensity reduction (2005 baseline), 50% non-fossil power (achieved early at ~60% projected), and 2.5–3 $GtCO_2e$ sink. Renewables reached ~220 GW by 2025, with solar leading. Bihar, as an agrarian state,

benefits from solar pumps and agroforestry but faces vulnerability to floods/monsoons, requiring localized NBS. Challenges: coal dependence (70% power), finance needs ($1T+ for net-zero), and development priorities. India's "just transition" model emphasizes equity, influencing Global South approaches.

Global South (Africa, Latin America, Southeast Asia): Lower emissions but high vulnerability. Strategies focus on leapfrogging via renewables (e.g., Morocco's solar leadership) and REDD+ forestry. Barriers: debt, technology transfer gaps, and adaptation-mitigation trade-offs. CCPI shows Pakistan and Nigeria performing relatively well on policy. International finance (promised $100B/year, often unmet) is critical.

Comparisons reveal: Advanced economies excel in policy innovation but lag ambition scale; Asia drives deployment volume; the South needs enabling environments. Convergence via technology transfer and finance could accelerate global progress.

Challenges and Barriers Geopolitical tensions, fossil fuel subsidies ($7T+ globally), and uneven finance flows hinder mitigation. Developing nations face "carbon colonialism" risks from Northern demand-side policies. Technological lock-in and political resistance (e.g., US shifts) slow transitions. Equity issues—historical emitters vs. current—persist, as do measurement challenges for NETs.

Policy Recommendations

1. Strengthen NDCs with economy-wide, 1.5°C-aligned targets by COP30.
2. Scale climate finance to $1T+/year via reformed multilateral banks and innovative mechanisms.
3. Accelerate technology transfer and capacity-building for the Global South.
4. Integrate mitigation with adaptation and sustainable development goals.
5. Promote just transitions via reskilling and social protection. International cooperation, carbon clubs, and sub-national action are vital.

Conclusion Comparative analysis shows mitigation strategies are proven and available, yet ambition and implementation gaps persist. With 2025 data signaling insufficient progress toward Paris goals, coordinated global action—led by high-emitters but supported equitably—remains the pathway to limit warming and build resilience. India's progress offers hope for development-compatible mitigation; scaling such models worldwide can secure a livable planet. Future research should monitor AR7 outcomes and post-2030 trajectories. The window for effective action is narrowing but still open.

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