# Policy Pathways for a Green Transition: Assessing the Interplay of Energy Diversification and Economic Complexity on the OECD's Load Capacity Curve

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**Abstract**

This study investigates policy-relevant pathways for achieving a green transition by examining the impact of energy diversification (ED) and economic complexity (EC) on load capacity factors (LCFs) across the Organization for Economic Co-operation and Development (OECD) countries from 1999 to 2021. To capture structural heterogeneity in environmental performance, this study develops a novel Energy Mix Concentration Index (EMCI), based on the Herfindahl-Hirschman Index, and employs Method of Moments Quantile Regression (MMQR), allowing for distribution-specific analysis beyond conventional mean-based estimators. The empirical framework integrates three distinct dimensions of ECI trade-based (ECI-Trade), technology-based (ECI-Technology), and research-based (ECI-Research) alongside GDP per capita and its squared term to test the validity of the load capacity curve (LCC) hypothesis. The findings of MMQR confirm the validity of the LCC hypothesis in OECD countries. ED is found to exert a statistically significant downward pressure on LCFs across all quantiles, with particularly strong adverse effects in environmentally constrained economies, highlighting the relevance of Jevons' paradox when diversification is not explicitly oriented toward low-carbon energy sources. Regarding EC, research-driven complexity positively affects LCFs, especially in lower LCF quantiles, by facilitating structural shifts toward cleaner, knowledge-intensive activities. In contrast, trade- and technology-based ECI reduce LCFs due to scale effects, supply-chain emissions, and rising energy demand, except in high-performing economies where strong institutions, stringent environmental regulations, and advanced renewable systems enable complexity-induced eco-innovation. These results underscore that innovation and diversification are not environmentally neutral and must be strategically directed. Overall, this study demonstrates that a successful green transition requires more than ED and economic upgrading alone. Effective policy pathways must combine targeted low-carbon energy strategies, mission-oriented research and development, and demand-side regulatory frameworks to ensure that EC reinforces, rather than undermines, environmental sustainability. The findings offer nuanced guidance for OECD policymakers seeking to align post-pandemic recovery strategies with long-term ecological resilience.

**Keywords**

**Author Keywords:** green transition; energy diversification; economic complexity; load capacity curve

**Keywords Plus:** CO2 EMISSIONS; GROWTH; CONSUMPTION; IMPACT

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**Data availability statement**

The data is openly available and was downloaded from https://databank.worldbank.org/source/world-development-indicators, assessed on 4 October 2025.

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