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Global Low Carbon Transitions in the Power Sector: A Machine Learning Archetypical Clustering Approach

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Abstract : This study presents an archetype-based approach to designing effective strategies for low-carbon transitions in the power sector. To achieve global energy transition goals, a renewable energy transition is critical, and understanding diverse energy landscapes across different countries is essential to design effective renewable energy policies and strategies. Using a clustering approach, this study identifies 12 energy archetypes based on the electricity mix, socio-economic indicators, and renewable energy contribution potential of 187 UN countries. Each archetype is characterized by distinct challenges and opportunities, ranging from high dependence on fossil fuels to low electricity access, low economic growth, and insufficient contribution potential of renewables. Archetype A, for instance, consists of countries with low electricity access, high poverty rates, and limited power infrastructure, while Archetype J comprises developed countries with high electricity demand and installed renewables. The study findings have significant implications for renewable energy policymaking and investment decisions, with policymakers and investors able to use the archetype approach to identify suitable renewable energy policies and measures and assess renewable energy potential and risks. Overall, the archetype approach provides a comprehensive framework for understanding diverse energy landscapes and accelerating decarbonisation of the power sector.

Keywords : fossil fuels, power plants, energy transition, renewable energy, archetypes
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