

The Choice between Renewables and Non-renewables: Evidence from Electricity Generation in 29 Countries

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For decades, electricity has been the fastest growing form of global end-use energy consumption globally. To achieve the environmental goals set out in the Paris Agreement, both developed and developing nations are undergoing transitions in the composition of their energy mixes and making efforts to increase the role of renewable energy sources, while balancing these with concerns regarding continued economic growth.

We investigate the effects of rising income and changes in relative prices on the usage of renewable and non-renewable energy sources in electricity generation using a dataset comprising 29 countries over the last three decades (1985-2017). Adopting the panel version of the fully modified ordinary least squares (FMOLS) method, we empirically analyse the income elasticities of energy usage for major primary energy sources: oil, coal, natural gas, nuclear, hydroelectric, as well as other renewable sources (including wind, solar, and geothermal), and explore complementary and substitution effects across various energy sources.

For developing nations, we find that while rising income is associated with significant increases in usage of all primary energy sources in electricity generation, the increase of greatest magnitude is for renewable sources. As for developed nations, increasing income is not necessarily associated with a significant rise in the use of nuclear or hydro for electricity generation. Comparing developing to developed economies, we find that developing nations have a higher income elasticity for all primary energy sources than do high-income countries.

With regards to renewable and non-renewable sources for electricity generation, the results indicate that the complementarity or substitutability of energy sources vary from developed to developing nations and the trade-offs are not simply between renewables and non-renewables. Nonetheless, there are some consistencies across income groups: oil is consistently used as a substitute for other fossil and non-fossil fuels except nuclear. Natural gas (as a transitional fuel) is a complement for oil and other renewables in both developing and developed economies.

Our analysis provides insight into the nature of ‘energy ladder’ behaviour that economies have historically exhibited in electricity generation. As policy makers plan and manage energy mix transitions towards zero emission systems, our study provides insights into feasible substitutions appropriate for both developing and developed nations.

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