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A Data-driven Approach for Building Energy Benchmarking Using the Lorenz Curve

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ABSTRACT

A building energy benchmark indicates the reasonable level of energy demand, and it facilitates the policy making when facing with uncertain information at the planning stage. Traditional benchmarks are established based on statistical indicators or physical simulations of prototype buildings, while the diversified consumption levels of various buildings are rarely considered carefully. Pointing to this, a data-driven benchmarking methodology is explored based on the Lorenz curve, which is a specific measurement tool of income inequality. In this paper, the Lorenz curve is used to identify the distribution inequality of energy consumption among buildings. In particular, the Lorenz curves of energy consumption were firstly derived from 195 buildings of three building types in Beijing. Afterwards, a variable was extracted from the fitting Lorenz curve, in order to quantify the nonlinear distribution principles of energy use intensity along with the accumulative building area. Finally, empirical benchmarking formulae for the three building types were achieved together with stepwise applications. The validation showed that relative errors of accumulated energy consumption for offices, hotels and shopping malls were -5.27%, 3.57% and -3.56% respectively. This data-driven approach is developed based on the limited information, and it attempts to assist energy-policy planners in establishing energy benchmarking targets and promoting energy efficiency.

Keywords: building energy benchmarking; distribution inequality; data-driven; regional energy planning; Lorenz curve.
دریافت فوری

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