

Energetic Limits to Economic Growth

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Abstract

The human population and economy have grown exponentially and now have impacts on climate, ecosystem processes, and biodiversity far exceeding those of any other species. Like all organisms, humans are subject to natural laws and are limited by energy and other resources. In this article, we use a macroecological approach to integrate perspectives of physics, ecology, and economics with an analysis of extensive global data to show how energy imposes fundamental constraints on economic growth and development. We demonstrate a positive scaling relationship between per capita energy use and per capita gross domestic product (GDP) both across nations and within nations over time. Other indicators of socioeconomic status and ecological impact are correlated with energy use and GDP. We estimate global energy consumption for alternative future scenarios of population growth and standards of living. Large amounts of energy will be required to fuel economic growth, increase standards of living, and lift developing nations out of poverty.

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