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A population-induced renewable energy timeline in nine world regions

Kevin Warner and Glenn Jones
Texas A&M University Galveston Campus, Galveston, United States (kewarner@tamu.edu)

Population growth and increasing energy access are incongruous with forecasts of declining non-renewable energy production and climate change concerns. The current world population of 7.3 billion is projected to reach 8.4 billion by 2030 and 11.2 billion by 2100. Currently, 1.2 billion people worldwide do not have access to electricity. The World Bank's Sustainable Energy for All initiative seeks to provide universal global access to energy by the year 2030. Though universal energy access is desirable, a significant reduction in fossil fuel usage is required before mid-century if global warming is to be limited to <2˚C. Today, the global energy mix is derived from 91% non-renewable (oil, coal, natural gas, nuclear) and 9% renewable (e.g., hydropower, wind, solar, biofuels) sources. Here we use a nine region model of the world to quantify the changes in the global energy mix necessary to address population and climate change under two energy-use scenarios and find that significant restructuring of the current energy mix will be necessary to support the 2014 UN population projections. We also find that renewable energy production must comprise 87-94% of global energy consumption by 2100. Our study suggests >50% renewable energy needs to occur by 2028 in a <2˚C warming scenario, but not until 2054 in an unconstrained energy use scenario. Each of the nine regions faces unique energy-population challenges in the coming decades. We find that global energy demand in 2100 will be more than double that of today; of this demand, 82% will need to be derived from renewable sources. More renewable energy production will be required in 2100 than the 2014 total global energy production. Given the required rate and magnitude of this transition to renewable energy, it is unlikely that the <2˚C goal can be met. Focus should be placed on expanding renewable energy as quickly as possible in order to supply the projected world energy demand and to limit warming to 2.5-3˚C by 2100.