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Health and climate co-benefits of the rural residential energy transition in China

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Although, solid fuels are still widely used in rural China for cooking and heating, significantly contributing to the emissions and adverse health and climate effects, a rapid transition towards clean energy is occurring in China. However, this trend was not well recorded in mainstream literature, leading to possible misestimating. To fill the data gap, we conducted a nationwide survey to collect energy mix data for 34,489 households and fuel weight data for 1670 households. Here, we present the results of the survey and a full assessment of the relative contributions of rural residential energy consumption on emissions of various air pollutants, ambient air $PM_{2.5}$ (particulate matter with an aerodynamic diameter of less than $2.5 \mu m$) associated premature deaths and climate forcing in China. We found that the rural residential energy mix and consumption changed rapidly when clean cooking energy increased from 8% to 59% and heating energy from 2% to 15% from 1992 to 2012, resulting in a significant reduction of air pollutant emissions. Among other factors, per capita income is the leading driving force causing such changes. Consequently, the relative contributions of rural residential emissions to mean ambient exposure $PM_{2.5}$ concentrations, premature deaths, and climate forces decreased from 16.1 ± 10.4 to $7.2 \pm 5.1 \mu g/m^3$, from 271 (201-417 as semi-quartile range) to 61 (47-131) thousand, and from 0.058 to $0.030 W/m^2$ from 1992 to 2012, respectively. Such changes vary extensively among regions and months.