Global energy inequality in households

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Global wealth and income distribution is extremely unequal among countries and households. Reduced inequalities is one of United Nations Sustainable Development Goals. There are wide studies about how to reduce inequalities, and the reasons and the impacts of inequality. The economic inequality also translates to energy inequality. Energy consumption is perceived as a better indicator of inequality as it captures the flow of durable goods and services which represent income and standard of living and are sustained by energy quantities . Householdsâ€™ direct energy consumption and energy footprints (or indirect energy use) are unequally distributed among countries and household groups due to differences in the size and patterns of household expenditure. In order to achieve more equitable energy use worldwide, it is crucial to understand the current global distribution of energy consumption by household groups. However, previous studies about energy footprints and inequality seldom consider different energy types, economic sectors, and detailed household categories.

By using the latest GTAP v11 dataset (MRIO table and energy data of 160 countries in 2017), and global expenditure data from World Bank (201 expenditure bins of 116 countries which almost consist of 90% of the global population), we computed country- specific energy footprints by 201 household groups and 6 energy types using an environmental-extended multi-regional analysis and revealed the global household energy inequality by using Gini coefficients. We find that the direct energy uses of 116 countries were 1,787 Mtoe in 2017, while the energy footprints induced by the consumption of these countries were 9,390 Mtoe. The inequality of energy footprints varies across different countries and economic sectors. In general, energy footprint Gini coefficients are negatively correlated to GDP per capita. European countries have the lowest energy equality, while African countries have the highest. China and the USA have a relatively large energy footprint and large energy inequality. As for economic sectors, the Transport sector is the most unequal sector in most developed countries, and the inequality of this sector is strongly related to the economic development levels of countries. In the meantime, the Manufacture sector is more likely to be the most unequal sector in developing countries such as Cambodia, Vietnam and China, which play the role of manufacturing factories in the world. Besides, the electricity energy footprints of the Water sector are the most unequal in most African countries which implies the Africaâ€™s low energy efficiency in water industries. Meanwhile, the trade among countries or regions not only allows the exchange of goods and services but also leads to the enlargement the energy inequality among and within countries. By comparing the inequality of direct energy use and energy footprints, it is found that the Gini coefficients which represent the energy inequality, are enlarged by the complex supply chains among countries.

Such detailed measures of global household energy inequalities could help us understand the current energy conditions among and within countries, inform policy interventions to promote energy transition, and achieve equitable energy access to more affordable energy while satisfying the basic needs and even improving the living standards of poor countries and poor households.