The structure of life-cycle environmental impact of the U.S. economy

Topic:
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Environmental impacts associated with the U.S. economy pose significant global implications. This paper integrates hybrid, multi-regional input-output and Life Cycle Impact Assessment (LCIA) approaches to quantify the environmental impact of the U.S. economy. An integrated system is constructed using various data sources that embrace about 2,600 environmental pressures, over 400 industrial commodities for the U.S, 123 industrial commodities for China, 8 final demand categories, over 4,000 process Life Cycle Inventories and over 1,200 environmental impact characterization factors, which, altogether represent one of the most comprehensive frameworks for analyzing environmental impacts. The structure of the hybrid input-output framework is analyzed, and the generality of the hybrid frameworks proposed Suh (2004) over Konijn et al (1997) is shown. The composition and structure of the environmental impacts are analyzed using contribution analyses and environ analysis by Patten (1982). Particularly, environ analysis result is used to visualize the network structure of the life-cycle environmental impact of the U.S. economy. The results show that private household consumption and investment is responsible for about 66% of the total environmental impacts induced by the U.S. economy, half of which is caused by the consumption expenditures for the provision of ‘Mobility’, ‘Food’ and ‘Shelter’. Major industrial activities that generate direct environmental impacts were ‘Natural gas, Electricity and Utility’, ‘Mining, Drilling and Refining’ and ‘Agriculture, Forestry and Fishery’. Overall, it is shown that provision of energy, transportation, food and materials are the major conduits of environmental impacts in the U.S. economy. The contribution of environmental impacts by imports to the U.S. is estimated to be responsible for about 28% of the total impact created by the U.S. economy, while the results associated with imports are relatively more uncertain. The current study demonstrates a novel combination of various tools and techniques that are developed in the fields of natural science, engineering, ecosystem science and input-output economics in addressing major environmental policy imperatives. The results are expected to inform the U.S. EPA in prioritizing major areas of effort needed to reduce the environmental impact of the U.S. economy.