CO2 Emission Hotspot Anlysis in the Supply Chain Complexity for Wooden Houses in Japan

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Buildings (e.g., houses, apartment buildings) are essential to peopleâ€™s lives, but these building have a significant impact on climate change and other environmental issues. For example, CO2 emissions induced by each country construction actives and the electricity and heat consumption accounted for 19% of total CO2 emissions induced by worldâ€™s economic activities. In addition, 94% of CO2 emissions induced by final demand in the global construction sector come from the supply chain. Therefore, reducing CO2 emissions from the supply chain is important to mitigate the CO2 emission load of the construction sector. To reduce CO2 emissions from the supply chain, it needs to identify the CO2 emission hotspots in the supply chain. Several previous studies identified CO2 emission hotspots throughout the construction sector, including civil engineering (e.g., dam, tunnel construction) and housing. However, these studies didnâ€™t only focus on the housing supply chain structure. Therefore, this study identified CO2 emission hotspots in the supply chain structure of wooden house, which account for 90% of detached houses in Japan.

This study used the following methodology. (1) We used environmentally extended input-output analysis to estimate CO2 emissions from wooden houseâ€™s supply chain in 2015. (2) We used Unit Structure Model to estimate the supply chain structure of a wooden house. (3) We estimated Create an adjacency matrix weighted by CO2 emissions for the wooden house supply chain structure. (4) We applied cluster analysis to the adjacency matrix to identify CO2 emission hotspots.

To decide functional unit of housing, we used data on the total floor area of wooden house from 2018 to 2021, as published by the Ministry of Land, Infrastructure, Transport and Tourism. We defined a house with a total floor area of 119 m2 as an average wooden house. We used data on the direct CO2 emission intensity, as published by National Institute for Environmental Studies. Also, we used on the input-output table in 2015, as published by Ministry of Internal Affairs and Communications.

This study revealed three results. (1) Direct and indirect CO2 emissions for the construction of one average wooden house in 2015, were 38t-CO2. (2) Top 10 clusters accounted for 30% of wooden houseâ€™s carbon footprint. (3) In particular, clusters related to steelmaking (Pig iron, Crude steel, Cast iron pipes and tubes, Cast and forged materials sector) and clusters related to cement products (Gravel and quarrying, Crushed stones, Cement, Ready mixed concrete, Cement products sector) accounted for 60% of CO2 emissions from cluster.

These results indicate that in order to reduce the carbon footprint of wooden houses, it is significant to reduce CO2 emissions from two clusters. Most of steel products and cement products are used by constructing wooden houses are used as foundation of the house. It is significant for house builder to promote renovation and remodeling vacant wooden house (2.4 million units) in Japan. This is because, renovation and remodeling enable house builder to reuse foundation of the house and to reduce CO2 emissions from producing foundation (i.e., CO2 emissions from top2 clusters).