

Life Cycle Carbon Dioxide Emissions from the Construction Phase of Highway Sector in China

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Abstract : Carbon dioxide (CO₂) emissions mitigation from road construction activities is one of the potential pathways to deal with climate change due to its higher use of materials, machinery energy consumption, and high quantity of vehicle and equipment fuels for transportation and on-site construction activities. Aiming to assess the environmental impact of the road infrastructure construction activities and to identify hotspots of emissions sources, this study developed a life-cycle CO₂ emissions assessment framework covering three stages of material production, to-site and on-site transportation under the guidance of the principle of LCA ISO14040. Then streamlined inventory analysis on sub-processes of each stage was conducted based on the budget files from cases of highway projects in China. The calculation results were normalized into functional unit represented as ton per km per lane. Then a comparison between the amount of emissions from each stage, and sub-process was made to identify the major contributor in the whole highway lifecycle. In addition, the calculating results were used to be compared with results in other countries for understanding the level of CO₂ emissions associated with Chinese road infrastructure in the world. The results showed that materials production stage produces the most of the CO₂ emissions (for more than 80%), and the production of cement and steel accounts for large quantities of carbon emissions. Life cycle CO₂ emissions of fuel and electric energy associated with to-site and on-site transportation vehicle and equipment are a minor component of total life cycle CO₂ emissions from highway project construction activities. Bridges and tunnels are dominant large carbon contributor compared to the road segments. The life cycle CO₂ emissions of road segment in highway project in China are slightly higher than the estimation results of highways in European countries and USA, about 1500 ton per km per lane. In particularly, the life cycle CO₂ emissions of road pavement in majority cities all over the world are about 500 ton per km per lane. However, there is obvious difference between the cities when the estimation on life cycle CO₂ emissions of highway projects included bridge and tunnel. The findings of the study could offer decision makers a more comprehensive reference to understand the contribution of road infrastructure to climate change, especially understand the contribution from road infrastructure construction activities in China. In addition, the identified hotspots of emissions sources provide the insights of how to reduce road carbon emissions for development of sustainable transportation.

Keywords : carbon dioxide emissions, construction activities, highway, life cycle assessment

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