ABSTRACT

STUDY ON DEMATERIALIZATION AND DECARBONIZATION OF INFRASTRUCTURE AND BUILDING CONSTRUCTION IN CHINA

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China, which is one of the fastest economy growing countries all over the world, has experiencing the rapid growth of building and infrastructure development. Since 1998, China government authorized increasing infrastructure construction and expanding domestic demand as the basic standpoint and long-term strategy of China's economic development. Thus, a large number of infrastructure and buildings will be constructed to support economic development and improve people's living standards in China. Large-scale construction and material consumption resulted serious environmental problems such as global warming. In addition, if the infrastructure and buildings construction continues, China will inevitably face a shortage of domestic resource supplies. Otherwise, the short lifetime of infrastructures and buildings will be caused a large amount of solid waste. Therefore, understanding the resource demands and dynamic material flow into infrastructure and buildings constructions and the associated environmental impacts, exploring effective ways to reduce resource consumption, and improving resource efficiency would be critical for China-the largest resource consumer and CO2 emitter in the world.

In this study, we aim to identify the characteristics of material consumption and flows associated with infrastructures and buildings construction until 2050, evaluate the impacts of the influencing factors for material input in infrastructures and buildings, and seek potential options for dematerialization and decarbonization of infrastructures and buildings construction.

According to our results, the material consumption in WWTIs (Wastewater treatment infrastructures) will increase rapidly until 2025 to meet the needs of the natural growth of wastewater discharged, but also to overcome the shortage of existing WWTPs (Wastewater treatment plants). In contrast with the moderate effects of water consumption growth, prolonging the design lifetime will greatly reduce material consumption in WWTI construction during the period 2028–2050, and about 60% of total material input will be saved in the medium-lifetime scenario compared with the short-lifetime scenario during the same period. Meanwhile, material output and CO2

emissions associated with WWTIs will be reduced by 87% and 37% respectively n the medium-lifetime scenario compared to the short-lifetime scenario under high-water-consumption growth. Moreover, our results highlight the great importance of pipeline construction and cement consumption in resource consumption associated with WWTI construction in China.

Our results also indicated that traffic volume is an important factor to drive the roadway demand and material consumption of roadway in China. In the contrast with the moderate effects of traffic volume, prolonging the lifetime of roadway will greatly reduce material consumption in roadway construction. The material consumption will reach 79 billion and 65.2 billion tons under the medium lifetime and short lifetime respectively, which reduce about 13.3% and 28.4% in 2050 compared to short lifetime scenario. Moreover, increases the asphalt pavement rate of roadway can effective reduce the CO_2 emissions in China. When Asphalt pavement reached 100% in 2050, the CO_2 emissions will reach about 3.3 billion tons in 2050 based on the short lifetime scenario, which will reduce about 48.9% compared to cement pavement scenario (cement pavement rate will reach 100% in 2050).

For the railway, the total material consumption, stock and demolition in railway are experiencing an increasing trend toward 2050; Prolonging the current lifetime of railway design to the level of long lifetime scenario will greatly reduce the material consumption and associated CO_2 emission by 17.53 % and 13.74 %; This study also indicated that improving the recycling rate from low to high level, will avoid the resource waste by 17.10 % in 2050 under medium scenario; Our study also paid attention to the environmental friendly technology, during the period of 2010-2050, CO_2 emission is projected to mitigate by 13.60 % when the carbon intensity embodied in production process is lowered down.

According to our results, prolonging the lifetime of building will greatly reduce material consumption. The material consumption will reach 2294 billion and 1484.7 billion tons under the high growth medium lifetime and short lifetime respectively, which reduce about 41% and 62% from 1950 to 2050 compared to short lifetime scenario. Moreover, improve CO_2 reduction technology can also reduce the CO_2 emissions in China. CO_2 emissions will reach about 641.7 billion tons from 1950 to 2050 based on the high growth technology short lifetime scenario, which will reduced about 15% compared to high growth scenario. Our results also indicate that improving the material recycling of building can effectively reduce the solid waste for case of China.