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Abstract

Resource Efficiency to Achieve a Circular Economy in the Asphalt Road Construction Sector †

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The construction and maintenance of the built environment consume a large quantity of resources and energy and contribute to the emission of a significant amount of greenhouse gases. Hence, improving resource efficiency and resource cycles is crucial to reducing environmental, economic and social impacts. The construction of roads mainly consumes mineral aggregates and binders, has the advantage of high recycling rates, and can utilise cascading materials. However, infinite recycling is impossible and recycled road construction material often cascades due to quality, quantity and economic issues. In addition, the extending and ageing road network faces increased traffic and climate changes, which might increase the probability of failure, inducing an increased maintenance effort. Maintenance has a minor contribution to resource consumption in developing countries, but it can have a major contribution in developed countries in the range of 50% to 75%. The increasing production of asphalt for surface wearing courses in Austria indicates the increase in materials used in maintenance. The production of surface course asphalt was about 25% to 35% before 2016, roughly reflecting the 3 cm asphalt surface layer of the total asphalt layer thickness of 15 cm to 20 cm used in municipalities' roads. The increase to 55% to 60% from 2017 to 2019 indicates the increasing maintenance work performed on the Austrian asphalt network. The reconstruction of roads and maintaining the road network accounted for about 65% in one Austrian municipality, reflecting the efforts of the municipality's administration to improve traffic concepts (increasing roadway width, adding cycle lanes and paths, reducing traffic speed and improving townscape), as well as addressing the structural problems and long-term solutions of degraded road surfaces. Since the reconstruction process is similar to initial construction, it consumes an identical amount of resources for asphalt layers. Hence, local factors such as traffic development, economic viability, and road lifespan are important to determine long-term resource efficiency. About 25% of the reclaimed asphalt of Austrian asphalt production in 2018 and 2020 corresponded to increased surface course asphalt production. This shows that system improvements are required to record waste generation, treatment and utilisation. 70% of the processed reclaimed asphalt is officially used to produce new asphalt. However, the cascading material flow of reclaimed asphalt pavements (used in unbound layers, gravel roads, road shoulders and backfilling) depends on local factors such as the short transportation distances of primary materials, low binder prices and administrative recycling commitments. A deeper understanding of the material flows related to asphalt roads, including primary and secondary material resources and resource consumers, and the economic interaction between the industries related to these flows, is necessary to establish sustainable asphalt roads without causing unwanted shifts in material flows and sustaining resource depletion.

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