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Abstract

Resource efficiency to achieve a circular economy in the asphalt road construction sector †

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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 are 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 is a consumer of cascading materials. However, infinite recycling is impossible and recycled road construction material is often cascaded due to quality, quantity and economic aspects. 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. An increase to 55% to 60% from 2017 to 2019 indicates the increasing maintenance work done on the Austrian asphalt network. Reconstructions of roads, maintaining the road network, accounted for about 65% in an 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 structural problems and long-term solutions of degrading 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. The amount of reclaimed asphalt of about 25% of the Austrian asphalt production in 2018 and 2020 corresponds to the increased surface course asphalt production. It shows that system improvements are required to record waste generation, treatment and utilisation. Processed reclaimed asphalt is officially used to 70% to produce new asphalt. However, a cascading material flow of reclaimed asphalt pavement (used in unbound layers, gravel roads, road shoulders and backfilling) depends on local factors like 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 economic interaction between industries related to these flows are necessary to establish sustainable asphalt roads without causing unwanted shifts of material flows, sustaining resource depletion.

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