Road Transport Infrastructure

HIGHLIGHTS

TECHNOLOGY STATUS - Road transport infrastructure enables movements of people and goods within and between countries. It is also a sector within the construction industry that has demonstrated significant developments over time and ongoing growth, particularly in the emerging economies. This brief highlights the different impacts of the road transport infrastructure, including those from construction, maintenance and operation (use). The operation (use) phase of a road transport infrastructure has the most significance in terms of environmental and economic impact. While the focus in this phase is usually on the dominant role of tail-pipe GHG emissions from vehicles, the operation of the physical infrastructure should also accounted for. In total, the road transport infrastructure is thought to account for between 8% and 18% of the full life cycle energy requirements and GHG emissions from road transport.

PERFORMANCE AND COSTS - Energy consumption, GHG emissions and costs of road transport infrastructure fall broadly into the three phases: (i) construction, (ii) maintenance, and (iii) operation (decommissioning is not included in this brief). The construction and maintenance costs of a road transport infrastructure vary according to location and availability of raw materials (in general, signage and lighting systems are not included in the construction costs). GHG emissions resulting from road construction have been estimated to be between 0.37 and 1.07 $ktCO_2$/km for a 13m wide road – depending on construction methods. Maintenance over the road lifetime (typically 40 years) can also be significant in terms of costs, energy consumption and GHG emissions. GHG emissions are estimated at between 26% and 67% of the total emissions from the construction phase, depending on materials and conditions of the maintenance regime. During operation, costs, energy consumption and GHG emissions result primarily from electricity use for lighting, signals and signage and so vary significantly depending on local conditions (e.g. lighting requirements, electricity generation mix). Significant reductions in costs and environmental impacts can be achieved during road operation using specific materials and design methods to improve energy efficiency. For example, a 50-70% energy savings in street lighting are deemed possible through the combination of LEDs paired with intelligent smart controls. Additional savings in cost, energy use and GHG emissions can be obtained from measures and technologies to mitigate/avoid congestion and from the use of appropriate coating with low surface rolling resistances. In some cases, these have been estimated to be significantly larger than savings from construction and maintenance activity.

POTENTIAL AND BARRIERS - The performance of road transport infrastructure has a long-term impact on future patterns of consumption and many national governments have already outlined an intention to improve or increase road transport infrastructure in the coming years. New materials and construction techniques, alternative maintenance regimes and new power sources are all options to help reduce the future costs of road transport infrastructure. Intelligent transport systems (ITS) are deemed to significantly reduce on-road emissions at relatively low cost and infrastructure impact, although there is little or no quantitative information available on this. Numerous new technologies and their utilisation for cost reduction are currently being investigated. However, long-term planning and the demand-driven nature of transport infrastructure may represent a barrier to using new, environmentally friendly techniques. Higher initial costs have often been a hindrance to implementation. Also, some novel technologies require significant development before they can be considered suitable for widespread use.

TECHNOLOGY STATUS

Road transport infrastructure forms physical links between regions and nations and is a key facilitator for the exchange of goods, services and people, and countries' economic growth [1]. The United Nations Economic Commission for Europe has provided UN countries with legal frameworks and agreements to facilitate a coherent international development of transport networks. Recently, road transport infrastructure has been recognised to have a significant impact on the overall greenhouse gas (GHG) emissions [2]. For the purposes of this brief, road transport infrastructure is defined as the road network and associated physical infrastructure such as signage, lighting and vehicle refuelling service. Energy consumption, environmental impacts and costs of a road transport infrastructure refer to three distinct but interlinked areas including (i) the construction of the physical infrastructure and the associated construction materials; (ii) the road maintenance over time; and (iii) the road operation (use), the latter being strongly related to the energy supply to vehicles that use the infrastructure and the energy needed for infrastructure operation (e.g. lighting, signage). Each such area has associated energy use, emissions and costs that are discussed in the text, with typical figures provided in the summary Tables 1 and 5. This brief primarily focuses on energy use, emissions and costs associated to these areas, and on future solutions to alleviate the negative impacts. Decommissioning and disposal phases [3] are beyond the scope of the brief.

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