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Capturing Time Effect of Pavement Carbon Footprint Estimation in the Life Cycle

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## **1 Capturing Time Effect of Pavement Carbon Footprint**

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## **Estimation in the Life Cycle**

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Abstract: The carbon footprint of pavement in the life cycle is regularly calculated by 7 aggregating the inventory of greenhouse gases (GHGs) at different timings. Comparisons by 8 9 the nominal values, therefore, ignore the temporal information and may lead to biased estimation of the environmental impact. This study proposed a time-dependent methodology 10 11 to dynamically assess the global warming potentials (GWPs) incorporating two time parameters, time of evaluation (TE) and time horizon (TH). The former defines the time 12 period of life cycle assessment (LCA) and the latter decides when the GWP is evaluated. Two 13 case studies were conducted. The first case study indicated for design lives (viz. TE) of 20 y 14 15 and 40 y, the GWPs are significantly overestimated by 59.7% and 33.0%; the second case study indicated that 66 y is the threshold value for TH that brings different policy preference 16 for two emission plans. Together with the concept of "time dominance", a generic 17 implementation framework was established for the methodology so that users can justify the 18 preferences of alternatives at any THs. The developed methodology can assist decision 19 makers in understanding the real impacts of carbon emission within and beyond pavement life 20 21 cycle.

- 22 Keywords: life cycle assessment; global warming potential; time effect; temporal scale
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- 24 Highlights
- A time-dependent methodology to calculate global warming potential (GWP) of
  pavement was built.
- Two time factors, time of evaluation and time horizon, were incorporated and defined.
- Both time factors influence the GWP calculation results.
- A framework to perform the developed methodology was established.
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