Abstract

Freight movement emits GtC02 and undermines pavement - adding additional emissions from pavement maintenance & rehabilitation (PMR) treatments. This study predicts the carbon footprint of freight movement and pavement maintenance on regional highways of Atlantic provinces of Canada. Integration of environmental analysis within a spatial input-output model estimates equivalent single ad loads (ESALs) and CO2 emissions on regional highways for a 30 year period. ESALs combined with observed pavement strength result in the generation of pavement deterioration curves. The curves are used for performance-based optimization to estimate necessary pavement maintenance operations. A total 1,279 million tons of CO2 and 1,403 - 1,759 million tons of carbon dioxide equivalent GHGs will emit from predicted fuel consumption and pavement surface treatments during 2012-2041.

Methodology

Step 1: Spatial input-output modeling

\[ \text{Consumption Zone (C) = Production Zone (P) +\% of intra-provincial trade} \]

Step 2: Transportation modeling

\[ C = C_i + C_o + C_t + C_m + C_e \]

\[ C_i = \text{Operating Cost} \]

\[ C_o = \text{Fixed operating cost of a truck once for every trip made, usually including drivers' salaries and capital payments} \]

\[ C_t = \text{Operating cost per km of a truck, usually including tires, spares, maintenance, lubricants, and others. This cost varies by link type} \]

\[ C_m = \text{Charges paid by driver for tolls, parking, duties, etc.} \]

\[ C_e = \text{Energy cost} \]

Objectives and Study Area

This study integrates freight movement for inter-provincial trade-flow, pavement maintenance as a consequence of deterioration imposed by such predicted freight movements, and the carbon footprint.

Case Study: Provinces network between New Brunswick, Prince Edward Island, Newfoundland and Labrador, Nova Scotia and Quebec

Results

Total demand & production of five provinces during 2012-2041

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Predicted ESALs per year for regional highways

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Carbon footprint of forecasted freight traffic and traffic induced pavement maintenance operations

Per year carbon footprint for fuel consumption 42602.58 Metric Tons
Total carbon footprint for fuel consumption 1,279 Million Metric Tons (30 years)
Per year fuel cost $91.70 Millions
Total fuel cost $2790.96 Millions (30 years)
Per year fuel consumption 4.19 Millions gallon
Total fuel consumption 125.61 Millions gallon (30 years)
Annual carbon footprint (Metric ton) for pavement maintenance

Cumulative IRI for moisture index of 60, 80 and 100

Pavement surface treatments of links (km) of selected routes

References


The carbon footprint of freight traffic and pavement treatments for interprovincial trade flows of Atlantic Canada

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