

## Developing a Sustainable Transit Planning Index Using Analytical Hierarchy Process Method for ZEB Implementation in Canada

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**Abstract :** Transportation is the fastest growing source of greenhouse gas emissions worldwide. In Canada, it is responsible for 23% of total CO<sub>2</sub> emissions from fuel combustion, and emissions from the transportation sector are the second largest source of emissions after the oil and gas sector. Currently, most Canadian public transportation systems rely on buses that operate on fossil fuels. Canada is currently investing billions of dollars to replace diesel buses with electric buses as this is perceived to have a significant impact on climate mitigation. This paper focuses on the possible impacts of zero emission buses (ZEB) on sustainable development, considering three dimensions of sustainability; environmental quality, economic growth, and social development. A sustainable transportation system is one that is safe, affordable, accessible, efficient, and resilient and that contributes minimal emissions of carbon and other pollutants. To enable implementation of these goals, relevant indicators were selected and defined that measure progress towards a sustainable transportation system. These were drawn from Canadian and international examples. Studies compare different European cities in terms of development, sustainability, and infrastructures, by using transport performance indicators. A Normalized Transport Sustainability index measures and compares policies in different urban areas and allows fine-tuning of policies. Analysts use a number of methods for sustainable analysis, like cost-benefit analysis (CBA) to assess economic benefit, life-cycle assessment (LCA) to assess social, economic, and environment factors and goals, and multi-criteria decision making (MCDM) analysis which can compare differing stakeholder preferences. A multi criteria decision making approach is an appropriate methodology to plan and evaluate sustainable transit development and to provide insights and meaningful information for decision makers and transit agencies. It is essential to develop a system that aggregates specific discrete indices to assess the sustainability of transportation systems. These prioritize indicators appropriate for the different Canadian transit system agencies and their preferences and requirements. This study will develop an integrating index that allies existing discrete indexes to support a reliable comparison between the current transportation system (diesel buses) and the new ZEB system emerging in Canada. As a first step, the indexes for each category are selected, and the index matrix constructed. Second, the selected indicators are normalized to remove any inconsistency between them. Next, the normalized matrix is weighted based on the relative importance of each index to the main domains of sustainability using the analytical hierarchy process (AHP) method. This is accomplished through expert judgement around the relative importance of different attributes with respect to the goals through a pairwise comparison matrix. The consideration of multiple environmental, economic, and social factors (including equity and health) is integrated into a sustainable transit planning index (STPI) which supports realistic ZEB implementation in Canada and beyond and is useful to different stakeholders, agencies, and ministries.

**Keywords :** zero emission buses, sustainability, sustainable transit, transportation, analytical hierarchy process, environment, economy, social

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