INTISARI

Sektor transportasi merupakan salah satu kontributor utama emisi gas rumah kaca di Indonesia, dengan sepeda motor sebagai moda transportasi dominan, khususnya dalam layanan ojek online yang memiliki intensitas operasional tinggi. Sepeda motor listrik dipromosikan sebagai alternatif yang lebih ramah lingkungan, namun kinerja lingkungannya sangat dipengaruhi oleh bauran energi listrik nasional yang masih didominasi oleh pembangkit berbahan bakar fosil. Oleh karena itu, diperlukan evaluasi dampak lingkungan sepeda motor listrik dan sepeda motor bensin berdasarkan kondisi operasional nyata.

Penelitian ini bertujuan untuk membandingkan dampak lingkungan sepeda motor listrik dan sepeda motor bensin dalam layanan ojek online di Yogyakarta serta mengidentifikasi faktor operasional yang memengaruhi efisiensi penggunaan kendaraan. Analisis dilakukan menggunakan pendekatan *Life Cycle Assessment* (LCA) dengan batas sistem *Well-to-Wheel* dan unit fungsional jarak tempuh 70 km per hari, menggunakan metode IMPACT World+ yang mengaitkan hasil pada tingkat *midpoint* dengan kategori kerusakan (*endpoint*) pada area perlindungan kesehatan manusia (*Human Health*) dan kualitas ekosistem (*Ecosystem Quality*). Selain itu, analisis Decision Tree digunakan untuk mengevaluasi pengaruh faktor operasional seperti biaya energi dan jarak tempuh harian.

Hasil penelitian menunjukkan bahwa pada fase *Well-to-Tank*, sistem kelistrikan Jawa-Madura-Bali memiliki beban lingkungan yang relatif lebih besar dibandingkan sistem bensin akibat dominasi pembangkit fosil. Namun, pada tingkat *Well-to-Wheel*, sepeda motor listrik berpotensi menurunkan emisi gas rumah kaca sebesar 35-40% serta memberikan manfaat signifikan pada kategori dampak terkait kualitas udara dan kesehatan manusia. Keunggulan sepeda motor listrik bersifat kontekstual dan akan semakin optimal apabila didukung oleh transisi menuju bauran energi listrik yang lebih bersih serta kondisi operasional yang sesuai.

Kata kunci: *Life Cycle Assessment*, *Decision Tree*, Sepeda Motor Listrik, Sepeda Motor Bensin, Ojek Online

ABSTRACT

The transportation sector is one of the major contributors to greenhouse gas emissions in Indonesia, with motorcycles representing the dominant mode of transportation, particularly in online motorcycle taxi services that operate with high daily intensity. Electric motorcycles are promoted as a more environmentally friendly alternative; however, their environmental performance is strongly influenced by the national electricity mix, which is still largely dominated by fossil fuel-based power generation. Therefore, an assessment of the environmental impacts of electric and gasoline motorcycles under actual operating conditions is required.

This study aims to compare the environmental impacts of electric motorcycles and gasoline motorcycles used in online motorcycle taxi services in Yogyakarta and to identify operational factors that influence vehicle efficiency. The analysis employs a Life Cycle Assessment (LCA) approach with a Well-to-Wheel system boundary and a functional unit of 70 km per day, using the IMPACT World+ method, which links midpoint results to endpoint damage categories related to human health and ecosystem quality. In addition, Decision Tree analysis is applied to evaluate the influence of operational factors such as energy cost and daily travel distance.

The results indicate that during the Well-to-Tank phase, the Java-Madura-Bali electricity system exhibits a relatively higher environmental burden than the gasoline system due to the dominance of fossil fuel power plants. However, at the Well-to-Wheel level, electric motorcycles have the potential to reduce greenhouse gas emissions by 35-40% and to provide significant benefits in terms of air quality and human health. The environmental advantages of electric motorcycles are contextual and can be further optimized through a transition toward a cleaner electricity mix and appropriate operating conditions.

Keywords: Life Cycle Assessment, Decision Tree, Electric Motorcycles, Gasoline Motorcycles, Online Motorcycle Taxis