

# A New Equation for Fuel Economy of Hybrid Vehicles in Republic of Korea Based on 5-Cycle Test

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## Abstract

Fuel economy labeling serves a market-driven system that provides consumers with essential information to encourage the purchase and development of highly efficient vehicles. Since 2012, Korea has utilized derived 5-cycle equations, modeled after the US 5-cycle fuel economy calculation method, to enhance the reliability of these labels. However, with the growing prevalence of environment-friendly vehicles, particularly hybrids, it has become necessary to reassess and validate these equations specifically for hybrid models. In this study, 20 of the latest hybrid vehicle models available in the Korean market were selected for comprehensive 5-cycle testing. By analyzing the correlation between 5-cycle and 2-cycle fuel consumption results, we evaluated the applicability of the current derived 5-cycle equations for Hybrid Vehicles (HVs) and subsequently developed dedicated equations tailored to their performance characteristics. The application of the derived 5-cycle equations for HVs to the fuel economy reveals a decrease in city fuel economy by up to 0.9 km/L and an increase in highway fuel economy by up to 2.2 km/L. Consequently, this adjustment is expected to lead to the reclassification of up to three models within each fuel economy rating category, ensuring more accurate and representative labeling for consumers..

**Keywords** 5-Cycle fuel economy · Derived 5-cycle fuel economy · Fuel economy label · Hybrid Vehicles

## Abbreviations

FC	Fuel consumption, L/km
FE	Fuel economy, km/L
FTP	Federal test procedure
HWFET	Highway fuel economy test
NEC	Net Energy Change
2-cycle	FTP-75, HWFET
5-cycle	FTP-75, HWFET, US06, SC03, Cold FTP

## 1 Introduction

According to World Motor Vehicle Statistics by the Korea Automobile and Mobility Association (2023), global vehicle sales reached 82 million in 2022, marking a 0.9% increase

over the past decade. The number of vehicles owned globally surged by 46.9% to 1634 million during the same period. The primary energy source for these vehicles is secondary energy, mainly refined petroleum, leading to increased oil demand as vehicle number rise. Fossil fuels are the leading contributors to global greenhouse gas emissions, with each gallon of gasoline burned producing 20 pounds of CO<sub>2</sub> (U. S. Environmental Protection Agency, 2023). In 2022, the road transport sector globally emitted 5.87 gigatons (Gt) of CO<sub>2</sub>, which needs to be reduced by 1.78 Gt by 2030 to meet the Net Zero Scenario (International Energy Agency, 2024).

Rising oil consumption also poses a threat to national energy security, particularly for countries heavily dependent on energy imports. South Korea, for instance, imported 156.7 million tons of oil equivalent (Mtoe) of crude oil in 2022, according to the Year of Energy Statistics (Korea Energy Economics Institute, 2023). High energy import dependency makes a country vulnerable to disruptions in supply or sharp price increases, complicating efforts to secure national energy needs.

To address these challenges and promote both emission reductions and energy stability, fuel economy labeling systems have been adopted worldwide. These systems act as a market pull strategy, encouraging consumers to purchase

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