Annex 55: Real Driving Emissions and Fuel Consumption

Project Duration	November 2015–April 2019
Participants **Task Sharing** **Cost Sharing**	 Canada, Denmark, Finland, Sweden, Switzerland, USA No cost sharing
Total Budget	~€400,000 ($483,764 US)
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Purpose, Objectives, and Key Question

The levels of air pollutants from internal combustion engine (ICE)-powered vehicles that are being sold in the marketplace today are much lower than those from vehicles 4 to 10 years ago. This change is largely the result of technology forcing regulations to control the exhaust emission rates of various air pollutants such as hydrocarbons, carbon monoxide, oxides of nitrogen (NO_x), and particulate matter. Over time, changes to those regulations have reflected the extraordinary advances in fuels, engines, and emission control technologies that have been produced by automotive researchers/manufacturers over the past decades. There is evidence to suggest that the performance of vehicles may not be fully captured in compliance or type approval tests, even though they are conducted with varying driving cycles and in an environmentally controlled chamber.

This project aims to develop an emission rate, fuel consumption, and energy efficiency inventory of vehicles driven on-road in varying countries in typical seasonal corresponding climates, using vehicles fueled with advanced, renewable, and conventional fuel. Vehicle performance will be investigated over typical regional driving conditions such as city, highway, arterial, free-speed, and congested routes. In short, the objective of this project is to explore the real driving emissions and real-world performance of vehicles operating under a range of worldwide driving conditions.

Activities

The team finalized the Annex 55 formal text in the summer of 2017. The purpose, objectives, audience, and methodologies are defined. The team defined the following work packages:

- Work package 1: Annex management

- Work package 2: Literature review and world regulation review
- Work package 3: Fuel and technology effects on real-world driving emissions and efficiency
- Work package 4: Comparison of on-road testing to laboratory testing
- Work package 5: Assessment of weather conditions on real-world driving emissions and efficiency
- Work package 6: Evaluation of different emissions measurement technics

Currently, the annex members are in the testing and data collection phase. On-road testing and dynamometer testing results have been shared and compared. Several participants defined their own real-world driving routes.

Key Findings

Canada completed on-road testing in Ottawa, Ontario, with five distinct driving segments. The vehicles were also tested in the laboratory on a chassis dynamometer. Great variability in test results occurred during the on-road emissions testing compared to the chassis dynamometer testing. Canada tested several vehicles: a cylinder deactivation vehicle, a compressed natural gas/gasoline bi-fuel vehicle and its gasoline counterpart for baseline, and three pairs of vehicle with both gasoline and diesel models. Canada found that fuel consumption from real-world testing is, on average, 22% higher than the observed fuel consumption from tests on a chassis dynamometer. Furthermore, 84% of vehicles that were tested on-road presented a statistically significant increase in NO_x when comparing real-world and laboratory results on a chassis dynamometer.

Denmark completed the testing of five vehicles in cold weather conditions on track as well as on an 80-km real driving emission route. The results showed a wide range of NO_x emissions between the different test cars in real-world driving.

Sweden completed the testing of 30 vehicles on different cycles and ambient conditions. The data analysis is currently in progress.

The US tested a gasoline vehicle as well as a plug-in hybrid vehicle on three specific routes (urban, arterial, and highway) on roads in the Chicago metropolitan area. The vehicles were extensively instrumented beyond the portable emissions measurement equipment. On the basis of specific drive metrics (such as potential kinetic energy and accelerations), the dynamometer testing was very repeatable in energy intensity compared to

the on-road testing. For the gasoline vehicle, the emissions, as well as the driving aggressiveness, in the real world were generally higher (30%–100%) than laboratory certification testing. For the plug-in hybrid vehicle, small amounts of emissions came from the engine through short operations during the charge depleting phase. Overall, emissions are still very low in both charge-depleting mode and charge-sustaining mode.