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COPERT 4 v8.0

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Summary

This report presents the methodological and software revisions of COPERT 4 version 8.0, compared to version 7.1.

Keywords

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Contents

1 Methodology revisions

1.1 New CO, NOX, VOC, PM (exhaust) and FC Hot Emission Factors for Heavy Duty Vehicles

The CO, NOX, VOC, PM (exhaust) and FC hot emission factor parameters of the COPERT 4 methodology have been updated for Heavy Duty Trucks and Buses (except Urban CNG Buses Euro I-III) on the basis of the latest HBEFA version (version 3.1 – May 2010) [1].

Euro V emission factors are distinguished in two main technologies: Euro V EGR and Euro V SCR technology. Some manufacturers have introduced exhaust gas recirculation (EGR) to reduce the combustion temperature and thus reduce NOx. Some other manufacturers have implemented selective catalytic reduction (SCR) aftertreatment devices. SCR operates by injecting urea in the exhaust line. Urea liberates ammonia which reacts with nitrogen oxides to produce nitrogen and water. Both technologies are effective in meeting the Euro V emission standards. However, in real world operation, SCR is not efficient for exhaust gas temperatures below approximately 150 grad Celsius. As a result, the true NOx emission factors of SCR equipped trucks are much higher than EGR ones at low speeds. Therefore, allocating a realistic emission factor to Euro V trucks requires knowledge of the share of EGR and SCR equipped Euro V trucks in circulation and separate sets of emission factors

This share can be provided in COPERT 4 v8.0 by a new form (Figure 1) under the 'Advanced > EGR, SCR ratios' menu. The user needs to introduce the percentage share of EGR equipped trucks in column **EGR ratio (%)**. Then the column **SCR ratio (%)** is calculated as the difference "100-**EGR ratio (%)**". In order to assist the user, some values have been already filled in. These values originate from market surveys and sales of Euro V trucks in 2008, 2009 and first quarter of 2010. These values therefore reflect our best knowledge for the year 2010. The user may change these values if better information is available. On the basis of the same analysis, the EGR ratio for 2008 was 26.6% and 24.6% for 2009.

As representative examples, the differences in hot emission factors of version 7.1 and version 8.0 for HDT Rigid 14-20t and HDT Articulated 34-40t Euro IV, Euro V-EGR-SCR, Euro VI vehicles are presented in Annex I. In particular the NOX emission factors of Euro V SCR trucks appear much higher than what earlier believed. Due to the high ratio of SCR vehicles on the road (>70%), the mean Euro V emission factor appears now much higher than what we have assumed in the past. This will evidently further aggravate the NOx emissions reported by member states. Although such increase in NOx emissions appears dramatic, this has been also confirmed by on-road measurements of typical trucks in a relevant report by TNO [2]

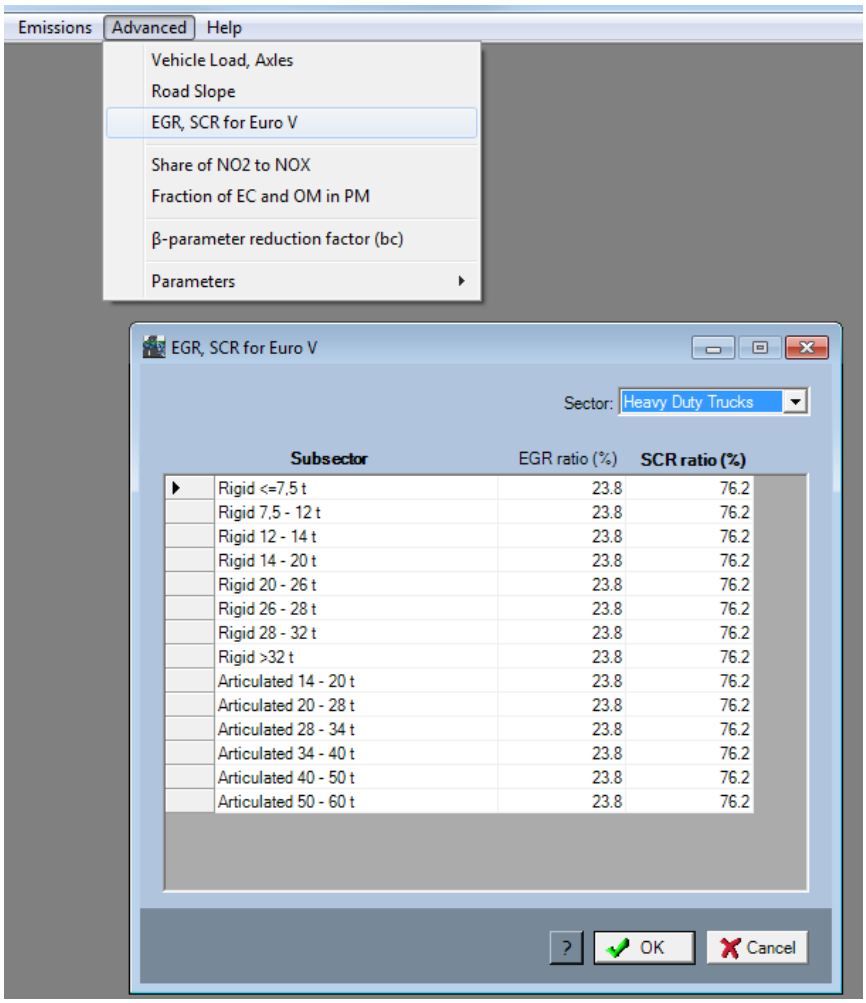


Figure 1: EGR, SCR for Euro V

1.2 Updated minimum speed limit of Hot Emission Factors Parameters for Hybrid Passenger Cars

The minimum speed limit of hot emission factors parameters for hybrid passenger cars is now 20 km/h instead of 10 km/h that was in version 7.1.

The decision to do so is because the methodology resulted in negative NOx hot emission factors with speed values lower than 20 km/h, which is not possible.

2 Software revisions

2.1 Sulphur Content removed from the 'Improved_Fuel_Specs' worksheet of the Excel Import/Export files

Columns "Gas_Sulphur_ppm_wt" and "Diesel_Sulphur_ppm_wt" are removed from the 'Improved_Fuel_Specs' worksheet of the Excel export files and they are also ignored during the Import process.

The reason for this change is because the Sulphur Content is based on the values that the user provides in the 'Sulphur_Content_perc_wt' worksheet. The user may provide in this sheet, different values for each year and this cannot be done in the 'Improved_Fuel_Specs' worksheet. Also many users would fill in the values in "Sulphur_Content_perc_wt" and leave the 'Improved_Fuel_Specs' values zero that would result in incorrect calculations.

2.2 COPERT 4 can be installed with .NET frameworks more recent than 1.1

COPERT 4 can now be installed in computers that have a .NET Framework more recent than 1.1 (e.g. 2.0 or 3.5). In case the user has no .NET framework installed, the setup software will prompt him to download and install .NET Framework 1.1.

2.3 Reports software patch

A software patch is released for the users that had a problem viewing or exporting in Excel format the reports of the 'File > Reports > Driving mode oriented' and 'File > Reports > Source oriented' forms. This software patch is available from the website of COPERT (http://lat.eng.auth.gr/copert/) and it has to be installed after the installation of COPERT 4 v8.0.

2.4 Load/Slope effect separately selected

In version 8.0 the user can select separately to apply Road Slope or Load Effect. In each form there are buttons to activate the effect (Figure 2, Figure 3) and also there are two different fields in the Run Details table (Figure 4).

In version 7.1 the Road and Slope effect was activated only from the Vehicle Load form and the user could not apply separately one of the two effects.

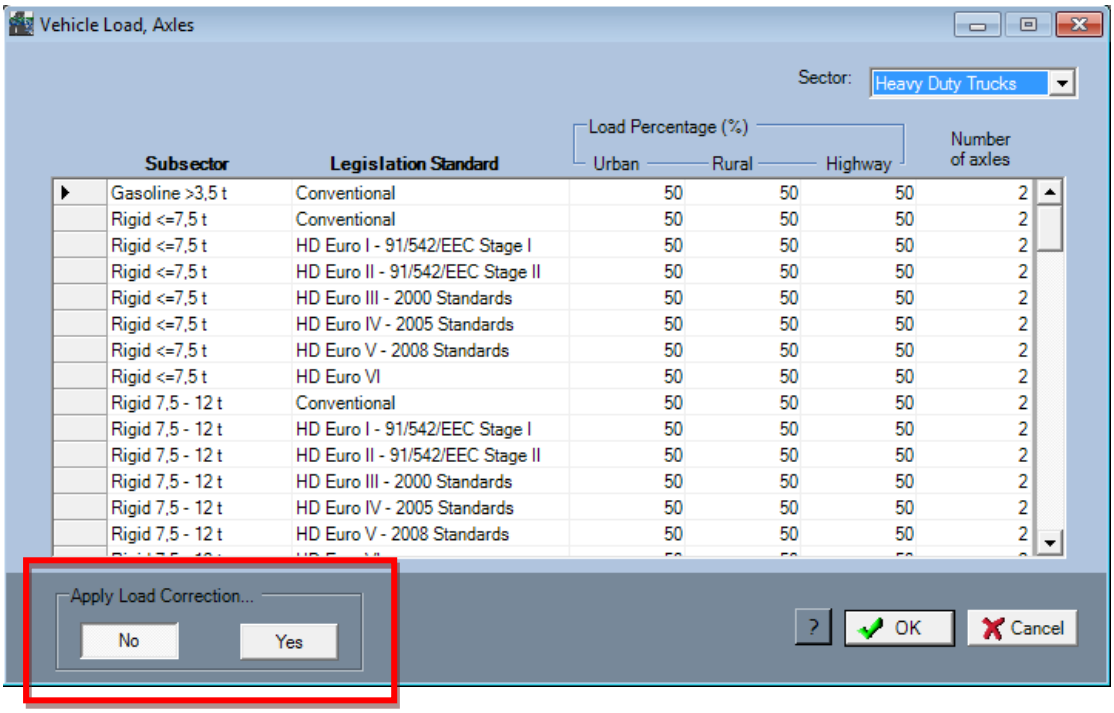


Figure 2: Vehicle Load form

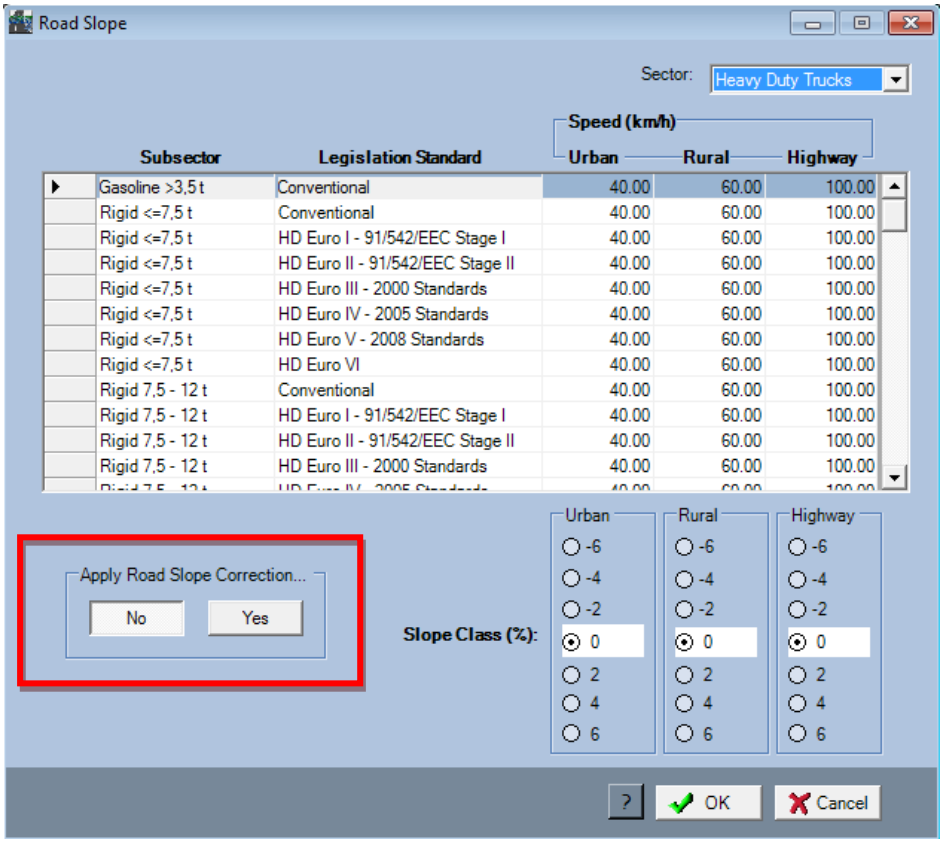


Figure 3: Road Slope form

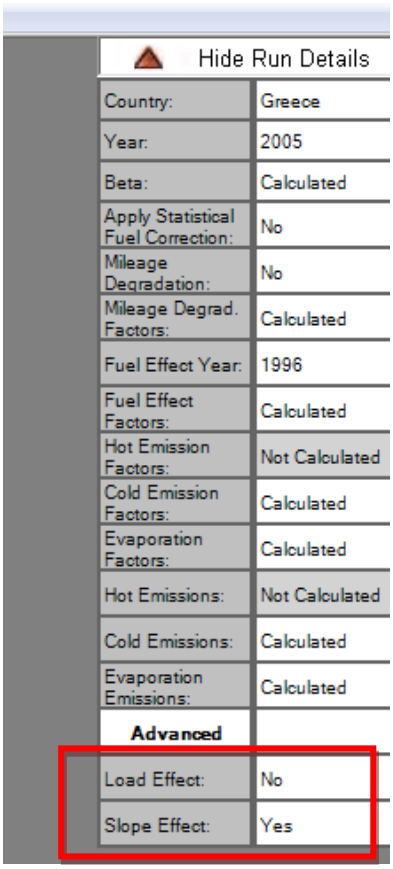


Figure 4: Load and Slope Effect on Run Details table

3 Bugs Fixed

3.1 Corrected Mileage Degradation Factors calculation

There was a software bug during the calculation of the mileage degradation factors. When the user tried to create a new fleet configuration and he imported all the data without the 'Mean_Fleet_Mileage_km' worksheet, the Cumulative mileage values were not correctly updated for the Mileage Degradation calculation process. This is now corrected.

3.2 Corrected Evaporation Emission Factors calculation

There was a software bug during the calculation of the evaporation emission factors. When the user provided temperatures in the 'Country > Country Info' form, lower than -11°C, the software resulted in a message error. This is now corrected by

considering temperatures lower than -11°C as -11°C since the methodology of the evaporation emission factors calculation produces valid results only for temperatures equal or greater than this value. This consideration applies only for the evaporation emission factors calculation and not for other calculations, such as the calculation of beta values.

3.3 Corrected export process of Fuel Balance results

There was a software bug during the export of the fuel balance results in the 'File > Import/Export > Export Data (Excel File)' form. If the user had a file with more than one year the results of the first year would only appear in the export file. This is now corrected.

4 Literature

1. Hausberger S., Rexeis M., Zallinger M., Luz R. (2010). Emission Factors from the Model PHEM for the HBEFA Version 3. Technical University Graz report, p.76. Available online at http://www.hbefa.net/e/index.html.

2. Ligterink, N., de Lange, R., Vermeulen, R., Dekker, H. 2009. On-road NOx emissions of Euro-V trucks, TNO report MON-RPT-033-DTS-2009-03840. Delft, NL, p.19.

5 Annex I

In Figure 2 to Figure 11 are presented the differences between the hot emission factors of version 7.1 (v7.1) and version 8.0 (v8) for HDT Rigid 14-20t and HDT Articulated 34-40t Euro IV, Euro V-EGR-SCR, Euro VI vehicles. In the case of Euro V vehicles the emissions factors of Euro V version 7.1 (v7.1), of SCR technology (100% SCR), of EGR technology (100% EGR), of 23.8% EGR and 76.2% SCR (23.8% EGR) are included.

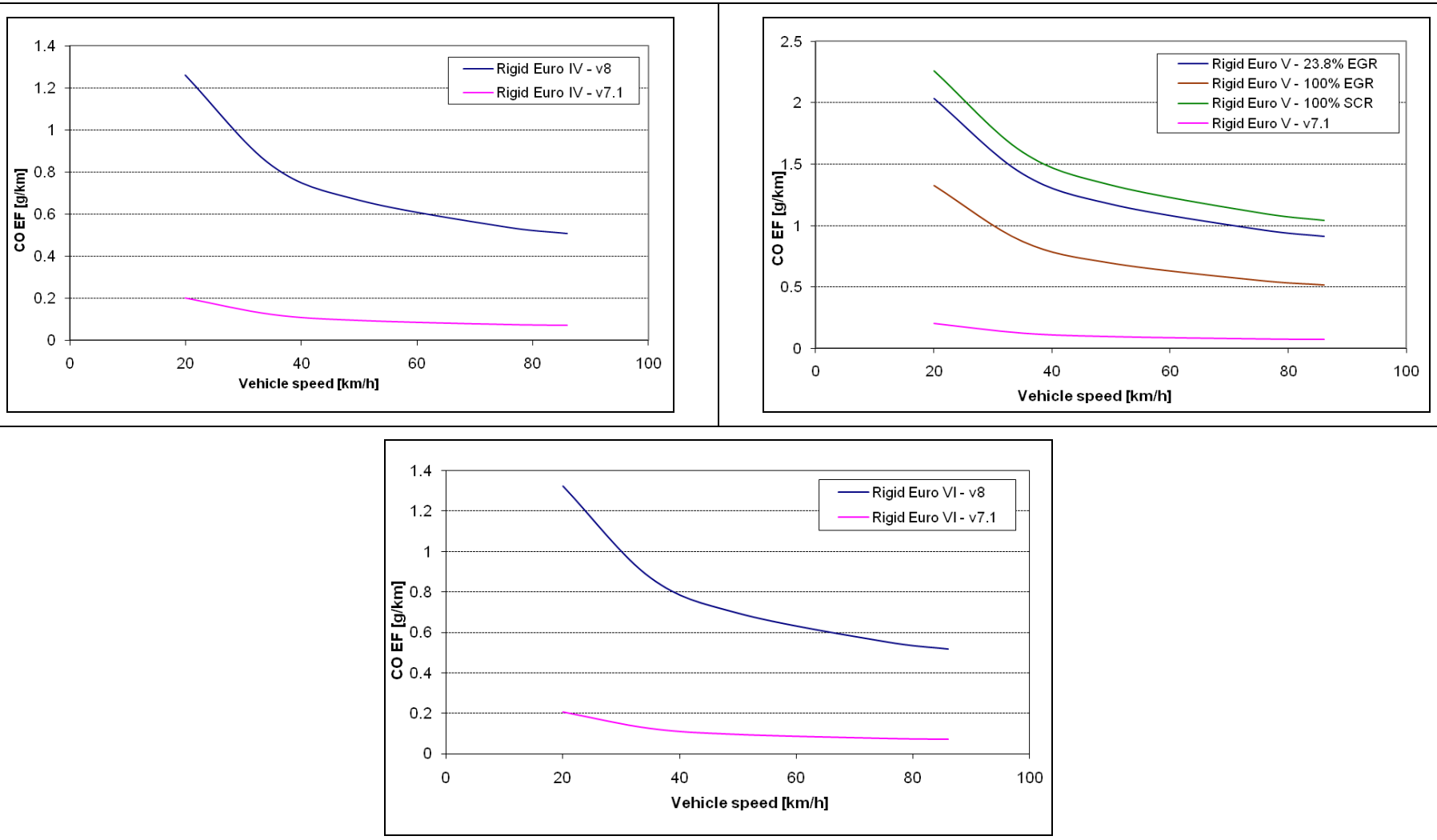
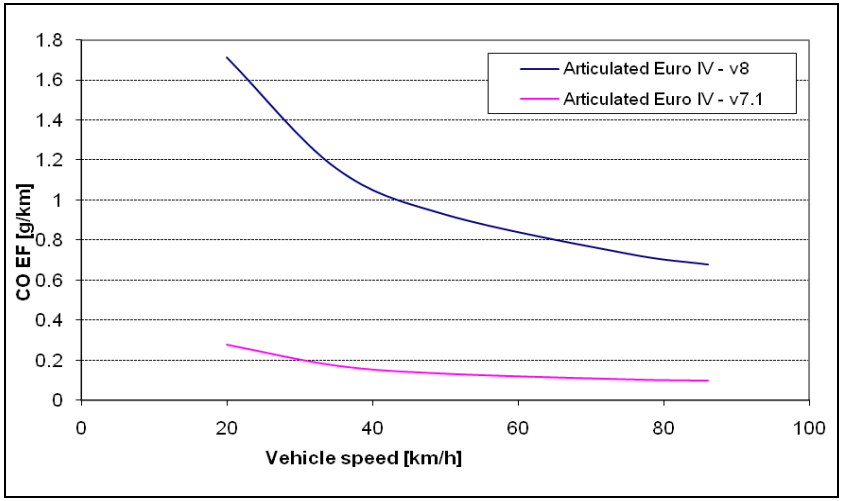
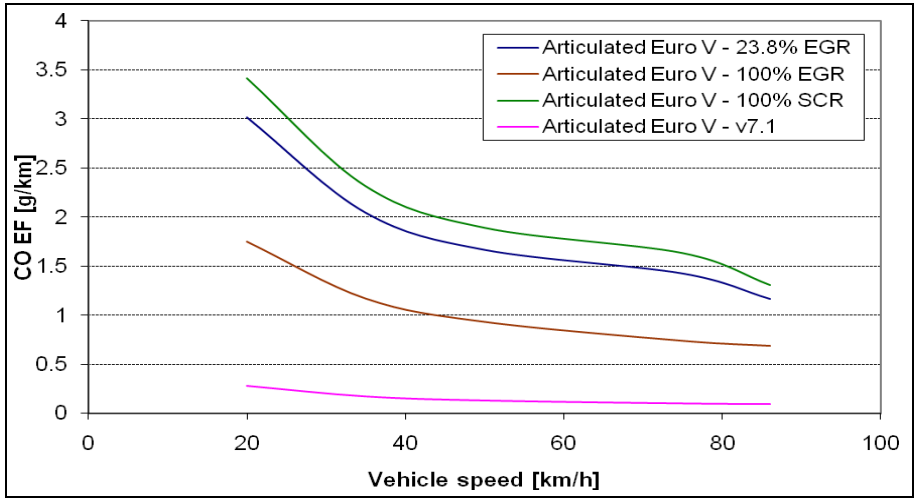


Figure 5: CO - HDT Rigid 14-20t





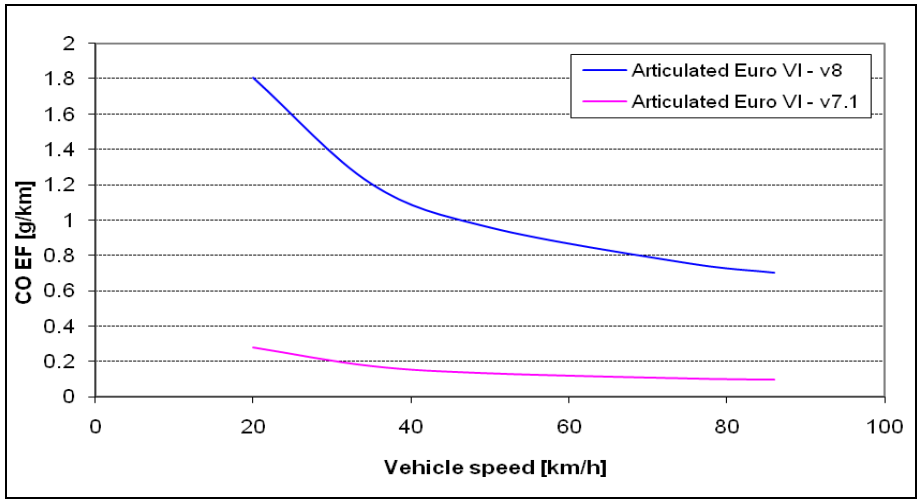


Figure 6: CO - HDT Articulated 34-40t

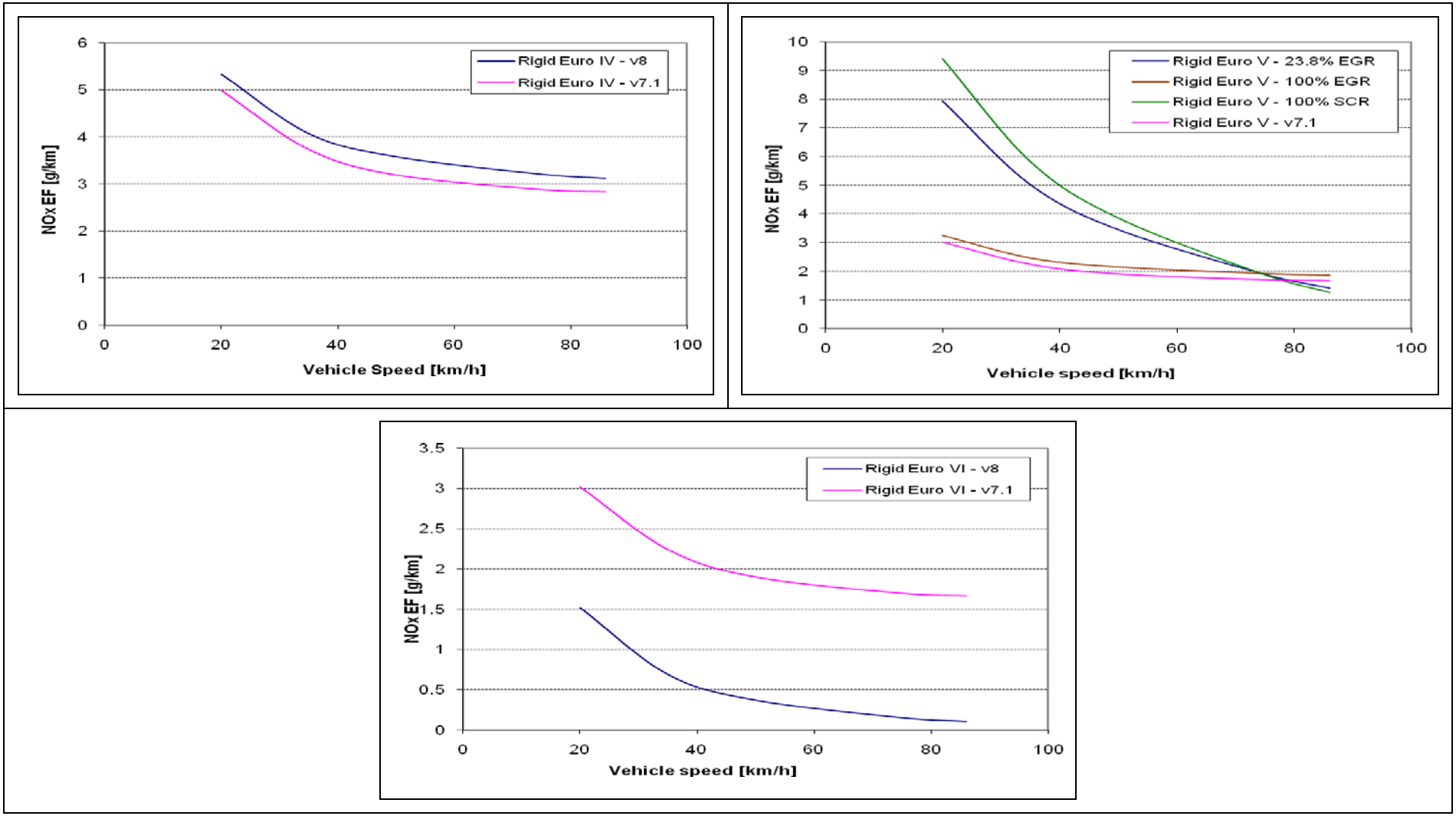


Figure 7: NOx - HDT Rigid 14-20t

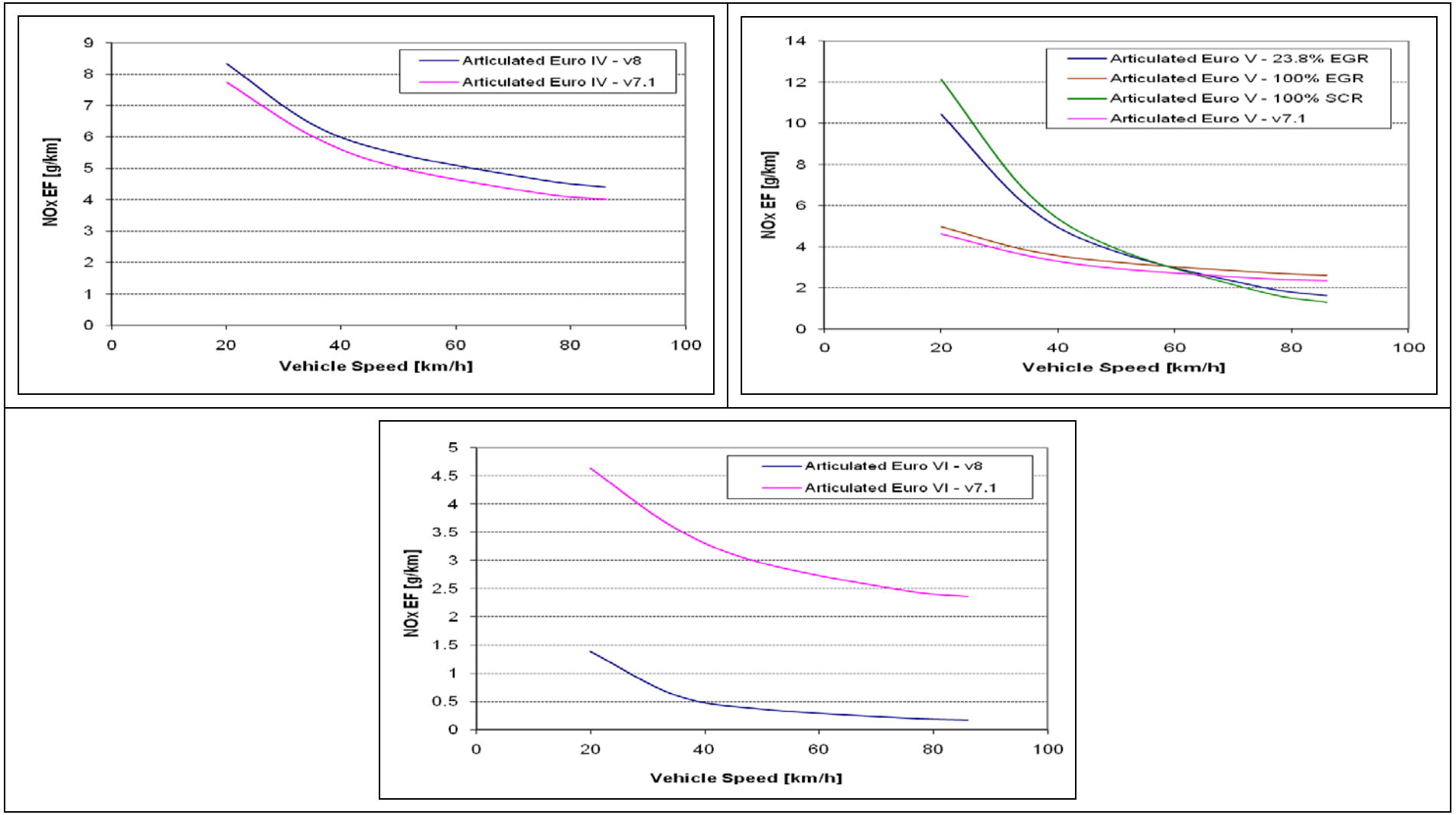


Figure 8: NOx - HDT Articulated 34-40t

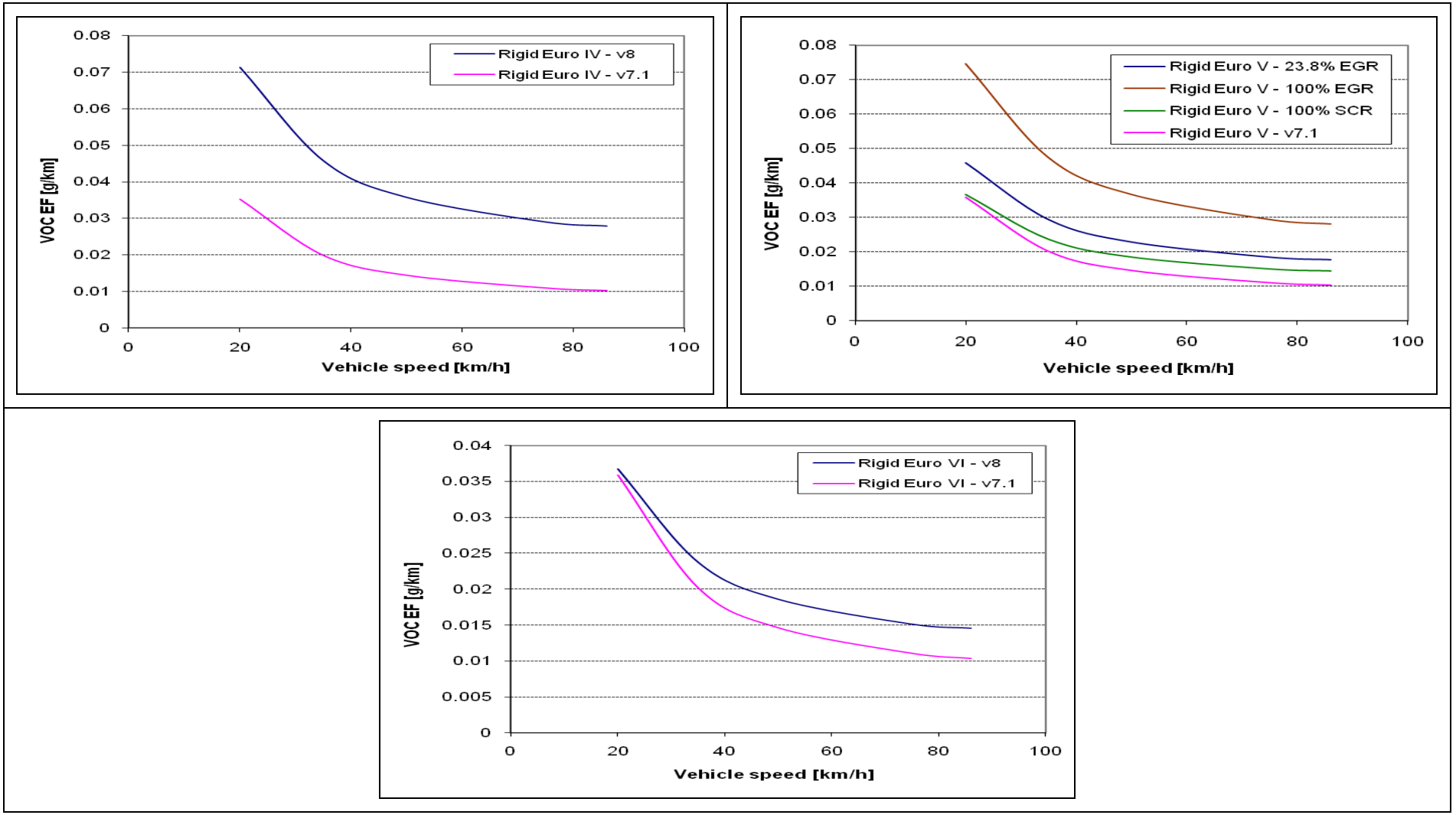


Figure 9: VOC - HDT Rigid 14-20t

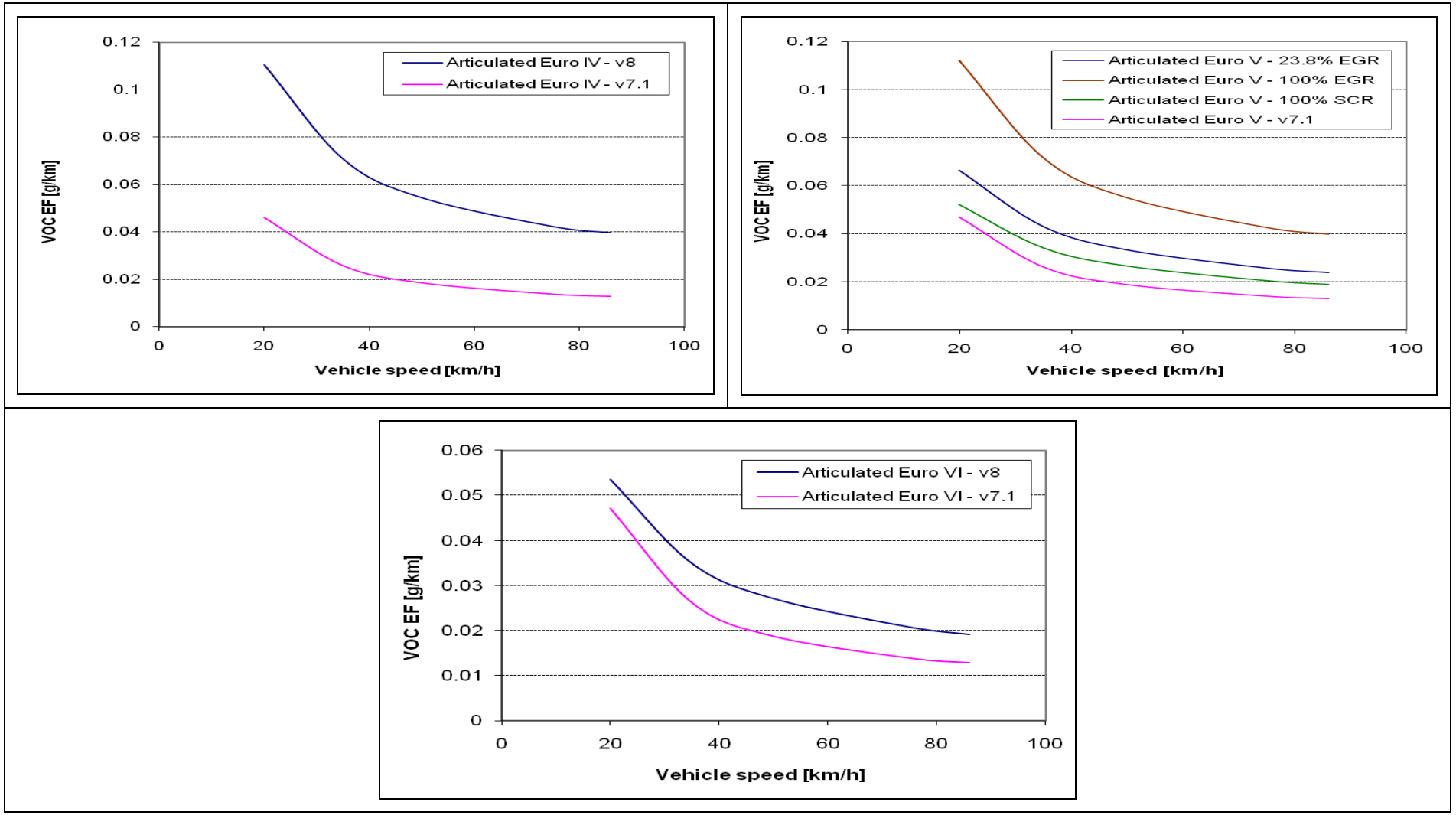


Figure 10: VOC - HDT Articulated 34-40t

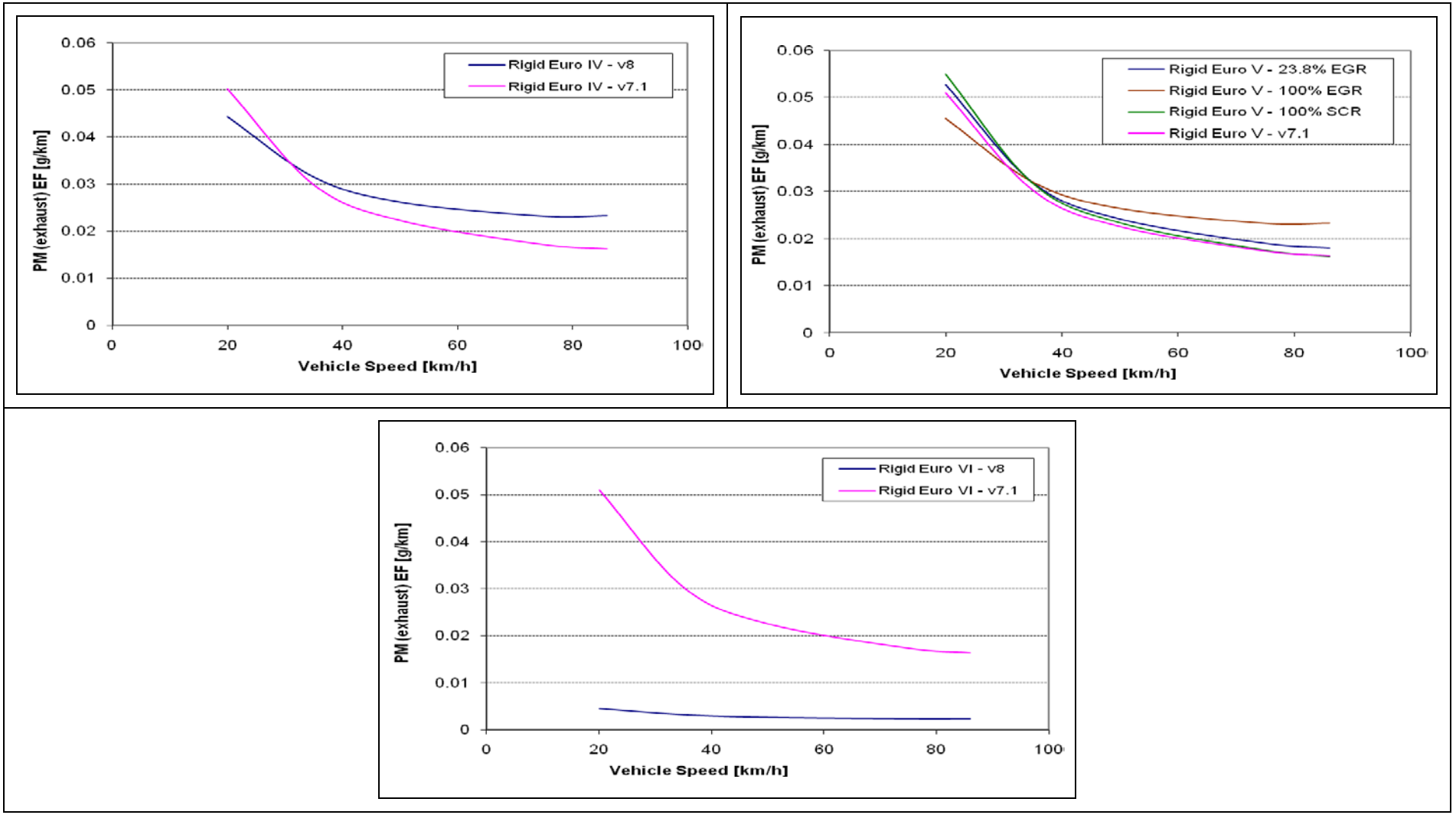


Figure 11: PM (exhaust) - HDT Rigid 14-20t

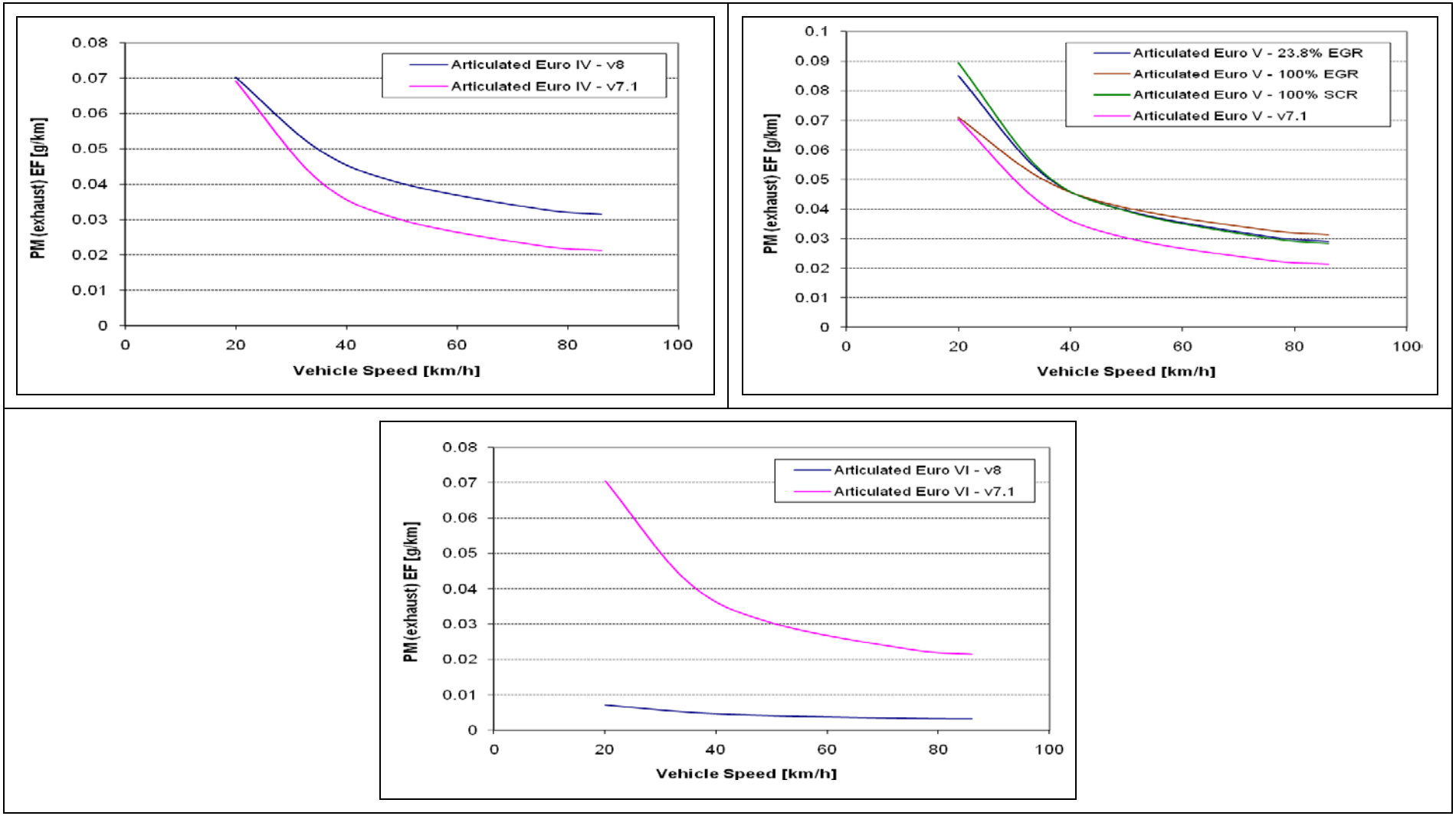


Figure 12: PM (exhaust) - HDT Articulated 34-40t

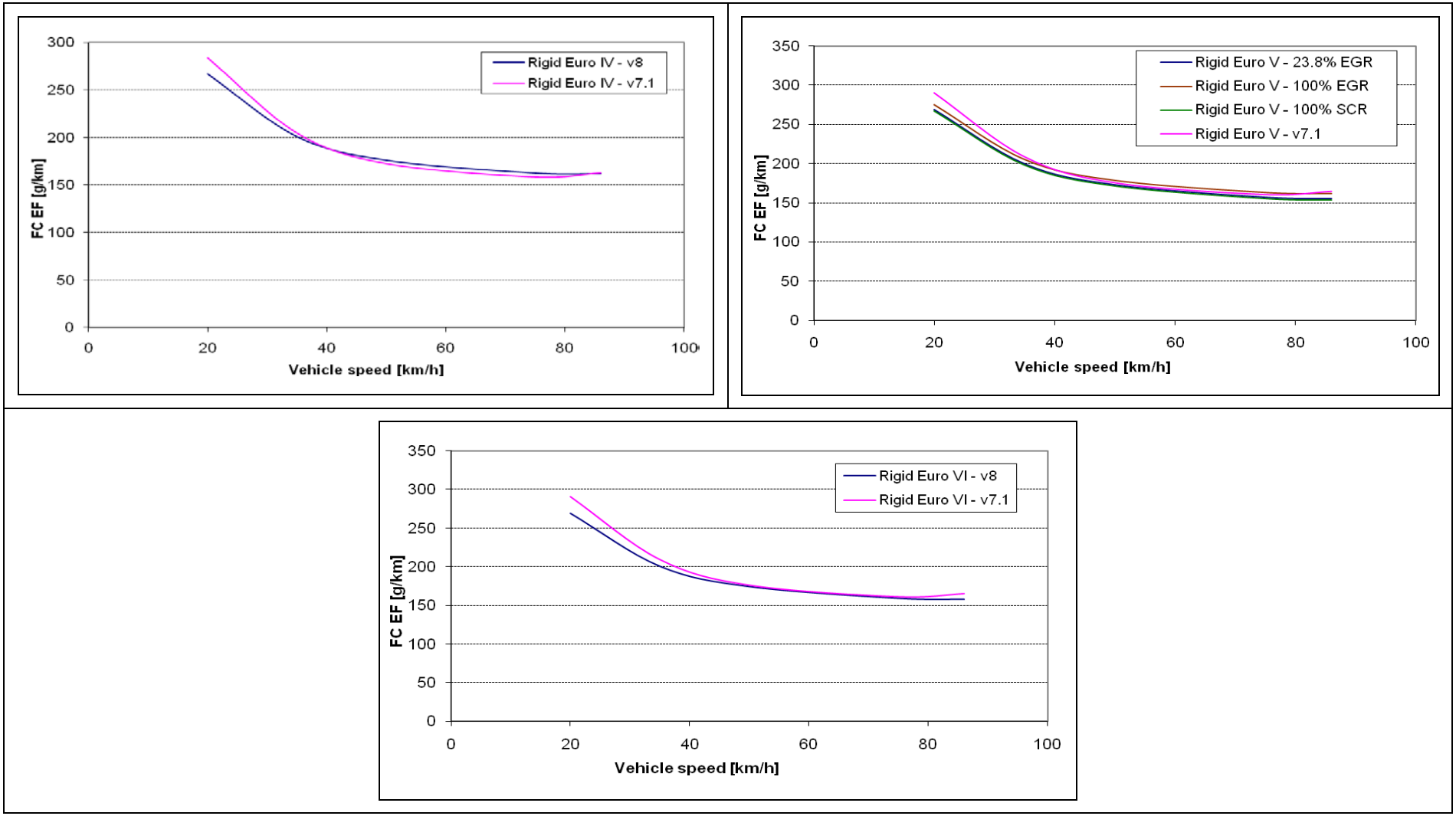


Figure 13: FC - HDT Rigid 14-20t

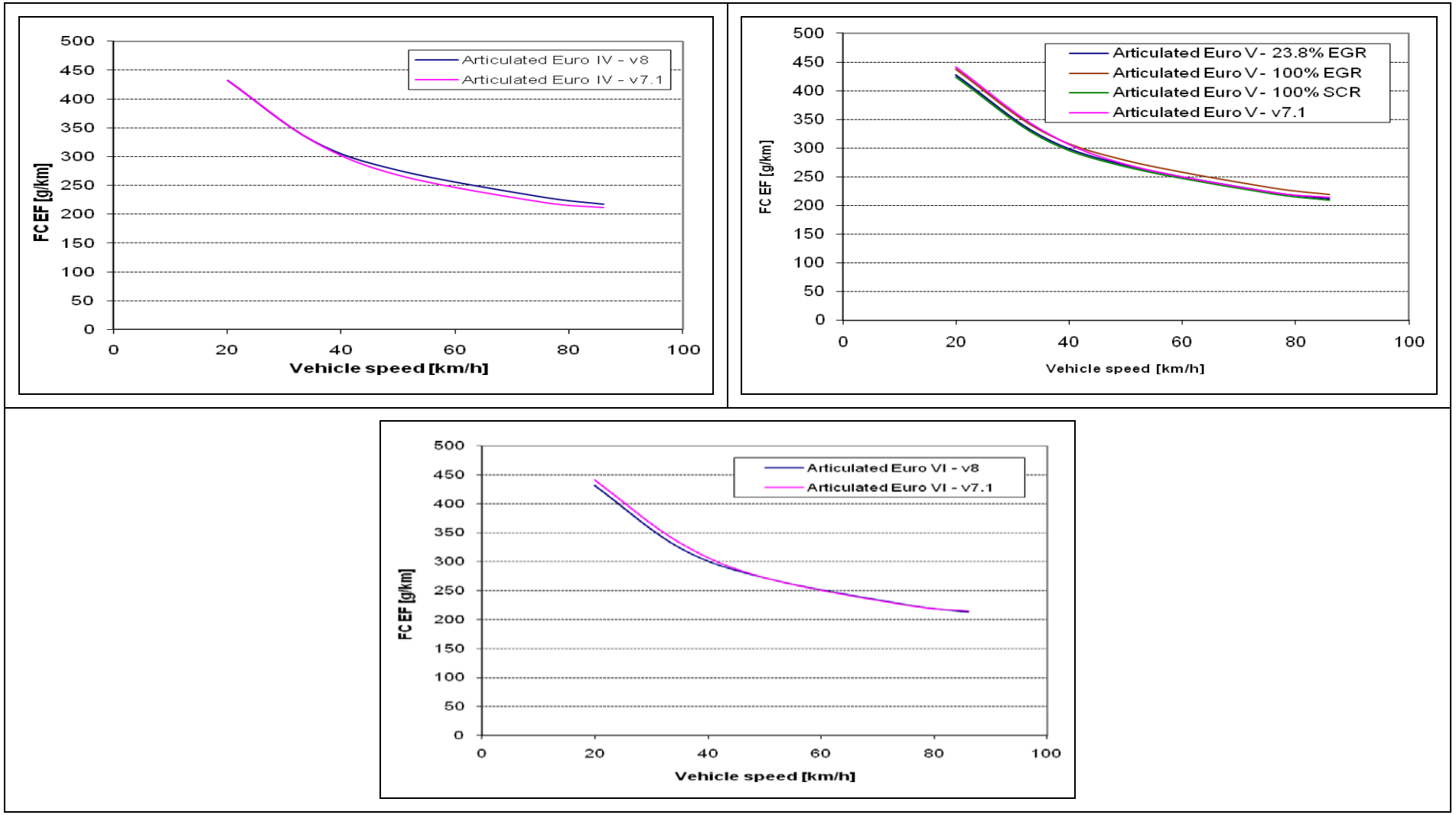


Figure 14: FC - HDT Articulated 34-40t