Determination the relation between the target regulations about End of Life Vehicles (ELVs) and Greenhouse Gas emissions in Turkey

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Abstract—The aim of this study was to determine the potential reduction on GHG emission from transportation sector, in particular from passenger cars (according to car figures in 2016). The GHG reductions were determined for different scenarios (1) current situation (2) to implement of the taxation system based on carbon emission (3) to make reduction on taxes (rate of 18% and 27%) and (4) to apply a regulation for End of Life Vehicles (ELVs) We found that the best scenario is to apply the regulation for ELVs. If the regulation is applied for banning vehicles which were produced before 2000, 1996 and 1990, the reduction rate of CO_2 emission would be 48%, 36% and 26%, accordingly. The CO_2 reduction rates in transportation sector calculated for different scenarios will change approximately 2% to 15%. Consequently, the total GHG emission reduction in Turkey will be about 0.2% to 2%.

Keywords— Road transport; passenger car; end of life vehicles; greenhouse gas emission

Introduction

Air pollution is one of the most important environmental problems in the world. The essential effect of air pollution is greenhouse effect by reason of the fact that it causes climate change directly. The biggest part of the greenhouse gas (GHG) emissions is caused by energy sector in the world. Additionally, transportation in the energy sector is the essential source of the anthropogenic emission of the GHG. Because of the rising of population and the development of technology, the emission of GHG has been rising. It's very important to invest in new technologies along with the enforcements of new regulations.

In the world, the increase in the number of vehicles has caused a rise on the GHG emissions such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). To prevent the rising of CO_2 emissions, most of the EU and OECD member countries have based on the CO_2 emissions for the taxation of motor vehicles instead of the cylinder volume, the age and weight of vehicle. These countries have used the taxation system as a tool to reduce carbon emissions and they are taking more taxes from the vehicles which have more carbon emissions. But the taxation system is based on the cylinder volume and age of vehicle in Turkey now.

Turkey signed in the United Nations Framework Convention on Climate Change in 2004 and the Kyoto Protocol in 2009. Even though Turkey does not have any responsibility for reducing GHG emissions according to Kyoto protocol, Turkey committed to apply requirements of developing and implementing policies to prevent climate change and taking necessary measures to increase energy efficiency and energy saving. In Turkey, the automotive sale figures and economic indicators between the years 1993 and 2011 showed that the demand for automobiles is very sensitive to economic factors. Despite the fluctuations in economic indicators in Turkey, the demand for automobiles has increased in the long term and the main reason is that the population and income growth [1]. In Turkey, the rate of vehicle ownership is 141 vehicle/1000 people in 2011; this is the lowest rate in European countries. It is expected that the rate will be reached to 160 vehicle/1000 people by the year 2020 [1].

The main goals and objectives of transportation sector are given in The National Action Plan on Climate Change covering between 2011 and 2023; (1) To make legal regulations to increase the use of alternative fuels and clean vehicles (2) To take measures in urban transport for encouraging using of alternative fuels and clean vehicles [2-4].

In this study, the potential reduction on GHG emission from passenger cars was determined according to the different scenarios.

I. METHOD

A. Greenhouse gas emissions sourced from ELVs in Turkey

The current situation for the passenger cars and commercial vehicles (older than 12, 16 and 20 years) are given in Table 1. The percentage of passenger cars older than 12 years in the total passenger car is 54.8%.

TABLE 1. The number of passenger car and commercial vehicle in Turkey

Vehicle age range	The number of vehicle	%	Passenger car	%	Commercial vehicle	%
1-3	1.841.044	15,3	1.196.520	14,7	644.524	16,3
4-6	1.714.448	14,2	987.508	12,2	726.940	18,4
7-11	2.494.718	20,7	1.487.135	18,3	1.007.583	25,5
12-15	1.892.709	15,7	1.318.892	16,3	573.817	14,5
16-19	1.391.310	11,5	1.056.979	13.0	334.331	8,5
+ 20	2.727.785	22,6	2.066.077	25,5	661.708	16,8
Total	12.062.014	100	8.113.111	100	3.948.903	100

Source: Turkish Statistical Institute (2012) [5]

The percentage of pre-Euro, Euro1 and Euro4 model passenger cars in Turkey are 14,3%, 65.6% and 20%, respectively. A pre-Euro car emits CO_2 emission of 270 gr CO_2/km, while a Euro 5 model car emits 140 gr CO_2/km. Table 2 shows that the decrease on GHG and other exhaust emissions in the case of withdrawing of automobiles over 12, 16 and 20 years from the traffic. It can be seen that the decrease rate of emissions is quite high, but this situation is not realistic because it's not possible to withdraw the all passenger cars older than 12 years. For this reason, the reduction on emissions was calculated for different scenarios and the vehicle numbers were predicted for the future with econometric approach. EMEP/CORINAIR (2007) emission factors were used for the GHG and other exhaust (NOx and CO) emissions [6].

TABLE 2. The reduction on GHG emissions in the case of withdrawing of passenger cars from the traffic, 1000 tone/year (percentage)

Car age	CO_2	N_2O	CH_4	HC	NOx	CO
≥12 years	10095 (48%)	0,91 (63%)	3,07 (86%)	117,6 (95%)	57.6 (80%)	915,5 (96%)
≥16 years	7556 (36%)	0,69 (48%)	2,77 (77%)	115,4 (93%)	51.9 (72%)	890,4 (93%)
≥20 years	5442 (26%)	0,45 (31%)	2,50 (70%)	113,5 (91%)	47.5 (66%)	865,1 (90%)

B. Scenarios and predictions for the future

There are two approaches to be able to make predictions for the future. These are time series analysis approach and econometric approach. In this study, automobile and total vehicle demand was calculated using by econometric approach. The details of the calculation were given in the previous study

[1]. The calculations of passenger car number were made according to the projected regulations given below.

CS-1a: Over the age of 20, all cars were expected to withdraw from the market until the end of 2016 when OTV (Specific Consumption Tax) is reduced to 18% of and the emission based tax system is applied.

CS-1b: Over the age of 20, 50% of all cars were expected to withdraw from the market until the end of 2016 when OTV (Specific Consumption Tax) is reduced to 27% of and the emission based tax system is applied.

CS-2a: Over the age of 16, all cars were expected to withdraw from the market until the end of 2016 when OTV (Specific Consumption Tax) is reduced to 18% of and the emission based tax system is applied.

CS-2b: Over the age of 16, 50% of all cars were expected to withdraw from the market until the end of 2016 when OTV (Specific Consumption Tax) is reduced to 27% of and the emission based tax system is applied.

CS-3a: Over the age of 12, all cars were expected to withdraw from the market until the end of 2016 when OTV (Specific Consumption Tax) is reduced to 18% of and the emission based tax system is applied.

CS-3b: Over the age of 12, 50% of all cars were expected to withdraw from the market until the end of 2016 when OTV (Specific Consumption Tax) is reduced to 27% of and the emission based tax system is applied.

C. GHG and other exhaust pollutant (NOx and CO) emissions

In this study, we determined the potential reduction on GHG emission from transportation sector, in particular from passenger cars (according to car figures in 2016). The GHG and exhaust pollutant reductions were determined using by future predictions for passenger car number and emission factors considering the different scenarios (1) current situation (2) to implement of the taxation system based on carbon emission (3) to make reduction on taxes (rate of 18% and 27%) and (4) to apply a regulation ELVs (OTA) designation.

There is a regulation in Turkey related to the withdrawal of ELVs from the market. The main goal of this regulation is to arrange the withdrawal of ELVs to reach the more economic, more safely and clean road transport. In this study, we considered the potential of ELVs in Turkey and suggested that a payment incentive of 1 TL-2 TL for kilo of ELVs for four years for ELVs designation.

II. RESULTS

A. OTV scenarios

Figure 1 shows the comparison between the current situation emission and the reduction emissions. The best scenario was observed as CS3a for GHG and emissions (CO_2, N2O, CH4) and other exhaust emissions (NOx). We observed that the best scenarios for all emissions is including the withdrawal of older than 12 years passenger cars from the traffic.
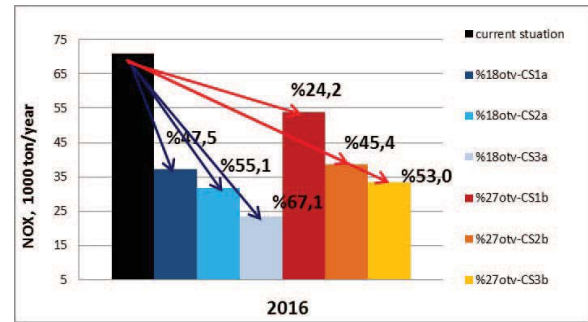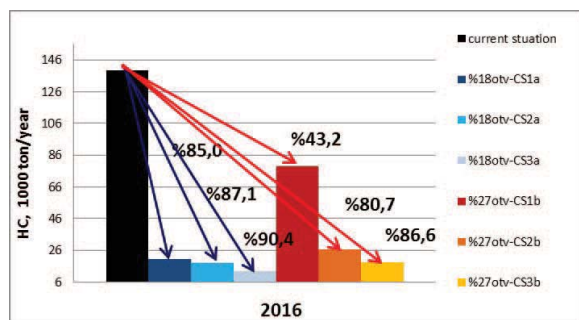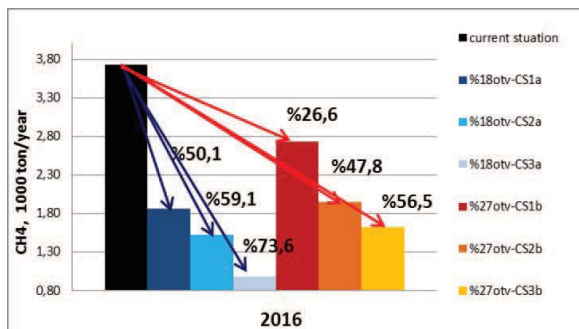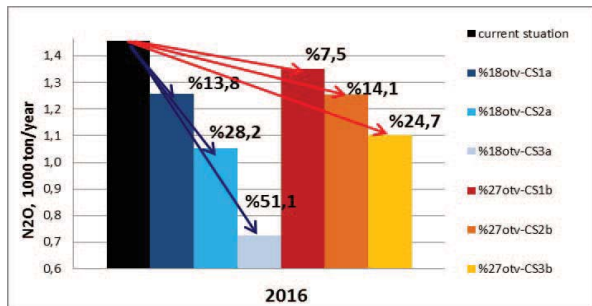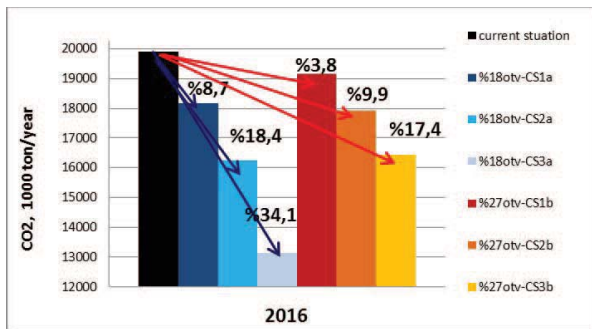

Figure1: GHG emissions decrease for automobile sector (compare between current situation and 2016)

In Turkey, according to The National Action Plan on Climate Change, the total GHG emission for all sectors (energy, industrial, agriculture, waste) is 369,6 Mtone CO_2e (million tone CO_2 equvalent). The biggest part of CO2 emission is energy sector with 75%. The scope of the energy sector, there are energy production, industry, transportation and other sectors (agriculture, forestry, fishing). Total GHG emission sourced from transportation is 47,4 Mtone CO_2e in 2009.

The CO_2 reduction with the scenarios CS-1a and CS-1b (withdrawal of older than 20 year passenger car) was corresponded to 15% of the GHG emission sourced transportation sector and corresponded to 1,9% of the total GHG emission in Turkey.

B. ELVs scenarios

We found that the best scenario is to apply the regulation for ELVs. If the regulation is applied for banning vehicles which were produced before 2000, 1996 and 1990, the reduction rate of CO_2 emission would be 48%, 36% and 26%, accordingly. The CO_2 reduction rates in transportation sector calculated for different scenarios will change approximately 2% to 15%. Consequently, the total GHG emission reduction in Turkey will be about 0.2% to 2%. In this study, we evaluated only passenger cars. 50% of road transport is consisted of passenger cars. If all the vehicles were evaluated within ELV regulation, the decrease of greenhouse emission might be 2 times more.
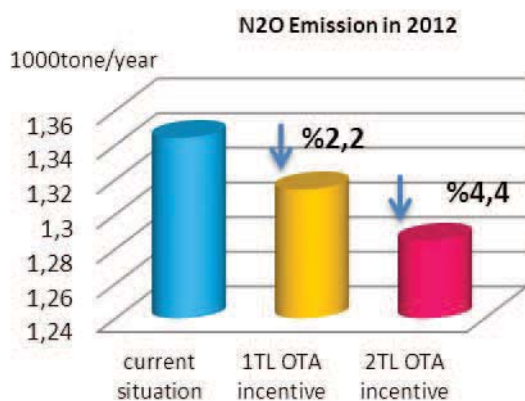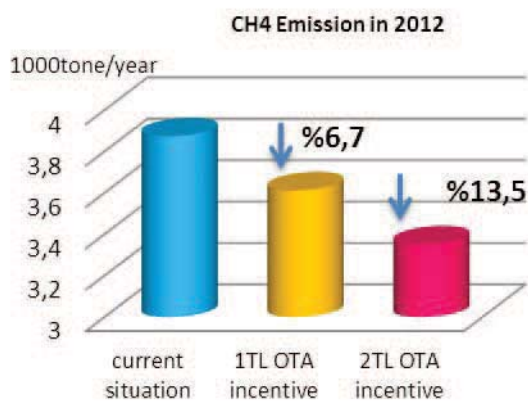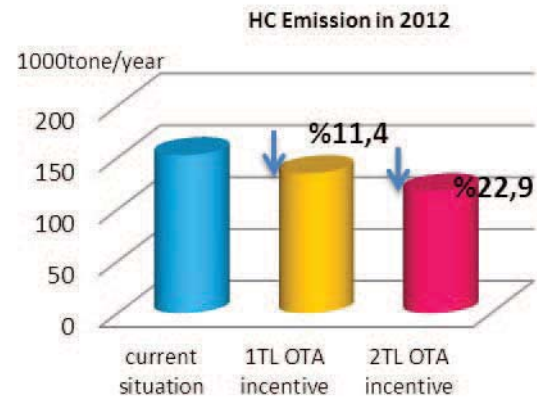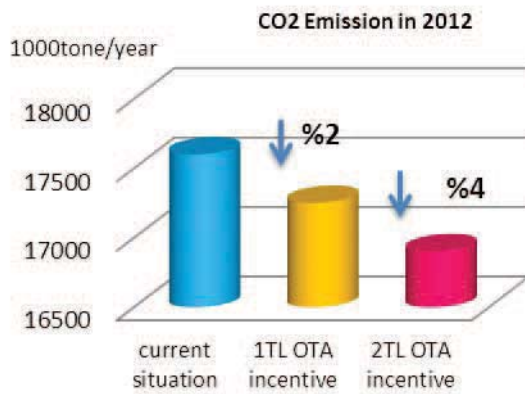
Figure 2: GHG emission reduction when applying ELVs (OTA)incentive regulation

As a result, air pollutants from the highway in the world tend to fall after 1990. The most important reason is the implementation of EURO standards after 1990 manufactured vehicles. Compared to the gasoline vehicle older than 20 years, an Euro 4 gasoline automobile produce less than 25% CO_2, 98% HC and 91% CH_4 and N_2O emissions. Therefore, to increase the tax rates for old cars or to applicate the additional pollution tax may be encourage the buying the new cars less polluted the environment, will be right approach. In addition, through legal regulations, the ELVs in Turkey, should be scrapped. The reduction of CO_2 emissions to be made by the arrangements in the transport sector, Turkey's future goals that are part of the Kyoto Protocol in 5 February 2009 will be reached more easily.

3. ACKNOWLEDGMENT

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