Renewable and Sustainable Energy Reviews ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

The impact of energy policies in scenarios on GHG emission reduction in passenger car mobility in the EU-15

Amela Ajanovic*, Reinhard Haas

Vienna University of Technology, Energy Economics Group, Austria

ARTICLE INFO

Keywords:
Policy
Scenarios
Passenger car transport
GHG emissions

ABSTRACT

This paper compares and discusses possible greenhouse gas (GHG) emission reductions due to different policy measures implemented in passenger car transport in the EU-15. The major instruments analyzed are fuel and registration taxes, support measures for biofuels as well as standards for specific CO_2 emissions from new passenger cars.

The methodology applied is based on scenarios for the dynamic development of GHG emissions and energy consumption depending on implemented policies. Using the ALTER-MOTIVE model, created in the scope of an EU-funded project, in a dynamic framework a Business as usual and a Policy scenario are compared to extract the impacts of policies up to 2030.

The major result is that in total, GHG emissions could be reduced at least by 33% in a selected Policy scenario compared to a Business-as-usual scenario up to 2030. In the future only a broad portfolio of different policy instruments and alternative technologies and fuels can reduce energy consumption and the resulting GHG emissions remarkably.

Contents

1. Introduction

Between 1990 and 2012 in the EU-28 the share of transport on final energy consumption increased from 23% to 32%. Currently, the transport sector is responsible for about 20% of the total greenhouse emissions (GHG) in the EU-28. The largest part of these emissions, about 72%, is caused by road transport [1]. In spite of the fact that a broad portfolio of policies is already implemented in the EU, emissions from the transport sector have been, in contrary to other sectors, continuously increasing from 1990 to 2007 as shown in Fig. 1.

To implement efficient policy portfolio which can contribute to the reduction of GHG emissions, it is necessary to understand how different policies work and to identify the possible interactions between them [3]. However, policy measures implemented in the transport sector have been developed in different ways in different EU-countries. Some of the measures (e.g. CO_2 emission standards for cars) are set at the EU level, and some (e.g. various taxes) are implemented on national level driven by different goals (e.g. to reflect environmental impacts, to increase government revenues, to reflect road damage costs, to promote alternative fuels and vehicles, etc.) [4].

In literature a wide range of policies and strategies for the reduction of GHG emissions from road transport is investigated [5–10]. Most common strategies are promotion of alternative fuels [11,12] and alternative automotive technologies [13,14] as well as implementation of standards and various types of taxes [15,16].

Since passenger cars account for approximately 72% of total passenger transport activities in the EU-28 by, this paper focuses on policies that impact passenger car transport [1]. In detail, this paper

* Corresponding author.
E-mail address: ajanovic@eeg.tuwien.ac.at (A. Ajanovic).

http://dx.doi.org/10.1016/j.rser.2016.02.013
1364-0321/

Please cite this article as: Ajanovic A, Haas R. The impact of energy policies in scenarios on GHG emission reduction in passenger car mobility in the EU-15. Renewable and Sustainable Energy Reviews (2016), http://dx.doi.org/10.1016/j.rser.2016.02.013

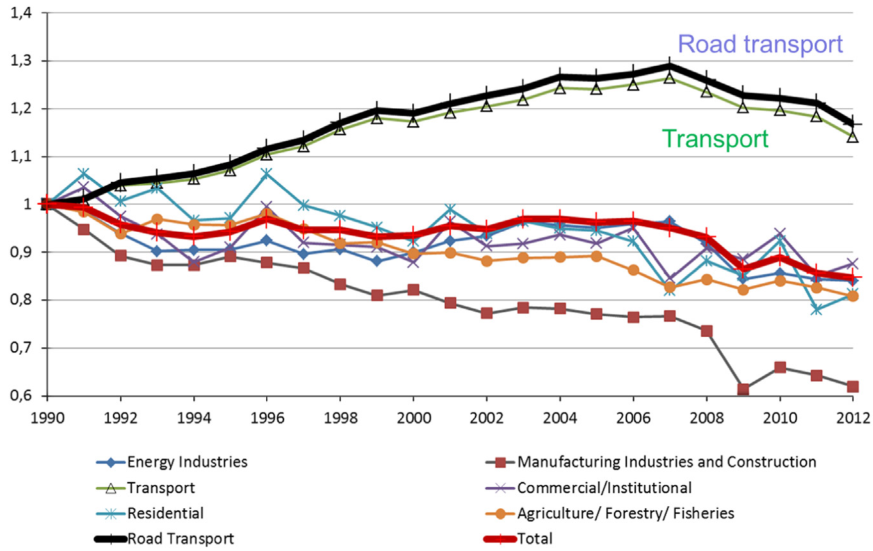

Fig. 1. Development of GHG emissions in EU-28 countries (1990 = 1) [2].

investigates the effects of different policy measures in the long-term and their contribution to the reduction of GHG emission in the EU-15.[1] Major policies implemented at the national level (such as taxes, support for biofuels, etc.) as well as at EU level (such as standards for the CO_2 emissions from the new passenger cars) are considered. This paper provides an update of the scenarios derived within the project ALTER-MOTIV funded by European Commission, see [17]. A partial equilibrium model which is created in the scope of this project is used in this paper to derive long-term scenarios showing the impact of different policy strategies.

The paper is organized as follows: Section 2 describes policies currently implemented and EU energy and transport targets. Next, the methodology is described in Section 3. Section 4 presents the results of two scenarios derived, a Business-as-usual and Policy scenario. Finally, the main conclusions of this work can be found in Section 5.

2. Review: policies and targets in the EU

The major challenges for EU climate and energy policies are to implement effective policies and measures to mitigate global warming, to improve air quality and to reduce fossil energy consumption. Since transport contributes by about one-quarter of the EU's total GHG emissions, a large part of EU policies and targets is directed towards road transport. A wide range of EU policies to lower emissions from passenger car transport is already in place, such as emissions targets for new cars, targets to reduce the greenhouse gas intensity of fuels, labeling requirements, etc.

To be able to implement successful policies, it is important to know how CO_2 emissions in passenger car transport come about and how they can be reduced. They depend in principle on the total amount of energy used for transport and the specific CO_2 emissions coefficient of different fuels used. This coefficient can be improved for example with better quality of fossil fuels, better ecological performance of biofuels or increasing use of electricity from renewable energy sources for mobility.

Total energy consumption can be reduced with better fuel efficiency of cars, lower travel activity, smaller cars (less kW) as well as with better individual driving behavior [5–7,18]. To reach this a broad range of policy instruments can be used to (i) increase fuel efficiency of cars (e.g. standards, registration taxes), (ii) support "eco-driving" (e.g. education), (iii) reduce number of km driven (e.g. by increasing fuel taxes), and (iv) support the use of alternative and more environmentally friendly fuels (with e.g. subsidies and quotas).

However, different policies can have multiple and even contradicting impacts. For example, the total number of vehicle kilometers driven can be reduced by increasing fuel taxes, and it can be increased by fuel efficiency improvements due to the rebound effect [3].

In the EU some policies are set at a national level such as various taxes (e.g. fuel-, registration-, ownership taxes), and they vary across EU countries. Moreover, there are also common measures implemented on the EU level such as limits on emissions from new cars (Regulation on CO_2 from cars 2009/443/EC [19]) and support to biofuels (Biofuels directive 2003/30/EC [20]).

The earliest agreements with car manufactures regarding the limits on emissions from new cars were based on voluntary agreements. In 1998, the European Automobile Manufacturers' Association (ACEA) adopted a commitment to reduce average emissions from new cars sold to 140 g CO_2/km by 2008 and, in 1999, the Japanese Automobile Manufacturers' Association (JAMA) and the Korean Automobile Manufacturers' Association (KAMA) adopted a commitment to reduce average emissions from new cars sold to 140 g CO_2/km by 2009 [21].

Since these targets were not met on time the first mandatory CO_2 emission standards for cars were adopted in the EU [22]. According to the Regulation (EC) No. 443/2009 [21] average CO_2 emissions from new cars should not exceed 130 g CO_2/km by 2015 and should drop further to 95 g CO_2/km by 2020 [23]. Currently, no specific targets after 2020 are defined.

However, as discussed in Ajanovic et al. [3], to make measurements between manufacturers comparable, the specific CO_2 emissions of a vehicle type are determined using an approval test cycle (i.e. the New European Driving Cycle (NEDC)) under laboratory conditions. The problem is that NEDC cycles represent an artificial driving speed pattern with low accelerations, constant speed cruises and many idling events. As a result, the measured emission levels can be different from those in real-world conditions [24].

In addition, it was found that the German automaker Volkswagen Group had intentionally programmed turbocharged direct injection diesel engines to activate certain emissions controls only during laboratory emissions testing. The programming caused the

[1] The EU-15 comprises the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

Please cite this article as: Ajanovic A, Haas R. The impact of energy policies in scenarios on GHG emission reduction in passenger car mobility in the EU-15. Renewable and Sustainable Energy Reviews (2016), http://dx.doi.org/10.1016/j.rser.2016.02.013