



Demand forecast for road transportation fuels including gasoline, diesel, LPG, bioethanol and biodiesel for Turkey between 2013 and 2023



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ABSTRACT

In Turkey, more than 90% of passengers and goods are transported by roads. In order to flow this immense traffic nearly 2.7 million m³ of gasoline, 11.5 million m³ of diesel, and 5.2 million m³ of liquefied petroleum gas (LPG) was consumed in 2011. Starting from 2013, Turkey plans to blend biofuels to gasoline and diesel gradually reaching to 10% (volume) by 2020. Turkey's economy has been growing at unprecedented rates since 2003. As a result, both diesel and LPG consumption reached to record levels. Yet, gasoline demand decreased almost linearly in the same period. Accordingly, forecasting road transportation fuel demand becomes more difficult and yet more important than ever before. Gasoline, diesel, LPG, bioethanol and biodiesel demand has been forecast for the first time in this study using semi-empirical models in the view of Turkey's Vision 2023 goals, Energy Market Regulatory Authority targets, and European Union directives. The models suggested that in 2023, annual gasoline consumption in Turkey could decrease below 2.0 million m³, whereas, diesel and LPG consumption could rise to 16.4 and 8.8 million m³, respectively. Consequently, 0.3 million m³ of bioethanol and 1.4 million m³ biodiesel could be required to fulfil the official targets in 2023.

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1. Introduction

Turkey is a member of G20 major economies, an associate member of the European Union (EU) and a regional power in the Middle East. Based on gross domestic product (GDP) at current prices in 2011 the country has the 18th largest economy in the world and 7th largest economy within the EU [1]. Turkey has a very resilient economy, which proved its strength in the global economic crisis of 2008 and the following worldwide financial recession. The country's economy expanded by 9.2% in 2010, and 8.5% in 2011, thus standing out as the fastest growing economy in the EU and one of the fastest growing economies in the world [2]. In parallel to these developments, it is expected that Turkey will become the fastest growing economy amongst the Organisation for Economic Co-operation and Development (OECD) members during 2011–2017 with an annual average real GDP growth rate of 6.7% [3].

Turkey's economy minister stated that the biggest challenge ahead of Turkish economy is the high rate of trade deficit [4], which

was nearly \$100 billion in 2011. More than half of this trade deficit was due to imported fossil energy sources, estimated at \$54 billion [5]. In the same year, Turkey spent nearly \$25 billion to imported petroleum [6] and \$20 billion to imported natural gas [7]. The International Energy Agency (IEA) chief economist predicted the energy bill of Turkey at \$68 billion in 2012 [8]. It is expected that Turkey will spend \$500–\$750 billion to imported energy sources over the next decade and it is widely anticipated that spending at this level could hinder the country's thriving economy and growth plans.

In order to tackle these problems and reduce reliance on imported fossil fuels the Turkish government has recently announced a set of very ambitious targets for the country's energy sector under the Vision 2023 agenda. Details of which are shown in Table 1 [9]. The author has recently analysed Turkey's natural gas and renewable energy demand forecasting under the Vision 2023 agenda [10–13]. However, Turkey's dependence on foreign petroleum has not yet been analysed in the view of the Vision 2023 and related information is scarce in the published literature.

Turkey imports more than 90% of its petroleum and already consumed 72.8% of its proved reserves, and forecasting based on production, import, and consumption statistics suggests that the import ratio could rise to 99% within the next few decades [14].

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Table 1
Turkey's Vision 2023 targets for the energy sector [9].

Installed power	125,000 MW
Share of renewable sources in power generation	30%
Transmission lines	60,717 km
Power distribution unit capacity	158,460 MVA
Electricity loss-theft via smart grids	5%
Natural gas storage capacity	5 billion m ³
Energy stock exchange	Established
Nuclear power	8 Reactors with a capacity of 10,000 MW
Nuclear power (under construction)	4 Reactors with a capacity of 5,000 MW
Coal power	18,500 MW
Hydropower	Full utilisation
Wind power	20,000 MW
Solar power	3000 MW
Geothermal power	600 MW

Beginning from the second half of 1990s with rapid expansion in the use of natural gas for power generation and residential-commercial heating sectoral end use of petroleum changed significantly. Today, road transportation sector is by far the largest user of petroleum. Currently, more than 95% of passengers and 90% of goods are transported by road [15] and there is an unslakable thirst for petro-based road transportation fuels: gasoline, diesel, and liquefied petroleum gas (LPG). In total, the three have a market share of more than 99%.

The Turkish government plans to reduce the country's dependency on petro-based road transportation fuels by blending biofuels with gasoline and diesel. However, there is little information in the literature and no roadmap to follow. Consequently, this paper is intended to provide that crucial information together with demand forecasting for petro-based road transportation fuels and biofuels based on the Vision 2023 goals and impending EU regulations.

2. Methods

2.1. Analysis of Turkey's road transportation fuels market

Turkey's economy has been growing at unprecedented rates since 2001. Economic growth has generally been followed by increase in road transportation fuel consumption in developing/recently developed countries. Likewise, it was expected that gasoline consumption in Turkey would increase concurrently in the

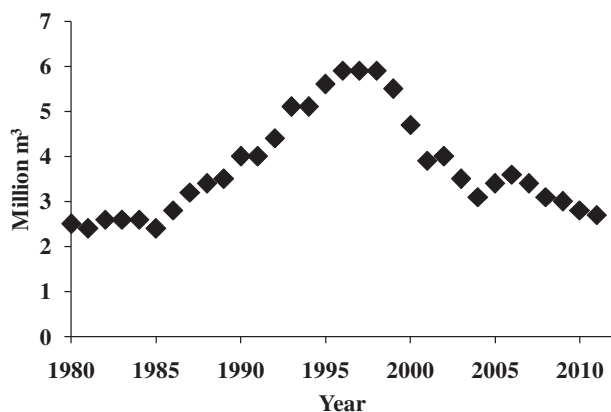


Fig. 1. Road sector gasoline consumption in Turkey between 1980 and 2011, million m³ [16–23]. Assuming density of gasoline as 0.739 kg/litre [24].

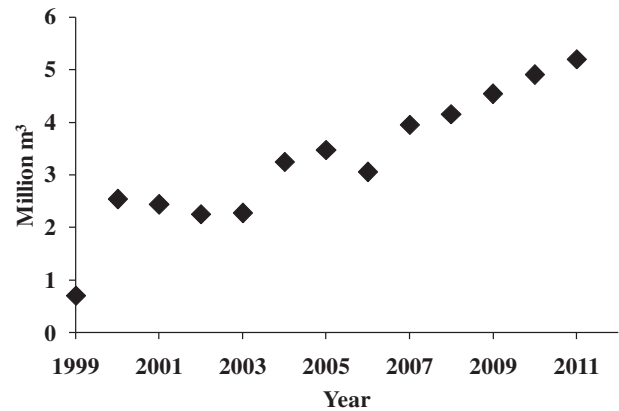


Fig. 2. Road sector LPG consumption in Turkey between 1999 and 2011, million m³ [27–33]. Assuming density of LPG as 0.508 kg/litre [34].

same period. However, gasoline consumption has been constantly decreasing since 1997 as shown in Fig. 1. This seemed puzzling at first. But after a careful analysis it is concluded that the main reason for this reduction is gasoline's steep price.

Turkey has the highest gasoline price among all the OECD member states due to the high excise taxes that are reflected at the level of retail price [25]. In July 2013, for the first time in history, the retail price of unleaded gasoline surpassed 5.0 Turkish Lira/litre or approximately US \$2.60/litre. In March 2012, Petroleum Industry Foundation of Turkey stated that approximately \$235 billion worth of tax was collected from the transportation fuels sector between 2006 and 2011 [26]. In 2011, 60.4% of unleaded gasoline (95 octane) and 51% of diesel retail prices were made from value added (VAT) and private consumption (PCT) taxes [23]. In 2012, taxes collected from road transportation fuels were equal to 13% of all the taxes collected in Turkey.

In Turkey, consumers are shifting to LPG as gasoline prices keep on increasing. Private consumption of LPG started as early as 1997. However, centralised distribution & consumption for road transportation began in 1999, and since then its consumption has been constantly increasing as shown in Fig. 2. As a result, gasoline consumption has been constantly decreasing since 1999. Even though retail price of diesel increased like gasoline its consumption has not decreased in the same period. On the contrary, diesel consumption in Turkey has been increasing almost constantly since 1980's as shown in Fig. 3. This is because there is no alternative to diesel in the Turkish market.

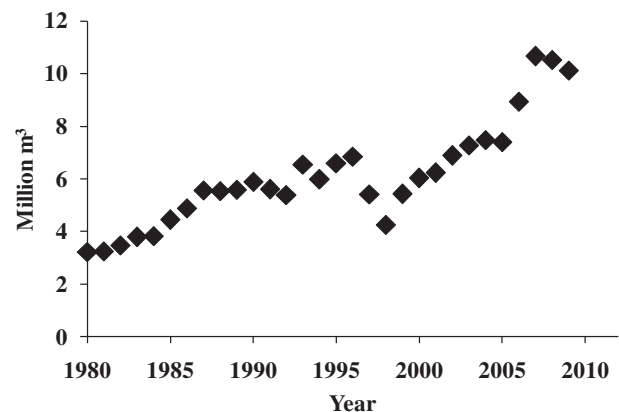


Fig. 3. Road sector diesel consumption in Turkey between 1980 and 2011, million m³ [17,35]. Assuming density of diesel as 0.840 kg/litre [36].

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