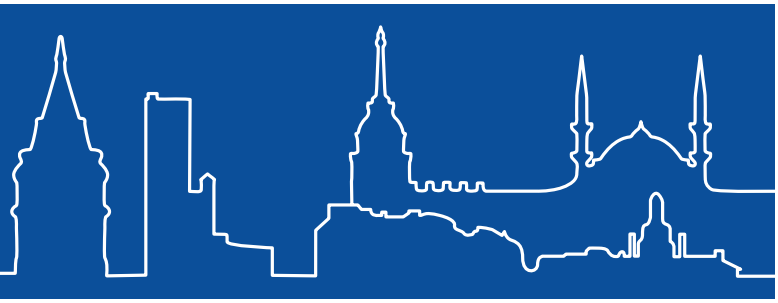
IPC–MERCATOR POLICY BRIEF



DRIVING CHANGE: A SNAPSHOT OF THE AUTOMOTIVE SECTOR IN TURKEY

Peter Mock*

Executive Summary

Turkey is one of the largest vehicle manufacturing countries in the world. Given the strong dependence of the Turkish economy on the automotive industry, it is of particular importance to ensure that this industry sector is ready to meet current and future challenges, such as local air pollution, climate change, and energy security, by offering innovative vehicles that can compete on the global market. An extensive set of policy measures can help drive forward the necessary innovations.

Passenger cars and light commercial vehicles account for three-quarters of the vehicle fleet in Turkey. When taking into account differences in fleet characteristics, such as vehicle weight, size, and engine power, fuel consumption and CO_2 emission levels for new vehicles in Turkey tend to be similar to those on the EU market. While taxes on sales and ownership of passenger cars in particular are relatively high in Turkey, these taxes currently are not directly linked to the CO_2 emissions and fuel consumption of a vehicle. Furthermore, Turkey is one of the few key automotive markets worldwide not yet having introduced mandatory CO_2 standards for cars and light commercial vehicles. The same is true for heavy-duty vehicles, which are responsible for more than half of total fuel consumption and CO_2 emissions. Meanwhile, other key markets – such as the United States, Canada, China, and Japan – have already implemented mandatory efficiency regulations for new heavy-duty vehicles. In addition to these policy measures at the national level, urban areas can take complementary action, for example, to incentivize the deployment of low-emission vehicles. This is of particular relevance for Turkey, where about half of new cars are first registered in the Istanbul area.

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The interpretations and conclusions made in this article belong solely to the author and do not reflect IPC's official position.

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Introduction

In Turkey, the automotive sector is a vital part of the national economy, with numerous production plants and employees in the vehicle and vehicle parts manufacturing industry. And yet, the number of vehicles on the road in Turkey today is still significantly lower than in many other markets. For example, the total number of vehicles in Turkey is only about one-third of that in Germany although the countries have a similarly sized population. It is to be expected, however, that this situation might change as, given its relatively young population and its continued growth in gross domestic product (GDP), the Turkish government predicts a further expansion of vehicle sales in Turkey in future years.[1]

It is yet to be questioned though whether Turkey could and should follow the development pathway that other markets have taken in the past. Facing significant challenges, such as local air pollution, global climate change, and energy security, it is imperative that in the future the automotive sector, including developing countries like Turkey, focus on developing clean technologies and innovative pathways for further economic growth.

It is the objective of this assessment to provide the basis for analyzing potential future development pathways for the automotive industry in Turkey. In a first step, the current status of vehicle production, sales, fuel consumption, and emissions are studied and compared in particular to the situation in Germany, given that the automotive industry plays such a vital role in both these economies. Vehicle market statistics for Turkey are then compared to the EU-28 market and other key automotive markets worldwide.[a]

[a] As part of this IPC-Mercator Policy Brief, some key results of the Turkey baseline market analysis are presented. For a more detailed insight, please refer to the corresponding White Paper of the International Council on Clean Transportation (ICCT).[2]

Vehicle Fleet Structure

In Turkey, there are about 17 million vehicles currently on the road.[3] This is significantly less than in Germany (52 million),[4] despite both countries having about the same population. As a result, the number of passenger cars per 1,000 inhabitants in Turkey is only around 120, compared to 550 on average in Germany. Given the expected growth of the Turkish vehicle market in future years, it is therefore of particular importance to ensure that new vehicles coming to the road in Turkey are as efficient and clean as possible.

Vehicle production and sales in Turkey

Passenger cars account for the majority of vehicle sales in Turkey, with about 60% of the 1 million new vehicles sold every year being cars (Figure 1). Light commercial vehicles (also called “light trucks”) are significantly more popular in Turkey than in Germany (15% vs. 7% market share). A key underlying reason is the fact that light commercial vehicles in Turkey are subject to a drastically lower vehicle sales tax than passenger cars (4-15% “Special Consumption Tax” instead of 45-145%).[5] Motorcycles are also more popular in Turkey, accounting for 16% of vehicles in Turkey but only 8% in Germany. Further, there are about ten times more buses on Turkish roads than on German roads.

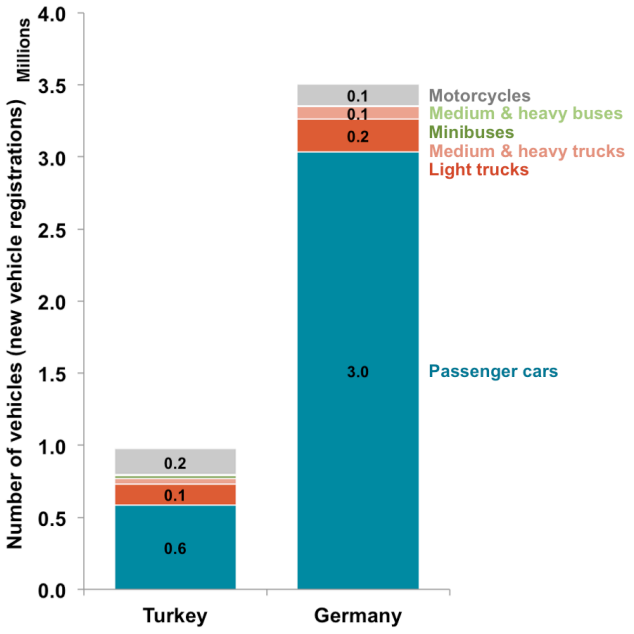


Figure 1. *New vehicle registrations (2014), differentiated by vehicle type, in absolute numbers.*[3,4,6]

The automotive sectors in Turkey and Germany are very similar in the sense that both countries have a large number of vehicle manufacturing plants and are exporting a majority of their local vehicle production abroad. In fact, the automotive sector is the number one export sector in both nations. In 2014, 0.7 million passenger cars were produced locally in Turkey, with about 79% of these being exported abroad.[7] In addition, another 0.4 million commercial vehicles were produced locally, with 0.3 million being exported abroad. The importance of vehicle exports in Turkey is particularly strong for buses and trucks. In comparison, 77% of the 5.6 million passenger cars produced in Germany were exported abroad.[8] In Turkey, exports from the automotive sector overall account for about 12% of the country's total export volume.[3] In Germany, automotive exports comprise about 18% of total exports.[9]



Figure 2. *New passenger cars (2014) in Turkey by region*[3] *(Regions with a market share at 10% or above are annotated).*

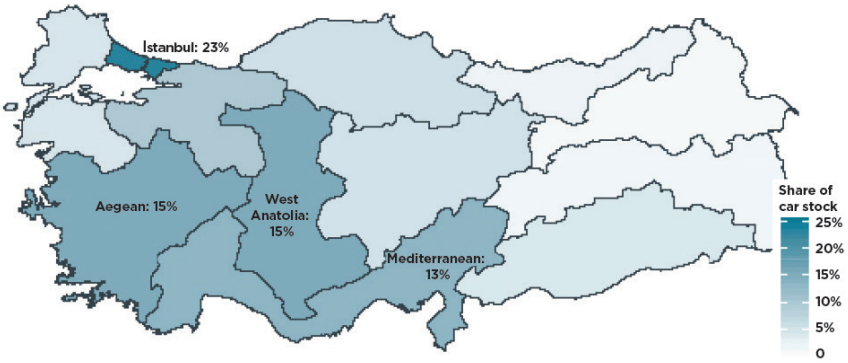


Figure 3. *Passenger car stock (2014) in Turkey by region.*[3] *(Regions with a market share at 10% or above are annotated).*

Around half of new passenger car registrations in Turkey take place in the region of Istanbul (Figure 2). However, throughout the lifetime of a vehicle, it is likely to shift eastward. The statistics show that of the total number of passenger cars on the road, only around 23% are still registered in the Istanbul area (Figure 3). This pattern suggests that many new vehicles are first registered in Istanbul but are then sold as secondhand cars to other regions in Turkey. Overall, the average age of passenger cars in Turkey is 12 years, with the vehicle fleet in Istanbul being significantly younger than that. As a result, when tackling vehicle fuel consumption and emissions, regional policies for Istanbul, supplementing action at the national level, are seen as a promising way of leveraging positive developments and accelerating progress towards clean vehicles.

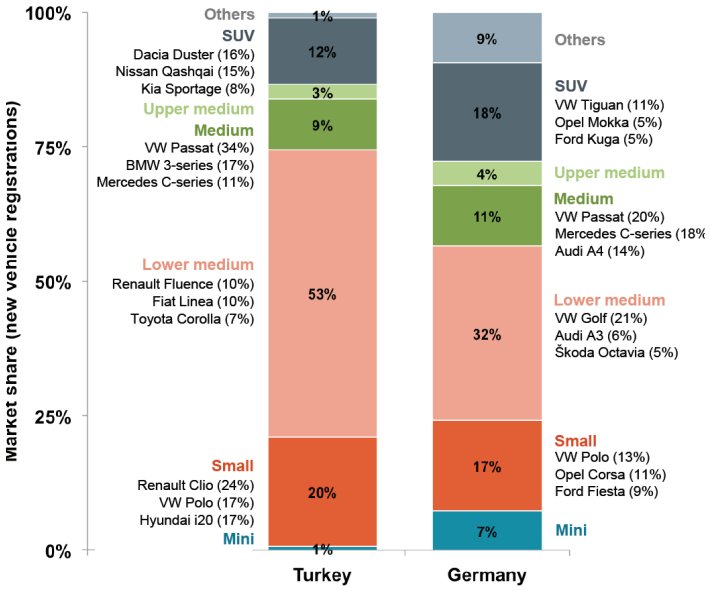


Figure 4. *New passenger cars (2014) by segment, including top three vehicle models for selected segments.*[10]

The vehicle fleet in more detail

In Turkey, more than half of all new passenger cars are from the lower medium segment (Figure 4). Within this segment, it is in particular the Renault Fluence and Fiat Linea models that are most popular. In Germany, the lower medium segment only accounts for 32% of new car registrations, with the VW Golf being the most popular model. Vehicles from the mini segment, such as the VW up! or smart fortwo, are largely absent from the Turkish market. At the other end of the spectrum, the market share of larger vehicles, including sport utility vehicles (SUV), is significantly lower in Turkey than in Germany.

Looking at the distribution of sales by vehicle manufacturers, it can be seen that Renault and Volkswagen both account for about 22% of all new passenger cars in Turkey. The majority of car sales are divided among a number of other manufacturers, unlike in Germany where the Volkswagen group alone sells about 40% of all newcars, and BMW and Daimler account for another 19% of the market (Figure 5).

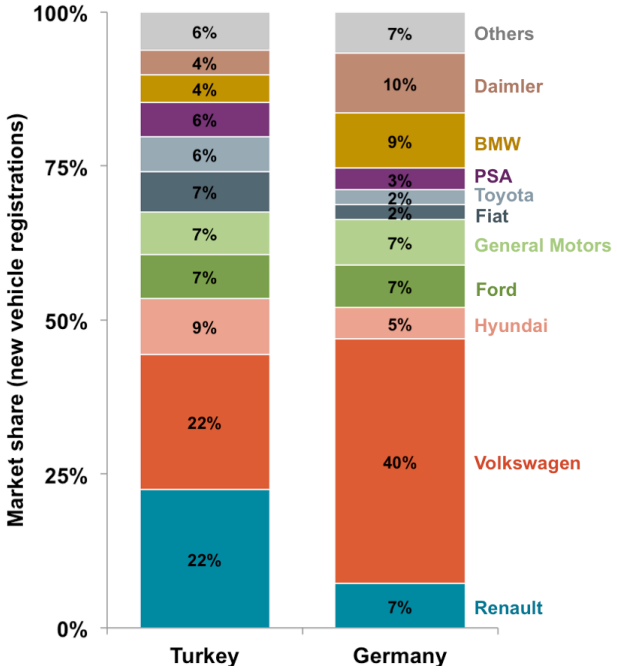


Figure 5. *New passenger car registrations (2014) by manufacturer.*[3,10]

In terms of technical characteristics, it is particularly remarkable that 95% of all new cars in Turkey have an engine displacement of 1.6 liters (l) or less, while in the EU about 30% of new cars have an engine displacement above 1.6l. (Figure 6). Most likely the underlying reason for this phenomenon is the vehicle taxation scheme in Turkey that is based on engine displacement and includes an important tax threshold at 1.6l engine displacement. Under this system, a vehicle with 1.6l displacement is subject to a 45% "Special Consumption Tax" (calculation basis is the net price of the vehicle) while the sales tax for a vehicle with 1.7l displacement is 90%.[5] The difference, for example for a 20,000 EUR vehicle, amounts to 9,000 EUR and thereby provides a strong incentive for picking a car with an engine displacement of 1.6l or less. In addition, the annual tax is also based on engine displacement, again with a tax threshold at 1.6l. The difference in the annual tax rate for a 1.6l and a 1.7l displacement vehicle is about 240 EUR.

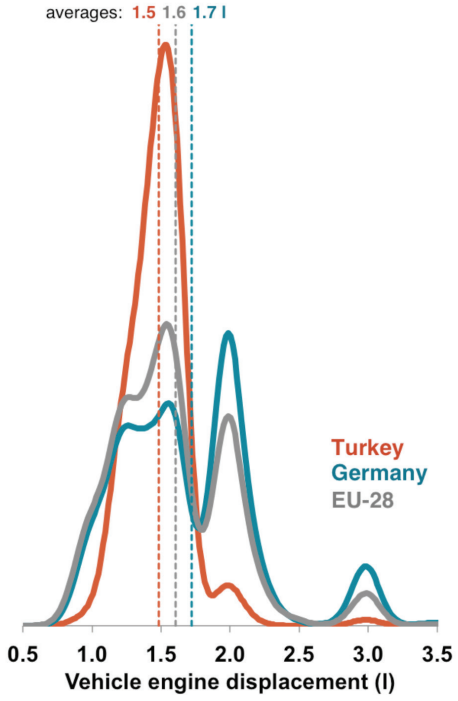


Figure 6. *New passenger car registrations (2014) by engine displacement, estimated probability density function.*[10]

In comparison to other key automotive markets worldwide, it can be seen that in terms of average engine displacement (1.5l) and engine power (80 kW), the market in Turkey is most similar to those in the EU-28, China, Japan, and Brazil (Table 1). In terms of average vehicle weight (1.3 metric tons) and size (4.0 m^2), new cars in Turkey are most similar to those sold on average in the EU-28 and in China. The power-to-weight ratio is a measure for expressing how powerful the engine of a vehicle is in comparison to its weight. Here the average for Turkey (0.059 kW/kg) is most similar to the average value for the EU-28.

The market share of diesel cars in Turkey (62%) is among the highest in the world. Only some EU member states (such as Luxembourg, Ireland, and Portugal) have a higher diesel share than Turkey. Outside of Europe, only India and South Korea have a significant diesel market share among passenger cars. Given the general health concerns regarding emissions from diesel vehicles[12] and the recent revelations regarding on-road exceedances of emission levels for diesel cars,[13] it should be critically assessed whether the current high market share of diesel in Turkey is desirable from a societal point of view.

Of the 40% of new cars that are petrol-fuelled, a large portion is being converted to run on gas, taking advantage of tax incentives.[14] For a comprehensive assessment, the entire fuel supply chain needs to be critically assessed to decide whether for Turkey natural gas vehicles are indeed beneficial in terms of well-to-wheel emission reductions and in terms of strengthening national energy security.

With respect to hybrid-electric vehicles, Japan and the United States are the leading markets. Meanwhile, in the EU the current market share is only 2% and for Turkey the number of hybrid-electric vehicles is currently insignificant. Hence,

	Turkey (2014)	Germany (2014)	EU-28 (2014)	U.S. (2014)	China (2012)	Japan (2011)	Brazil (2013)	India (2012)	S. Korea (2013)
Sales (million)	0.6	3.0	12.5	7.9	15.5	3.5	3.0	2.6	1.3
Number of cylinders	4.0	4.0	3.9	4.6	---	3.8	4.0	3.6	4.3
Engine displacement (l)	1.5	1.7	1.6	2.5	1.6	1.4	1.4	1.3	1.9
Engine power (kW)	80	103	90	150	86	78	76	55	120
Curb weight (metric tons)	1.3	1.5	1.4	1.6	1.3	1.2	1.1	1.1	1.5
Footprint (m^2)	4.0	4.1	4.0	4.3	3.8	3.7	3.7	3.4	4.2
Power-to-weight-ratio (kW/kg)	0.059	0.070	0.065	0.093	0.066	0.065	0.067	0.052	0.084
Energy consumption - U.S. CAFE (MJ/km)	1.6	1.7	1.6	2.0	2.2	1.8	2.0	1.8	1.9
Current emission standard	Euro 5	Euro 6	Euro 6	Tier 2	Euro 4_{eq}	Euro 6_{eq}	Euro 5_{eq}	Euro 4_{eq}	Euro 6_{eq}
Petrol	38%	50%	43%	93%	99%	86%	6%	56%	46%
Diesel	62%	48%	53%	2%	1%	0%	0%	40%	42%
Hybrid-electric	0%	1%	2%	6%	0%	13%	0%	0%	0%
Others	0%	1%	2%	0%	0%	1%	94%	4%	12%
Manual transmission	54%	70%	77%	5%	60%	1%	83%	98%	9%
Automatic transmission	46%	30%	23%	95%	40%	99%	17%	2%	91%

Table 1. *International market comparison of new passenger car fleet characteristics (sales/registration weighted averages).*[10,11]

for hybrid-electric as well as fully electric vehicles there is a great potential for uptake in Turkey, both from the vehicles sales and vehicle production point of view.

For light commercial vehicles, more than half of the market in Turkey is dominated by Fiat and Ford (Figure 7). While Volkswagen and Renault are the largest passenger car manufacturers, for light commercial vehicles they are only third and fourth, with about 20% market share altogether. In Germany, it is particularly the Mercedes-Benz Sprinter that is a popular light commercial vehicle. In Turkey on the other hand, it is smaller vehicles, such as the Fiat Fiorino and Fiat Doblo, that are most popular in the light commercial vehicle segment. New light commercial vehicles in Turkey are running entirely on diesel fuel.

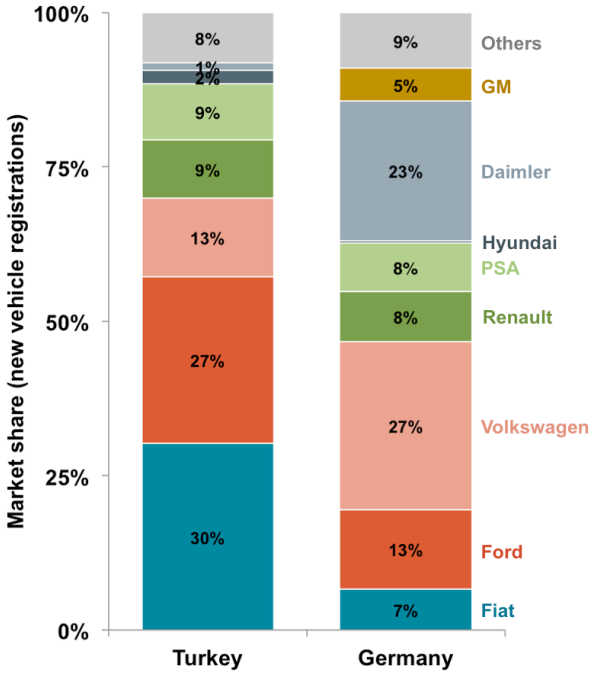


Figure 7. *New light commercial vehicle registrations (2014) by manufacturer.*[10]

The market for heavy-duty trucks in Turkey is dominated by Daimler, accounting for about half of new truck sales (Figure 8). The remaining 50% of the market is split between several companies, with Ford Otosan (owned by Ford Motor Company and Koç Holding) being the second largest truck manufacturer (16%) and Volkswagen being third (10%).

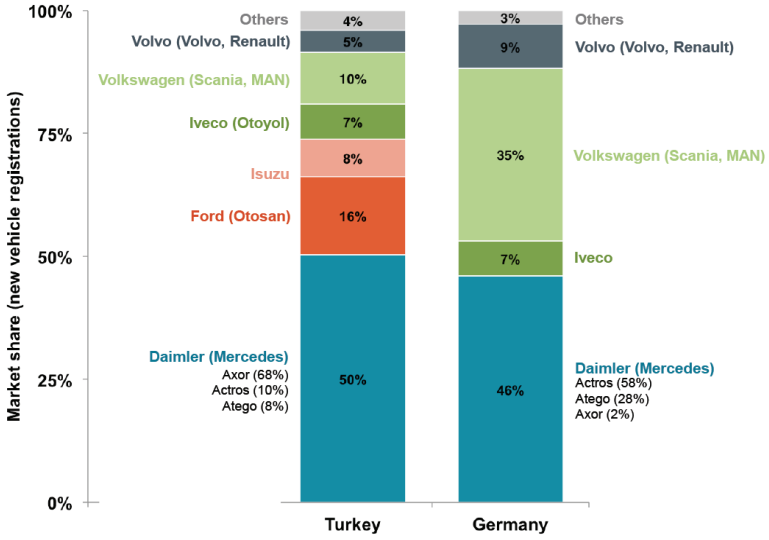


Figure 8. New heavy-duty truck registrations (2014) by manufacturer, including top three vehicle models for Daimler.[3,10]

Fuel Consumption and Emissions

New passenger cars in Turkey in 2014 had an average CO_2 emission level of 121g/km.[10] As CO_2 emissions and fuel consumption of a vehicle are directly proportional, the value of 121g/km is equal to a fuel consumption of approximately 4.8l/100km. For light commercial vehicles, the average level in 2014 was 157g/km, or about 6.2l/100km. These values are according to the official type-approval test procedure in Europe, the New European Drive Cycle (NEDC).

Vehicle efficiency

The average fuel consumption and CO_2 emission levels of new cars and light commercial vehicles in Turkey are thereby slightly lower than the EU average (123g/km for cars and 171g/km for light commercial vehicles). At the same time, new vehicles in Turkey tend to have less engine power and are slightly lighter and smaller than the EU average. On the other hand, the level of techologies for improving vehicle efficiency is about the same in both markets. Hence, taking into account the differences in vehicle weight and power, CO_2 emission as well as fuel consumption levels tend to be very similar for Turkey and the EU-28 average (Figure 9).

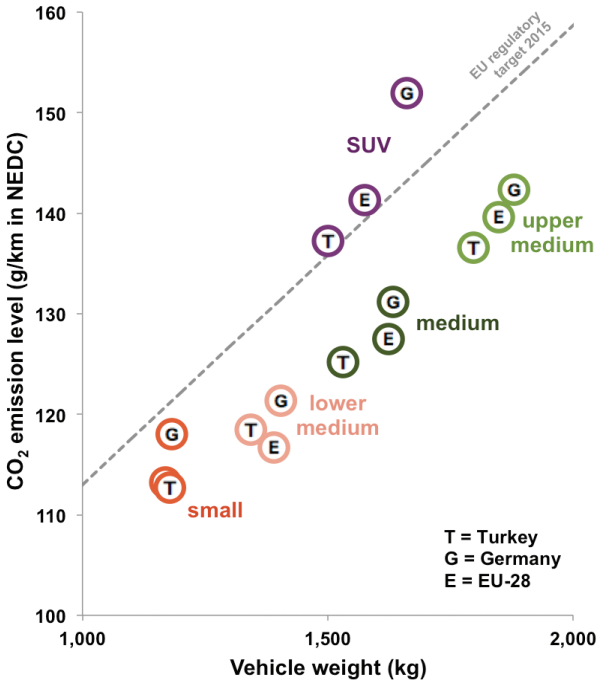


Figure 9. Average CO_2 emission level of new passenger car registrations (2014), all vehicles by vehicle segment and weight.[10]

Turkey is one of the few key automotive markets worldwide not yet having introduced mandatory CO_2 standards for cars and light commercial vehicles. Figure 10 depicts four of the markets that have already introduced standards: the

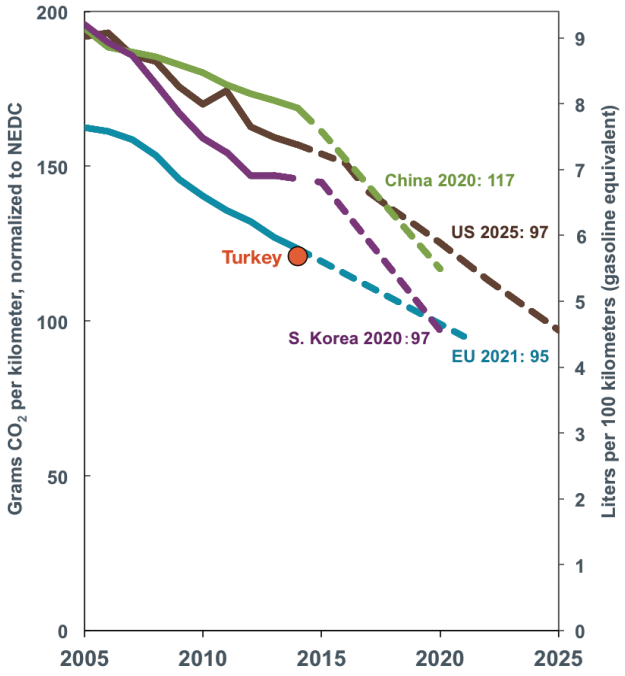


Figure 10. *Average new passenger car CO_2 emission levels for selected countries/regions, normalized to the NEDC test procedure.*[16]

EU, United States, China, and South Korea. The historic development is shown with solid lines, and target values that were adopted for future years are indicated by dotted lines. The EU's target of 95g/km for 2021 is currently the most stringent one – if based on the official NEDC laboratory test procedure – while the U.S. target of 97g/km for passenger cars for 2025 is the most forward reaching one. It can be seen that the expected annual CO_2 emission reduction rates are higher in the United States, as well as in China and South Korea, when compared to the EU target corridor.

The average mandatory CO_2 emission target for new passenger cars in the EU was fixed at 130g/km for 2015. Targets for individual manufacturers depend on the weight of the vehicle fleet: the heavier the vehicle, the more CO_2 it is allowed to emit. If the EU targets for 2015 (cars) and 2017 (light commercial vehicles) were applied to the Turkish market, they would have already been met in 2014 or before. As a result, if Turkey were to simply transfer the EU's CO_2 target system, only a limited steering effect is to be expected. This is because Turkey already benefits from vehicle CO_2 regulations in other markets, given that about 70% of new car registrations in Turkey are imported from abroad and 79% of locally produced cars are exported to the EU and other markets that are subject to CO_2 standards. In addition, fuel taxes in Turkey are amongst the highest in the world,[15] thereby providing a strong incentive for consumers to purchase vehicles with nominally low fuel consumption figures.

Business-as-usual scenario

Total oil demand in Turkey is estimated at 670,000 barrels per day.[17] Nearly all of this oil is imported from abroad, with Iran, Saudi Arabia, and Russia being the main sources. Germany is similarly dependent on oil imports from abroad: Of the more than 2 million barrels consumed every day, around 40% is imported from Russia. In both countries, transport accounts for about half of the total oil consumption.[18] In terms of greenhouse gas (GHG) emissions, the transport sector accounts for about 15% of total GHG emissions, both in Turkey and Germany, with CO_2 being the highest contributing emissions category.[19,20]

As part of the analysis, a business-as-usual scenario for future vehicle emissions and fuel consumption in Turkey and Germany was developed. It is important to emphasize that the objective of this modeling exercise is not to produce a highly accurate reflection of the current emission situation in both countries and future developments. Instead, the modeling results are intended to allow for approximate estimates and for highlighting similarities and differences between both markets. For the modeling, the ICCT Global Transportation

Roadmap Model was applied. The model is publicly available, and a detailed description of it can be found online.[21]

In a business-as-usual scenario, fuel consumption of road transport in Turkey is estimated to almost double by 2030. As Turkey is importing most of its oil from abroad, this would be linked to a doubling also of its oil imports, thereby implicitly weakening national energy security. With fuel consumption and CO_2 emissions being directly linked to each other, CO_2 emissions would approximately double by 2030, from about 40 million metric tons (Mt) in 2010 to 79Mt in 2030 (Figure 11). The expected increase would be due mostly to trucks and buses, while the CO_2 emissions from passenger vehicles would increase to a lesser extent. Hence, even though the number of trucks and buses is relatively small compared to passenger cars, their fuel consumption and CO_2 emissions have a significant effect.

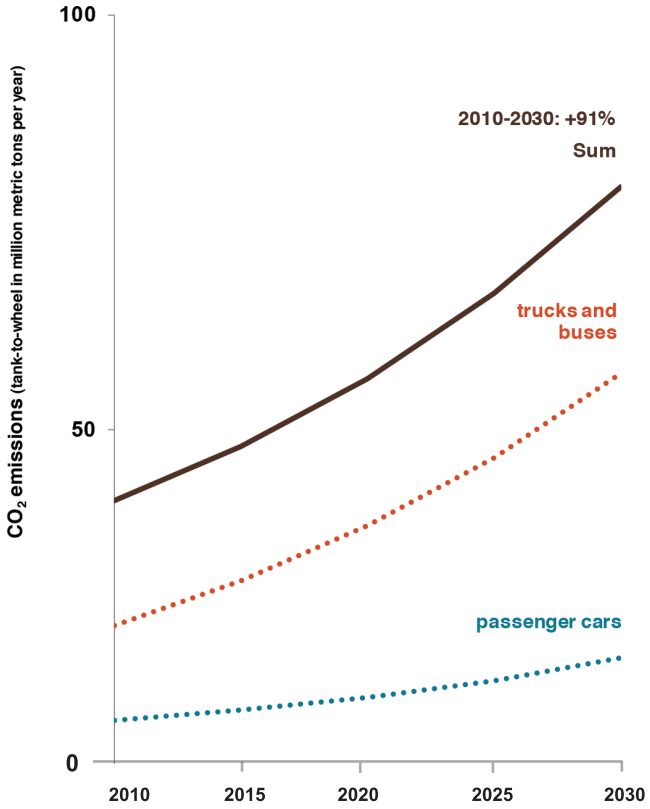


Figure 11. *Estimated CO_2 emissions from road transport in Turkey (2010-2030) in a business-as-usual scenario.*

About 45% of overall nitrogen oxides (NO_x) emissions in Turkey and 37% in Germany come from the road transport sector.[22,23] Despite the lower number of vehicles, NO_x emission levels from vehicles in Turkey are at about the same level as in Germany. For heavy-duty vehicles, nitrogen oxides emissions are expected to significantly decrease in future years as new trucks and buses that fulfill the latest Euro VI emissions standard will penetrate the vehicle fleet.

For passenger cars, Turkey is introducing the Euro 6 standard from 2016/17 onwards. However, even with Euro 6, real-world nitrogen oxides emissions from diesel cars are expected to remain at high levels. As a number of recent studies demonstrate, the emission levels, and particularly the NO_x emissions of diesel cars, are much higher under real-world driving conditions on the road than during laboratory testing.[13] This problem is expected to be even more relevant in Turkey than in the EU, given the particularly high share of diesel cars in Turkey.[24,25]

The EU has decided to amend the Euro 6 regulation by introducing mandatory on-road emissions testing, the so-called Real Driving Emissions (RDE) testing procedure, from 2017 onwards. In order to ensure a significant reduction of nitrogen oxides levels under real-world driving conditions, Turkey will need to take similar action, such as implementing systematic on-road testing and stringent not-to-exceed limits for real-world emissions. Furthermore, an increased uptake of electrified vehicles would be beneficial not least from an air pollution point of view particularly for urban hot spots, such as Istanbul and Ankara.

Conclusions and Outlook

The findings of this baseline analysis of the Turkish automotive sector allow for some conclusions regarding what policy measures seem promising specifically for the market situation in Turkey and hence should be assessed in more detail as part of future research.

Turkey is one of the few key automotive markets worldwide not yet having introduced mandatory CO_2 standards for cars and light commercial vehicles. If, however, the EU CO_2 targets for new vehicles would simply be transferred to the market situation in Turkey, only a limited steering effect is to be expected. At the same time there are other regions worldwide that haveadopted more accelerated emission reduction pathways than the EU. Given Turkey's strong dependence on vehicle exports and with respect to ensuring long-term competitiveness, it should therefore be further assessed whether going beyond the current EU pathway of fuel consumption and CO_2 emission reduction might be more beneficial for the Turkish economy when competing with other global markets.

Taxes on sales and ownership of vehicles (in particular of passenger cars) are relatively high in Turkey. However, these taxes currently are not directly linked to the CO_2 emissions and fuel consumption of a vehicle. Revising the Turkish vehicle taxation scheme to take into account the CO_2 emission level of a vehicle could complement and leverage the effects of CO_2 vehicle standards, thereby further driving technological innovation. Similarly, mandates and incentives specifically for electrified vehicles and alternative fuels should also be assessed in more detail.

Heavy-duty vehicles account for only about one-tenth of the market in Turkey but at the same time are responsible for more than half of fuel consumption and emissions. Currently there are no mandatory fuel consumption and CO_2 emission standards for heavy-duty vehicles, neither in Turkey nor in the EU. However, other regions, such as the United States, Canada, China, and Japan, have recently introduced efficiency standards for new heavy-duty vehicles, and it is likely that the EU will be moving in this direction as well in the near future. Given the particular importance of trucks and buses not only for the local vehicle market in Turkey but also for the export market, the introduction of efficiency standards should be considered and be assessed in more detail.

About half of new cars in Turkey are first registered in the Istanbul area. This highlights the importance of cities, and in particular the city of Istanbul, with respect to the deployment of innovative vehicle technologies.

Urban areas are typically most affected by the negative impacts of road transportation, such as high levels of local air pollutants. At the same time, these urban areas can take complementary action, in addition to any policy measures at the national level, to incentivize the deployment of low-emission vehicles. Examples for such measures include an improved infrastructure for alternative fuels and electricity as well as restrictions for high-emission vehicles when entering urban areas. In light of the particular importance of urban areas for the new vehicle market in Turkey, these complementary measures should also be assessed and discussed in more detail.

It was the objective of this baseline assessment to provide an overview of the current vehicle market in Turkey to domestic policymakers and stakeholders as well as to an interested international audience. In the follow-up to this policy brief, specific potential policy measures will be analyzed and discussed in more detail.

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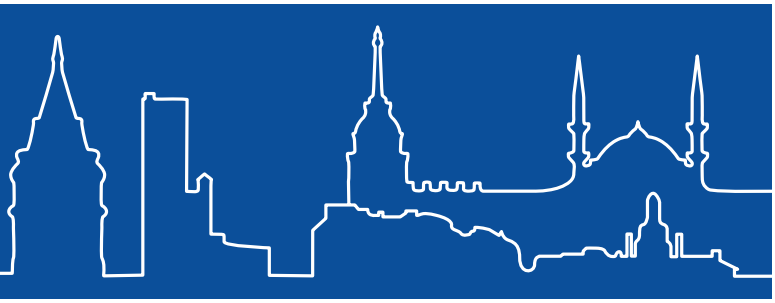
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