IPC–MERCATOR POLICY BRIEF

POLICY OPTIONS TO REDUCE EMISSIONS FROM THE ROAD TRANSPORT SECTOR IN TURKEY

Peter Mock*

Executive Summary

Vehicle sales and emissions are steeply rising in Turkey. It is important not only from an environmental and health protection perspective but also from an economic and international competitiveness point of view that new vehicles coming into the market in Turkey in future years are equipped with the best available technology and have the lowest possible emissions. A set of distinct policy measures can help increase the efficiency and reduce the emissions levels of the vehicle fleet in Turkey.

Mandatory CO_2 emission standards for new vehicles have been successfully applied in other markets but at this point have not yet been introduced in Turkey. At an annual reduction rate of 4% and 6%, an average new car fleet CO_2 level of 84 g/km and 69 g/km, respectively, would be achievable by 2023 while maintaining a consumer payback period as short as four to five years thanks to the fuel cost savings associated with lower CO_2 emission levels. Revising the current vehicle taxation scheme in Turkey to be partly based on vehicle CO_2 emissions would provide a strong financial incentive for customers to choose more efficient cars that emit less CO_2. By introducing the new Worldwide Harmonized Light Vehicles Test Procedure (WLTP), mandatory on-road emissions tests for new vehicle models and regular retesting of in-use vehicles by the authorities or independent third parties, Turkey would significantly improve the reliability of vehicle emissions data, which is seen as the basis for all policy measures.

With these policy measures implemented, the total CO_2 emissions of the light-duty vehicles fleet in Turkey could be reduced by about 36% compared to a business-as-usual scenario. The policy measures are expected to result in higher investments in vehicle technologies and less spending on fuel and oil imports, thereby providing benefits for all stakeholders in Turkey, including consumers and the vehicle and vehicle parts manufacturing industry.

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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

Turkey is among the most important vehicle manufacturing countries in the world. Of the more than 1.1 million vehicles produced in Turkey every year (including passenger cars, light commercial vehicles, and heavy duty vehicles), about three-quarters are currently being exported abroad.[1] At the same time, the number of vehicle sales in Turkey itself is growing quickly at a rate of about 8% per year.[2] As a result, the automotive sector in Turkey is a vital part of the national economy, with numerous production plants and employees in the vehicle and vehicle parts manufacturing industry.

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 and national market. An extensive set of policy measures can help drive forward the necessary innovations.

In a previous report, an assessment of the current vehicle market in Turkey, as well as a comparison to other key automotive markets worldwide, was provided.[3] As part of the findings it was shown that the level of efficiency for new cars and light commercial vehicles in Turkey is similar to the efficiency of comparable vehicles in the European Union (EU). Furthermore, it was estimated that in a business-as-usual scenario, oil consumption and carbon dioxide (CO_2) emissions from road transport in Turkey would approximately double by 2030.

It is the objective of this policy brief to build on the previous baseline analysis of the Turkish automotive sector by assessing a set of concrete policy measures that could help drive down fuel consumption and emissions from the road transport sector in Turkey in future years.[a]

Vehicle CO_2 Standards

A CO_2 standard requires vehicle manufacturers to ensure that the emissions of their new vehicles sold are below a certain target value by a certain target year. Usually CO_2 standards are applied at the fleet level, i.e. a manufacturer can continue selling some vehicles with emissions above the target value as long as the sales-weighted average for the new vehicle fleet remains below the corresponding target level.

Turkey in comparison to other markets

Altogether the G20 countries account for more than 80 million vehicle sales per year, more than 90% of global annual vehicle sales. By now, half of the G20 countries have implemented mandatory CO_2 reduction standards for new passenger cars and light commercial vehicles (Table 1).

The United States and Canada currently have the furthest reaching standard in terms of target year. Both markets have set a mandatory CO_2 target for 2025 with passenger cars requiring a 35-39% reduction compared to 2015 levels, which equals an annual reduction rate of 4.2-4.8%. China requires a 42% reduction (5.3% per year) to meet its proposed 2025 target. South Korea currently has the most stringent standard in terms of annual CO_2 reduction, having set a mandatory standard for 2020 that will bring down new car CO_2 emissions by 34% compared to 2015 at a rate of 8.0% per year. The EU requires new cars to emit not more than 95 g/km (grams per kilometer) of CO_2 on average by 2021, which is equivalent to a reduction of 21% compared to 2015 at an annual rate of 3.8%.[b]

Turkey is one of the G20 countries not having implemented mandatory CO_2 standards for new cars or light commercial vehicles at this point. For passenger cars, the average CO_2 emission level in Turkey (121 g/km in 2014) is only slightly below the EU-28 average (123 g/km), despite vehicles in Tur-

a For more detailed insight, please refer to the corresponding White Paper of the International Council on Clean Transportation (ICCT). As part of this IPC - Mercator Policy Brief, some key results are presented here. [7]

b All CO_2 emission targets and reduction rates given are expressed as being measured in the New European Driving Cycle (NEDC) vehicles test procedure.

Region	Total vehicle sales in 2015		Passenger cars			Light-commercial vehicles			
			CO_2 standard, years implemented		CO_2 reduction		CO_2 standard, years implemented		CO_2 reduction	
			2015 2020 2025		Total	Annual	2015 2020 2025		Total	Annual
China	24,597,583	28%			42%	5.3%			12%	2.5%
U.S.	17,470,659	20%			39%	4.8%			34%	4.0%
EU	15,786,092	18%			21%	3.8%			13%	2.8%
Japan	5,046,511	6%			0%	0.0%			13%	2.7%
India	3,425,336	4%			13%	2.8%				
Brazil	2,568,976	3%			5%	2.8%				
Canada	1,939,949	2%			35%	4.2%			31%	3.6%
South Korea	1,833,786	2%			34%	8.0%			16%	3.3%
Russia	1,437,930	2%								
Mexico	1,351,648	2%			5%	4.6%			5%	4.9%
Australia	1,155,408	1%								
Indonesia	1,031,422	1%								
Turkey	1,011,194	1%								
Saudi Arabia	830,100	1%			18%	4.8%			15%	3.9%
South Africa	617,749	1%								
Argentina	605,933	1%								
All G20 countries	80,710,276	91%								
All countries	88,677,983	100%								

Table 1. *Overview of mandatory CO_2 emission standards for new passenger cars and light commercial vehicles in the G20 countries.*[3,4,5]

key —on average— being lighter and less powerful than in the EU (Figure 1). In the years 2012-2014, for which data on the new car CO_2 emissions is available, the annual rate of reduction is similar to that of the EU average. In comparison, in the Netherlands,

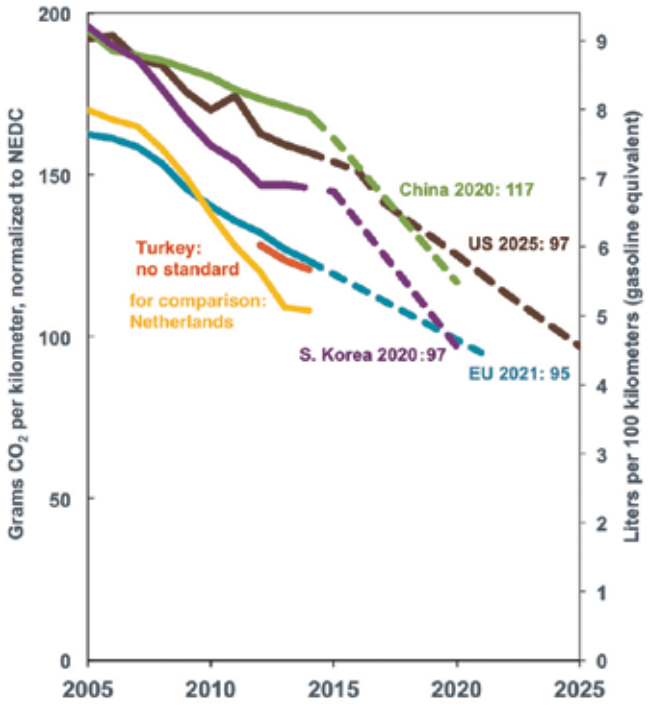


Figure 1. *Average new passenger car CO_2 emission levels for selected countries/regions, normalized to NEDC.*[3]

where the vehicle fleet structure and taxation levels tend to be more similar to those in Turkey, the new car fleet CO_2 level is significantly lower than in Turkey, and the annual CO_2 reduction rate is significantly higher than in Turkey.

Comparing the annual CO_2 reduction rates for new passenger cars side by side, it can be seen that the current estimated reduction rate for countries with mandatory CO_2 standards varies between 2.8 and 8.0% (Figure 2). For Turkey, despite not having introduced any mandatory CO_2 regulation for new cars at this point, the annual reduction rate (3.0%) is at the lower bound of this range. This is most likely due to the fact that the market in Turkey is indirectly affected by CO_2 regulations in the EU and other markets, given that about 79% of Turkey's car production is exported abroad and about 73% of new cars sold in Turkey are imported from abroad.[1] As a result, there are spillover effects from vehicle regulations abroad that have an influence on the vehicle market, and also CO_2 emission levels, in Turkey. More important, however, is the fact that fuel and vehicle taxation levels tend to be among the highest in the world in Turkey, thereby driving the new car market towards models with smaller engine size, lower engine power, and —indirectly— also lower CO_2 emission levels.[6] With this in mind, the current annual CO_2 reduction in Turkey appears

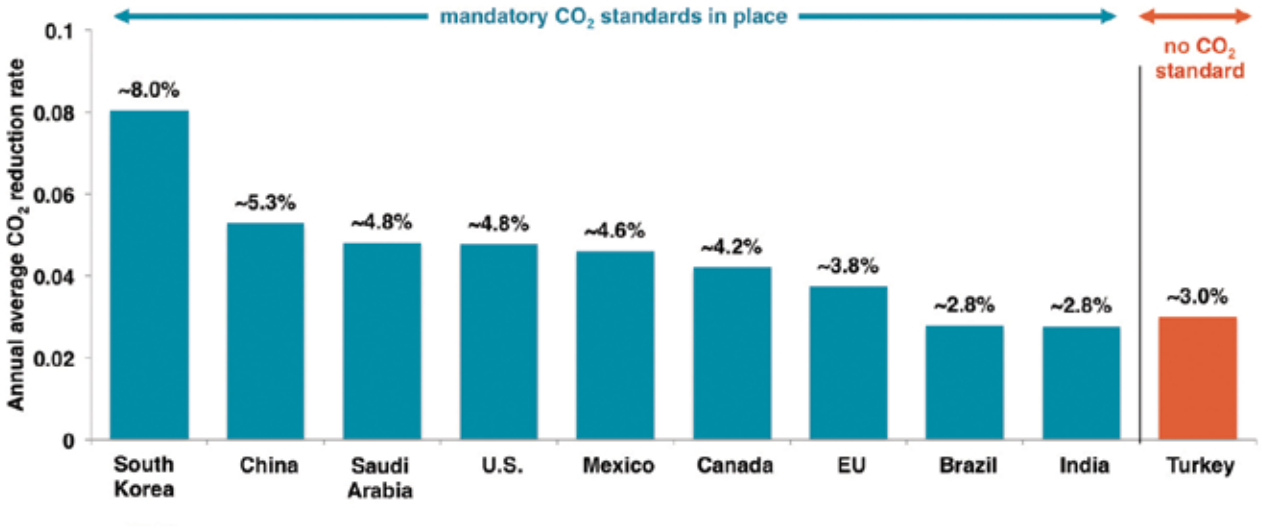


Figure 2. *Comparison of estimated average annual new passenger car CO_2 emission reduction rates.*[3,4]

rather low, for example, when compared with markets that are more similar to Turkey in terms of vehicle fleet structure and taxation levels, such as the Netherlands.

Introducing a CO_2 standard in Turkey

In the future, it is expected that if Turkey would introduce mandatory CO_2 emission standards, the annual CO_2 emission reduction rate could be increased significantly. Simply applying the existing EU CO_2 regulation to the Turkish market would not result in any significant additional CO_2 reductions, however, as the EU's 95 g/km CO_2 target for passenger cars for 2021 would only translate into an approximately 3.4% annual CO_2 reduction for Turkey —not much higher than the current business-as-usual rate without any CO_2 regulation.

Figure 3 illustrates the current situation of the new passenger car market in Turkey, including all vehicle model variants of which more than 100 vehicles were registered in 2014. Nine selected vehicle model variants were specifically highlighted. These selected vehicle models include some of the top-selling vehicle models within their segment, all of them being diesel (D) powered except the Toyota Yaris, which was chosen as an example of a hybrid (H) vehicle that is available on the Turkish market.

The 2015 and 2021 CO_2 emission targets that apply to new passenger cars in the EU are also shown. It can be seen that the majority of vehicle models registered in Turkey already outperform the EU 2015 target line.[c] Furthermore, some vehicle models already comply with the CO_2 emission target that will apply in the EU in 2021. Specific examples include the Toyota Yaris hybrid, as well as variants of the Peugeot 208 and Renault Mégane.

Looking at the target lines for a hypothetical 2023 (the 100th year anniversary of the Turkish Republic) new car CO_2 standard in Turkey, it can be seen how these would go one step beyond the current EU 2021 regulation if an underlying annual reduction rate of 4.0% or 6.0% (compared to a 3.8% reduction rate in the EU) is assumed. At the same time it is noteworthy that already in 2014 —nearly ten years before the standard would apply— some vehicle models, such as the Toyota Yaris hybrid, would already comply or nearly comply with the respective CO_2 emission targets.

c The current vehicle CO_2 emission standards in the EU for 2015 and 2021 use vehicle weight as the underlying target parameter. This means that the heavier a vehicle, the higher its allowed CO_2 emission level.

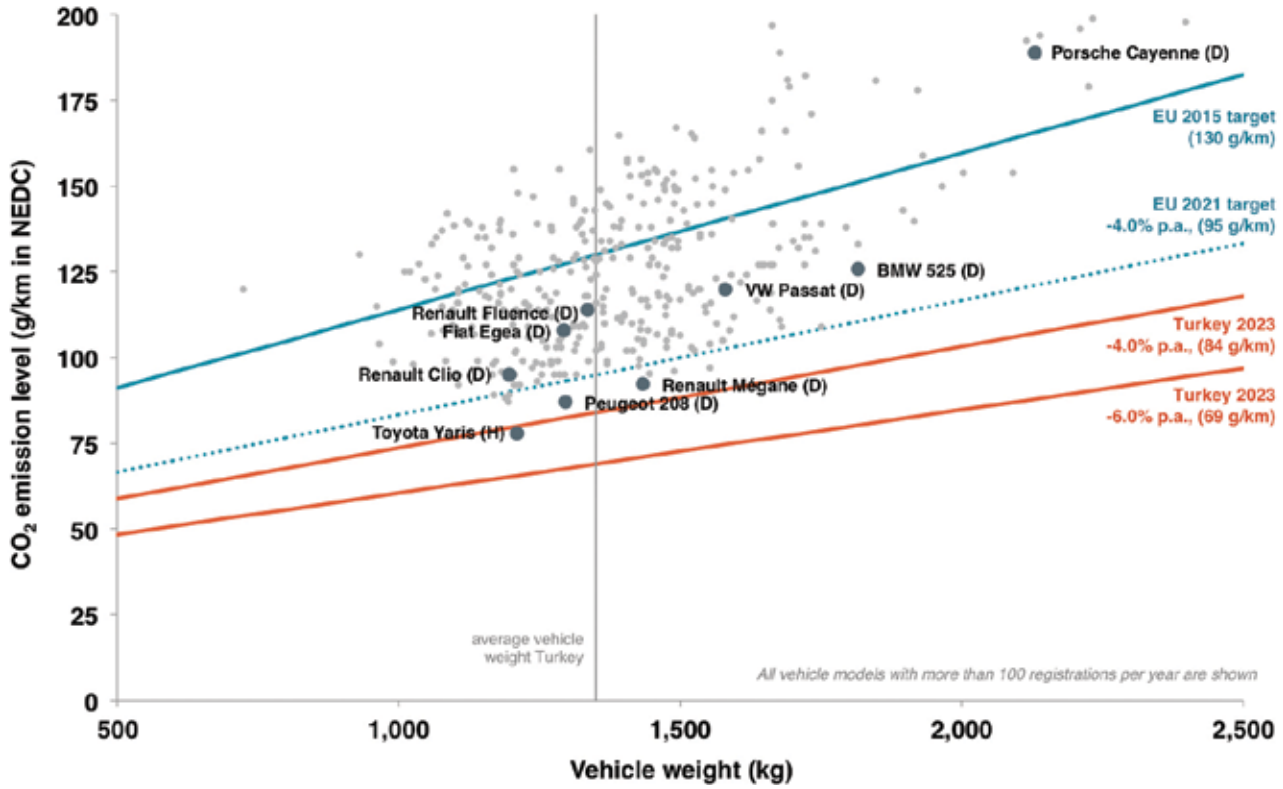


Figure 3. *New passenger car registrations in Turkey in 2014, differentiated by vehicle weight and CO_2 emission levels. Some selected vehicle models are highlighted.*

This observation is in line with the expectation that a 4.0% per year (p.a.) and even a 6.0% p.a. 2023 CO_2 standard could largely be met by further improving conventional combustion engine vehicles and also making use of the mild and full hybrid electric vehicle technology. For an average new car fleet CO_2 target of 84 g/km by 2023 (equivalent to a 4% p.a. reduction), the additional direct manufacturing cost is estimated to be around 2,400 Turkish Lira (TL) (≈720 EUR). For a target of 69 g/km (-6.0% p.a.) it is around 3,800 TL (≈1,150 EUR). Comparing the estimated necessary investments into improved technologies to the expected savings in fuel costs, it is found that the expected payback period would be below five years. This means that after five years of driving the total fuel costs saved are larger than the initial investment into advanced technologies. Over the lifetime of the vehicle, for the second or thirdhand owner the cumulative fuel cost savings would greatly offset any initial technology investment.

Vehicle CO_2 Labeling

Vehicle CO_2 labeling helps inform customers' purchase behavior by providing data on the CO_2 emission level of a vehicle in a more accessible and easier to understand format than would otherwise be the case. A standardized format, furthermore, allows for an easier comparison between different vehicles and ideally results in a situation where the customer chooses a vehicle with a lower CO_2 emission level. In Turkey, CO_2 labeling for new passenger cars was introduced in January 2009, and the practice continues today.

Figure 4 shows the vehicle CO_2 label that is currently in place in Turkey. In addition to providing some basic technical information about the vehicle (make and model, fuel type, engine displacement, transmission type), the label includes data on the fuel consumption (in liters per 100 kilometers, l/100 km) of the vehicle when driven in inner-urban and extra-urban areas, as well as a weighted average of the different driving conditions. The average CO_2 emission value of the vehicle is given in the form of an absolute number and a color rating. In addition to the CO_2 label itself at the point of purchase, the current CO_2 label regulation in Turkey foresees additional ways of informing customers about the CO_2 emission levels of vehicles on offer, for example, by providing data on vehicle CO_2 emissions online in form of a website.

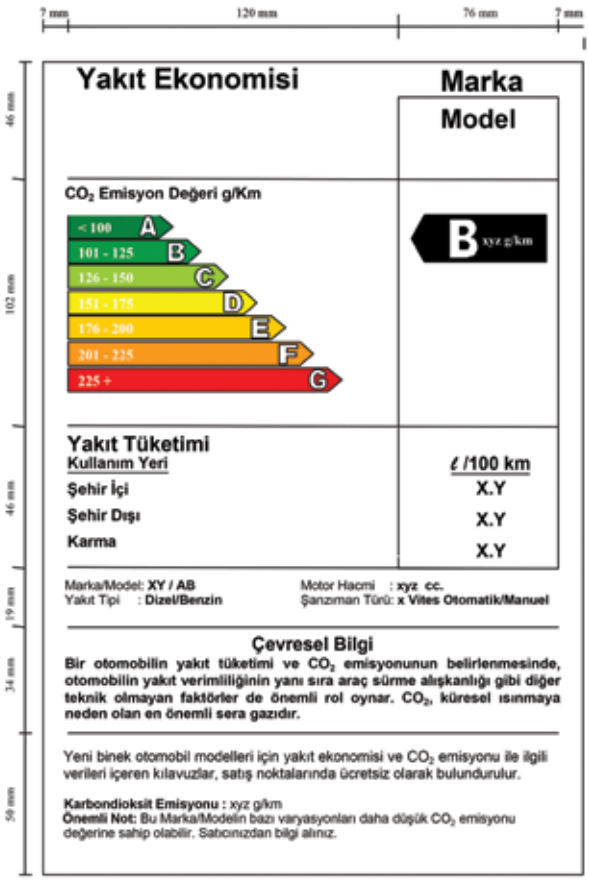


Figure 4. *New car CO_2 label currently applied in Turkey.*[8]

When comparing the current vehicle CO_2 labeling scheme in Turkey to the corresponding schemes in other markets (Table 2), it is notable that the labeling scheme is not linked to other fuel efficiency-related policies (1-2.), i.e. there is no mandatory CO_2 regulation for new cars in place in Turkey for which the CO_2 label could help to leverage customer purchase behavior. Similarly, there is no CO_2-based vehicle taxation scheme in place in Turkey for which the CO_2 label could help raise consumer awareness. Ideally, all three elements (CO_2 vehicle standards, CO_2 vehicle labeling, and CO_2-based vehicle taxation) together would help to create a market "push" and "pull" situation wherein low-CO_2 vehicles are produced and offered by vehicle manufacturers ("push") and those vehicles would be demanded and purchased by consumers ("pull"). This would thereby leverage the CO_2 reduction effects of each of these individual policy measures. An additional element missing in the CO_2 labeling scheme in Turkey when compared to other markets is the indication of running costs or other financial parameters to the customer (3-2.). This kind of information would help consumers to better understand the financial implications of their purchase decision and how low-CO_2 emission vehicles help to reduce their spending on fuel over the lifetime of the vehicle. In addition, improving the vehicle CO_2 information website to be more user-friendly (4-1.), providing an indication of real-world fuel consumption and CO_2 emissions data to consumers (2-4.), and giving special consideration to the efficiency of advanced technologies such as electric vehicles (3-4.) are other important elements in which the CO_2 labeling scheme in Turkey could be strengthened.

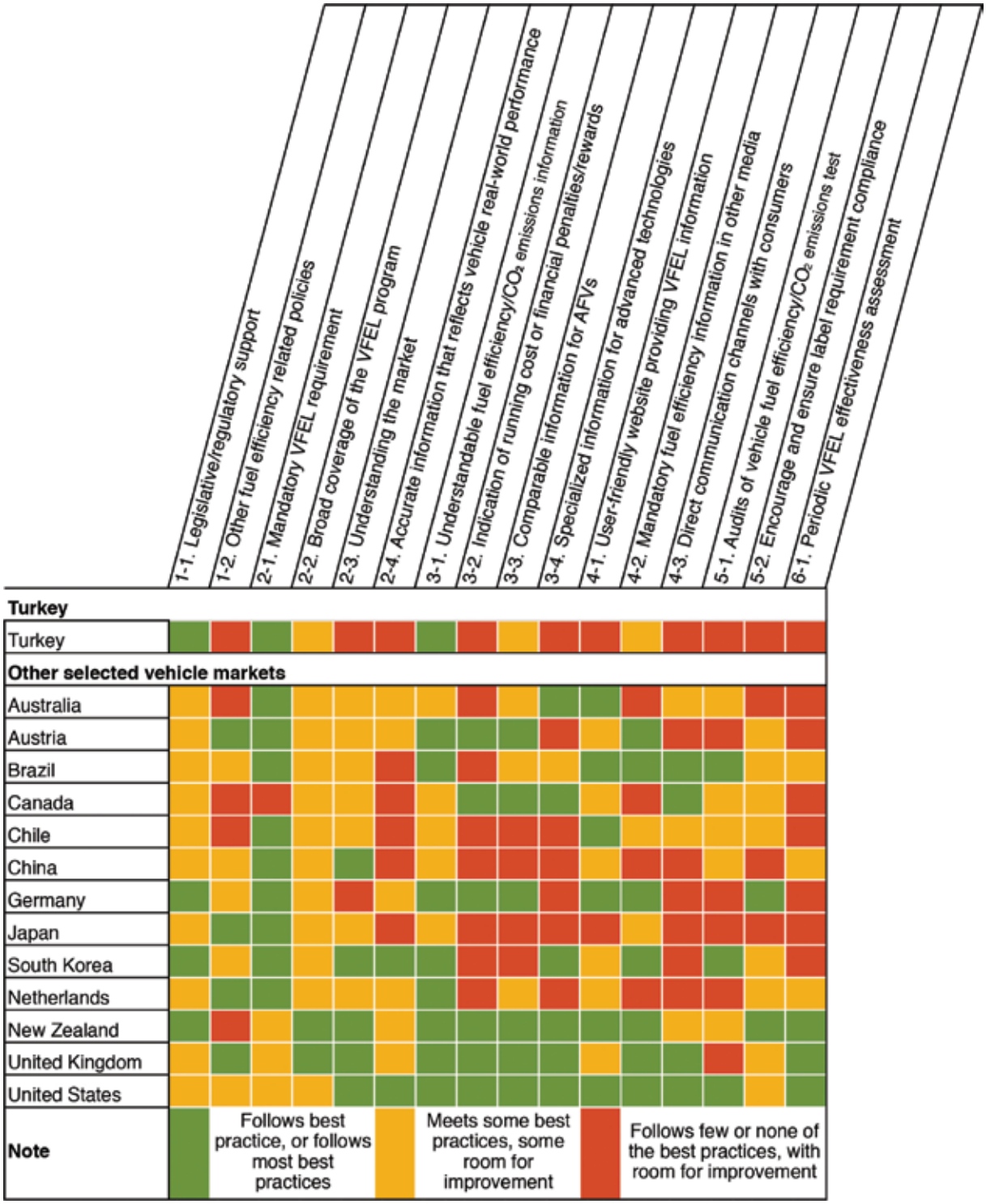


Table 2. *Comparative evaluation of vehicle CO_2 labeling schemes in selected markets[9] (VFEL = Vehicle Fuel Efficiency Labeling, AFVs = Alternative Fuel Vehicles)*

Vehicle CO_2-based Taxation

Most countries have implemented a tax on vehicle purchase and/or vehicle ownership. Using the CO_2 emissions of a vehicle as the basis for its taxation level results in a situation where the customer has to pay less tax if the vehicle emits less CO_2. As a result, there is an incentive for customers to choose vehicles with lower CO_2 emissions, thereby helping to reduce the average CO_2 emission level of the new vehicle fleet and supporting vehicle manufacturers in their attempt to sell vehicles with lower CO_2 emissions.

The current situation in Turkey

In Turkey, currently new passenger cars are subject to the general value-added tax (VAT, or *Katma Değer Vergisi* —KDV— in Turkish), which is 18% and applies to all goods. In addition, a special sales tax is levied, the *Motorlu Taşıt Araçlarına İlişkin Özel Tüketim Vergisi* (ÖTV), also called Special Consumption Tax (SCT).

The amount of ÖTV to be collected depends on the engine displacement of a vehicle and ranges from 45% to 145% (Table 3). The calculation is based on the net price of the vehicle, i.e. without any taxes. VAT is then added to the sum of net price and ÖTV, resulting in the gross sales price of the vehicle. In addition to these taxes, which are applied once at vehicle purchase, any passenger car in Turkey is subject to an annual ownership tax, the *Motorlu Taşıtlar Vergisi* (MTV). This annual tax is again linked to the engine displacement of the vehicle and it decreases with the age of the vehicle.

The ÖTV, in particular, strongly influences customer purchase behavior. One indication is the fact that 95% of all new cars in Turkey have an engine displacement of 1.6l or less. In comparison, in the EU only about 70% of all new cars are equipped with an engine of 1.6l or smaller. Approximately 40% of cars in Turkey are right at the tax threshold of 1.6l, indicating the importance of this step in the tax rate. Figure 5 illustrates the current situation, using the example of a new car with a net sales prices of 66,000 TL (≈20,000 EUR). The tax difference between a vehicle with a 1.6l engine and one with a 1.7l engine then is 29,700 TL (≈9,000 EUR) if only considering ÖTV and 31,866 TL (≈9,700 EUR) if also taking into account MTV for the first three years of ownership. This significant difference in taxation levels provides a strong incentive for consumers to pick a vehicle with an engine displacement of 1.6l or less. A similar tax threshold can be found at the 2.0l engine size. Again using the example of a 66,000 TL vehicle, the tax difference between the 2.0l and 2.1l engine size amounts to 40,239 TL (≈12,200 EUR). As a result, another clustering of new car sales around the 2.0l tax threshold is observed, accounting for nearly 5% of vehicle sales. Vehicles above the 2.0l engine size are very rarely found in the Turkish new car fleet.

In order to assess the effect of the current vehicle taxation scheme in Turkey on consumer prices, five vehicle models were selected and compared to the same vehicle models in Germany, France, and the Netherlands (Figure 6). Each of the selected vehicle models is the most popular within its respective vehicle size segment.

The first three models, the VW Polo, Golf, and Passat, fall below the 2.0l threshold and, therefore, in

Engine displacement (l)	Special sales tax ("OTV"), one-time	Value-added tax ("KDV"), one-time	Ownership tax ("MTV"), annual (in TL), based on age of vehicle				
			year 1-3	year 4-6	year 7-11	year 12-15	more than 16
≤ 1.3	45% of net sales price	18% of net sales price + special sales tax	591	412	231	175	63
> 1.3 and ≤1.6			945	709	412	291	112
> 1.6 and ≤1.8	90% of net sales price		1,667	1,304	786	469	182
> 1.8 and ≤2.0			2,626	2,024	1,189	709	280
> 2.0 and ≤2.5	145% of net sales price		3,939	2,860	1,787	1,068	423
> 2.5 and ≤3.0			5,491	4,777	2,985	1,607	591
> 3.0 and ≤3.5			8,362	7,524	4,553	2,263	831
> 3.5 and ≤4.0			13,147	11,352	6,686	2,985	1,189
> 4.0			21,516	16,135	9,556	4,296	1,667

Table 3. *Overview of passenger car vehicle taxes in Turkey in 2015.*

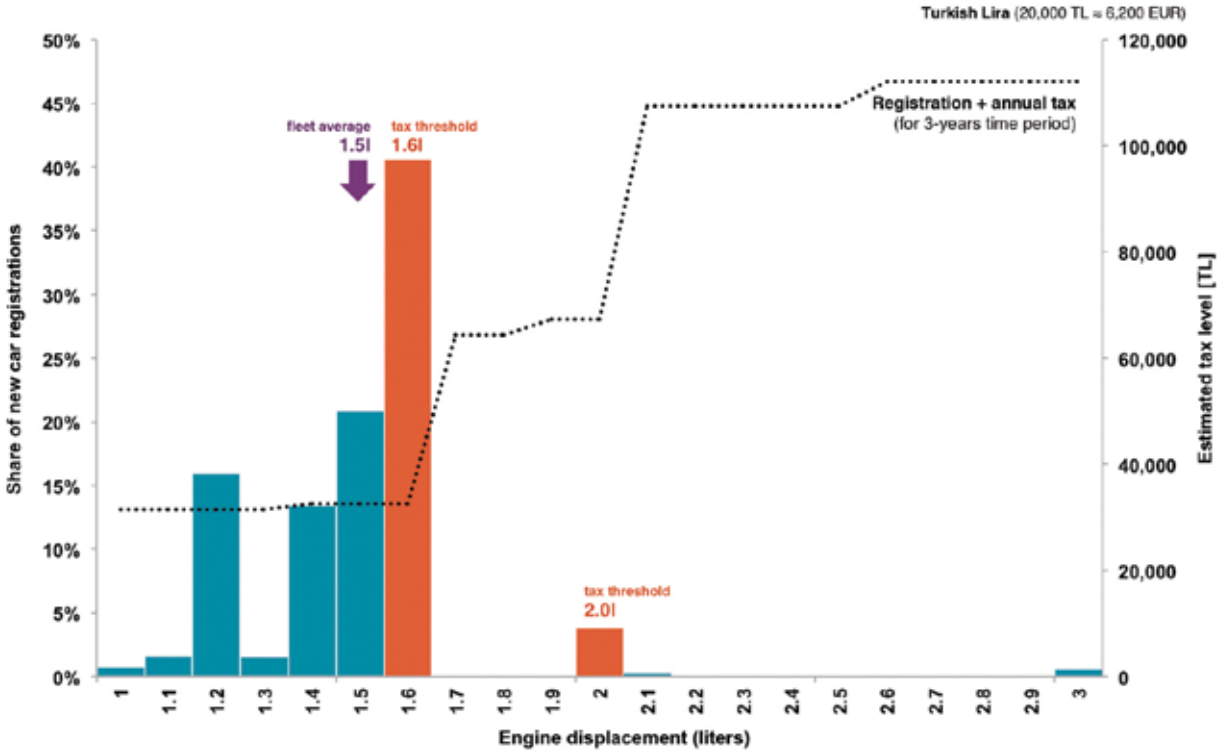


Figure 5. Taxation levels for a 66,000 TL (≈20,000 EUR) new car in Turkey and distribution of new car sales by engine displacement.

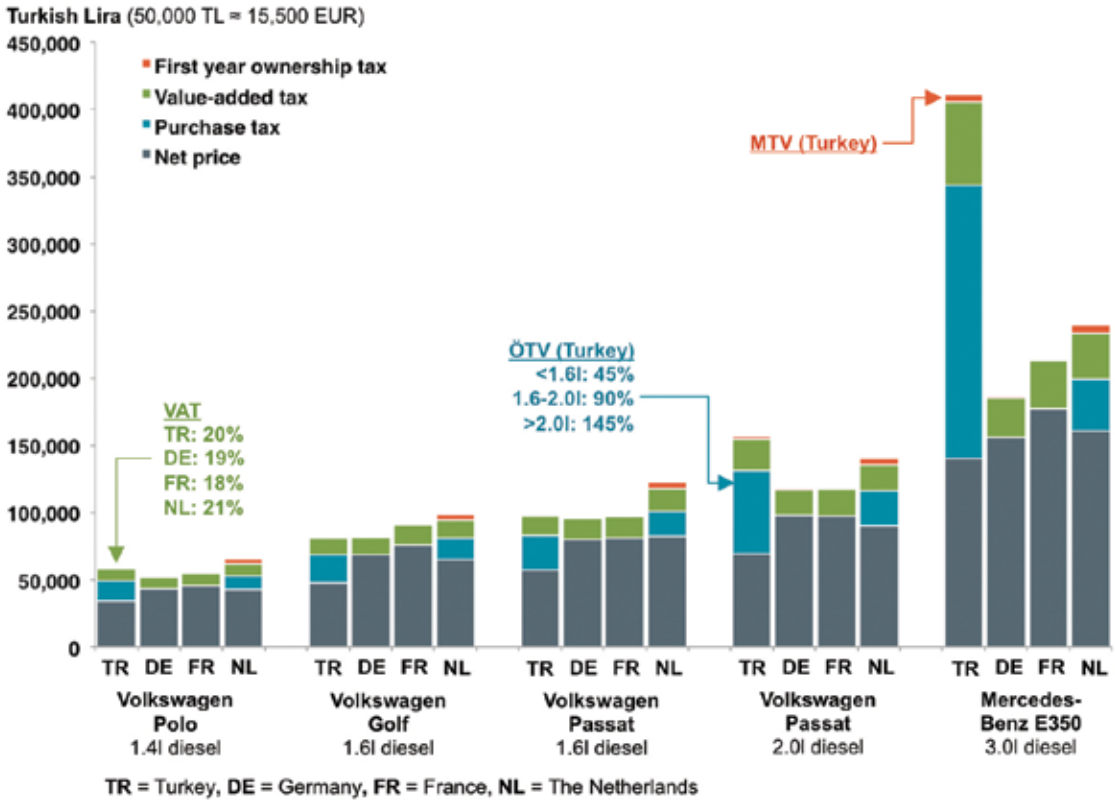


Figure 6. Sales prices and taxation levels for selected vehicle models in Turkey, Germany, France and the Netherlands.

Turkey are subject to 45% ÖTV. It can be seen how the impact of ÖTV increases with vehicle value, being highest for the Passat. The fourth vehicle, again a VW Passat, falls above the 2.0l engine displacement tax threshold and, therefore, in Turkey is subject to 90% ÖTV. The impact of the ÖTV is even stronger in the case of the fifth vehicle, a 3.0l engine Mercedes-Benz E350.

It can be seen that gross vehicle prices (i.e. including taxes) for vehicles below 1.6l engine size are relatively similar for Turkey, Germany, and France, with the prices in the Netherlands being notably higher than in the other three markets. For the 2.0l Passat and the 3.0l E350, however, consumer prices in Turkey are significantly higher than in Germany and France. Even though tax levels for these two vehicles are comparably high in the Netherlands, vehicle prices in the Netherlands are still lower than in Turkey.

A potential redesign of Turkey's tax scheme

Vehicle taxation levels in Turkey are comparably high and as a result have strong effects on consumer purchase behavior. However, currently taxes for passenger cars in Turkey are only linked to the engine displacement and the price of a vehicle. They, therefore, provide an incentive to choose a vehicle with lower engine displacement and lower net price but still have a weak effect on increasing the demand for new passenger cars with lower fuel consumption and CO_2 emissions.

Figure 7 illustrates schematically the design of a best-practice vehicle taxation scheme. The taxation basis should be the CO_2 emission level of a vehicle, and a linear tax function should be applied without any discrete tax threshold steps. This means that the tax rate (in TL per g/km of CO_2) is the same for every vehicle, thereby ensuring technology neutrality and avoiding any clustering of vehicles around discrete tax thresholds. Vehicles below a set pivot point would receive a bonus payment while vehicles above the pivot point have to pay a malus. The revenue collected from the malus payments would be used to balance out the bonus payments for low-emission vehicles, thereby ensuring budget neutrality from a government perspective. Additional tax revenue could be collected, if desired by the government, by placing the pivot point in such a way that the sum of revenue collected from malus payments is larger than the sum of bonus payments to low-emission vehicles.

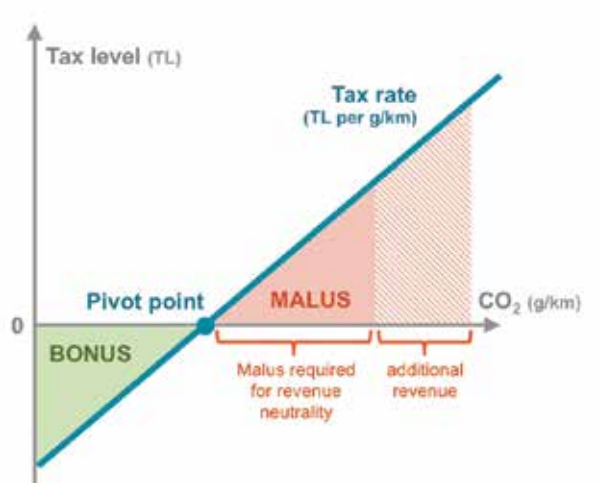


Figure 7. *Schematic illustration of best-practice design for a feebate-like vehicle taxation scheme.*

Figure 8 illustrates how such a feebate-like vehicle taxation scheme could be implemented in practice in Turkey. In the near term, to avoid any sudden market disruptions, the majority of tax revenues would still be collected by applying an engine displacement and net sales price-based tax rate as it is the case today. Instead of the engine displacement dependent taxation levels being 45%, 90%, and 145% as is currently the case, they could be lowered to 30%, 80%, and 140%. This would reduce tax revenues by about 4.1 billion TL (≈1.1 billion EUR). This loss in tax revenues could be balanced out by the introduction of a feebate-like system with a tax rate of 270 TL (≈95 EUR) per g/km of CO_2.

In the suggested modified vehicle taxation scheme, the taxation level of a vehicle would no longer be only dependent on engine displacement and net sales prices: it would now also depend on the CO_2 emission level of a vehicle. By modifying the current system instead of replacing it entirely by a system solely based on CO_2, a sudden change in market structure is avoided while still a strong steering effect would be expected. This is due to the fact that the vehicle taxation levels in Turkey are already high enough, so even a partial switch to a CO_2-

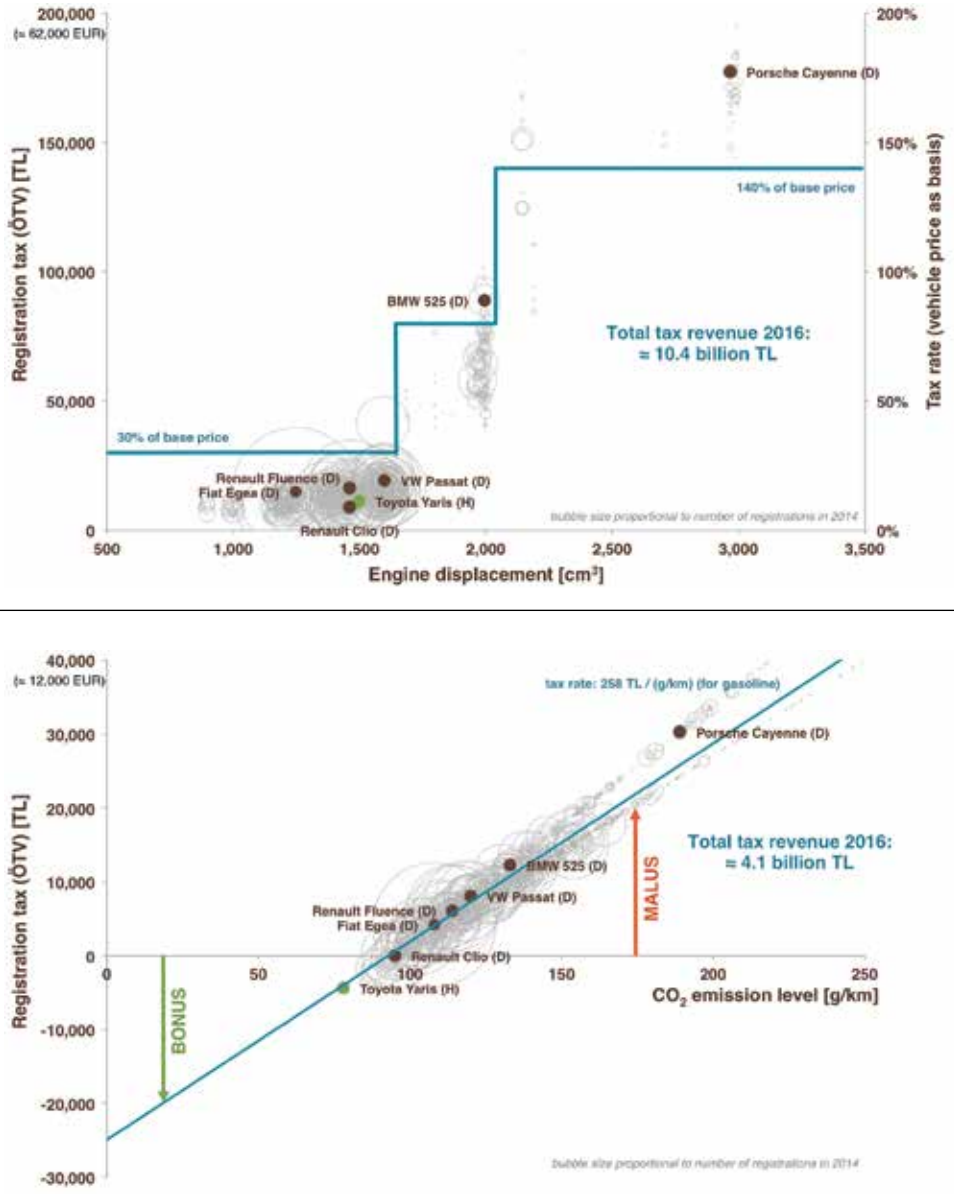


Figure 8. *Level of vehicle sales tax (ÖTV) in Turkey in 2016 —in an alternative taxation scheme— at vehicle model version level, dependent on engine displacement and CO_2 emission level. Note that both pillars of the revised taxation system together would ensure tax revenue neutrality (14.5 billion TL).*

based feebate system would be sufficient to generate a notable steering effect. Government budget neutrality would also be ensured as any foregone revenue from the displacement/price part of the taxation scheme would be balanced out by the new CO_2 part. Finally, by lowering the current displacement dependent taxation rates more strongly for the smaller vehicle size categories than for the larger vehicles, social equity is ensured as well.

From a customer's point of view, a CO_2-based vehicle taxation scheme would make it more attractive to choose a vehicle with low CO_2 emissions at the point of purchase. This is due to the fact that any initial investment into CO_2 reducing technologies such as hybrids would pay off more quickly for the customer. Not only would the customer have to pay less on fuel but also due to the direct link between lower CO_2 and lower fuel consumption, the taxation level to be paid would be lower. This effect would be even stronger if not only the purchase tax (the ÖTV) but also the annual ownership tax (the MTV) was adapted to be based on CO_2.

Enhanced Vehicle Emissions Testing

The basis for any kind of vehicle emissions regulation is reliable data, both for CO_2 and other air pollutants. New vehicle models are typically tested in the laboratory, following pre-set test cycles and framework testing conditions. After Volkswagen was found to have communicated incorrect emission values, it is known that laboratory emission results diverge from the real-world emissions data measured while driving on the road.

In response to the outdated NEDC test procedure that was originally developed in the 1970s, a new vehicle emissions test procedure was developed at the United Nations (UNECE) level. The so-called Worldwide Harmonized Light Vehicles Test Procedure (WLTP) includes a test cycle that more realistically represents the average driving pattern of customers and also includes a number of improvements for the test procedure itself, for example, by tightening allowed tolerances and flexibilities.[10] The EU is planning to implement the WLTP by 2017, then replacing the current NEDC. Similarly, Japan and South Korea have announced that they will replace their respective test procedures by the WLTP. For Turkey, which already follows the vehicle emissions regulation of the EU, switching to the WLTP as soon as possible is seen as an important next step.

The WLTP will need to be complemented by a not-to-exceed (NTE) limit for on-road emission levels. The Real-Driving Emissions (RDE) regulation in the EU recently introduced such a NTE for nitrogen oxides (NO_x) emissions.[11] Introducing RDE-like on-road testing in Turkey and extending the coverage from only air pollutants to also include CO_2 emissions is seen as another key step to lower the real-world emission levels of new vehicles sold in Turkey.

As a third pillar, in addition to introducing the WLTP and RDE, the vehicle emissions testing scheme itself will need to be revised in the future to allow for enhanced oversight and enforcement power for regulators. The European Commission recently came forward with a regulatory proposal, introducing elements that are intended to strengthen the vehicle emissions testing scheme in the EU.[12] Again, given that Turkey is closely following the EU's vehicle emissions regulation, these revisions will have to be mirrored also in the Turkish market in a next step.

In addition to the aforementioned strengthening of vehicle emissions testing at the national level, it is possible to supplement with policy measures at the local level. In particular, city level authorities can decide to restrict access to their inner-urban areas to vehicles that are in line with the recent emission requirements. For example, a number of European cities (London, Paris, and Berlin, as well as many smaller cities) have implemented low emission zones that only allow vehicles meeting recent emission standards access to their centers, levying a charge on those vehicles that only meet older emission standards. In the case of Istanbul, a concept for restricting vehicle access to the historical peninsula has already been described in detail.[13] It is conceivable to further develop such a concept to cover a wider range of the city center and to also differentiate between vehicles depending on their emission levels. As a result, this would help to not only improve the air quality levels in Turkish cities but also provide another incentive for customers to choose vehicle models with low emissions.

Conclusions and Outlook

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 would be expected. Assessing standards with an annual CO_2 reduction rate of 4% and 6%, resulting in an average new car fleet CO_2 level of 84 g/km and 69 g/km by 2023, respectively, it was found that the required investment into new vehicle technologies to meet future CO_2 targets is reasonably low from the manufacturers' side, at a maximum of 2,400-3,800 TL (≈720-1,150 EUR). At the same time there is significant fuel cost savings from the consumers' side thanks to the higher efficiency of those vehicles equipped with modern technologies, which allow for payback periods as short as four to five years. The introduction of CO_2 standards is therefore seen as a win-win situation for all stakeholders, allowing for significant savings of fuel cost, oil imports, and emission reductions, as well as the stipulation of technological innovation and international competitiveness.

One policy measure already implemented in Turkey is providing consumer information by means of vehicle CO_2 labeling. Comparing the current Turkish labeling scheme to those in other markets, there are some areas where further improvement is possible. Examples include a revision of the current website to allow customers a better overview of available vehicle models and their CO_2 emission labels, as well as including information on vehicle taxation levels and on-road driving emission levels on the label. It should be emphasized that the vehicle CO_2 label by itself is not expected to have a significant effect on customer purchase behavior but that it can help to leverage the effects of other policy measures such as CO_2 standards and CO_2-based vehicle taxation if those measures are introduced in parallel to a labeling scheme.

Taxes on the purchase and ownership of passenger cars in Turkey are high in comparison to other markets worldwide and have a strong effect on the sales structure of the vehicle market. In particular the ÖTV has a strong influence as it can be as high as the net price of the vehicle itself or even higher. However, this tax is currently based solely on the engine displacement of a vehicle and its purchase price and has no or very little effect on the CO_2 emissions level of new vehicles. Revising the current vehicle taxation scheme in Turkey to be partly based on vehicle CO_2 emissions is expected to make it easier for manufacturers to market their low-emission vehicle technologies as it would provide a strong financial incentive for customers to choose cars that emit less than other models available on the market. Acknowledging that vehicle taxes account for a large portion of the revenue budget of public authorities in Turkey, it should be emphasized that a switch to a CO_2-based vehicle taxation scheme can be implemented in a budget-neutral way, i.e. without lowering the government's revenue stream in any way.

All of the abovementioned policy measures rely on correct data on vehicle emission levels. To ensure that official and real-world emission levels of new vehicles are as much in line as possible, it is recommended that Turkey not only introduce the new WLTP test procedure as soon as possible but also introduce mandatory on-road emissions tests for new vehicle models, both for CO_2 and other air pollutants. As a third pillar, regular retesting of the emission levels of vehicles in use, carried out by the authorities or independent third parties, is strongly advised. Together, these measures for enhanced vehicle emissions testing will help to reduce the discrepancy between official and real-world data and will ensure a solid basis for any future policy measures.

Figures 9 and 10 provide a rough estimate of the expected total impact of the discussed policy measures. The total CO_2 emissions of the light-duty vehicle fleet in Turkey would increase from about 16 Mt in 2015 to 22 Mt by 2030 if no further policy measures would be taken. With only a mandatory CO_2 standard in place, the emissions level would be lower, at 17-19 Mt by 2030. Complementing CO_2 standards by also introducing a CO_2-based vehicle taxation scheme and enhanced vehicle emissions testing would help to further reduce the emissions level to about 14-16 Mt by 2030. This is up to 36% lower than in a business-as-usual scenario. Similarly, the amount of fuel consumption in the light-duty vehicles sector could be reduced by about the same extent.

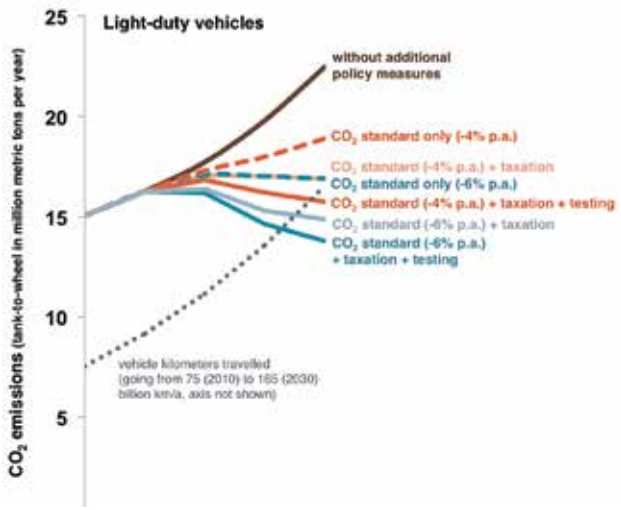


Figure 9. *Estimated CO_2 emissions from light-duty vehicles in Turkey (2010-2030).*

It should be emphasized that all of the discussed policy measures do not result in any additional cost from the government's perspective and in addition also help to reduce the financial burden from the consumer's perspective. This is due to the fact that after a payback period of four to five years consumers would benefit from significantly lower fuel costs over the lifetime of the vehicles, thereby also benefitting second and thirdhand car owners. In summary, the policy measures discussed would result in higher investments in vehicle technologies and less spending on fuel and oil imports, thereby providing benefits for all stakeholders in Turkey, including the vehicle and vehicle parts manufacturing industry.

The scope of policy options selected for the discussion within this policy brief (vehicle CO_2 standards, CO_2 labeling, CO_2-based taxation, and enhanced vehicle emissions testing) is by no means to be seen as complete. Instead, it is meant to cover measures that are commonly applied in other automotive markets worldwide and that were identified as potentially relevant in the context of Turkey during discussions with stakeholders throughout the duration of this research project. Furthermore, it is important to acknowledge that the focus of this work is on policy measures to tackle the emissions of passenger cars. Light commercial vehicles make up about 15% of the new vehicles market in Turkey, which is why any policy measure to reduce emissions should also be extended to those vehicles as well. Similarly, heavy-duty vehicles are important as they account for more than half of fuel consumption and emissions in Turkey and, therefore, should be subject to future research and policy discussions.

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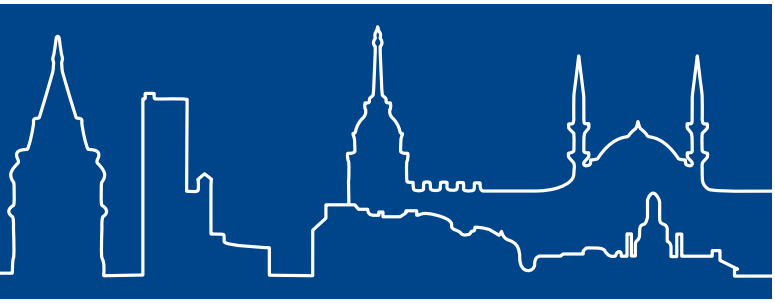
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