EU Automotive Emissions Standards

Rethinking Decarbonisation Incentives – Policy Case Studies

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This case study has been developed for the UK's Energy Systems Catapult under the *Rethinking Decarbonisation Incentives* project, aiming to draw lessons from international experience of policies to improve the framework of economic drivers for decarbonisation in the UK.

The EU automotive standards were established in 2009 for passenger cars and 2011 for light commercial vehicles (LCVs). The standards set carbon dioxide emission intensity limits (CO_2/km) for all new vehicles sold in Europe. A portfolio approach was taken that allowed manufacturers to continue to produce a range of vehicle types (with different engine sizes and weight), while driving down average emission across the new fleet.

This case study investigates how manufacturers have performed against the standards and the limitations of this approach from the point of view of an economic signal for decarbonisation. It also examines how the standards function alongside other EU policy initiatives, such as vehicle and fuel taxation, and to what extent a consistent and uniform investment signal has been created. While this policy is applied to the transport sector, the issues arising from use of this kind of instrument, advantages and limitations, can be applied in other sectors.

Key findings

- The EU's CO_2 performance standards for passenger cars and vans are widely considered to have been successful in terms of reducing the carbon intensity of the transport sector. They are credited with being the main driving force behind the sector's improvements.
- Design of appropriate measurements for performance standards is critical to ensure that they translate into overall emission reductions. Experience from the test procedure shows that it did not adequately reflect real-world driving conditions and hence there has been a discrepancy between theoretical fuel efficiency and the performance experienced by consumers.
- Non-market measures like performance standards are thought to be necessary in the transport sector, since the economic signal from emissions trading schemes covering multiple sectors (such as the EU ETS) would not be strong enough to induce technological change. This is because of the high marginal abatement costs in transport compared to other sectors, coupled with low elasticity of demand.
- Nevertheless, the standards do not address the demand-side aspect, and hence may be better combined with complementary and sector-specific market-based measures. There are also possible rebound effects from changes in consumer behaviour, that could be addressed using market-based approaches.

> "Fuel efficiency can be effective (a) with respect to reducing energy consumption and GHG emissions per km driven and (b) with respect to absolute reductions in GHG emissions (within and beyond the transport sector)."
>
> F. Creutzig et al, 2011

Abbreviations

ETS	Emissions trading scheme
LCV	Light commercial vehicle
EEA	European Environment Agency
WLTC	World-wide harmonized Light duty Test Cycle
WLTP	Worldwide Harmonized Light Vehicle Test Procedure
GHG	Greenhouse gas

Nomenclature

tCO_2e	Tonnes of carbon dioxide equivalent
g CO_2/km	Grams of carbon dioxide emitted per kilometre driven

Policy overview

Policy Narrative

The CO_2 performance standards were implemented in 2009 through Regulation 443/2009 for passenger cars, and in 2011 through Regulation 510/2011 for LCVs. They set out maximum fleet average CO_2 emission limits for new vehicles sold in Europe.

The standards for 2020 were confirmed in 2014 through Regulation 333/2014. Post-2020 standards have not been finalised, but a proposed regulation suggests targets for 2025 and 2030.

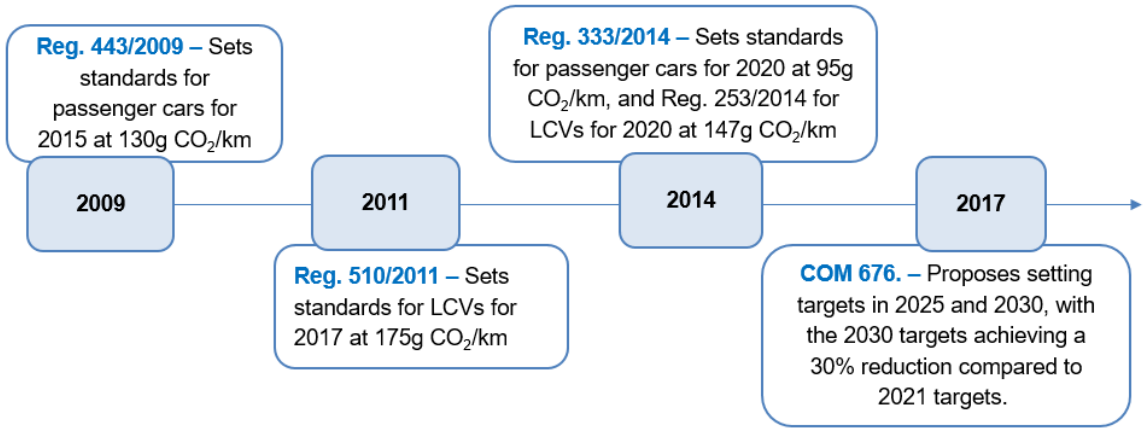

Figure 1 Policy timeline

Coverage and obligated entities

Transport was responsible for 871 $MtCO_2e$ of GHG emissions in 2015, which accounts for over 20% of total EU emissions, as shown in Figure 2. Light duty vehicles (passenger cars and vans) are the single largest contributor to transport emissions, making up 73%[1] (approximately 635 $MtCO_2e$) of the total.

[1] Share of transport GHG emissions from the EEA, https://www.eea.europa.eu/data-and-maps/daviz/share-of-transport-ghg-emissions#tab-chart_1

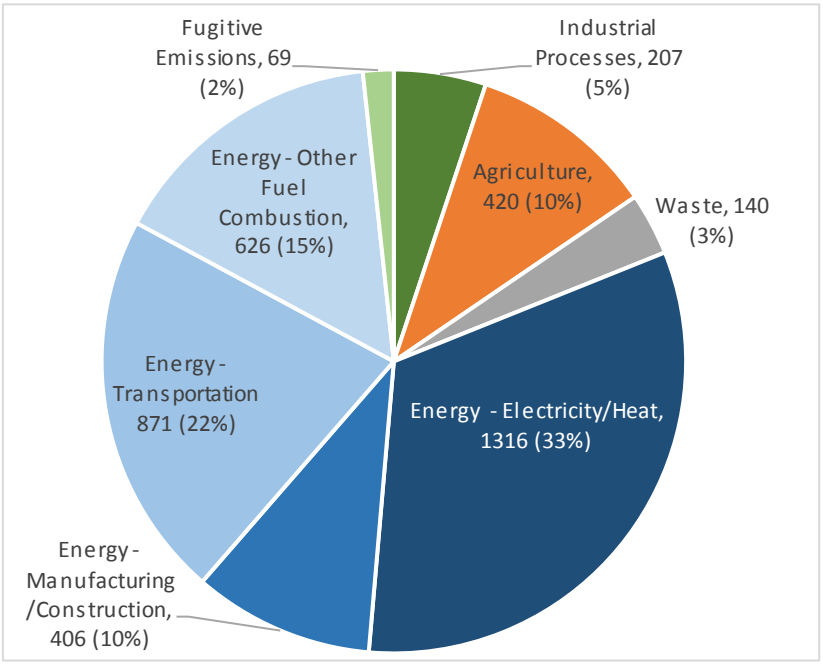

Figure 2 Total GHG emissions by sector for the European Union ($MtCO_2e$)[2]

The CO_2 performance standards cover passenger cars and vans sold by vehicle manufacturers on the European Market, who are required to report the emissions as an average across all vehicles sold each year. The Regulations are applicable to manufacturers rather than Member States, and the targets are to be met by manufacturers through improvements in vehicle technology.

In order for the targets to be able to reflect the characteristics of each manufacturer's vehicle fleet, it was necessary to relate the targets to a measure of a vehicle's 'utility'. Various possible 'utility parameters' were considered in the studies that were undertaken in support of the legislation, but 'mass' (defined as the mass in running order) was chosen for both Regulations. Elsewhere in the world, some countries (most notably the United States) have chosen vehicle footprint as the utility parameter.

While this makes the Regulations more complex compared to setting a single target value, as the emissions target is not the same for each vehicle, the utility parameter approach was considered to be important for competitive neutrality as it took account of the diversity of manufacturers and their vehicles. It does this by directly relating manufacturers' targets to a characteristic of their vehicles, while still requiring higher emissions reductions from manufacturers of larger (heavier) vehicles.

Derogations are provided for small volume and niche vehicle manufacturers. Manufacturers responsible for fewer than 1,000 new cars and LCVs registered each year do not have a specific emissions target, whereas those that produce between 10,000 and 300,000 new cars registered each year can apply for less stringent targets.

Mechanism and economic incentive

The standards are not a market-based instrument and so do not provide an explicit price signal. Additionally, it is difficult to calculate an implicit price signal based on the marginal abatement costs to firms. This is because of significant uncertainties around the marginal costs to manufacturers to implement technological improvements, the market competition between manufacturers and price elasticities for vehicles[3].

[2] Based on data from CAIT Climate Data Explorer. 2017. Washington, DC: World Resources Institute. Available online at: http://cait.wri.org

[3] Linn, J., (2011). *Emission Reduction Policies and Implicit Carbon Prices in the United States*. Resources for the Future.

There are however financial penalties for exceeding the standards, which provide a direct incentive for manufacturers to comply. The penalties are charged on any excess emissions above the manufacturers target, and are calculated from the excess emissions above the standard, multiplied by the number of vehicles that manufacturer produced that year. Theoretically, the penalties must outweigh the marginal abatement costs for the standards to be effective[4]. The structure of the penalties is designed so that larger deviations from the standard attract a higher penalty per g CO_2/km, and scale with the number of cars registered in excess of the standards.

The ex-ante and ex-post marginal abatement costs to manufacturers are shown in Table 1. While these are not directly comparable to a price signal for the reasons given above, they provide an indication of the expected and realised costs for compliance. The ex-ante costs were used in the design of the standards to ensure that they were economically feasible for manufacturers. The ex-post evaluation showed that the actual costs to manufacturers were lower than expected – this is likely because manufacturers have focused on applying the lowest cost technologies to achieve the reductions so far, but may have higher costs to achieve the reductions needed for future targets.

Table 1 Ex-ante and ex-post costs to manufacturers from the EU CO_2 standards for passenger cars and LCVs[5]

Vehicle Type	Ex-ante cost per g CO_2/km	Ex-post cost per g CO_2/km
Passenger cars	€15 to €34 per gCO2/km[6]	€5 per gCO2/km
LCVs	€37 per gCO2/km[7]	€10 per gCO2/km

Another efficiency metric is the overall carbon abatement cost (Table 2). Again, these are not comparable to a price signal since they include costs and benefits to all parties (for example, including fuel savings to the consumers); however, they do give an indication of the cost-effectiveness of the policy. The ex-post figures found the standards were more cost-effective than originally expected, with negative net costs to society as a whole.

Table 2 Ex-ante and ex-post carbon abatement costs from the EU CO_2 standards for passenger cars and LCVs[8, 9]

Vehicle Type	Ex-ante abatement cost / €/tonne CO_2	Ex-post abatement cost / €/tonne CO_2
Passenger cars	32.4 to 38.7	-46.4
LCVs	-38.9 to 32.6	-172

[4] Creutzig, e. a., (2011). *Climate policies for road transport revisited (I): Evaluation of the current framework*. Energy Policy, May, 39(5), pp. 2396-2406

[5] Ricardo, (2015). *Evaluation of Regulations 443/2009 and 510/2011 on CO2 emissions from light-duty vehicles*. Retrieved on 13/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/evaluation_ldv_co2_regs_en.pdf

[6] European Commission, (2017). *Statistical Pocketbook: EU Transport in figures.* Retrieved on 14/03/2018 from https://ec.europa.eu/transport/sites/transport/files/pocketbook2017.pdf

[7] AEA, (2009). *Quantification of the effects on greenhouse gas emissions of policies and measures: Final Report to the European Commission*. Retrieved on 14/03/2018 from https://ec.europa.eu/clima/sites/clima/files/strategies/2020/docs/ghgpams_report_180110_en.pdf

[8] Ricardo, (2015). *Evaluation of Regulations 443/2009 and 510/2011 on CO2 emissions from light-duty vehicles*. Retrieved on 13/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/evaluation_ldv_co2_regs_en.pdf

[9] European Commission, (2007). *COMMISSION STAFF WORKING DOCUMENT Accompanying document to the PROPOSAL FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND COUNCIL for a regulation to reduce CO2 emissions from passenger cars Impact Assessment*. Retrieved on 14/03/2018 from https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:52012SC0213

Compliance

The average CO_2 emissions are reported by the manufacturers to the European Environment Agency (EEA) who were designated as the competent body for collecting and communicating the data related to these regulations.

The details of the regulations are presented in Table 3. There are a number of key design elements that were included on the basis of specific justifications:

- The phase in of the targets was introduced to facilitate the transition and give manufacturers time to plan to meet their targets
- Super-credits give manufacturers additional incentives to produce vehicles with very low emissions by counting these as additional vehicles against their targets. These were intended to support the competitiveness of the European automotive industry by encouraging production and sale of such vehicles.
- Similarly, allowances for eco-innovations were included in order to promote the long-term competitiveness of the sector.
- The inclusion of pooling was considered to be an important flexibility that could improve the overall cost-effectiveness of the Regulation, as it allows manufacturers without a wide range of vehicles to create a pool with other more mainstream manufacturers.

Table 3 Summary of passenger car and LCV CO_2 emissions regulations (Regulations 443/2009 and 510/2011)[10]

Element of the regulations	Car CO_2 regulation	LCV CO_2 regulation
First target	130g CO_2/km by 2015	175g CO_2/km by 2017
Phasing in of first target	For the purpose of determining each manufacturer's average CO_2 emissions, 65% of registered cars are taken into account in 2012, rising to 75% (2013), 80% (2014) and 100% from 2015 to 2019.	For the purpose of determining each manufacturer's average CO_2 emissions, 70% of registered LCVs are taken into account in 2014, rising to 75% (2015), 80% (2016) and 100% from 2017.
Super-credits for first target	Each new car with less than 50g CO_2/km shall be counted as 3.5 cars in 2012 and 2013, 2.5 cars in 2014, 1.5 cars in 2015 and 1 car from 2016; there is no limit as to the number of vehicles for which a super-credit can be given.	Each new LCV with less than 50g CO_2/km shall be counted as 3.5 LCVs in 2014 and 2015, 2.5 LCVs in 2016, 1.5 LCVs in 2017 and 1 LCV from 2018; super-credits can be applied up to a maximum of 25,000 LCVs per manufacturer over the entire period.
Second target	95g CO_2/km by 2020	147g CO_2/km by 2020
Phasing in of second target	95% of registered cars taken into account in 2020 and then 100% from 2021.	100% of registered LCVs from 2020.
Super-credits for second target	Each new car with less than 50g CO_2/km shall be counted as 2 cars in 2020, 1.67 cars in 2021, 1.33 cars in 2022 and 1 car from 2023; the limit for the use of super-credits is set at a maximum of 7.5 g/km for 2020 to 2022 for each manufacturer.	The use of super-credits is not allowed in relation to the 2020 target.

[10] Ricardo, (2015). *Evaluation of Regulations 443/2009 and 510/2011 on CO2 emissions from light-duty vehicles*. Retrieved on 13/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/evaluation_ldv_co2_regs_en.pdf

Pooling	Manufacturers may form a pool to meet their specific emissions targets (except for manufacturers with a 'small volume' or 'niche' derogation; see below).	Manufacturers may form a pool to meet their specific emissions targets (except for manufacturers with a 'small volume' derogation).
Excess emissions premium	From 2012 (or 2014 for LCVs) to 2018, where a manufacturer's (or pool's) CO_2 emissions exceed their target, they will have to pay an 'excess emissions premium' for each new vehicle registered that year of: €5 for the first gram over (or part thereof); €15 for the second gram over (or part thereof); €25 for the third gram over (or part thereof); and €95 for each gram thereafter. From 2019 the premium will be €95 for each gram.	
'Small volume' derogation	Manufacturers that are responsible for fewer than 10,000 new cars (or 22,000 new LCVs) registered each year and are not part of a wider group may apply for a derogation under which the manufacturer proposes a specific CO_2 emissions reduction target consistent with its reduction potential. The application needs to be approved by the Commission.	
'Niche' manufacturer derogation	'Niche' manufacturers, i.e. those responsible for between 10,000 and 300,000 new cars registered each year, can apply for a derogation to have a reduction target for 2012 to 2019 that is 25% less than their average specific CO_2 emissions in 2007 and a reduction target from 2020 that is 45% lower than the 2007 value.	No equivalent provision.
Eco-innovations	Manufacturers or suppliers can apply for the CO_2 savings achieved as a result of innovative technologies to be considered, as long as these deliver verifiable CO_2 emissions reductions that are not measured under the test cycle. The 'eco-innovations' that are approved by the Commission can be used to contribute up to 7g of the manufacturer's specific emissions target.	
De minimis	Manufacturers responsible for fewer than 1,000 new cars and LCVs registered each year do not have a specific emissions target.	
'M_0 adjustment'	The average mass of the new vehicle fleet (referred to as M_0) is part of the formula used to calculate each manufacturer's CO_2 reduction target. From 2016 (2018 for LCVs) an adjusted M_0 will be used, which will be the average mass of the new vehicle fleet from 2011 to 2013 (2013 to 2015 for LCVs). A similar adjustment will subsequently occur every 3 years.	

Performance against the standards

The performance standards require that the fleet average CO_2 emissions were less than 130g CO_2/km by 2015 for passenger cars, and 175g CO_2/km for LCVs. The EU passenger and LCV fleet have overperformed against the standards, reaching an average of 119.5g CO_2/km for passenger cars, and 168.3g CO_2/km for LCVs, in 2015 (EEA, 2016). The 2015 limits were achieved two years early for passenger cars and four years early for LCVs; however, there is still significant work to be done to achieve the 2020 target of 95g CO_2/km for passenger cars and 147g CO_2/km for LCVs.

Table 4 Reported passenger car and van average CO_2 emissions for EU[11]

Year	Passenger cars		Vans	
	Average CO_2 emissions g CO_2/km	% change YOY	Average CO_2 emissions g CO_2/km	% change YOY
2009	145.7	-	-	-
2010	140.3	-3.7%	-	-
2011	135.7	-3.3%	-	-
2012	132.2	-2.6%	180.2	-
2013	126.7	-4.2%	173.3	-3.8%
2014	123.4	-2.6%	169.1	-2.4%
2015	119.5	-3.2%	168.3	-0.5%
2016	118.1	-1.2%	163.7	-2.7%
Total change	**-27.6**	**-18.9%**	**-16.5**	**-9.2%**

Historical evidence suggests that in the absence of regulatory measures, vehicle fuel economy remains static or can even worsen[12]. The Regulations are thought to have been responsible for around 65-85% of reductions in g CO_2/km seen in the car fleet between 2009 and 2015, with smaller contributions coming from national policy measures, residual impacts from the voluntary agreement, shifting consumer preferences and autonomous improvements[13].

Limitations to the approach

Traditional command-and-control regulations such as the CO_2 performance standards can play an important role in reducing emissions per kilometre driven[14]. Performance standards are expected to be effective as long as they are enforceable and controlled, and if penalties for non-compliance are higher than the corresponding compliance costs.

However, performance standards may not be effective in reducing absolute emissions from transport, since they do not regulate the total activity of the sector. In practice, real-world emission reductions have been lower than the corresponding improvements as measured by the performance standards (respectively about 1% per year since 2009, compared to 3.8% per year reduction in fleet average emissions[15]). There are several reasons for this:

- A growing discrepancy between test results and real-world emissions.
- Rebound effects (increased activity due to the reduced per unit cost).

[11] EEA, (2016). *Monitoring CO2 emissions from passenger cars and vans*. Retrieved on 14/03/2018 from https://www.eea.europa.eu/publications/co2-emissions-new-cars-and-vans-2016
[12] Ricardo, (2015). *Evaluation of Regulations 443/2009 and 510/2011 on CO2 emissions from light-duty vehicles*. Retrieved on 13/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/evaluation_ldv_co2_regs_en.pdf
[13] Ricardo, (2015). *Evaluation of Regulations 443/2009 and 510/2011 on CO2 emissions from light-duty vehicles*. Retrieved on 13/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/evaluation_ldv_co2_regs_en.pdf
[14] Creutzig, e. a., (2011). *Climate policies for road transport revisited (I): Evaluation of the current framework*. Energy Policy, May, 39(5), pp. 2396-2406
[15] ICCT, (2018). *The role of standards in reducing CO2 emissions from passenger cars in the EU*. Retrieved on 8/03/2018 from https://www.theicct.org/sites/default/files/publications/Role_of_EU-CO2_Standard_20180212.pdf

The discrepancy between the test results and real-world emissions has been well established in the literature[16, 17, 18]. The test procedure used to determine vehicle CO_2 emissions is susceptible to "gaming", where manufacturers optimise the vehicles for the test cycle rather than real-world driving conditions[19]. This highlights the importance of designing the test procedure for performance standards in a way that will closely mirror the real-world functioning of the object, in order to ensure that emission reductions remain in line with performance improvements as measured by the rule-making procedure.

In Europe, the previous test cycle has undergone revisions to improve the extent to which it reflects real-world performance. The new World-wide harmonised Light duty Test Cycle (WLTC) and Test Procedure (WLTP) is being phased in from 2017 to 2019. The average fleet emissions under the new test cycle are expected to increase by approximately 30%[20], and so the standards will continue to use the previous drive cycle values until 2020 inclusive. Standards set post-2020 will be based on WLTP figures, and reduce the discrepancy with real-world performance.

The improvements in fuel efficiency can also result in rebound effects, where consumers respond to lower fuel costs per vehicle kilometre travelled by increasing distance travelled. The existing literature does not suggest that the rebound effect is large enough to reverse energy efficiency gains; however, it does mean that the emissions savings associated with the Regulations would be lower than otherwise anticipated. Typically, the rebound effect for personal automotive transport is estimated to be between 10-30%[21]. The rebound effect applies to all types of energy efficiency across other sectors, and hence highlights the importance of also addressing demand-side issues through complementary measures such as taxes.

Performance standards are effective in incentivising manufacturers to meet the targets, but once they have done so there is little incentive to exceed them[22]. Comparatively, other pricing instruments continue to exert a consistent signal for further reductions, regardless of the current levels of performance.

Interaction with other policy objectives and measures at EU level

The European Commission's original strategy to address CO_2 emissions from cars aimed to address both supply (voluntary commitments) and demand (labelling and taxation). It was supported by three pillars: CO_2 performance standards for new cars, improved consumer information, and reforms to the system of vehicle taxes[23].

The first pillar began as a voluntary commitment by the car manufacturers to reach a target of 140g CO_2/km by 2008. Once it became clear that the manufacturers would not achieve this target, the European Commission pursued regulations that became the CO_2 performance standards.

[16] ICCT, (2018). *The role of standards in reducing CO2 emissions from passenger cars in the EU*. Retrieved on 8/03/2018 from https://www.theicct.org/sites/default/files/publications/Role_of_EU-CO2_Standard_20180212.pdf
[17] TNO, (2016). *Supporting analysis on real-world light-duty vehicle CO2 emissions*. Retrieved on 8/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/analysis_ldv_co2_emissions_en.pdf
[18] JRC, (2017). *From NEDC to WLTP: effect on the type-approval CO2 emissions of light-duty vehicles*. Retrieved on 8/03/2018 from http://publications.jrc.ec.europa.eu/repository/bitstream/JRC107662/kjna28724enn.pdf
[19] TNO, (2016). *Supporting analysis on real-world light-duty vehicle CO2 emissions*. Retrieved on 8/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/analysis_ldv_co2_emissions_en.pdf
[20] JRC, (2017). *From NEDC to WLTP: effect on the type-approval CO2 emissions of light-duty vehicles*. Retrieved on 8/03/2018 from http://publications.jrc.ec.europa.eu/repository/bitstream/JRC107662/kjna28724enn.pdf
[21] Ricardo, (2015). *Evaluation of Regulations 443/2009 and 510/2011 on CO2 emissions from light-duty vehicles*. Retrieved on 13/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/evaluation_ldv_co2_regs_en.pdf
[22] The Climate Reality Project, (2017). *Handbook on Carbon Pricing Instruments*. Retrieved on 17/03/2018 from https://www.climaterealityproject.org/sites/climaterealityproject.org/files/HandbookonCarbonFinancing_Final_May16.pdf
[23] European Commission, (1995). *Communication from the Commission to the Council and the European Parliament. A Community strategy to reduce CO2 emissions from passenger cars and improve fuel economy. COM(95) 689 final*. Retrieved on 07/03/2018 from http://aei.pitt.edu/4992/

The second pillar involved the creation of the labelling Directive 1999/94/EC which required manufacturers to make fuel economy and CO_2 emission data available to the consumer on new passenger cars. However, pressure from Member States resulted in the Commission allowing significant flexibility in the implementation of this measure. While the Directive was successful in ensuring labelling in all Member States, and indeed spurring the creation of similar schemes worldwide, the impact on new car CO_2 emissions varied, depending on the design of the labelling scheme and potential linking with other fiscal measures[24].

The third pillar aimed to address vehicle taxation differences between Member States to create a harmonised economic signal to reduce CO_2 emissions from passenger vehicles. However, tax policy is governed at Member State level and efforts to harmonise vehicle tax at an EU level have been unsuccessful[25]. As a result, each country has pursued its own vehicle tax scheme, and Member States with more progressive vehicle tax schemes have achieved much greater reductions in average vehicle CO_2 emissions. Countries such as Norway and Netherlands have significant vehicle taxes for less efficient vehicles, as well as subsidies for clean vehicles, which has resulted in a greater shift to lower emission vehicles compared to countries that have lower vehicle taxes with less differentiation by emissions[26, 27]. Clear taxation schemes are considered effective policies to address the demand side of the transport industry in conjunction with the standards which address the supply side.

Empirical evidence suggests that the combination of fiscal incentives with the standards is likely to have synergies – studies have found that countries that have reduced their CO_2 emissions above average were generally those which introduced a CO_2 component into their vehicle taxation systems. For example, the Netherlands have achieved an estimated 50% further reductions in average vehicle emissions from taxation policies and standards, compared to that achieved under the standards alone[28]. Evidence from a study on the vehicle taxation schemes in France, Germany, and Sweden find the same conclusion but to a lesser degree[29]. However, isolated tax strategies may reduce emissions in that country alone through changes to vehicle registrations, without encouraging the manufacturers to improve the vehicle design, while standards alone do not address the demand side of the industry.

Fuel consumption is directly linked with CO_2 emissions, and therefore fuel tax can also provide an effective economic signal. Directive 2003/95/EC sets minimum fuel excise duties for each fuel type at EU level. However, Member States can apply additional fuel taxes on top of this minimum, which results in large variations in fuel tax across the EU; for example, fuel tax in the Netherlands is over double that in Bulgaria[30]. Consumers who drive a vehicle with a lower CO_2 performance have lower fuel bills, however the strength of this economic signal depends on the relative cost of fuel (partially determined by fuel tax) compared to driving a more efficient vehicle, or compared to other types of transport. As with vehicle tax, if the cost of fuel is still sufficiently low, then it will not influence consumer choice[31].

[24] Ricardo, (2016). *Evaluation of Directive 1999/94/EC ("the car labelling Directive") Final Report*. Retrieved on 07/03/2018 from https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/labelling/docs/car_labelling_final_report20160728_en.pdf
[25] ICCT, (2018). *The role of standards in reducing CO2 emissions from passenger cars in the EU*. Retrieved on 8/03/2018 from https://www.theicct.org/sites/default/files/publications/Role_of_EU-CO2_Standard_20180212.pdf
[26] ICCT, (2018). *The role of standards in reducing CO2 emissions from passenger cars in the EU*. Retrieved on 8/03/2018 from https://www.theicct.org/sites/default/files/publications/Role_of_EU-CO2_Standard_20180212.pdf
[27] Transport & Environment, (2015). *Car tax regimes determine countries with lowest CO2 from new vehicle sales*. Retrieved on 08/03/2018 from https://www.transportenvironment.org/news/car-tax-regimes-determine-countries-lowest-co2-new-sales
[28] Kok, R., (2015). *Six years of CO2-based tax incentives for new passenger cars in The Netherlands: Impacts on purchasing behaviour trends and CO2 effectiveness*. Transportation Research Part A: Policy and Practice, Volume 77, pp. 137-153.
[29] Linn, T. K. a. J., (2012). *Using vehicle taxes to reduce carbon dioxide emissions rates of new passenger vehicles: Evidence from France, Germany, and Sweden*. Retrieved on 17/03/2018 from http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-12-34.pdf
[30] EEA, (2018). *Transport fuel prices and taxes*. Retrieved on 13/03/2018 from https://www.eea.europa.eu/data-and-maps/indicators/fuel-prices-and-taxes/assessment-7
[31] ICCT, (2018). *The role of standards in reducing CO2 emissions from passenger cars in the EU*. Retrieved on 8/03/2018 from https://www.theicct.org/sites/default/files/publications/Role_of_EU-CO2_Standard_20180212.pdf

There has also been discussion on including the transport sector in the EU's Emissions Trading System (ETS). This proposal has been opposed by some stakeholders, who claim that the carbon price required to deliver emission reductions in the transport sector is significantly higher than for other sectors[32], and as such the price signal from the ETS would be too weak to drive change. The ETS was designed for large emitters in unsheltered markets, while transport is a sheltered market with small emitters. The high abatement cost in transport could raise the carbon price under the ETS, and result in carbon leakage in other trade-exposed sectors covered by the system[33].

To conclude, non-market policies such as performance standards are likely to induce significant emission reductions[34, 35, 36]. However, they do not address any demand-side measures and hence do not cover all potential abatement options. Standards may be best pursued as a complimentary measure alongside market-based instruments. For example, effective structuring of vehicle taxation has been used to drive decarbonisation alongside the standards, as shown in countries like the Netherlands and Norway.

Key findings

This case study has explored the passenger car and van CO_2 emissions standards in the EU with the aims of assessing the effectiveness of standards as an economic signal, and the consistency with other policies in the area.

The EU's CO_2 performance standards for passenger cars and vans are widely considered to have been successful in terms of reducing carbon intensity in the transport sector (g CO_2/km), and are credited with being the main driving force behind the sector's improvements.

Design of appropriate measurements for performance standards is critical to ensure that they translate into overall emission reductions. Experience from the test procedure shows that it did not adequately reflect real-world driving conditions and hence there has been a discrepancy between theoretical fuel efficiency and the performance experienced by consumers. A new test procedure should help to address this problem in the future.

Non-market measures like performance standards are thought to be necessary in the transport sector, since the economic signal from emissions trading schemes covering multiple sectors (such as the EU ETS) would not be strong enough to induce technological change. This is because of the high marginal abatement costs in the transport sector, coupled with low elasticity of demand. This argument has been made against including the transport sector in the EU ETS.

Nevertheless, the standards do not address the demand-side aspect, and hence may be better combined with complementary and sector specific market-based measures. For example, countries where the standards are supported by effective fiscal incentives for purchase of low CO_2 vehicles have seen far greater technological change (such as the Netherlands and Norway). There are also possible rebound effects from changes in consumer behaviour, which need to be addressed through policies aimed at the demand side of the industry.

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