EPATEE

[The Netherlands] Purchase tax reduction for efficient passenger cars

(Vergroening aanschafbelasting personenauto's (bpm))

About the measure

Policy instrument	Sector	Starting date and status
fiscal (tax reduction)	**transport (passenger cars)**	**[2006] – [ongoing]**

- **Policy objectives**: reduction of CO_2 emission of new passenger cars by the measure 'CO_2 related greening' of the tax system for purchases of passenger cars.
- **Main stakeholders**: Ministry of Finance (as responsible ministry), Tax Office (Belastingdienst, as responsible department in the Finance Ministry), RVO (Netherlands Enterprise Agency, as administer of the measure)
- **How it works**: The purchase tax for passenger cars (bpm) was first partly based on the energy classes from July 2006 to December 2009. From January 2010, the bpm tax was shifted progressively to a CO_2-related basis. From 2013, the tax was fully based on the CO_2 emission of the car, as a fixed fee per gram of CO_2 per km driven, progressively divided in categories (of CO_2 emission). Using a bonus/malus approach, additional fees are applied to cars with emission beyond a given threshold, and electric cars are exempted. Tax rates are revised annually.
- **Policy theory**: The lower tax leads to a lower purchase price of low emission passenger cars, which is expected to lead to increased sale of those cars and simultaneously leads to decreased sales of cars with high emissions.
- **Scope of the fiscal measure**: the bpm tax applies to both private passenger cars and company cars (through leasing).

Expected energy savings in 2020	Benchmark
Next to the overall objective to reduce CO_2 emission for new cars (from 180 gram per km in 2000 to less than 95 gram per km in 2021), there is also an effect of fuel savings, leading to a corresponding fuel saving of about 50 % (see figure 1 below). Expected cumulative final energy savings over 2014-2020 for EED art. 7 from all measures to promote efficient cars were estimated to range between 16 and 28 PJ (Dutch notification for EED article 7, 2013).	Dutch target for EED art.7: 482 PJ of cumulative final energy savings over 2014-2020. So the expected results from the measures for efficient cars represented about 3 to 6% of the Dutch target. The share of energy consumption of passenger cars in the Netherlands as percentage of final energy consumption in the Netherlands is some 12 % (250 PJ/2000PJ).

About the expected fuel savings, note that actual fuel savings are lower than theoretical fuel savings (expected from the emission norm) as the norm relates to a test cycle (NEDC) that does not sufficiently reflect real driving conditions.

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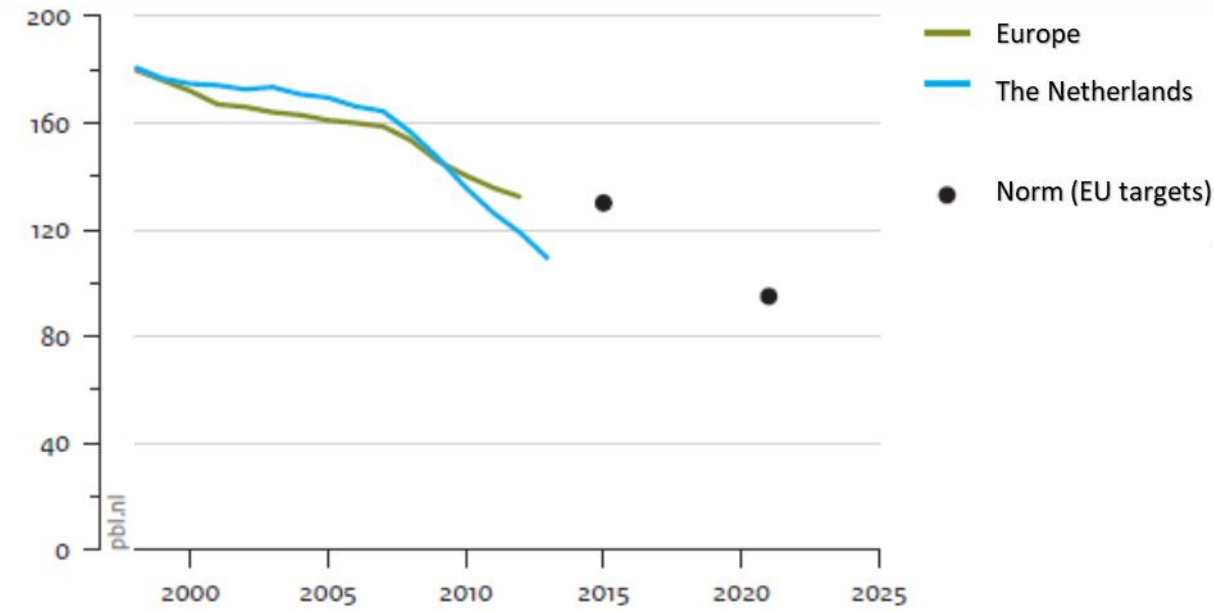


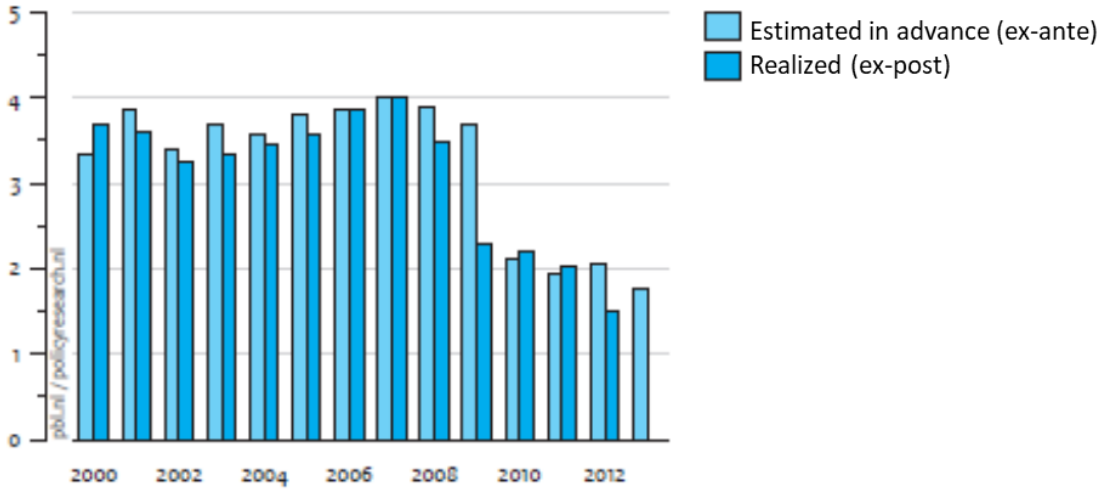
Source: Geilenkirchen, G. et al., 2014a.

Figure 1. CO_2 emission of new sold passenger cars in Europe and the Netherlands.

(about fiscal policies and trends in emissions of cars in Europe, see also Gerlagh et al., 2018)

Means and outputs

The public budget committed for this policy measure was provided as a fiscal tax measure, leading to an incentive, in the form of a reduction of the purchase tax for new cars with low CO_2 emission. The impact of this fiscal measure on the State budget depends on the distribution of the sales of new cars per category of CO_2 emission: sales of low emission cars lead to lower tax revenues, while sales of high emission cars lead to higher tax revenues.



Source: CBS, 2013

Figure 2. Revenue of purchase tax passenger cars (bpm), in billion euros (price level 2012).

In figure 2 above, the revenue of the purchase tax for passenger cars (bpm) is sketched, indicating the decline in revenue (both ex ante and ex post) after 2008, when the tax measure (which started in 2006

on a moderate scale) was intensified. We see an approximate 10^9 (billion) € less purchase tax income per year, as indication of the impact of the measure on State budget.

The decline in revenue of this tax measure leads to a tension by, on the one hand, the (government) desire of a tax measure that is stable and predictable and, on the other hand, the wish to stimulate the purchase of low CO_2 emission cars by an attractive incentive.

The bpm purchase tax involves on one hand the authorities (Ministry of Finance, directing the tax measure), various executing agencies (the Department of Transport: RDW, *Rijksdienst voor het Wegverkeer*) and on the other hand the millions of users (owners or leasers of passenger cars).

The bpm tax was first introduced in 2006, in the form of energy labels (figure 3). These labels are based on the fuel economy of cars, of comparable capacity and size. With these labels, potential buyers can easily distinguish car economy within one particular label class.

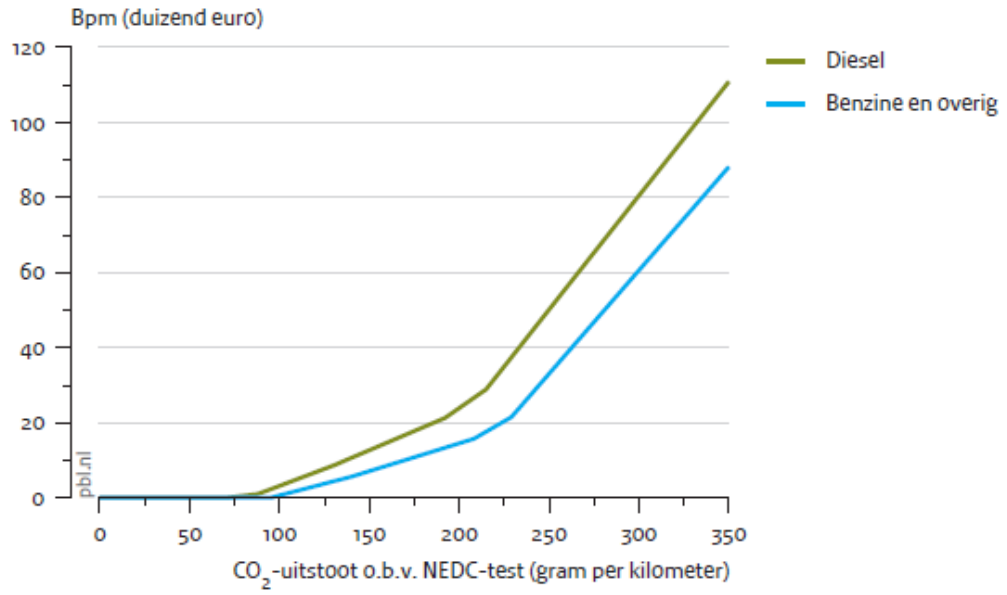
Energy label	A	B	C	D	E	F	G
Relative economy	>20 % more economical	10-20 % more economical	0-10 % more economical	0-10 % more uneconomical	10-20 % more uneconomical	20-30 % more uneconomical	>30 % more uneconomical
2006 untill 31-1-2008	discount of €1,000	discount of€500	€ 0	€ 135 addition	€ 270 addition	€ 405 addition	€ 540 addition
2008 untill 31-12-2009	discount of €1,400	discount of€ 700	€ 0	€ 400 addition	€ 800 addition	€ 1200 addition	€ 1600 addition

Source: Geilenkirchen, G. et al., 2014a.

Figure 3. Economy labels for passenger cars and corresponding reduction (label A,B) or addition (label E-G) in purchase tax.

After 2008 the tax measure was further intensified:

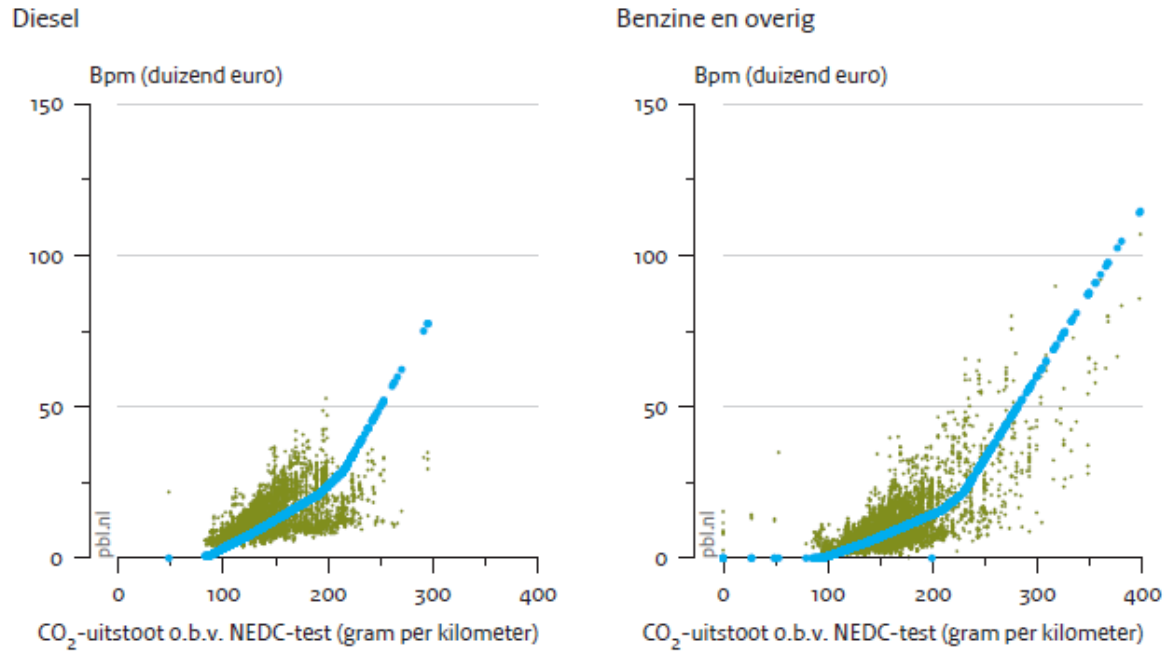
- In 2008 the purchase tax reduction for fuel efficient cars was further increased (see third row in figure 3).
- For fuel inefficient cars (label D-G) the addition to the purchase tax was further increased.
- For company cars, the increase in taxable income (for users of these cars) was differentiated to CO_2 emission.
- In 2009 an exemption of purchase tax for very low emission cars was introduced.
- From 2010 – 2013 the bpm system was gradually based on CO_2 emission of cars, thereby stimulating purchase of small and fuel efficient cars (figure 4). The figure shows the progressive character of the measure: a steeper curve at higher emission levels.



Source: Geilenkirchen, G. et al., 2014a..

Figure 4. Purchase tax (bpm, in thousand euros) and emission of cars (expressed as gram CO_2/km) for diesel cars (green) and gasoline/other fuels (blue)

As a result, the bpm tax based on CO_2 emission since 2010 is much more focused on the aim of lowering emission of CO_2 than in the old regime of the tax measure which was based on the purchase price of the car (the label system in figure 3). The difference in targeting CO_2 emission for the old regime and the new regime is given in figure 5.



Source: Geilenkirchen, G. et al., 2014a

Figure 5. Purchase tax passenger cars (bpm) based on purchase price of car (in thousand euros) and CO_2 emission (in gram CO_2/km) for diesel (left) and gasoline (right) cars

In the period 2010-2012, new passenger cars became 4-5 % more energy efficient, however also the car use for those new cars increased somewhat (a small rebound effect of more economic driving), leading to an overall 2% CO_2 reduction in this period. The overall CO_2 emission reduction of the total passenger car park in the 2010-2012 period is of course less than these percentages.

The bpm tax has contributed to CO_2 reduction of cars in the Netherlands. A side effect could be that it might lead to 'leaking' of CO_2 emissions to other countries with less stringent emissions, the 'waterbed effect': inefficient cars no longer sold in the Netherlands might be sold in another country with no disincentive on them. Another aspect is that cars with a low CO_2 emission profile may be exported, so that the low emission of these cars no longer attributes to the CO_2 emission in the Netherlands.

Data about energy savings

Unit	Main source of data
Intermediate indicator: average emission rate of new cars in gCO_2/km	PBL evaluation reports (Geilenkirchen, G. et al., 2014a; Geilenkirchen, G. et al., 2014b)

Note: this review of data on energy savings was done by ECN experts as a separate exercise, it was not part of the evaluation done by PBL; however this part was discussed with the author of PBL.

The main aim of the measure is the reduction of CO_2 emission of new passenger cars. Lower CO_2 emission per km comes from a lower fuel usage per km that results in fuel (and energy) savings. In case we consider a passenger car of the same weight (but with a less efficient car engine), the relative energy savings (in terms of fuel savings) will be the same as the relative savings in CO_2 emission. We will therefore use the CO_2 emission in g/km as an indirect measure of energy savings.

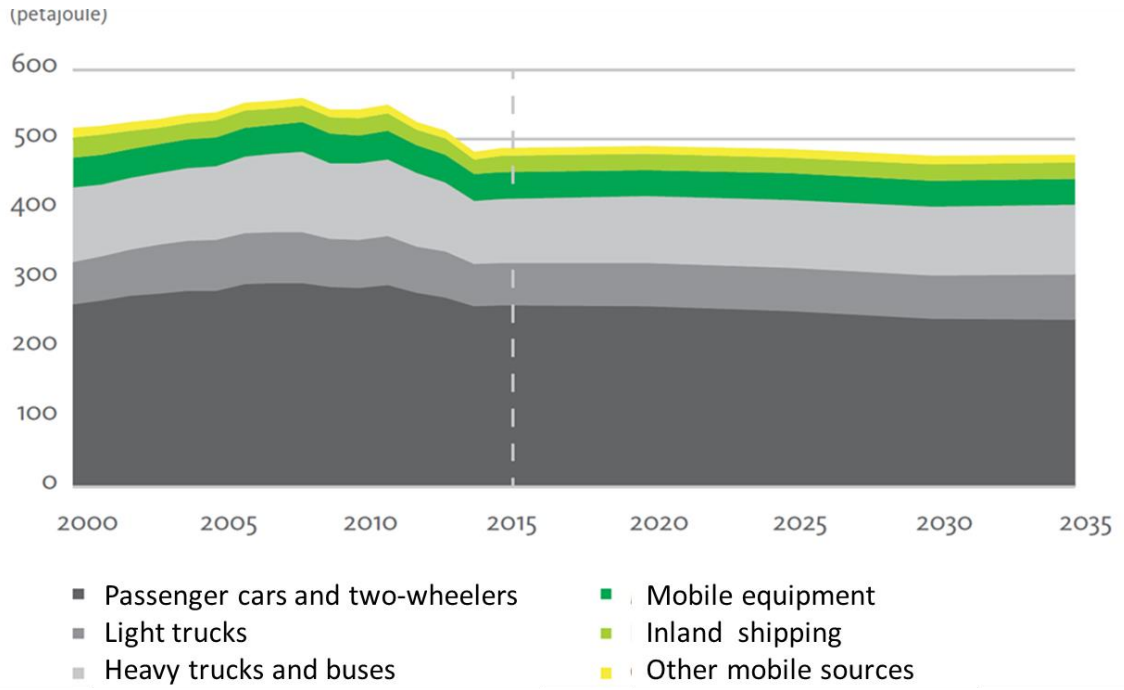
Figure 1 above shows that the CO_2-emissions of newly sold cars started to drop from about 2008 on, both in the Netherlands (blue line) and in the EU as a whole (green line). This trend of lower car CO_2 emissions resulted mainly from the implementation of European car CO_2 emission regulation, obliging car manufacturers to reduce the average CO_2-emission of their annually produced car fleets. Figure 1 shows that the average CO_2 emissions of newly sold car in the EU dropped at a rate of about 5,2 g/km per year.

However, the CO_2 emissions of Dutch cars declined even twice as fast, at a rate of even about 9,4 g/km per year. The net *additional* reduction in the Netherlands of about 4,2 g CO_2/km per year (9,4–5,2 = 4,2); see figure 1, resulted from the implementation of the above described new green vehicle tax regulations, favouring the sales of fuel efficient vehicles.

Net impact of the passenger purchase tax

If we consider the EU average drop in car CO_2 emissions (5,2 g/km per year) as a baseline, it follows that the additional annual drop of (9,4-5,2=) 4,2 g CO_2/km per year can be attributed to the impact of the new green vehicle tax regulations. Since the average fleet CO_2 emission in the targeted timeframe is in the order of 160 g CO_2/km per year, it follows that the additional drop of 4,2 g CO_2/km per year for the new vehicles corresponds to a decrease of about 2,6%.

The annual new sales roughly corresponds to about 1/12 of the total Dutch fleet. However, since more kilometers are driven in those new cars, the impact of the new cars will be larger. If we assume that new cars make 50% more km's, we may argue that the new cars in the fleet reduce CO_2 emissions and hence energy use by about 3,9% (The decrease of 2,6 % plus 50 % more driving in these cars).



Source: National Energy Outlook 2016. Figure 5.10 on page 151.

Figure 6. Energy use per transport mode (in PJ); future projections based on intended policies.

Figure 6 shows that the energy use of the passenger cars in the NL fleet in 2007 is about 286 PJ.

Consequently, as a first order estimate, it follows that the 2007 new green automotive tax system induced an ***additional annual energy saving*** in the Netherlands of about 11PJ for several years in a row (3,9 % of 286 PJ) (rough estimate cross-checked with PBL authors).

Sources of uncertainties about energy savings

Sources of uncertainty include:

- The uncertainty in the data for energy savings is in the estimate of total sold number of cars with the purchase tax advantage, and the total amount of km's driven by these new cars, the total amount of avoided CO2 emission of these cars and the related total avoided energy use (expressed as primary energy avoided)
- Sources of uncertainty include: data at CBS (the Dutch national statistics bureau), key data for modelling the changes in the stock of cars (see explanations below about the DYNAMO model)

Evaluation of the energy savings

Calculation method(s) and key methodological choices

- The calculation method used in this report is chosen based on data from the underlying evaluation report and in combination with data available from the National Energy Outlook (**deemed savings, method 3**).
- The baseline is the autonomous EU average CO_2 emission (type of "**control group**"), expressed in g CO_2/km of new passenger cars in the timeframe 2008-2012. See also figure 1 and 2 above.
- **Additionality** is thus assessed by **comparing the trends** in the average emission rates of new cars in the Netherlands and in Europe. It should be noted that the evaluation also included the use of **stock modelling** (**method 6**) with DYNAMO (Dynamic Automobile Market Model, see short description below) to assess the effects of the policy on the sales (and consequently stock) of cars.
- The evaluation published by PBL in 2014 (Geilenkirchen et al., 2014a and 2014b) also used an econometric analysis to investigate to what extent the tax measure stimulated the sale of clean and efficient cars (**causality**), and **leakage effects** (indirect impacts on car sales in other countries) (Geilenkirchen et al., 2014b). In parallel, test procedures were used to analyse fuel consumption and CO_2 emissions (**difference in test lab results vs. results in the field**) (Geilenkirchen et al., 2014a) (see *Focus on additional effects beyond lower emissions and energy savings*).

Ex-post verifications and evaluations

The ex-post evaluation as carried out by PBL is primarily based on national statistics about the sales and stock of cars (CBS, 2013). These data are the key inputs for DYNAMO, the model used to assess the effects of the tax measures on the sales and stock of car.

DYNAMO is a model developed by MuConsult (see MuConsult, 2013) that enables to analyse inflows and outflows of cars in the Dutch stock of cars. The main basis for the model is the statistics on car ownership of households (number of cars per household). A module of the model determines what type of car households will choose according to their income and car prices (economic modelling). The relationships between the market for new and second-hand cars are also included in the model. Two other modules deal with the renewal / aging of cars, and import / export flows. The model can also be used to evaluate the effects of the differentiation of the tax measure on the size and composition of the car flee (for more details see Meerkerk et al., 2014; and Geilenkirchen et al., 2014a).

In parallel, PBL has its own in-house model, KOTERPA (http://www.pbl.nl/sites/default/files/cms/publicaties/PBL_2014_KOTERPA_modelbeschrijving_1216.pdf). However, KOTERPA uses mostly static parameters to model the evolution of the stock (e.g., renewal rates to determine the outflow of cars from the stock are based on an assumption that historical trends will continue). DYNAMO was thus chosen for the evaluation due to its ability to determine the development of the stock of cars with more details and in a dynamic way. Still DYNAMO has also some limitations, for example to reflect developments such as increased export of recent diesel cars. KOTERPA is stronger on these points. Therefore combining the two models could be a way to improve the accuracy of the results.

The cost of this evaluation (ca. €100,000), as percentage of the total costs of the greening of the purchase tax system, is negligible.

Other indicators monitored and/or evaluated

Indicator	Explanations
CO_2 emission reduction	This indicator was used as primary indicator, as this was the main parameter of the measure and of the evaluation. This primary indicator was used to derive the corresponding energy savings.

Other aspects evaluated

PBL has also published an ex-ante study regarding the environmental aspects of the bpm fiscal measure. This study was completed in 2009 (Geilenkirchen et al., 2009).

Focus on additional effects beyond lower emissions and energy savings

The measure of incentivising purchase tax of passenger cars did stimulate the sale of CO_2 lean cars and thus contributed to lowering CO_2 emissions. It also led to energy savings, in comparison of absence of this measure.

It is to be expected that this measure did lead to free-rider behaviour (persons that anyhow would have purchased a low emission vehicle) and some rebound effect, which in the PBL publication is estimated at 10-30 %: a 10 % more efficient passenger car can lead to an increase in car use of 1-3 %. This assumption is based on Greening et al (2000): more fuel efficient cars, so lower costs of fuel may lead to some increased use of the car. About this issue see also (Su, 2011).

Other aspects that were evaluated include:

- The use of the purchase tax measure to stimulate the sale of clean and efficient cars.
- Leakage effects of the Dutch tax measure.
- Test procedures for analysing CO_2 emission (difference in test lab results vs. results in the field).

The two first effects (stimulation of the sale of clean cars and leakage effects) have been investigated in separate considerations about fiscal policy (Geilenkirchen et al., 2014b) and are a further elaboration of the greening of the fiscal system. For this, an econometric analysis, based on data from the finance ministry was used to quantify those effects.

About the third effect, the starting point is that CO_2 emissions of new cars are determined under a standardised test, the New European Driving Cycle (NEDC). Under these standardised test conditions, fuel usage and CO_2 emission are being measured. These test results are used in the calculation of the CO_2 emission factors (see figure 1) and are not representative (underestimate) of the emissions of the cars in daily practice (Geilenkirchen et al., 2014a). This issue is not specific to the Netherlands (see for example: Mock et al., 2013).

Experience feedback from stakeholders

Interview with Mr. Gerben Geilenkirchen (Evaluator at PBL, Dutch Environment Agency)

1. How do you see the value and role of evaluation of the purchase tax fiscal measure in the management of the scheme?

The evaluation by PBL was done on own initiative of PBL, with the aim to get a better insight in the effectiveness, opportunities and barriers of different policy instruments.

The value and role of the evaluation of the bpm fiscal measure was to get a better picture of the effectiveness of the fiscal measure. The primary impact of the fiscal measure is positive, the price elasticity (the variation in demand in response to a variation in price) is larger than 1.

However, the effectiveness of the measure in reality (emission of new cars in real life conditions) is lower than the effectiveness of the measure based on paper values (emission of new cars under standard test conditions). So in real life cars are much less economical (in terms of fuel savings) than on paper.

Despite the fact that real life fuel efficiency is lower, the extra investment in fuel efficiency of the car is paid back easily. However, the government pays most of this additional investment, whereas the car owner payed a minor part.

2. What were the main lessons learnt from the evaluations (about the impacts of the scheme and what could be improved)?

The measure is quite effective from the standpoint of the Dutch government. However, car companies may choose to sell more fuel efficient cars in the Netherlands (because of the favourable market conditions with the reduced purchase tax) and sell less of these fuel efficient cars in other European countries, initiating a "waterbed" effect. This is possible since manufacturers have to meet an EU wide efficiency target (rather than national targets).

3. What were the lessons learnt in terms of evaluation practices?

Controlling CO_2 reduction with the fiscal measure of CO_2 differentiated purchase tax (bpm) is effective, as long as boundary conditions (such as the waterbed effect) are known and can be managed. Another lesson is the fact that the bpm measure was an open ended measure for a 4 year period. This means there is no limit to the financial scope of the measure (as opposed to e.g. a subsidy measure).

4. In parallel of the ex-post evaluations, are there other evaluations or studies that provided insights about the impacts of the scheme and/or possible interactions with other policies or drivers (or barriers) for energy efficiency?

PBL also carried out an ex-ante evaluation of the purchase tax measure. Also, The Dutch Court of Auditors (Rekenkamer) has reported on the purchase tax measure.

5. What would you like to highlight about your experience related to the evaluations of the scheme?

The main highlight is the fact that the ex-ante evaluation was based on paper data (values derived under specified test conditions) and the ex-post evaluation was based on actual emission measurements. This results in a difference of 10-20 %.

To go further

About the measure

- Description in the MURE database: http://www.measures-odyssee-mure.eu/public/mure_pdf/transport/NLD27.PDF
- Description in NEEAP 2014 (pp.54-55 of the English version): https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive/national-energy-efficiency-action-plans
- Dutch notification for EED article 7 (2013, English version): https://ec.europa.eu/energy/sites/ener/files/documents/article7_en_netherlands.pdf
- Webpage of the Dutch government dedicated to taxes on cars (in Dutch): https://www.rijksoverheid.nl/onderwerpen/belastingen-op-auto-en-motor

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