No regrets

The cost effectiveness of achieving 120 g/km average CO_2 emissions from new cars in Europe by 2012

A note from Transport and Environment (T&E) for CARS21 WP on Integrated Approach

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Introduction

The objective of this paper is to arrive at an assessment of the cost effectiveness of more fuel efficient cars. More specifically, the paper assesses upfront technological costs and paybacks in fuel savings resulting from technical measures necessary to achieve the long-standing objective of 120 grams of CO_2 emissions per kilometre for new cars sold in the EU by 2010 at the latest.

Such an assessment is important as in late 2005 and early 2006 the European Commission is to present a strategy to follow up the voluntary commitment of the European, Japanese and Korean car manufacturers' associations ACEA, JAMA and KAMA. The organisations have pledged to achieve 140 grams of CO_2 as an average for their new vehicles by 2008 (ACEA) and 2009 (JAMA/KAMA) respectively. However, this effort falls short of achieving the long-standing Community target of 120 g/km CO_2 emissions by 2010 at the latest, as was established by the conclusions of the June 1996 Council and endorsed on numerous occasions ever since. The 120 g/km objective is currently under discussion in the CARS21 group and in the European Commission's inter-service policy preparation process.

The paper is built up as follows:

- The paper starts with an introduction of the climate and energy context of the policy.
- Then, the upfront technological costs of more efficient vehicles are estimated
- Subsequently, the fuel savings are estimated
- Finally, a socio-economic cost effectiveness assessment is made under several fuel price scenarios and conclusions are being drawn from the analysis

Climate and energy policy context

First, more fuel efficient cars are an important element in the EU's climate policy, as CO_2 emissions and fossil fuel consumption are inextricably linked.
Fears are mounting that the EU will be unable to live up to its commitments under the Kyoto Protocol. The then 15 EU Member States pledged to cut their emissions by 8 per cent between 1990 and 2008/12, but by 2003 only 1.7% reduction had been achieved – with a worrying 1.3 % rise in 2003 (EEA).
In addition, European Heads of State expressed at their 2005 Spring Summit the ambition to limit climate change to 2 degrees compared with pre-industrial levels, and stated that this would necessitate to look at 15-30% reduction of greenhouse gas emissions by 2020 compared with 1990 levels.
By contrast, the transport sector has been consistently seen emission rises rather than cuts. In 2001, passenger cars and vans were responsible for approximately 15 per cent of the EU's reported greenhouse gas emissions, or some 720 MT of CO_2

equivalents[1]. Despite the voluntary commitments of the industry, total passenger car CO_2 emissions in the EU have been rising by on average 1 per cent per year. This is due to the ever-increasing number and mileage of cars, but also to the fact that measured CO_2 emissions do not correspond with real-life CO_2 emissions, for example by the exclusion of emissions from mobile air conditioners from the test.

Non-achievement of climate objectives does not only accelerate climate change but also gives a serious blow to the credibility of the EU's leadership role in climate change. Achieving domestic objectives can be considered a minimum prerequisite for acting credibly in the global arena.

Second, the oil market situation is clearly worrying. Demand is rising, which the supply cannot match, resulting in prices reaching $70 a barrel (September 2005).
Oil will not run out quickly, but cheap and relatively 'clean' oil probably will. We will soon be facing a transition to so-called 'unconventional' oil (tar sands, oil shale) that takes a lot of energy (and CO_2!) to extract and is much more costly than the conventional oil we are currently using. In addition, the geographic concentration of oil reserves gives rise to concern – by 2020 the EU will have to import 86% of its oil.

So far, the strong euro has so far helped Europe somewhat to escape the worst impacts. If the euro were weaker, $65 a barrel of oil would not translate into today's €55 but rather into €80. Nevertheless, at today's price, the amount of oil needed to propel just the EU's cars and vans (not to mention lorries, ships and aircraft) pushes up the EU's oil import needs by some €85bn a year, close to 1 per cent of the EU's GDP. Moving to 120 instead of the current 163g/km, would on the longer term shave off a quarter of these recurring costs.

The high prices are generally considered to stay. In a dramatic policy shift, the IEA has called on western governments to intensify energy conservation and efficiency efforts as a vital part of protecting energy security.
Finally, international developments also force the EU to act. China has introduced fuel economy limits, the second phase of which will seriously affect a range of models offered on the Chinese market. Introducing more advanced fuel-saving technologies will help manufacturers to offer a broad range of products on this very promising market.

Choice for socio-economic cost assessment

It is very important to precisely define what type of costs and benefits we are talking about. There is often confusion as to whether costs apply to consumers, the industry, or even to other stakeholders. In this paper, we choose to work with costs and benefits to society as a whole (i.e. *socio-economic* costs and benefits). For public policy purposes, this is generally acknowledged by economists to be the most relevant type of cost because it includes costs and benefits to all relevant actors, and excludes charges and taxes from the costs. Charges and taxes are in macro-economic terms not costs but rather transactions. So the talk in this paper is about *pre-tax* vehicle and fuel prices.

The costs of achieving the 120 g/km target

Over the last years, strings of reports have been published on the costs of fuel-saving technologies, some of which specifically focused on the 120 g/km target. See the reference list at the end of this paper.

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[1] Based on (EEA, 2005), (EC 2003), and EEA fact sheets on energy use and greenhouse gas emissions in transport

By far the most comprehensive study on the topic yet is the IEEP/TNO/CAIR study. This study is the most comprehensive because it assesses and synthesises all previous studies on the topic so far, notably Ricardo (2003), DLR (2003), JRC (2002) and ADL (2003).

In addition, the study is the only one to recognise the importance of *policy options,* in particular the importance of *flexibility* (i.e. size of the 'regulated entity') in the policy options, and this in relation to the costs.

- Three degrees of flexibility in the regulation:
  1. inflexible – 'regulated entity' is the individual CAR: every individual car must meet the standard
  2. semi-flexible: 'regulated entity' is the MANUFACTURER: annual production of every individual manufacturer must on average meet the standard (i.e. compensation between models)
  3. fully flexible: 'regulated entity' is ALL MANUFACTURERS, the annual production of all manufacturers must on average meet the standard. Consequently, this option allows trading of CO_2 performance credits between manufacturers.
- Three types of CO_2 targets (that all lead to 120 g/km average CO_2 emission from vehicles sold in 2012)
  a. 'Same Improvement': every 'regulated entity' must achieve a certain % of improvement in CO_2/km per year;
  b. 'Relative Target': Every 'regulated entity' must achieve a certain CO_2 performance depending on its 'utility' (which could, for example, be expressed in terms of size of the car);
  c. 'Absolute target': Every 'regulated entity' must achieve the '120' standard.

Note that the US CAFÉ system is a type 2c regulation; the recent Chinese fuel economy regulations are type 1b, and the scheme as proposed by the Californian legislature type 3c.

The cost conclusions can be summarised below.

Table 1: Overview of *manufacturers' costs* of achieving the '120' target, starting from '140', in €/vehicle sold in 2012, per type of target and per choice of regulated entity

	Type of target		
Flexibility (Regulated entity)	**a** % improvement	**b** relative target	**c** absolute target
1 every car	591	741	987
2 manufacturer's average	580	605-635	700
3 fleet average	577	577	577

The main conclusion from this table is that achieving the 120 g/km objective would, if one of the cheapest policy options are selected, cost less than €600 per vehicle.

Costs are probably overestimated

In addition, there are a couple of reasons why it is likely that the mentioned €577 per vehicle is an overestimation of costs.

The first, and most important, reason is that the history of environmental policy clearly shows that ex-ante cost estimates of technologies that were later introduced at mass scale were usually grossly overestimated. The three-way catalyst needed to achieve ‘Euro 1’ standards was estimated to costs €700 or more in the early 90s. However, at this moment the actual price for a ‘Euro 4’ catalyst is mostly lower than €100 (AEAT 2004). Inflation is even left out of these figures. It is therefore safe to say that costs were overestimated by one order of magnitude.

As the IEEP/TNO/CAIR study puts it: *Costs of CO_2 reduction measures as used in the cost curves are assumed not to change over time, and are based on current cost estimates, assumed to be valid for mature technologies produced in sufficiently large quantities. This is due to modelling requirements and in order to have numbers that are on the conservative side'* (p114). A quote from p106 shows that this leads to severe overestimations: *'The history of procurement regimes managed by the vehicle manufacturers suggest year-on-year cost reduction of CO_2-saving technologies is not only possible, it is mandatory. Usually such reductions (say 5% per annum) are built into contracts for suppliers to the vehicle manufacturers, often there are additional ‘campaigns’ in times of crisis that seek far more aggressive savings of 10-15% in a one-off gain*.’

Secondly, the study chose a conservative factor to translate retail prices into manufacturer costs. *‘As this factor is lower than the often quoted rule of thumb of 2.5 to 3, this also causes the cost estimates to be on the conservative (i.e. high) side’ (p115).*

Thirdly, the report does not deal with ‘downsizing’ consumer choice, i.e. that CO_2 policy for cars might actually lead to some people buying cars with smaller engines or somewhat smaller cars. Obviously, omitting possible consumer reactions to CO_2 policy leads to an overestimation of the costs.

Benefits: fuel savings

Obviously, a move towards more fuel efficient vehicles does not just lead to costs, but also to benefits in terms of fuel savings. In fact, the balance of upfront investment costs and benefits from energy saving is the cornerstone of energy conservation policy in general.

It should be observed that the benefits of fuel savings are not just fuel costs. They extend further. Oil dependence leads to costs of macro-economic shocks when the price changes. Oil consumption leads to external effects such as CO_2 and other emissions. The other way round: more fuel efficient vehicles require less costly catalysts in order to comply with emission laws. These ancillary benefits of reduced oil consumption are NOT taken into account in this analysis.

Obviously the assumptions on fuel prices heavily influence the outcome. Therefore we chose to work with a scenario with high and low fuel prices.
The low scenario assumes pre-tax fuel prices of €0.40/l of petrol or diesel, the high scenario assumes pre-tax prices of €0.60/l of petrol and diesel. These figures correspond with oil prices of roughly €36 to €60 per barrel. As already said earlier, the relatively strong euro has so far offered some shelter for the EU from the high oil prices. A weaker euro could further inflate fuel prices from today’s levels.

Petrol cars are assumed to last 200,000 km, diesel cars 250,000. Both petrol and diesel cars are assumed to last 14 years and their annual mileage is assumed to decrease linearly from 160 to 40 per cent of average annual mileage over their lifetime.
The discount rate for future fuel savings is set at 3 per cent.
Fuel savings per km as a result of moving from 140 to 120 g/km are calculated to be 8.5 litres per 1,000 km for petrol cars and 7.6 litres per 1,000 km for diesel cars.

These values are calculated by dividing the 20 grams (140g-120g) difference by the CO_2 emissions resulting from burning a litre of petrol and diesel fuel (2,340 and 2,620 grams respectively).

The results of this analysis are that

- In the low fuel price scenario, discounted pre-tax fuel savings are €591 and €660 per petrol and diesel car, respectively. Assuming a 50/50 spit between petrol and diesel car sales yields €625 of savings per car.
- In the high fuel price scenario, discounted pre-tax fuel savings are €886 and €990 per petrol per and diesel car, respectively, or some €940 per car on average.

For the *consumer*, fuel savings are two to three times higher than these amounts, because from the consumer point of view the taxes on fuel are relevant too.

Cost/benefit assessment

The previous chapter showed that the extra technology costs per car were €577 on average.
Comparing these costs and the fuel saving benefits leads to the conclusion that in both the low and high fuel price scenarios, discounted lifetime fuel savings exceed the upfront investment in advanced technology, with a margin of some €50 and €360 per car. In other words: the net costs are negative.

Given these results, we performed an additional analysis with fuel prices of just €0.30 per litre, about half of today's. We found that this scenario leads to approx. €150 additional net costs per vehicle, which translates into abatement costs of €30 per tonne of CO_2, close to the price observed in the EU ETS today and which is certainly not expensive compared with other climate measures the EU has implemented.

The cost/benefit ratio calculated here is a conservative one (i.e. pessimistic), for the following reasons:

- Vehicle technology cost are highly likely to be overestimated;
- Ancillary benefits of fuel savings are not taken into account.

Note that from the perspective of the consumer rather than that of society, the equation is likely to be even more positive as fuel savings INCLUDING taxes are two to three times the amounts calculated in this paper.

Conclusion

The conclusion of this overall cost/benefit analysis of achieving the 120g/km target for CO_2 emissions from new cars through technological means (i.e. better fuel efficiency) is that it is, from an economic point of view, a 'no regret' measure of climate policy. The benefits from fuel savings are very likely to exceed the costs of better technology.

Even in the case where the cost figures we used were NOT overestimations (although there are several important reasons to suspect they were), even at pre-tax fuel prices of €0.40 per litre which is one third below today's level, and even if environmental benefits are not given an economic value, the benefits of the '120' objective through fuel savings exceed its costs.

Recommendations for next steps

The conclusions of this analysis implies that achieving the 120g/km objective through technical means is a measure that, for its economic merit alone, deserves to be part of any climate policy mix, regardless of what other measures may be under consideration. Other potential measures to reduce CO_2 emissions from transport, as considered in a so-called ‘integrated approach’, should therefore come *on top* rather than *instead of* technological measures to achieve the ‘120’ objective.

An additional big advantage of the technological measures is that the performance is *measurable* and specific stakeholders can be held *accountable*, in contrast with many other measures as considered in the ‘integrated approach’ such as fuel efficient driving, improving traffic flow, and the like.

The demonstrated economic attractiveness does, however, NOT imply that the ‘120’ objective will be reached without regulatory intervention. The reason for this is that costs and benefits do not accrue to the same stakeholders.

In addition, the comparative analysis of the policy options shows that the design of the regulation that is chosen to implement this measure is important too, for both the distribution and the level of costs.

Finally, as both the climate and the industry require long-term policies, an outlook for the post-2012 period is badly needed. A gradual downward path (120 by 2012, 100 by 2016, and 80 by 2020) would provide the desired regulatory stability for the next 15 years, give manufacturers the opportunity to optimise their technologies and get the costs down. Stabilising the climate, securing Europe’ energy future, and introducing regulatory stability are two reasons important enough to pursue this line.

References

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