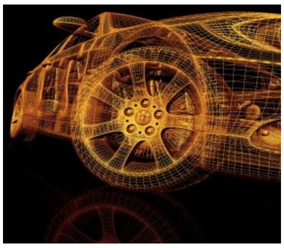
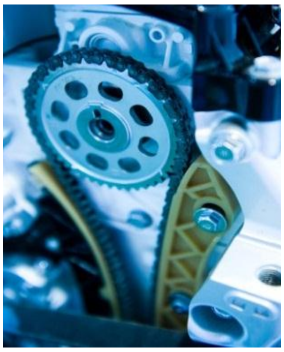
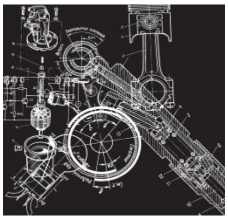
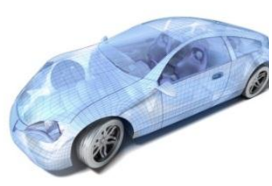
Low Emission Car Measures Under the EU's CO2 Regulations for Passenger Cars

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1 Introduction

1.1 Policy context

Passenger cars and vans together account for more than half of total greenhouse gas (GHG) emissions from the transport sector in Europe. While GHG emissions from other sectors are generally falling, those from transport have increased by 23% since 1990. In response, the European Union has implemented regulations to reduce CO_2 emissions from cars and vans.

The European Union first introduced mandatory CO_2 standards for new passenger cars in 2009 (Reg (EC) 443/2009). The car CO_2 regulations set a target of 130 g/km for the fleet average of all new cars in 2015 and a further indicative target of 95 g/km in 2020. In mid-2012 the European Commission proposed a review of the regulation in order to confirm the level of the 2020 target for new cars, and also to define the modalities for reaching this target (EC, 2012). This proposal has confirmed the 95 g/km value but has also reintroduced supercredits – previously included in the regulations as a system designed to help accelerate the early uptake of ultra-low emission vehicles (ULEV). This system of supercredits is phased out in the current regulations after 2015 (EU, 2009).

Under the current proposals the car CO_2 regulation requires on average cars sold in 2020 to achieve emissions of 95 g/km and sets individual carmakers a target based upon the average weight of the cars sold. Supercredits earn manufacturers additional emissions credits for every ultra-low emission vehicle they sell. ULEVs are defined in the Commission's proposal as vehicles with emissions below 35 g/km and the number of vehicles qualifying for supercredits is capped to 20,000 per manufacturer.

Discussion on the proposals is currently on-going and since the Commission proposal was originally published, there have been a range of alternative proposals/amendments put forward by various parties in relation to providing incentives for increased rates of ULEV uptake (EP 2013), (EP 2013a), (EP 2013b), (EP 2013c), (EP 2013d), (EP, 2013e), (EP, 2013f). A wide range of organisations, including environmental and consumer groups, have expressed concerns that supercredit based systems have the potential to significantly undermine the 2020 target for new car CO_2 emissions of 95 g/km. T&E has previously advocated the use of a flexible mandate for the introduction of ULEVs instead of a supercredit based-system (for which there have been various different designs proposed by other parties) (T&E, 2012).

1.2 Study objectives

Given the current policy context, Ricardo-AEA have been commissioned to carry out a piece of research to explore the impacts of different systems that are supposed to incentivise more rapid uptake of ULEVs, according to their proponents, to better understand their potential impacts in a range of areas. In particular three main areas that have been explored as part of this study:

1) Analysis of the impacts (on actual CO_2 emissions achieved and additional manufacturing costs) of the following **supercredit** design options, depending on take-up of ULEVs:
    a. Qualifying thresholds used to define ULEVs (in gCO_2/km).
    b. Caps in the numbers of qualifying vehicles.
    c. Annual or cumulative credits.
    d. The multipliers applied for supercredits.
    e. Different uptake scenarios for ULEVs in 2020.

2) Analysis of the impacts (on actual CO_2 emissions achieved and additional manufacturing costs) of the following **flexible mandate** design options, depending on take-up of ULEVs:
    a. Qualifying thresholds used to define an ULEV (in gCO_2/km).
    b. Central, lower and upper thresholds/targets for % sales of ULEV.
3) Analysis of the wider EU-wide impacts of the different supercredit or flexible mandate options in comparison with those for the Commission's proposal (EC 2012, EC 2012a, EC 2012b) in terms of estimations of:
    a. Average new car gCO_2/km in 2020.
    b. Total car fleet CO_2 emissions in 2020 and 2030.
    c. Typical fuel costs over the lifetime of the vehicle produced in 2020 and 2030, and average annual fuel costs for the whole EU car fleet in 2020 and 2030.
    d. The level and cost of oil imports in 2020 and 2030.

The analysis outlined above and presented in the later sections of this report has been quantified using predominantly publically available data sources through a limited range of sensitivities around different combinations of the key design parameters. The objective was to clearly show the potential impacts of different proposals and general design choices in the highlighted areas.

Ricardo-AEA is an independent consultant and has acted in this capacity to directly address Greenpeace and T&E's research analysis areas. Ricardo-AEA's results are impartial findings based on the available data.

2 Analysis of the potential impacts of different options for ULEV incentives

2.1 Study approach

Assessing and comparing the potential impacts of the various proposals for ULEV incentives is relatively complicated. This is due to both significant variations in their design and in attempting to predict the likely knock-on impacts in terms of manufacturer strategies for deploying technology into the new car fleet in order to ensure they complying with the regulations – and in turn the consumer response to these.

In order to carry out the assessment Ricardo-AEA developed a MS Excel-based calculation framework for assessing the potential impact of different supercredit and flexible mandate design options / proposals in terms of their impact on average new car CO_2 and estimating the resulting average marginal manufacturing costs.

A range of assumptions were used to develop the analysis framework and in the sensitivity analysis. Some of the key assumptions are summarised below, with further information on the methodological basis and other key assumptions used in the analysis provided in Appendix 1:

- The implications of different ULEV incentive system designs / proposals was explored for a range of alternate scenario trajectories based on the % sales of advanced EVs by 2020 (and beyond). These are further detailed in the next section (2.1.1).
- The default assumption for the composition of advanced (plug-in) EV sales is for a 1:1:1 ratio for PHEVs:REEVs:BEVs. (For simplicity, FCEVs are omitted since their effect on the effective CO_2 target is similar to BEVs).
- The breakdown of new car sales, by weight category and fuel type, was based on the 2010 car CO_2 monitoring database (EEA, 2012). A summary of this distribution is provided in Figure 2-1 below. This distribution was utilised in order to assess the potential numbers of qualifying vehicles of different powertrain types where these are not zero emission vehicles – which would always qualify irrespective of their weight – (i.e. HEVs, PHEVs and REEVs may all potentially qualify).
- The default assumption in the calculation of the basis of credits (in gCO_2/km) given to qualifying ULEVs is a weighted average based on the technology mix of qualifying vehicles (i.e. by powertrain/fuel type) and their respective gCO_2/km performance.
- No further targets are assumed beyond 2020. However, it is assumed that average new car fuel consumption/gCO_2 per km will continue improve at a minimum of 0.5% per annum after 2020, irrespective of mandatory requirements for CO_2 reductions.
- For proposals where banking of supercredits in the 2016-2019/2020 period is allowed, the assumed rate of use of supercredits from 2020 onwards is provided in Table 2-1.

Outputs from the calculation frameworks (e.g. vehicle efficiency by fuel/powertrain type) were fed into the SULTAN illustrative scenarios tool (AEA, 2012)[1] in order to estimate the wider EU impacts in terms of overall CO_2 emissions, energy consumption and fuel costs from the

[1] SULTAN is a transport policy scenario scoping tool that allows the exploration of impacts for the EU as a whole resulting from different GHG reduction measures for a range of transport modes. The SULTAN tool was developed and made publicly available as part of contract dated 16 December 2010 (contract 070307/2010/579469/SER/C2) between European Commission DG Climate Action and AEA Technology plc. More information is available on the EU Transport GHG: Routes to 2050 project website at: http://www.eutransportghg2050.eu

EU car fleet to 2030. The SULTAN tool was set up to be broadly consistent with the key assumptions used in the modelling analysis carried out for the European Commission's impact assessment for the car CO_2 regulation proposals (EC, 2012a) – including projected changes in activity/stock and energy prices.

Figure 2-1: Distribution of car sales by weight category in 2010

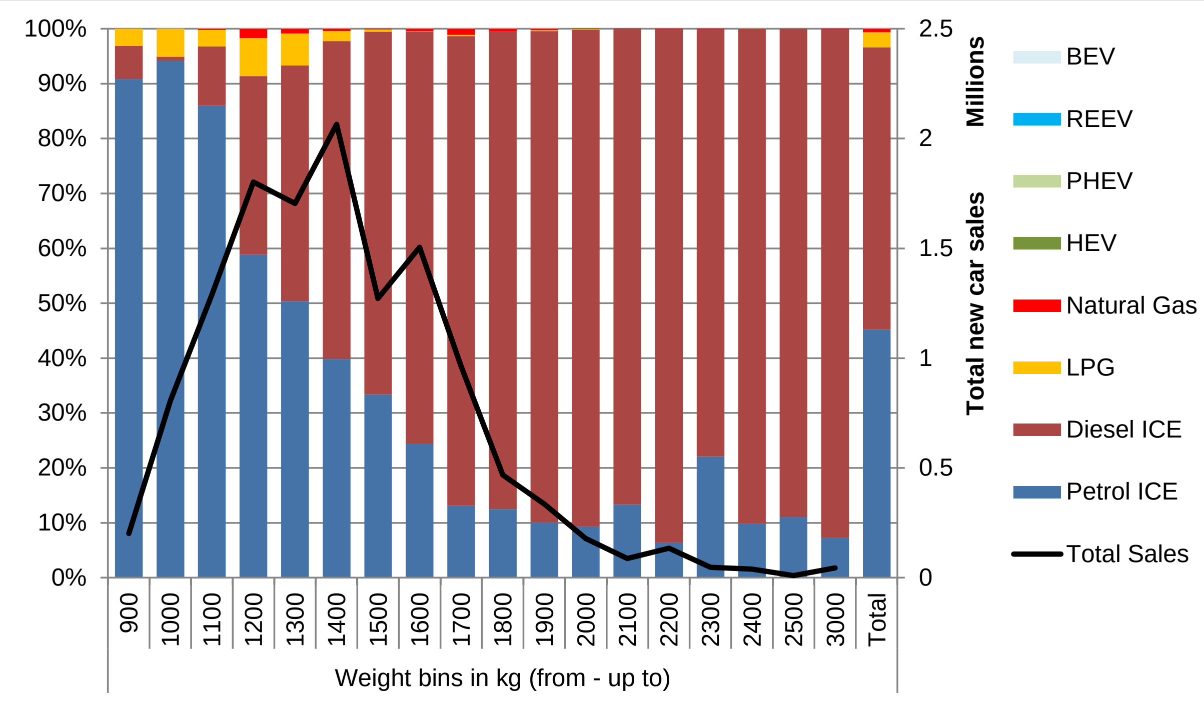


Table 2-1: Summary of the assumed rate of use of supercredits from 2020 onwards used in the analysis of proposals and sensitivities including supercredit banking

	Percentage of banked supercredits to be used in year		
Supercredit usage period	**4 (2023)**	**4 (VDA*) (2023)**	**6 (2025)**
2020	40%	15%	40%
2021	30%	40%	25%
2022	20%	30%	20%
2024	10%	15%	10%
2025			4%
2026			1%
	100%	**100%**	**100%**

Notes: * Only applies for the VDA proposal: since the supercredit multiplier of 2.5 is particularly high and runs throughout the period from 2016-2020, and the qualifying threshold is relatively high, a particularly large amount of credits are accumulated by 2020. As a result, when the supercredits run out (i.e. reduces to 1) immediately after 2020 under this proposal, it makes sense to reserve most of the banked supercredits for the years following this in order to achieve a smoother transition to 95g/km by 2024. See Appendix 2 for further details on the basis of different proposals.

2.1.1 Advanced EV deployment scenarios

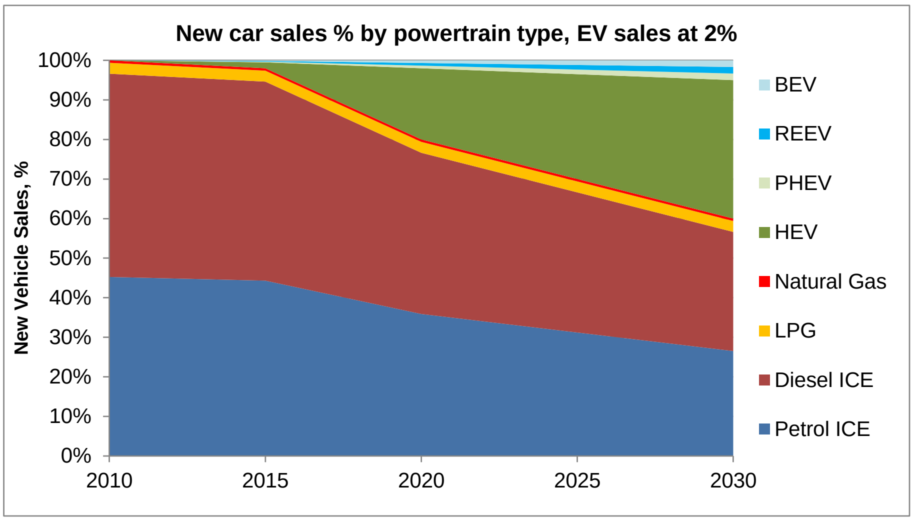
The impact of different ULEV incentive systems in terms of the effective gCO_2 per km target for new cars from 2020 will be highly dependent on the sales of advanced EVs (and also their exact technology shares within advanced EVs). For the purposes of the sensitivity analysis a range of EV deployment scenarios were used, representing the lower to upper estimates for 2020 EV sales. As already indicated it is assumed that these sales of EVs are equally distributed between PHEVs, REEVs and BEVs. Since under some of the proposed amendments there is the potential for smaller full HEVs to also qualify for supercredits (i.e. those proposals with higher qualification thresholds), it was also important to provide for a share of such HEVs in these trajectories.

In order to maintain some level of consistency between the different EV deployment scenarios, it was assumed there would be a share constraint – i.e. that the total share of EVs + full HEVs was consistent for a given year. The exception is for the highest EV deployment scenario (based on stated national targets/objectives; EC, 2013), which includes a more significant early deployment of EVs and HEVs. This is also the basis of the Commission's proposal on minimum infrastructure rollout (EC, 2013a). The basis/design of these scenarios is summarised in the following Table 2-2 and in Figure 2-2.

Table 2-2: Summary of EV deployment scenarios used in the analysis

Plug-in EVs	**2% Sales**		**5% Sales**		**10% Sales**			**14.6% Sales**		
	%EV	%HEV	%EV	%HEV	%EV	%HEV	**Total**	%EV	%HEV	**Total**
2015	0.50%	1.5%	0.50%	1.5%	0.50%	1.5%	**2.0%**	5.00%	5.0%	**10.0%**
2020	2.0%	18.0%	5.0%	15.0%	10.0%	10.0%	**20.0%**	14.6%	5.4%	**20.0%**
2025	3.5%	26.5%	9.5%	20.5%	19.5%	10.5%	**30.0%**	24.2%	5.8%	**30.0%**
2030	5.0%	35.0%	14.0%	26.0%	29.0%	11.0%	**40.0%**	33.8%	6.2%	**40.0%**

Figure 2-2: Summary of EV deployment scenarios used in the analysis



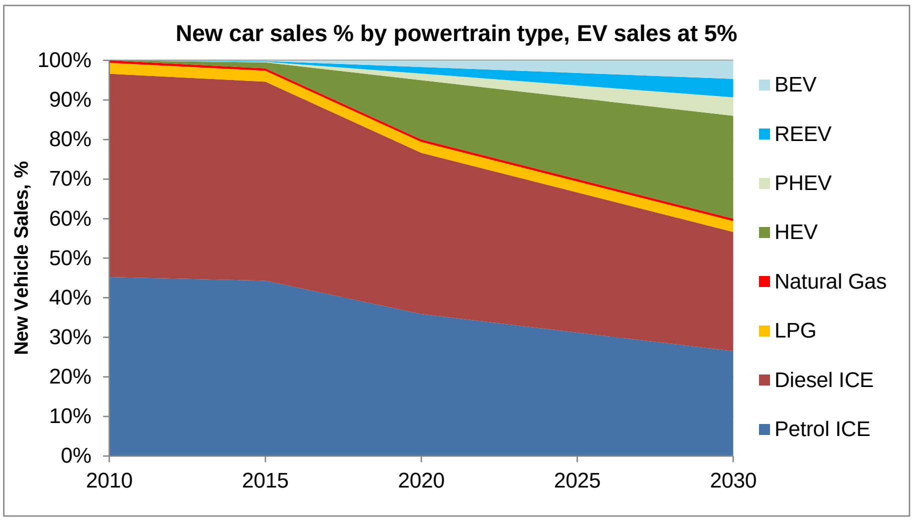
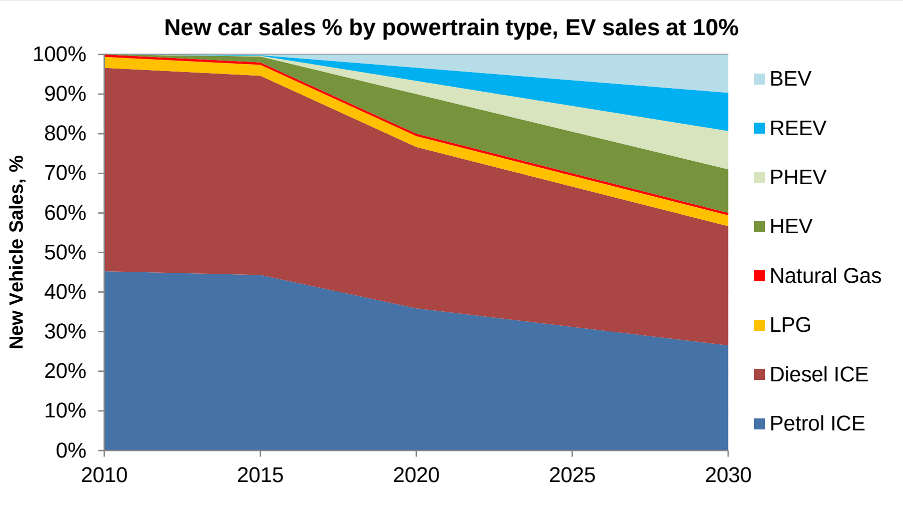
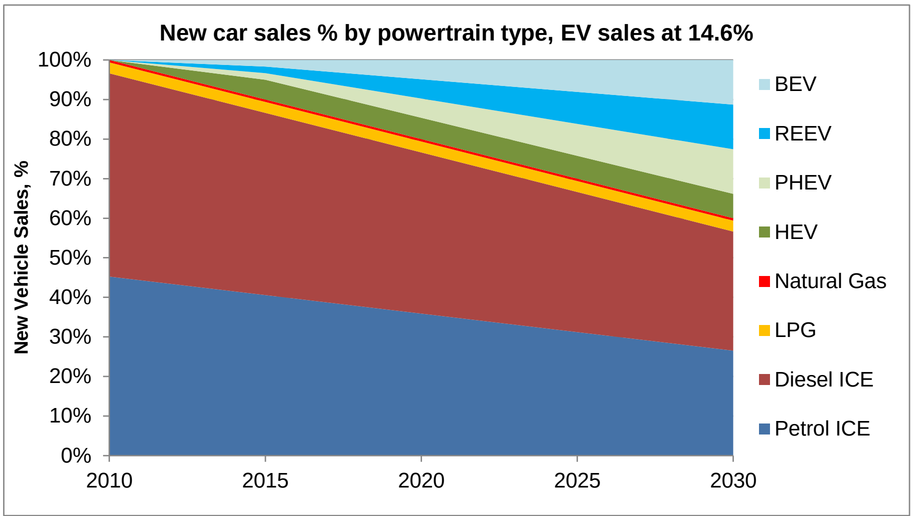


Figure 2-2: Summary of EV deployment scenarios used in the analysis (continued)





2.2 Scenario analysis

2.2.1 Preliminary assessment of different proposals

The first part of the analysis comprised of a preliminary assessment of the different proposed amendments to the car CO_2 regulations with respect to ULEV incentives (i.e. for both supercredit and flexible mandate options). This assessment was limited to potential 2020 impacts on the effective weakening of the 2020 gCO_2/km target and corresponding estimates of the marginal manufacturing cost to achieve this level. Analysis on the wider EU impacts was also carried out on a smaller selection of proposals, and is provided later (section 2.3).

A summary of the key design components of the different proposals used in the analysis is provided in Appendix 2. This information was largely provided by Greenpeace, but has been cross-checked with publically available information on the proposals from European Parliament documents (EP 2013; EP 2013a; EP 2013b; EP, 2013c; EP 2013d; EP 2013e). We were not able to check the validity of the assumptions for the German manufacturers' association (VDA) and German government proposals, which have not been identified as available in the public domain. However, we checked our study's assumptions for the German government proposal were consistent with those presented in the Commission's Non-Paper (EC, 2013).

In addition we have carried out an assessment of the Compromise Amendment voted in the Industry Committee (ITRE) on 19 March 2013 (EP 2013e); the basis of this is also outlined in Appendix 2. The Compromise includes an increase to emissions threshold (from 35 to 50 g/km), an increase to the supercredits multiplier (from 1.3 to 1.5), and a cap in the effective increase in the CO_2 target of 2.5 g/km for each manufacturer, and the exclusion of supercredit banking.

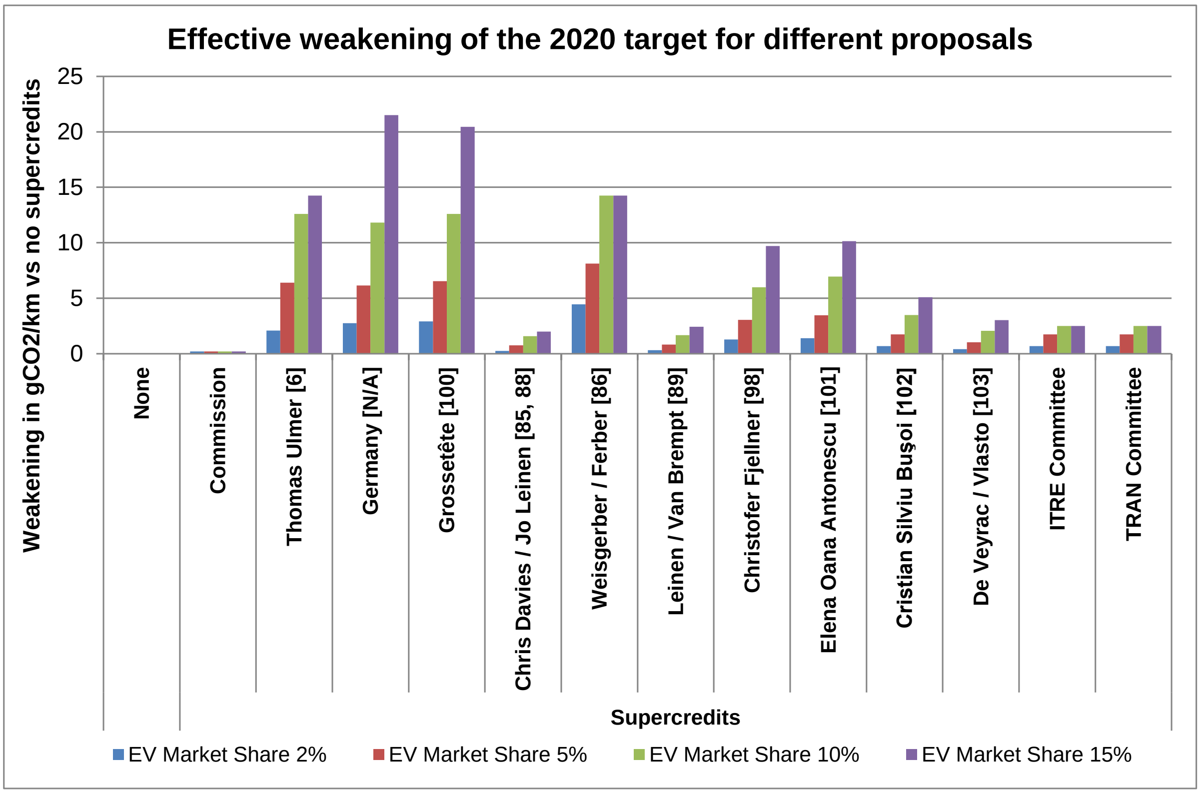
The following report sections provide a summary of the results from the analysis. For the assessment of potential impacts on manufacturing costs, the cost curves for medium sized cars from TNO et al (2011) were used to estimate average vehicle marginal capital costs for conventional ICE vehicles (petrol, diesel, LPG and natural gas). The default assumption was to use the Scenario C cost curves provided in Annex D of TNO et al (2011), scaled to be consistent with the previous analysis for Greenpeace and T&E by Ricardo-AEA (2012). The Scenario A cost curves from Annex B of TNO et al (2011) were used as alternative sensitivity comparison where a more limited potential for weight reduction is included for conventional ICE vehicles (presented in section 2.2.2.2).

2.2.1.1 Direct CO_2 emissions – effective weakening of 2020 target

Figure 2-3, Figure 2-4 and Figure 2-5 provide a summary comparison of the effective weakening of the 2020 target for different supercredit and flexible mandate proposals (a summary of the results for the full list of proposals analysed is provided in the charts located in Appendix 3 of this report). The figures show that some of the supercredit proposals could allow for quite considerable weakening of the target at higher EV sales levels – by over 20 g/km (to over 115 g/km) when EV sales reached levels equivalent to national targets (i.e. ~15% by 2020). In contrast, the flexible mandate proposals ensure only limited impacts in terms of weakening (or strengthening) the 2020 target.

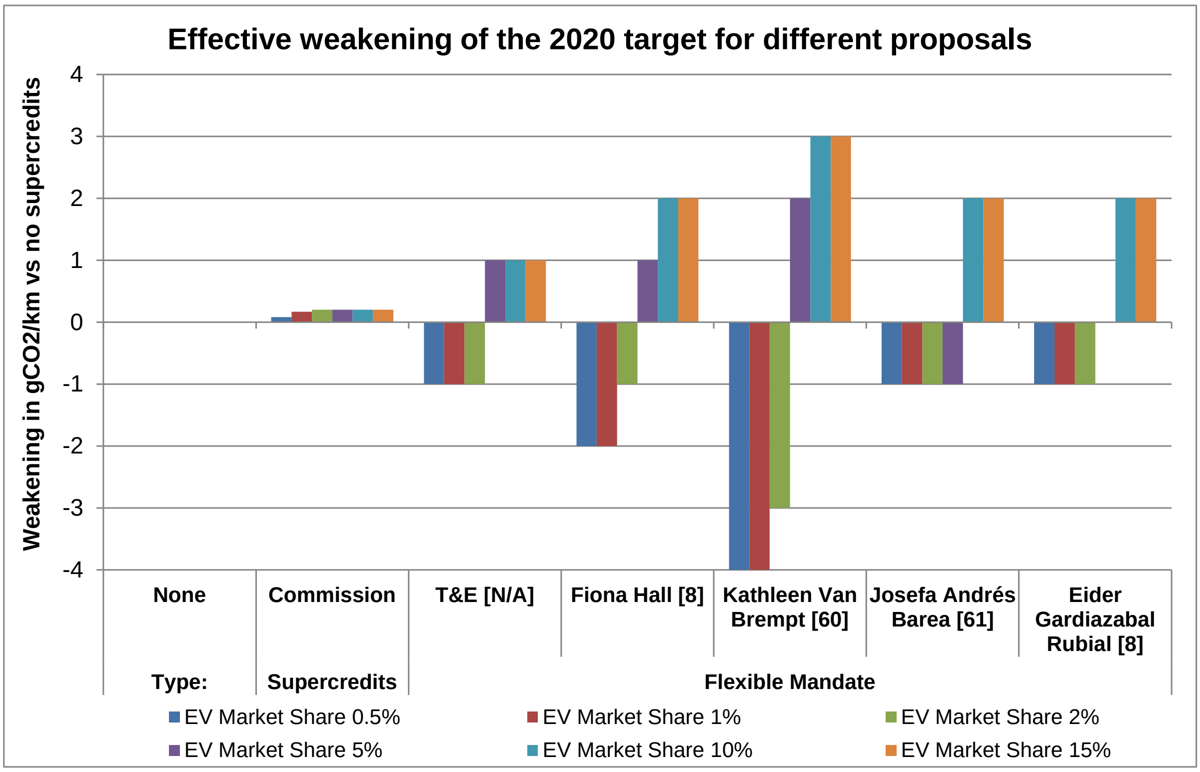
The actual weakening will depend upon the actual level of EV uptake to which there is a high level of uncertainty. Hence car manufacturers do not know to what extent they will be able to use supercredits and so are likely to apply a conservative approach in forward planning to ensure their target is reached.

Figure 2-3: Summary comparison of the effective weakening of the 2020 target for different supercredit proposals and for alternate 2020 EV % sales scenarios



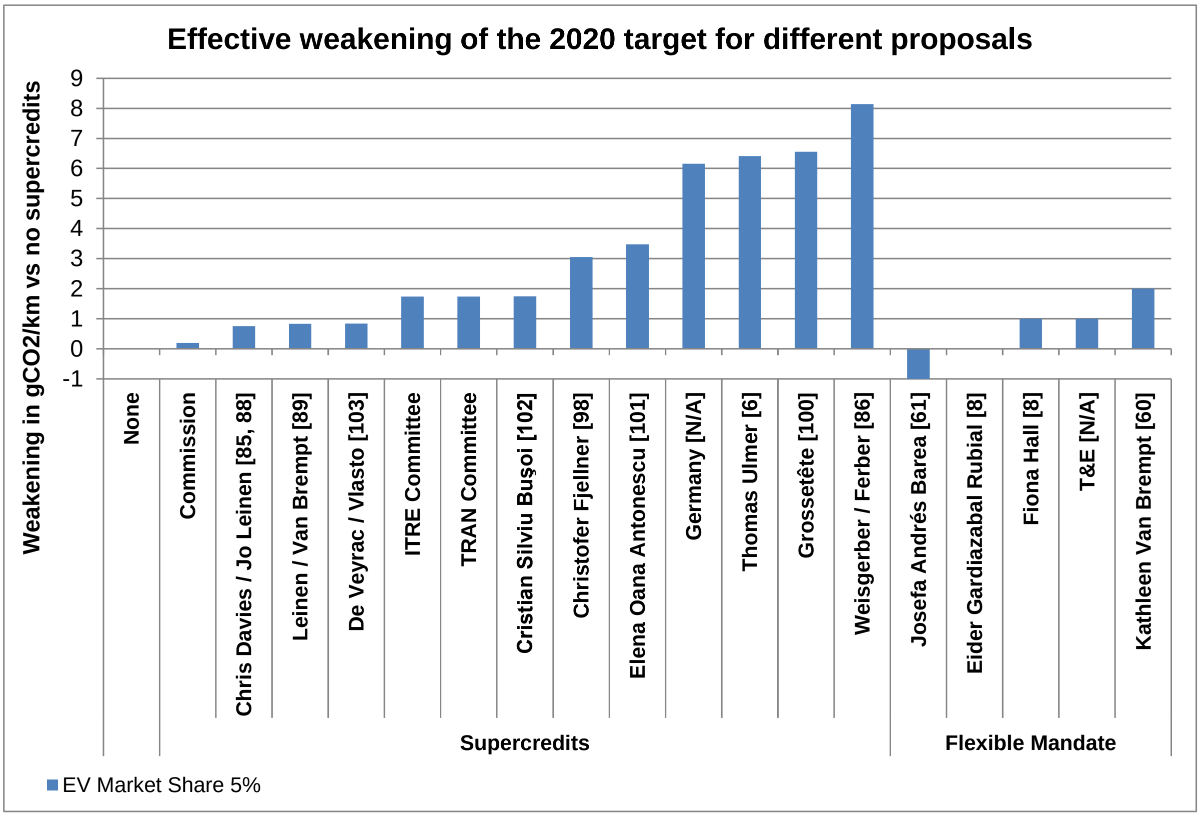
Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c).

Figure 2-4: Summary comparison of the effective weakening of the 2020 target for different flexible mandate proposals and for alternate 2020 EV % sales scenarios



Notes: The numbers of officially proposed amendments in the ITRE and TRAN Committees are indicated in square brackets where relevant (EP, 2013a), (EP, 2013b), (EP, 2013d).

Figure 2-5: Effective weakening of the 2020 target for both types of ULEV incentive proposals ranked in order of impact, 5% EV sales scenario for 2020



Notes: The numbers of officially proposed amendments in the ENVI, ITRE and TRAN Committees are indicated in square brackets where relevant (EP, 2013a), (EP, 2013b), (EC, 2013c), (EP, 2013d).

2.2.1.2 Marginal manufacturing costs

The following Figure 2-6, to Figure 2-11 provide a summary comparison of the estimated impact on marginal manufacturing costs for different supercredit and flexible mandate proposals, corresponding to the equivalent CO_2 target weakening charts in the previous section. A summary of the results for the full list of proposals analysed is also provided in Appendix 3 of this report. These marginal costs are compared to the 2010 situation (Figure 2-6, Figure 2-8 and Figure 2-10) and also to the no supercredits situation (Figure 2-7, Figure 2-9 and Figure 2-11), as alternative reference cases.

The average marginal costs per vehicle (compared to 2010) for meeting a target of 95 g/km in 2020 in the absence of ULEV incentives (i.e. the no supercredits case) and minimal EV sales is around €870, and over €1,300 for the highest EV deployment scenario. For all cases increasing sales of EVs increase the marginal manufacturing costs. Supplying these vehicles is therefore unlikely to be a major means for carmakers to achieve their targets. For the supercredit-based proposals the estimated marginal manufacturing costs are in all cases lower than the situation where there are no supercredits at all, for all EV deployment levels. However, the absolute difference between different EV deployment levels is reduced to a varying extent for different proposals. In the most extreme cases (i.e. proposed ENVI amendments #6, #86, #100 and German government proposal) the reduction in average manufacturing cost compared to the no supercredits case is over €200 for 2020 EV sales share at/above 10%.

In all the flexible mandate cases the cost at the lowest EV deployment scenario is higher than the Commission's proposal and also the case where there are no supercredits (by up to €120). In addition, in all the flexible mandate cases the cost at the highest EV deployment scenario is lower than the Commission's proposal and also the case where there are no supercredits (by up to €60). However, it is only in one proposal (from Kathleen van Brempt, ITRE amendment #60) that the lowest cost option is not the lowest EV deployment scenario (in this case it is the 5% EV deployment scenario).

This means that overall only one of the proposals (i.e. from Kathleen van Brempt) provides a clear/strong incentive to target intermediate EV sales over lower level sales, when only considering the marginal manufacturing costs. Therefore on this basis it would seem doubly prudent to avoid ULEV system designs that could potentially lead to significant weakening of the CO_2 target, as besides weakening the effectiveness of the 2020 CO_2 target they may not necessarily provide a higher level of incentive to maximise EV sales over alternatives.

It should be noted that in this study we have only considered the additional cost of manufacturing, but not the total cost of ownership (TCO), including fuel costs and maintenance/other operational costs as well as the upfront cost of the vehicle. The TCO will depend on a number of factors which are difficult to assess at this point in time, including the purchase price of vehicles, future taxes/incentives, as well as prices for petrol, diesel and electricity. However, an assessment has been carried out on the potential impacts on lifetime fuel costs to the consumer for a selection of proposals, which is presented and discussed in a later section (see Figure 2-29 to Figure 2-32 in subsection 2.3.1).

Figure 2-6: Summary comparison of the estimated impact on marginal manufacturing costs for different supercredit proposals and for alternate 2020 EV % sales scenarios

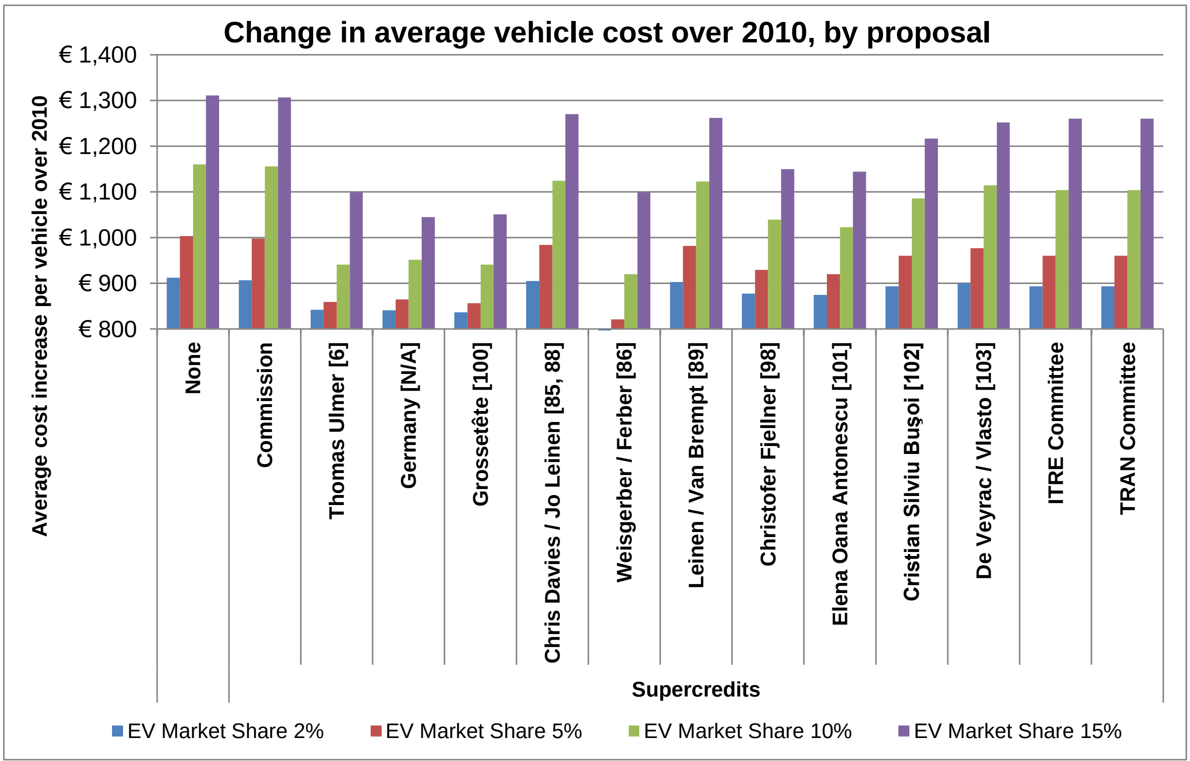
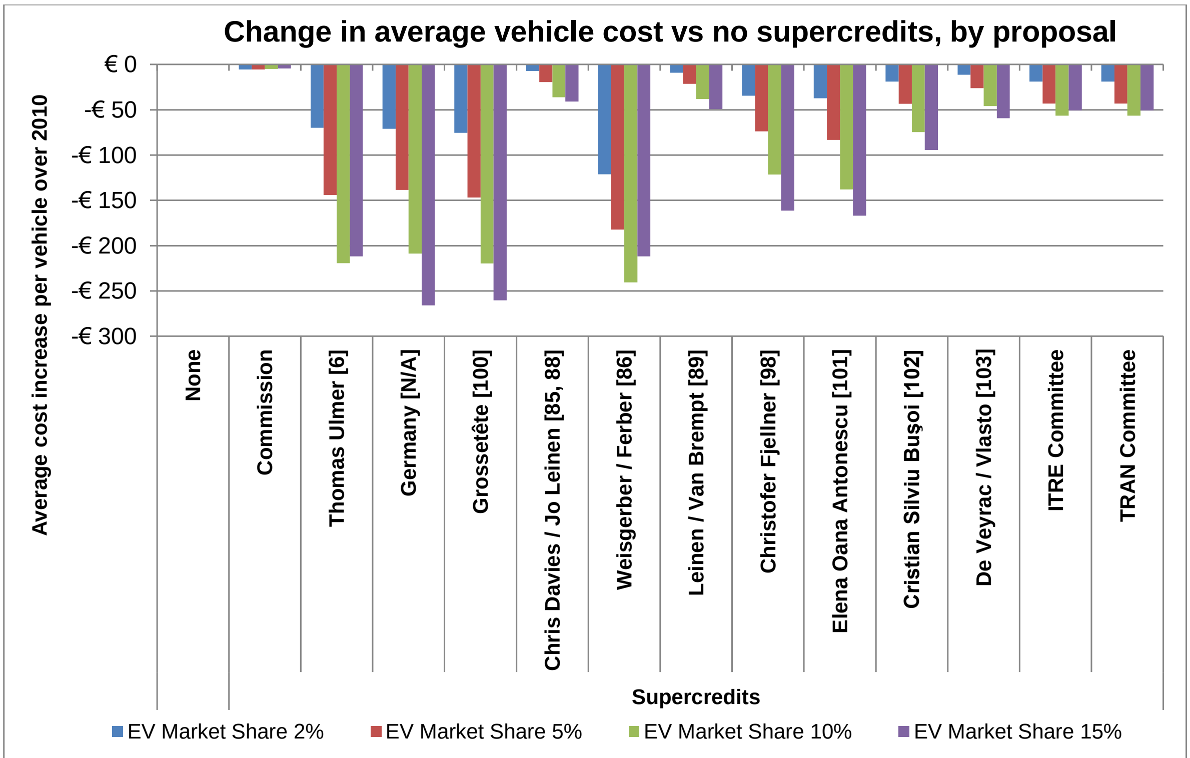


Figure 2-7: Summary comparison of the estimated impact on marginal manufacturing costs for different supercredit proposals and for alternate 2020 EV % sales scenarios, difference vs no supercredits



Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c). Marginal capital costs for conventional petrol and diesel ICE vehicles based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

Figure 2-8: Summary comparison of the estimated impact on marginal manufacturing costs for different flexible mandate proposals and for alternate 2020 EV % sales scenarios

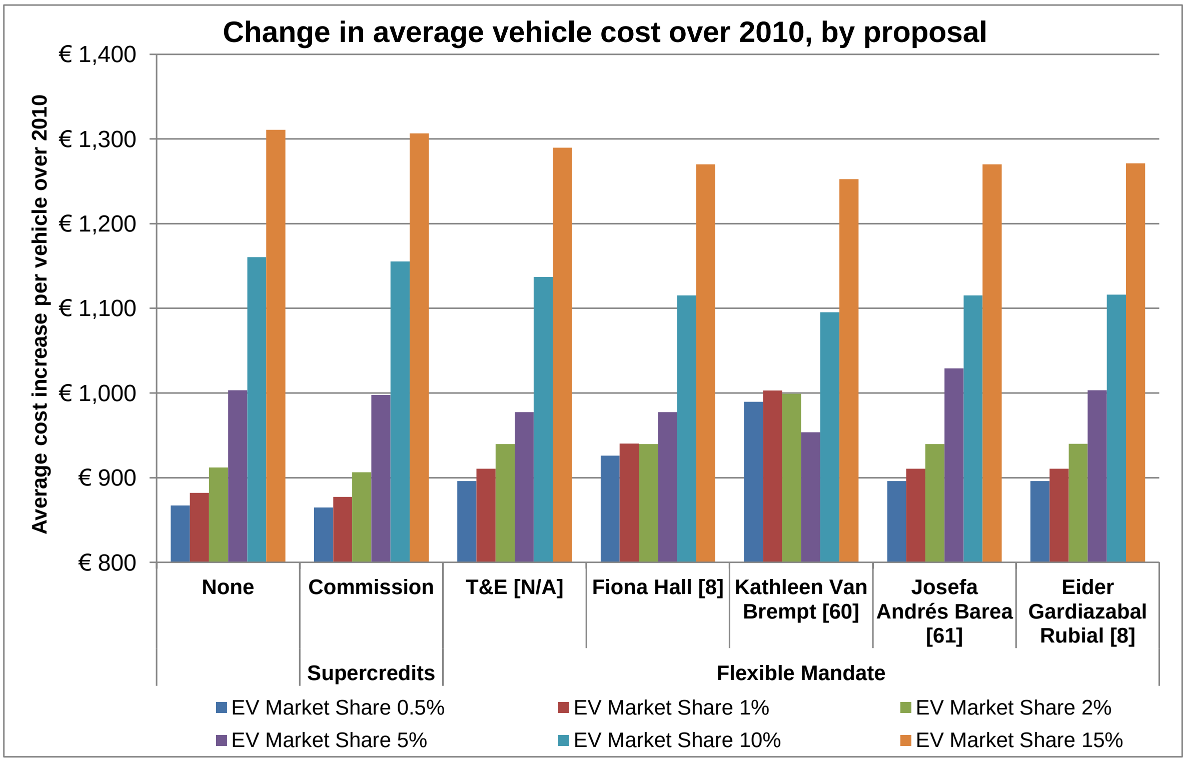
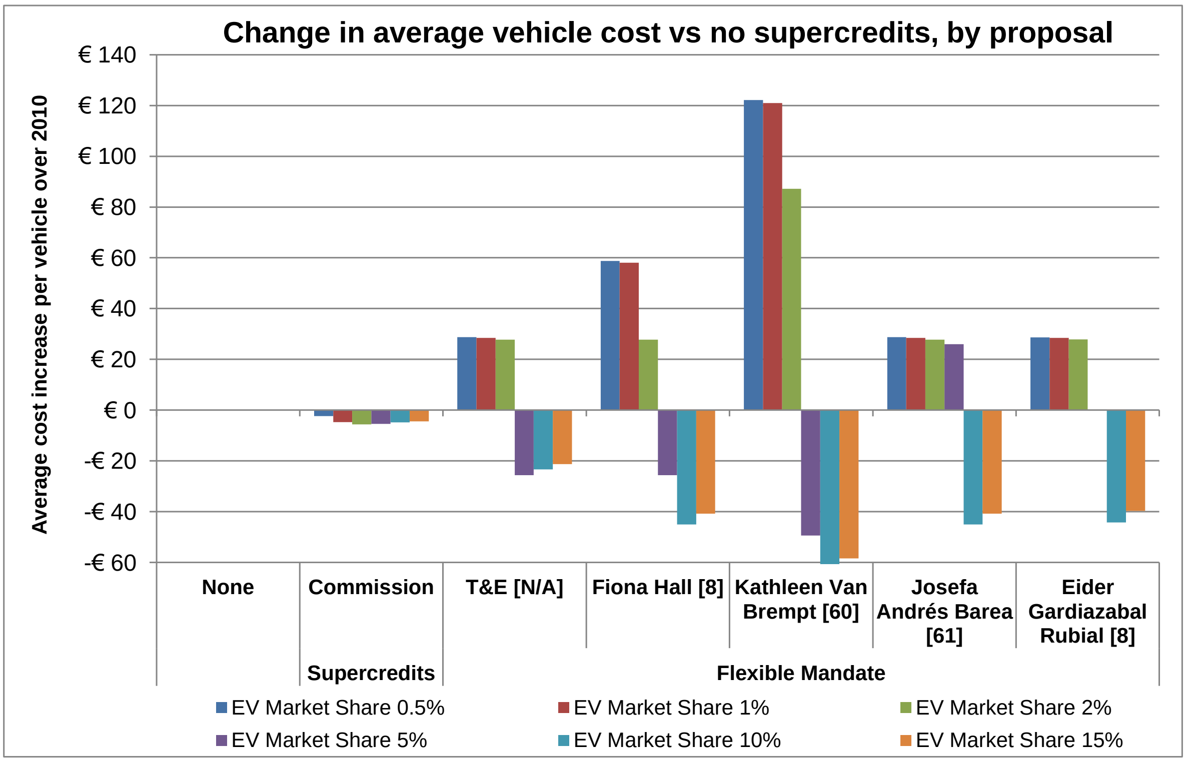


Figure 2-9: Summary comparison of the estimated impact on marginal manufacturing costs for different flexible mandate proposals and for alternate 2020 EV % sales scenarios, difference vs no supercredits



Notes: The numbers of officially proposed amendments in the ITRE and TRAN Committees are indicated in square brackets where relevant (EC, 2013a), (EC, 2013b), (EC 2013d). Marginal capital costs for conventional petrol and diesel ICE vehicles were estimated based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

Figure 2-10: Estimated impact on marginal manufacturing costs for different ULEV incentive proposals ranked in order of impact, 5% EV sales scenario for 2020

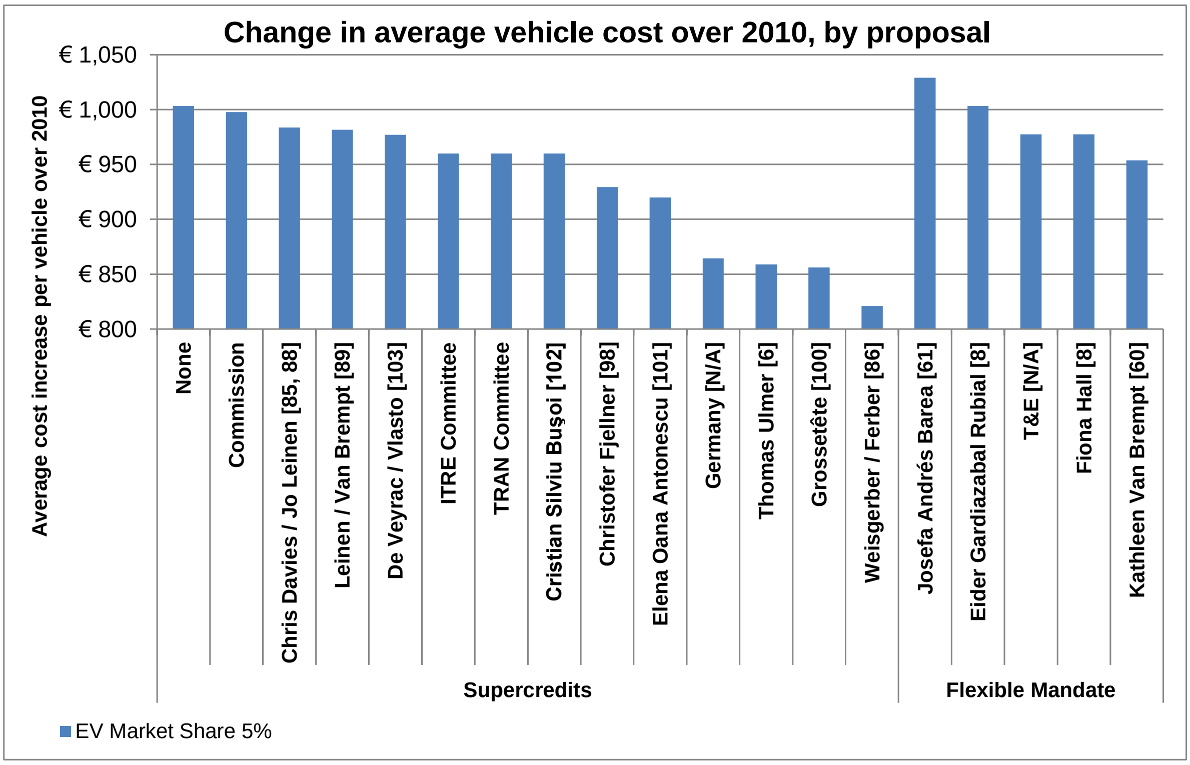
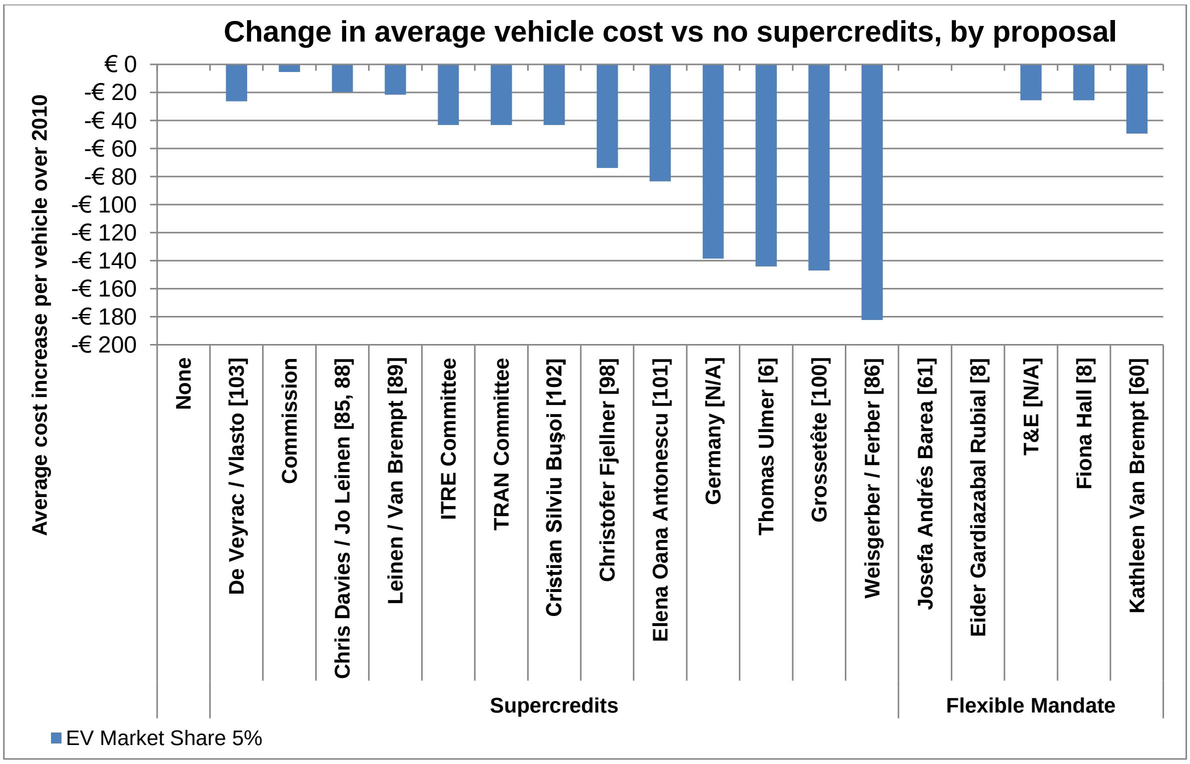


Figure 2-11: Estimated impact on marginal manufacturing costs for different ULEV incentive proposals ranked in order of impact, 5% EV sales scenario for 2020, difference vs no supercredits



Notes: The numbers of officially proposed amendments in the ENVI, ITRE and TRAN Committees are indicated in square brackets where relevant (EP, 2013a), (EP, 2013b), (EC, 2013c), (EP, 2013d). Marginal capital costs for conventional petrol and diesel ICE vehicles were estimated based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

2.2.2 Supercredit design sensitivity analysis

The following section provides a summary of a variety of sensitivity analysis scenarios that have been carried out on the design of supercredit based proposals and their impacts on (a) the level of effective weakening of the 2020 CO_2 target, (b) estimates for the marginal manufacturing costs.

2.2.2.1 Direct CO_2 emissions – effective weakening of the 2020 target

Figure 2-12 and Figure 2-13 provide an illustration of the potential impacts on the effective 2020 CO_2 target of different levels of supercredit multipliers (Figure 2-12) and the corresponding magnifying effect that adding supercredit banking adds to the equation (Figure 2-13). The sensitivities explored in the charts represent the range of values put forward in different proposed amendments to the legislation in comparison the case without any supercredits and to the Commission's proposal (COMM). It is clear from the charts that increasing the supercredit multiplier has a rapid and significant effect on weakening the 2020 target, and that banking could almost double the impact of this.

The impact that banking has on proposals is to significantly increase the number of vehicles that could meet the ULEV qualification criteria and therefore also the effective weakening of the 2020 target. Even though sales in earlier years will be at a lower overall level than at 2020, the impact can be quite pronounced, particularly at higher supercredit multipliers.

For example at the multiplier level proposed by the Commission (1.3) the maximum weakening of the 2020 target in the absence of a cap (in sales or level of weakening) may be limited to a maximum of ~2.4 g/km (for the ~15% EV sales case for 2020). However this effectively doubles to almost 4.8 g/km when banking is introduced from 2016 onwards.

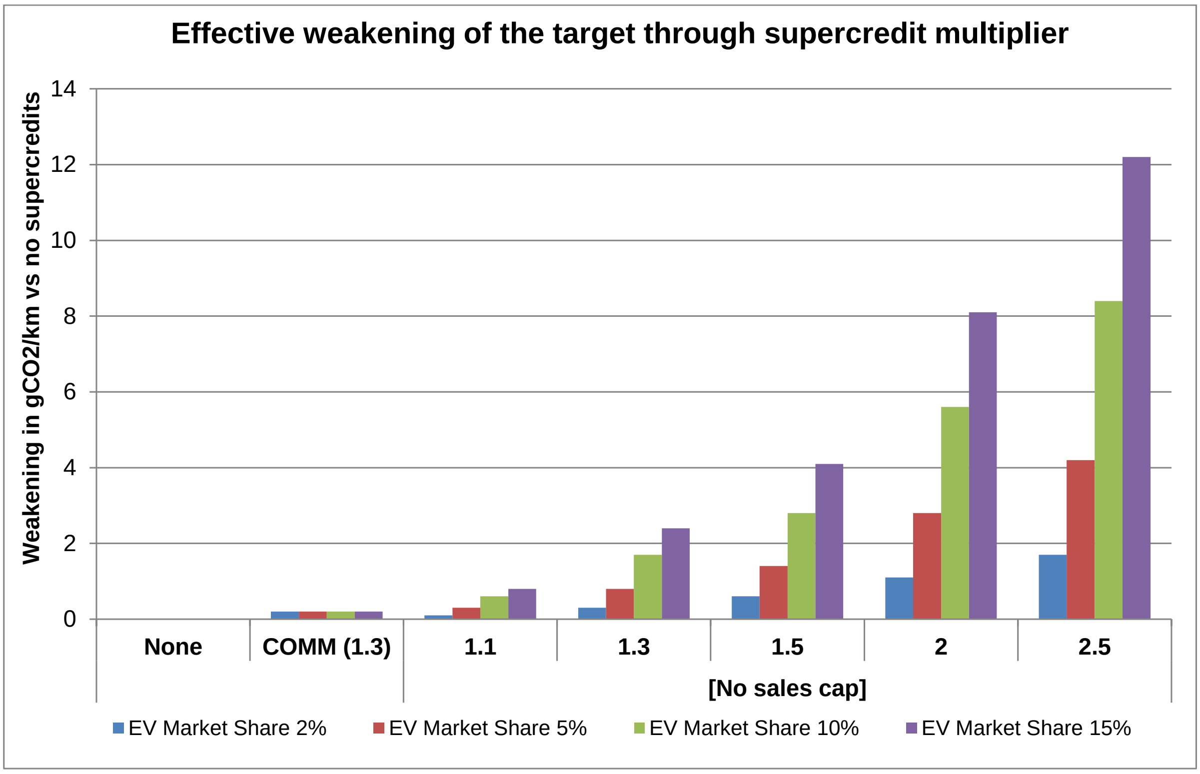
In comparison for the 2.0 multiplier level (e.g. as in Grossetête's proposed amendment #100, EP 2013c) the maximum weakening in the absence of any caps could reach 8.1 g/km (again, for the 15% EV sales case). However, applying banking of supercredits from 2016 could increase the level of weakening to 15.9 g/km (an effective CO_2 target of 110.9 g/km).

The next set of sensitivities explore the impact of varying the level and nature of the ULEV qualification threshold. There are effectively two main types of qualification threshold that have been proposed (sometimes in concert). The first type is a simple threshold that applies for all vehicle types/weights (e.g. the <35 gCO_2/km threshold proposed by the Commission). The second type of threshold that has been proposed is set in relation to the weight-based CO_2 limit curve (which is used to set the targets for individual manufacturers based on their respective sales adjusted average new car weight, in kg). For example, German government proposal suggests a lower qualification threshold set at 50% of the weight-based CO_2 limit curve (capped at a maximum of 65 g/km for larger vehicles). The effect of this second type of threshold is to have lower ULEV qualification thresholds for lighter vehicles, and higher ones for heavier vehicles.

Figure 2-14 provides an illustration of the effect that raising /altering the nature of the ULEV qualifying threshold might have on the effective weakening of the 2020 target. The chart shows that by itself the effect might be expected to be relatively small (compared to other design elements like supercredit multiplier and banking), since although more vehicles might qualify, the average size of the credit is lower. However, it should be noted that changing the threshold would be likely to have other effects – such as (a) allowing potentially significant numbers of HEVs to qualify, and (b) reducing the electric driving range required by PHEVs/REEVs to qualify for supercredits (and therefore their marginal capital costs).

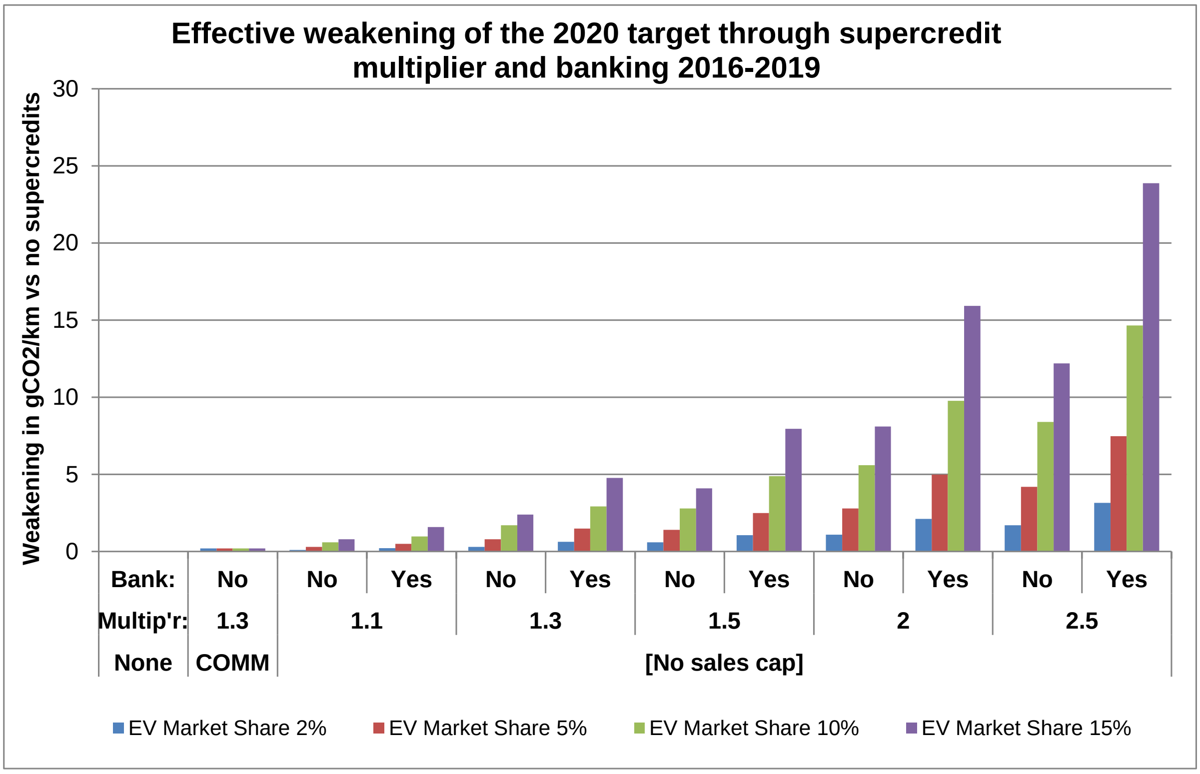
Figure 2-15 show the effect of the combination of different supercredit multipliers with three of the main ULEV qualifying thresholds being proposed, which serves to illustrate the greater importance of multipliers on the effective target. Table 2-3 shows the results of an assessment of the potential numbers of qualifying HEVs for four ULEV qualification thresholds and different full HEV 2020 sales shares. This analysis shows that the numbers of qualifying HEVs may be relatively low except for particularly high qualifying thresholds.

Figure 2-12: Sensitivities on supercredit multipliers



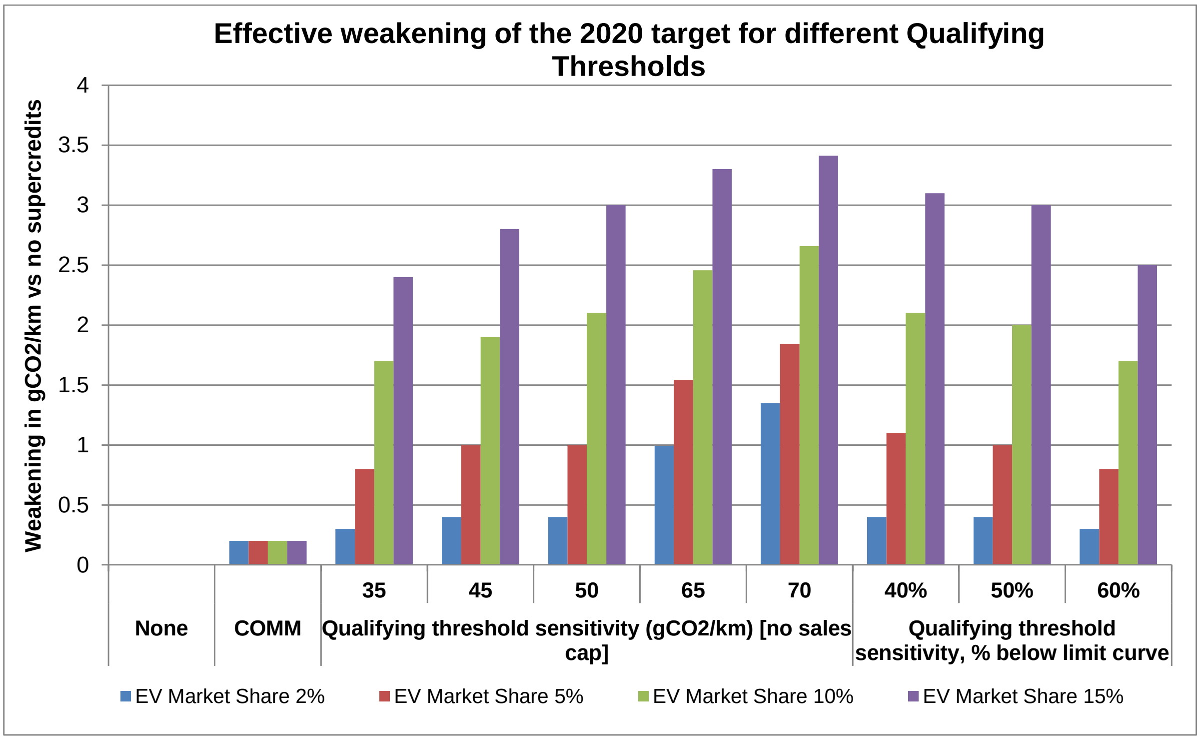
Notes: In all cases the values for parameters not being varied for the purposes of the sensitivity are set at the same level as the Commission proposal (COMM), but without the cap in the number of qualifying ULEV sales.

Figure 2-13: Sensitivities on supercredit multipliers with banking



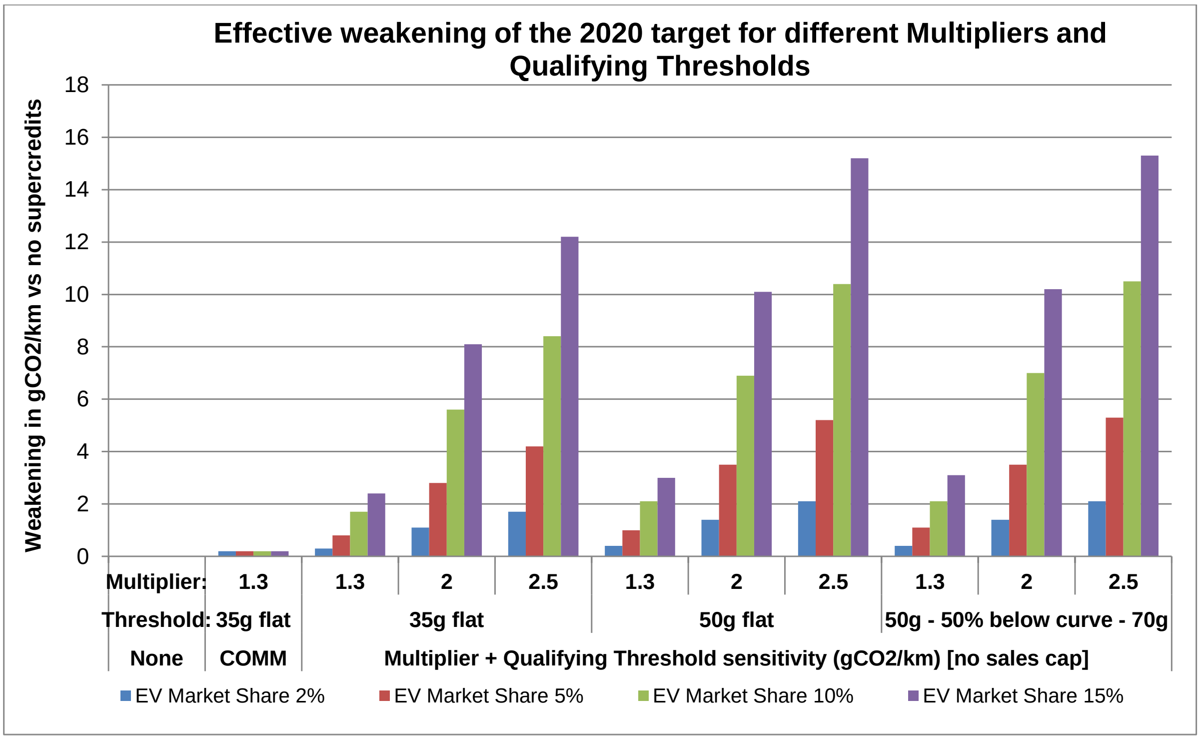
Notes: In all cases the values for parameters not being varied for the purposes of the sensitivity are set at the same level as the Commission proposal (COMM), but without the cap in the number of qualifying ULEV sales.

Figure 2-14: Sensitivities on ULEV qualifying threshold for supercredits



Notes: In all cases the values for parameters not being varied for the purposes of the sensitivity are set at the same level as the Commission proposal (COMM), but without the cap in the number of qualifying ULEV sales.

Figure 2-15: Sensitivities on ULEV qualifying threshold with supercredit multipliers



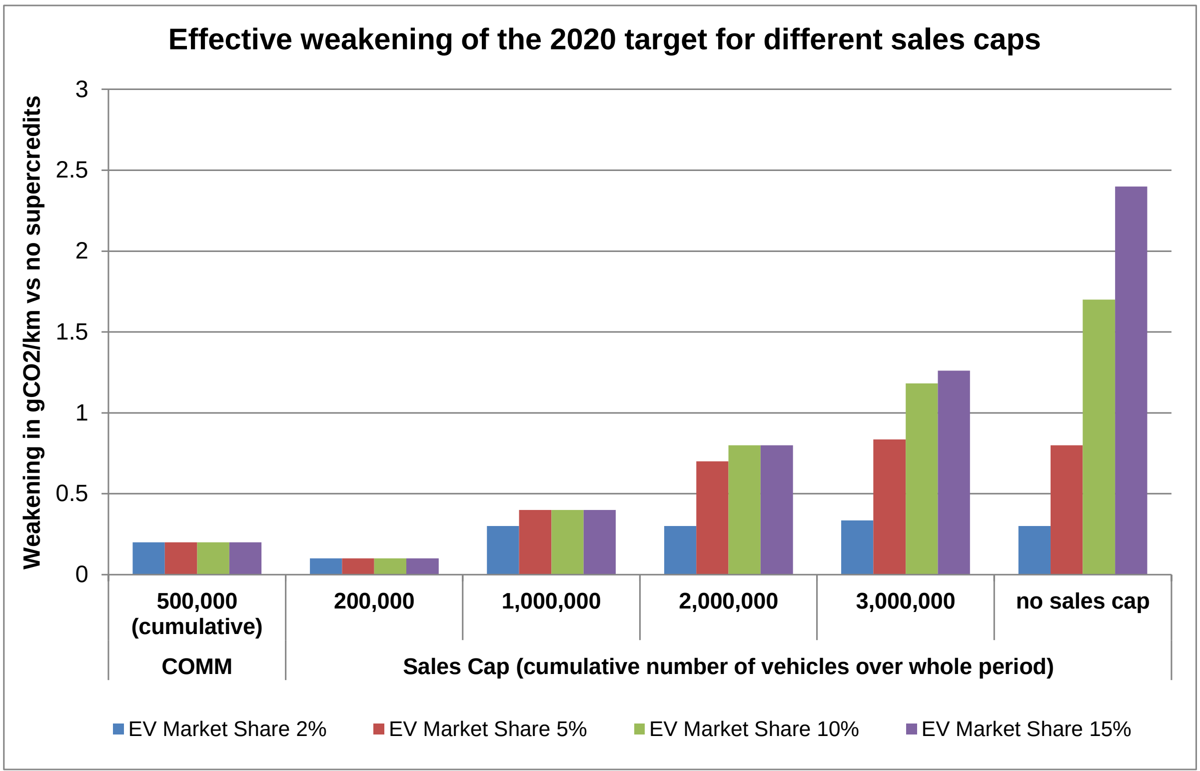
Notes: In all cases the values for parameters not being varied for the purposes of the sensitivity are set at the same level as the Commission proposal (COMM), but without the cap in the number of qualifying ULEV sales. '50g - 50% below curve - 70g' = <50 g or <50% of weight-based CO_2 limit curve, with a <70 g upper limit.

Table 2-3: Estimated number of qualifying HEVs for different ULEV supercredits qualification thresholds and full HEV new car sales shares for 2020

ULEV Qualification Threshold:		<35g	<50g	<70g	<50g or 50% below curve, <70g max
Full HEV Sales	5%	0	800	500,000	800
	10%	0	1,650	900,000	1,700
	15%	0	2,500	1,400,000	2,500

Figure 2-16 provides an illustration of the potential impacts of different sales caps (applied to cumulative sales over the supercredit qualification period from 2020). Applying a sales cap at the level proposed by the Commission is likely to allow for only a minimal proportion of vehicles to qualify, and therefore ensure minimal effective weakening of the target. Caps at higher levels would clearly allow for a degree of control of the degree to which the 95g target would be undermined by supercredits in combination with high EV sales, and would allow more vehicles to qualify.

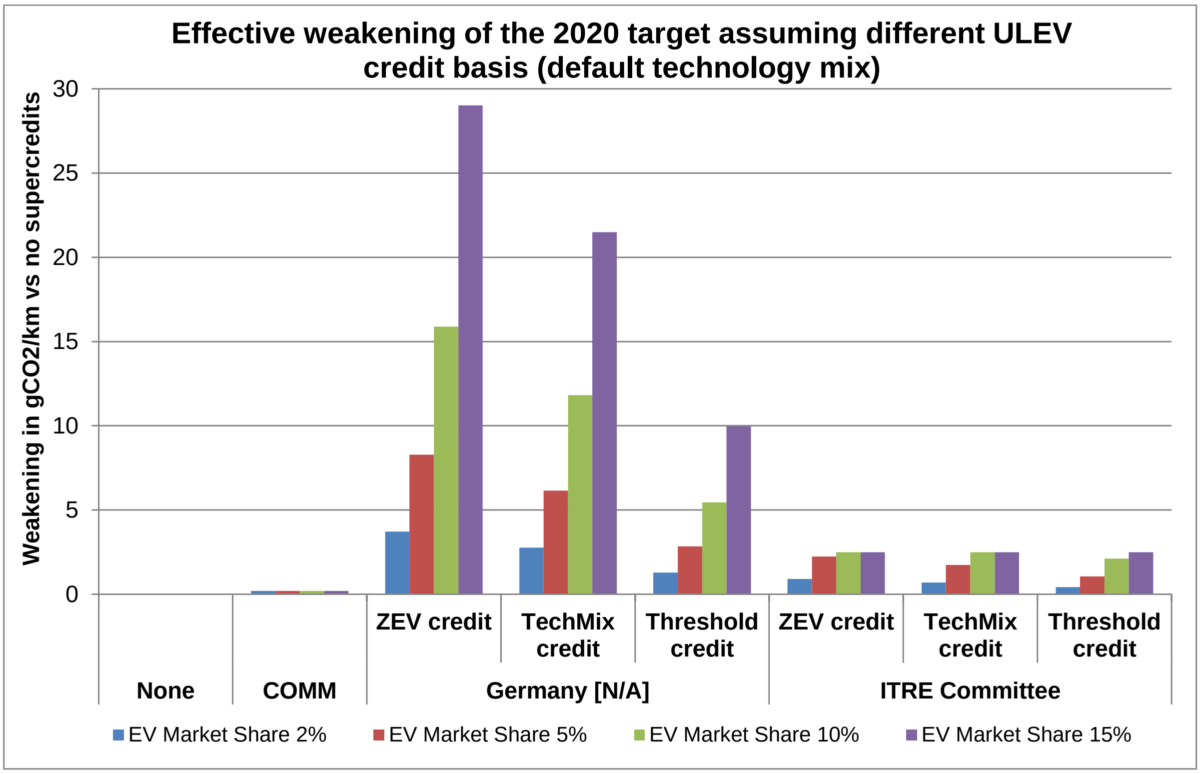
Figure 2-16: Sensitivities on sales caps for qualifying ULEVs



Notes: In all cases the values for parameters not being varied for the purposes of the sensitivity are set at the same level as the Commission proposal (COMM), but without the cap in the number of qualifying ULEV sales. Sales caps are cumulative over the whole supercredit period from 2020. The Commission proposal is for a 20,000 vehicle cap per manufacturer over 4 years; we have assumed the number of manufacturer groups is 25 by 2020.

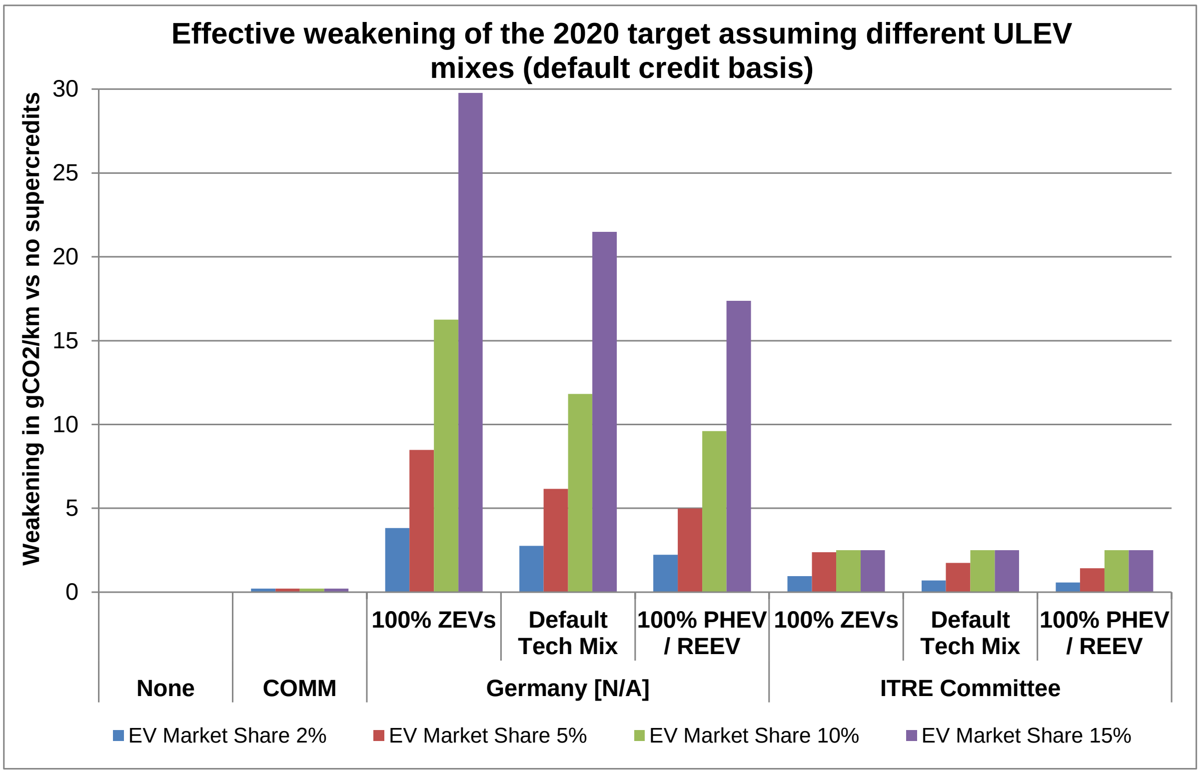
The final sensitivities carried out to explore impacts on effective weakening of the CO_2 target relate to the basis of the credits given: (a) in terms of the average performance (in gCO_2/km) assumed for the qualifying ULEVs (see Figure 2-17), and (b) on the EV technology mix itself (i.e. share of ZEVs vs PHEVs/REEVs) (see Figure 2-18). For sensitivity (a), the default assumption for the basis of credits (in gCO_2/km) given to qualifying ULEVs is a weighted average based on the technology mix of qualifying vehicles. Sensitivities were also carried out on the basis of two alternate assumptions representing extreme cases (i) a high weakening case where all qualifying vehicles are assumed to have an emission factor of 0 gCO_2/km ('ZEV credit', (ii) a low case where all qualifying vehicles exactly meet the average threshold ('Threshold credit'). These sensitivities are presented in Figure 2-17 and show that the assumptions here can have a significant impact on the degree of weakening and provide upper and lower bounds for this. A related sensitivity (b) for the assumed mix of EV types in new car sales is also presented in Figure 2-18, which shows similar results.

Figure 2-17: Sensitivities on the assumed credit levels for qualifying ULEVs



Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c).

Figure 2-18: Sensitivities on the assumed mix of EV types in new car sales



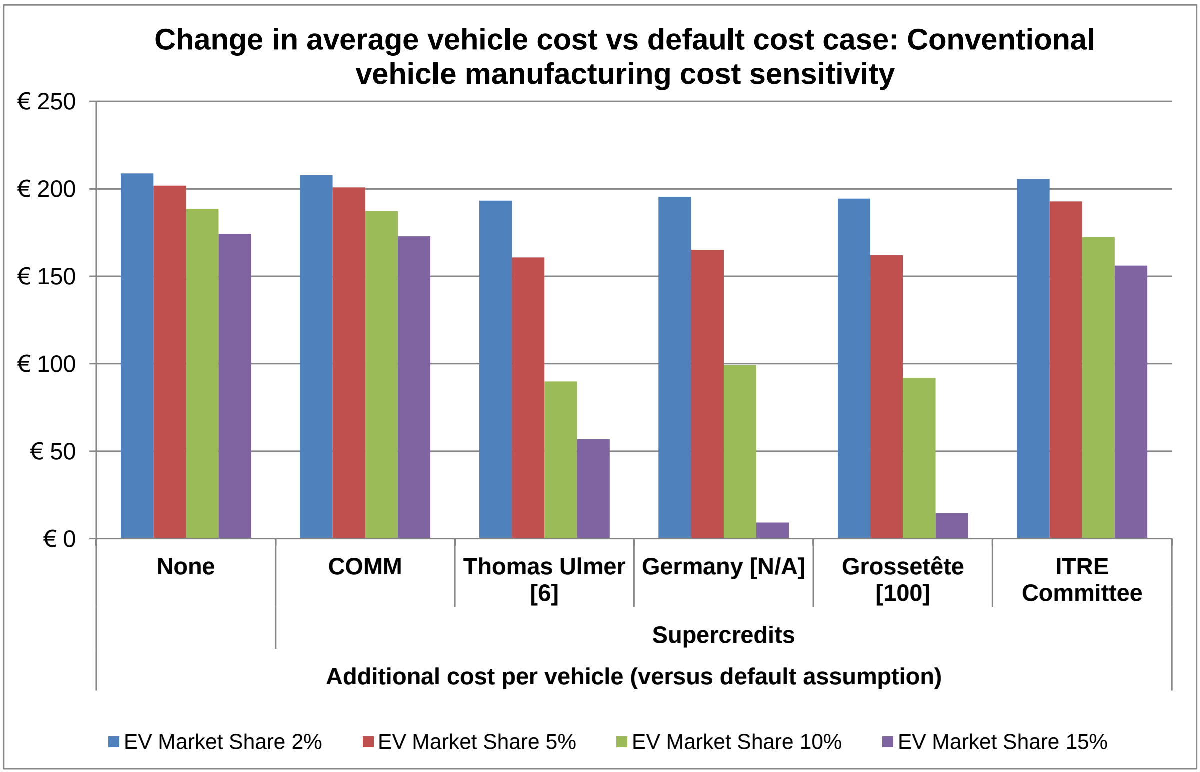
Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c).

2.2.2.2 Marginal manufacturing costs

A summary comparison of the alternate basis for the cost calculations is provided in Figure 2-19 and Figure 2-20 below for a selection the proposals. As indicated earlier (in section 2.2.1) the default cost case in Figure 2-19 and Figure 2-20 was estimated utilising the Scenario C cost curves from TNO et al (2011), with the sensitivity case using the Scenario A cost curves from the same study instead.

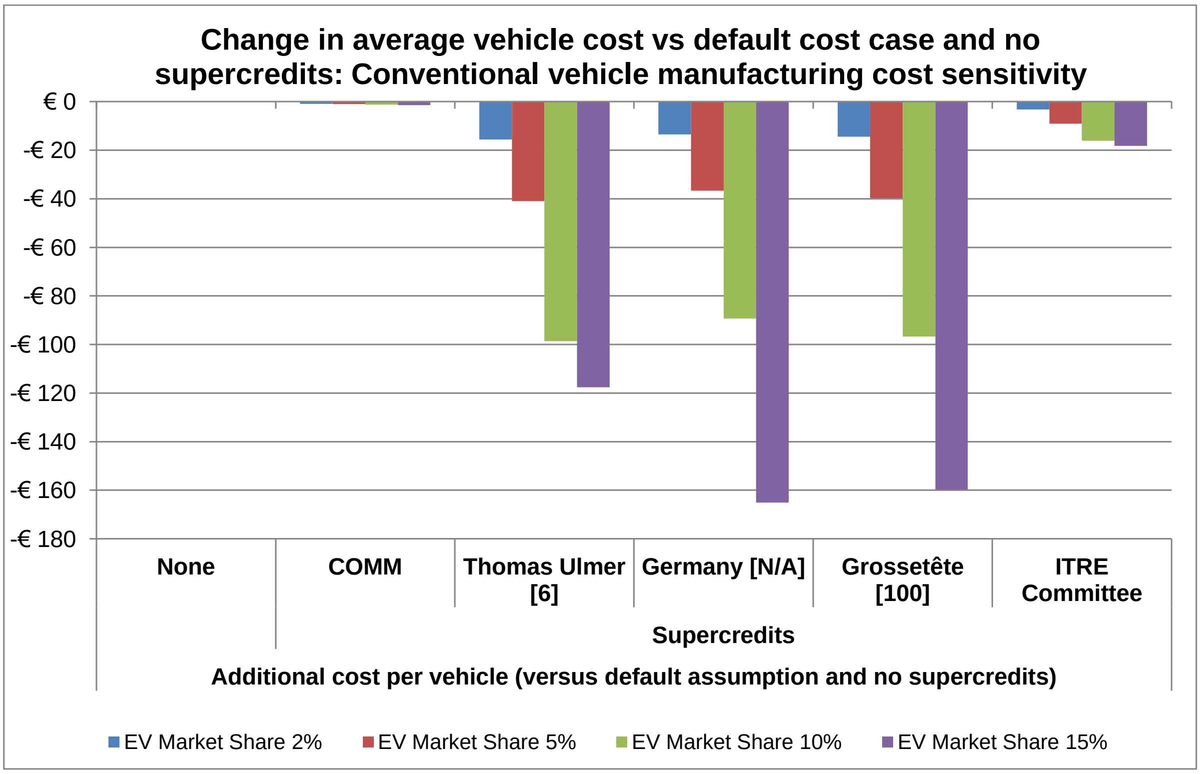
The sensitivity analysis seems to suggest that in the case that it is more costly than expected to improve conventional ICE vehicle efficiency, the relative costs for different levels of 2020 EV sales could be more similar. In addition, the average manufacturing costs of the different proposals relative to the no supercredits case will be further reduced in absolute terms. However, if the costs of EVs are higher than currently anticipated, or if battery (and other) costs do not reduce to the degree expected, then the relative differences between the different EV deployment scenarios may be more similar to the default assumption case.

Figure 2-19: Sensitivity on the marginal manufacturing cost basis



Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c). In all cases the values for parameters not being varied for the purposes of the sensitivity are set at the same level as the Commission proposal (COMM), but without the cap in the number of qualifying ULEV sales. Default = ICE vehicle marginal capital costs estimated using Scenario C cost curves from TNO et al (2011). Alt. = Alternative assumption where the Scenario A cost curves from TNO et al (2011) are used instead.

Figure 2-20: Sensitivity on the marginal manufacturing cost basis (vs no supercredits)



Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c). In all cases the values for parameters not being varied for the purposes of the sensitivity are set at the same level as the Commission proposal (COMM), but without the cap in the number of qualifying ULEV sales. Default = ICE vehicle marginal capital costs estimated using Scenario C cost curves from TNO et al (2011). Alt. = Alternative assumption where the Scenario A cost curves from TNO et al (2011) are used instead.

2.3 EU-wide impacts to 2030

The following sections provide a summary of more detailed analysis on the estimated EU-wide impacts from 2020 to 2030 of a selection of proposals covering the following areas:

i. Impacts on new vehicle GHG emissions and manufacturing costs
ii. Impacts on CO_2 emissions from the entire EU car fleet
iii. Impacts on annual fuel costs to drivers
iv. Impacts on fuel consumption and oil import costs

This detailed analysis was carried out for the following five selected proposals:

1. The European Commission's proposal (EC 2012).
2. The amendment proposed by Thomas Ulmer (ENVI AM 6, EP 2013).
3. The amendment proposed by the German government (provided by Greenpeace).
4. The amendment proposed by Françoise Grossetête (ENVI AM 100, EP 2013c).
5. The Industry Committee (ITRE) recommendation (EP 2013e).

These proposals are also compared to two alternative situations (a) the case assuming there are no further improvements to vehicle efficiency and in the deployment of EVs beyond current levels, (b) the case where the 2020 CO_2 target of 95 g/km for cars has to be met without any supercredit (or other ULEV incentive) measures applied.

2.3.1 Impacts on new vehicle GHG emissions, manufacturing costs and lifetime fuel costs to the consumer

2.3.1.1 New vehicle GHG emissions

The following Figure 2-21, Figure 2-23, Figure 2-25 and Figure 2-26 provide summaries of the trajectories for average EU new car tailpipe (TTW) CO_2, WTW (well-to-wheel) GHG and estimated marginal manufacturing costs for the different scenarios analysed assuming a 5% market share of EVs by 2020, and 14% in 2030. Figure 2-22 also provides an illustration of the magnifying effect higher EV sales has on the results in terms of widening the differentials between different proposals.

The CO_2 /GHG emissions and marginal cost trajectories for the different supercredit proposals are compared to the current situation as a reference case – i.e. ICE vehicles with no further additional technology/improvements in CO_2 emissions compared to current levels. Without further improvement/additional technology added to vehicles, and excluding other changes in specifications vehicles become cheaper to manufacture over time. For the purposes of the analysis the cost of the vehicle excluding the ICE powertrain (engine and transmission) is assumed to remain approximately constant, whilst the powertrain is assumed to reduce in cost by 0.5% p.a.

The charts show that assuming a medium ambition trajectory for EV deployment into the new car market, under the case without any supercredits average new car CO_2 could continue to improve after 2020, reaching ~80 g/km levels by 2030 even in the absence of further targets in the 5% 2020 EV sales case (and as low as ~73 g/km at 15% EV sales by 2020). However, under the Françoise Grossetête proposal emissions could be as much as 5-12 g/km higher (for 5%-15% range of 2020 EV sales cases). Similar differentials are also estimated for total fuel WTW emissions from new cars (see Figure 2-24). It is also important to highlight that at higher EV sales levels the Ulmer/Germany/Grossetête proposals could result in the meeting the 95 gCO_2/km target effectively being delayed until 2025.

Figure 2-21: Estimated impact on average new car tailpipe emissions (test-cycle basis) for different proposals, based on EV sales at 5% by 2020

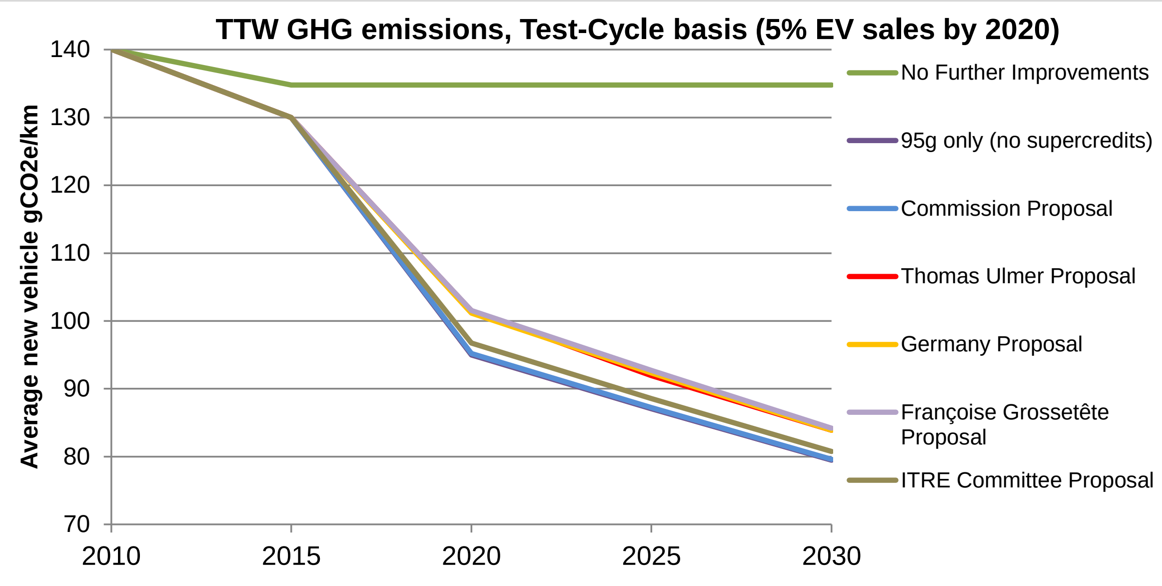


Figure 2-22: Estimated impact on average new car tailpipe emissions (test-cycle basis) for different proposals, based on EV sales at 15% by 2020

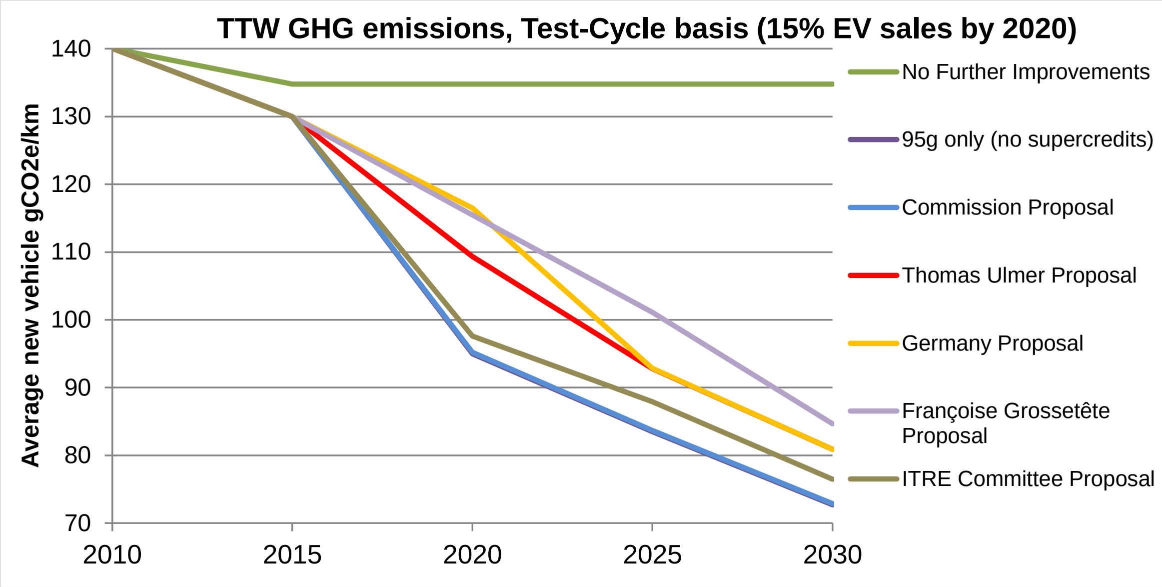


Figure 2-23: Estimated impact on average new car total WTW emissions (real-world basis) for different proposals, based on EV sales at 5% by 2020

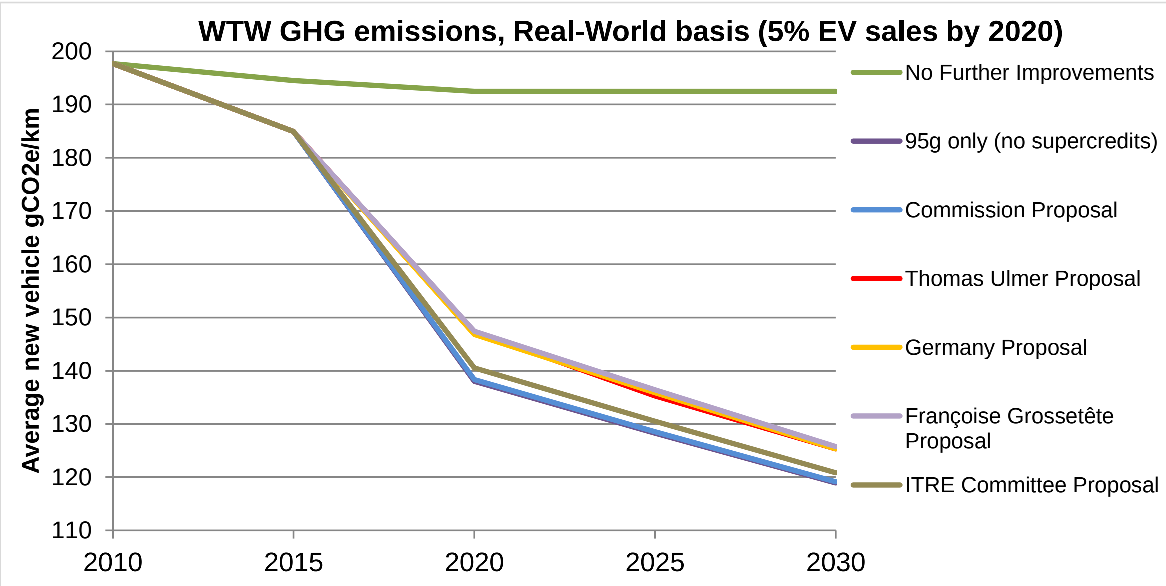
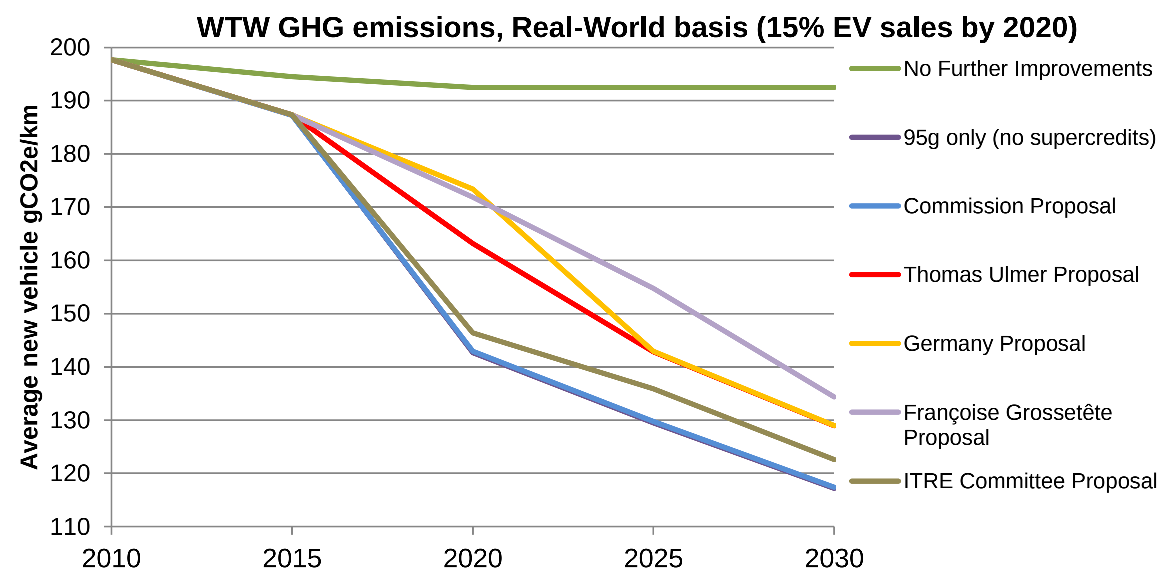


Figure 2-24: Estimated impact on average new car total WTW emissions (real-world basis) for different proposals, based on EV sales at 15% by 2020

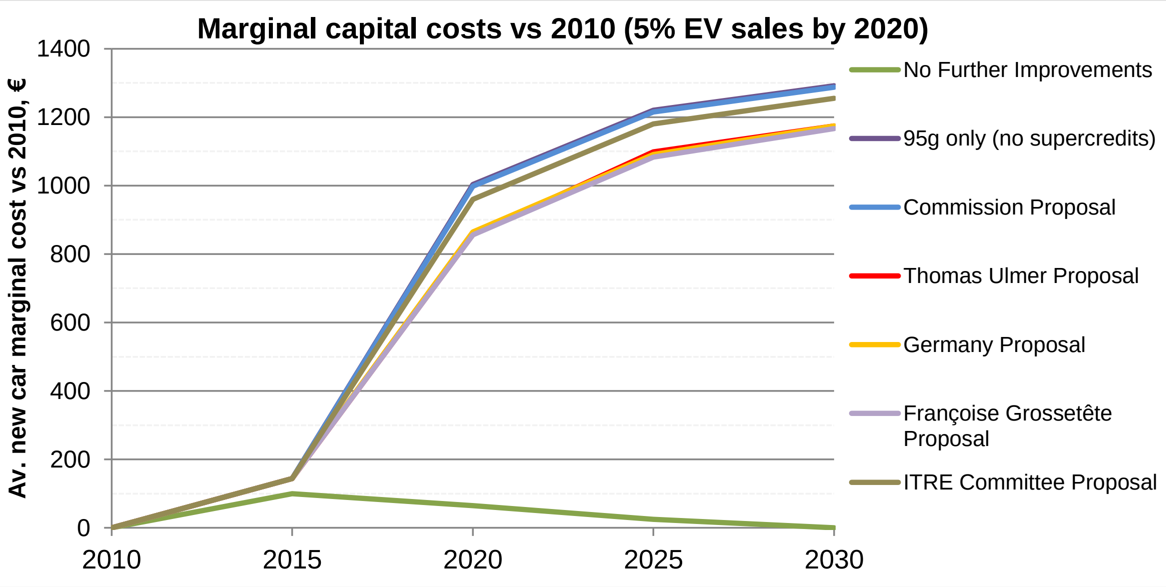


2.3.1.2 New vehicle manufacturing costs

In terms of the estimated average marginal manufacturing costs of new cars, an inverse trend is apparent in Figure 2-25 and Figure 2-27, compared to the situation for GHG emissions. The comparison of different proposals versus the no supercredits case is also provided in Figure 2-26 and Figure 2-28. In this case, unsurprisingly, the proposals leading to the highest average new vehicle emissions, also lead to the lowest manufacturing costs. Manufacturing costs could be lower by almost €150 vs no supercredits for 2020 in the 5% EV sales case and by €260 for 15% EV sales under the Françoise Grossetête Proposal. The corresponding lowering of costs for 2030 are €125 (via 5% EV sales share in 2020) and €210 (via 15% EV sales in 2020).

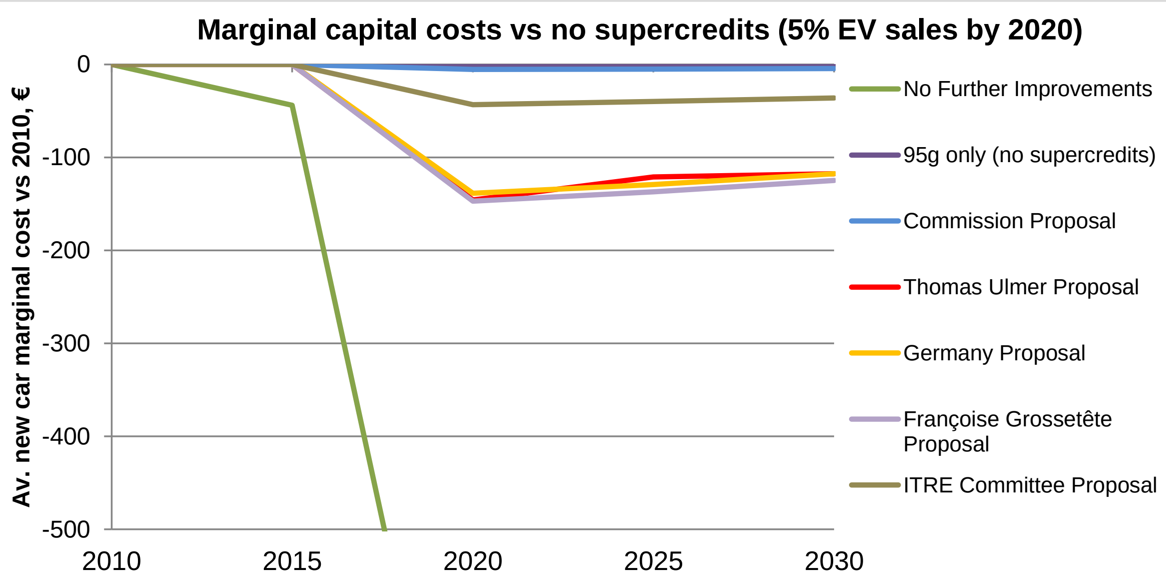
However, as discussed earlier it is also important to factor in other considerations, such as fuel and maintenance costs into the total cost of ownership. The impacts on lifetime fuel costs to the consumer for new cars is discussed next in this section, and significantly outweigh the estimated reduction in manufacturing costs. The impacts on fleet-wide fuel costs resulting from the different proposals is also explored in later subsection 2.3.3.

Figure 2-25: Estimated impact on average new car marginal manufacturing costs for different proposals, based on EV sales at 5% by 2020, difference vs 2010 costs



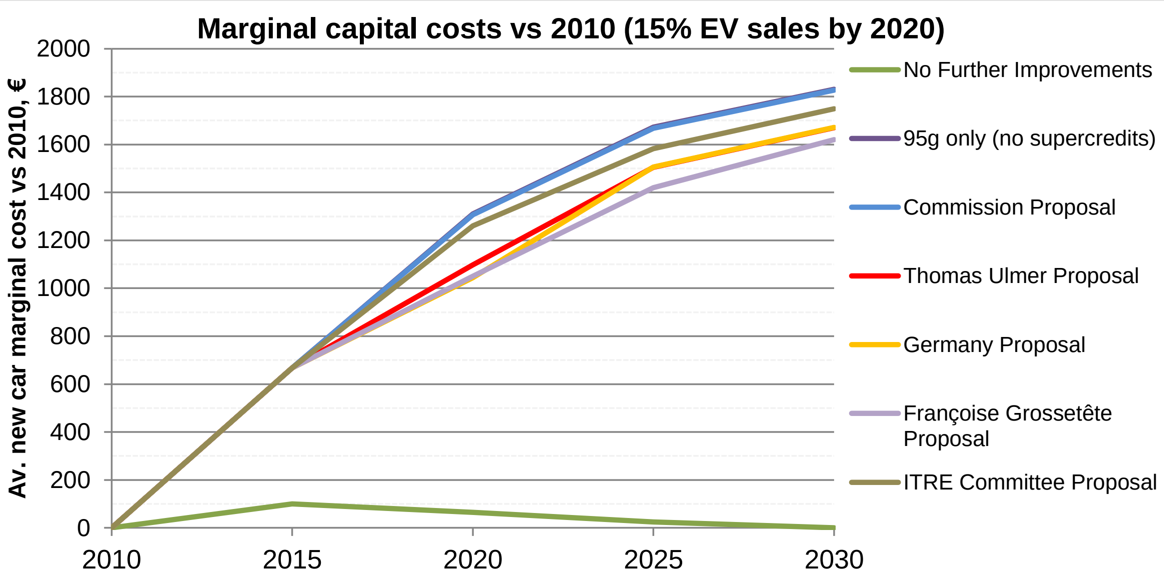
Notes: Marginal capital costs for conventional petrol and diesel ICE vehicles were estimated based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

Figure 2-26: Estimated impact on average new car marginal manufacturing costs for different proposals based on EV sales at 5% by 2020, difference vs no supercredits



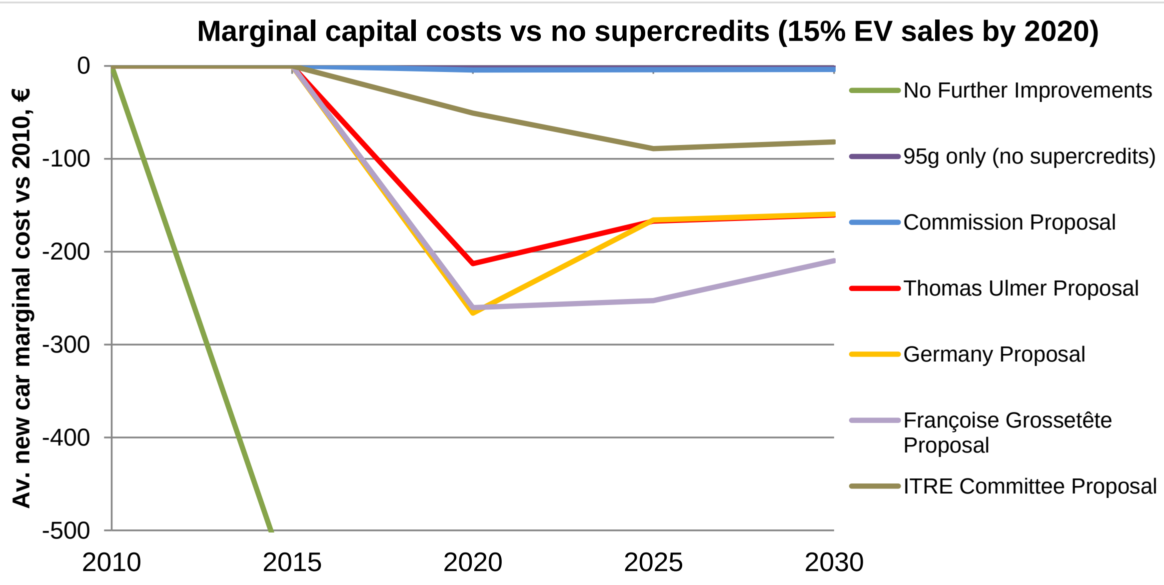
Notes: Marginal capital costs for conventional petrol and diesel ICE vehicles were estimated based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

Figure 2-27: Estimated impact on average new car marginal manufacturing costs for different proposals, based on EV sales at 15% by 2020, difference vs 2010 costs



Notes: Marginal capital costs for conventional petrol and diesel ICE vehicles were estimated based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

Figure 2-28: Estimated impact on average new car marginal manufacturing costs for different proposals based on EV sales at 15% by 2020, difference vs no supercredits



Notes: Marginal capital costs for conventional petrol and diesel ICE vehicles were estimated based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

2.3.1.3 New vehicle lifetime fuel costs

The following Figure 2-29 to Figure 2-32 provide a summary (for the 5% and 15% 2020 EV sales share cases) of the potential impacts of the different scenarios/proposals on the average lifetime fuel bill for new car owners in the EU – i.e. including taxes at their current levels but factoring in anticipated increases to the cost of oil (from EC, 2012a).

In the analysis we have assumed that the average car typically drives ~12,000 km/year over a 14 year vehicle lifetime.

The charts show that in the absence of further improvements the lifetime fuel cost could increase (from ~€14,100 for the average new vehicle in 2010) by almost €1,700 (11.8% on 2010) for cars purchased in 2030, relative to those purchased in 2010. The charts also show that, compared to the no supercredits case, the proposals leading to the highest average new vehicle emissions, also lead to by far the highest lifetime fuel costs. Lifetime fuel costs could be higher by €730 versus no supercredits for 2020 in the 5% EV sales case and by €2,270 for 15% EV sales under the Françoise Grossetête Proposal. The corresponding figures for 2030 are €570 (via 5% EV sales share in 2020) and €1,440 (via 15% EV sales).

Overall, it can be seen that the estimated increases in the typical car lifetime fuel costs to the consumer for different proposals (relative to the no supercredits case) very significantly outweigh the estimated reductions in manufacturing costs (by up to 4–9 times in 2020 for 5%-15% EV sales shares). This further reinforces the earlier conclusion (in section 2.2.1.2) that it would seem prudent to avoid ULEV system designs that could potentially lead to significant weakening of the CO_2 target, as besides not necessarily providing a higher level of incentive to maximise EV sales over alternatives they would seem also likely to result in greater net costs to the consumer over the lifetime of the vehicle.

Figure 2-29: Estimated impact on average new car lifetime fuel costs for different proposals, based on EV sales at 5% by 2020, difference vs 2010 costs

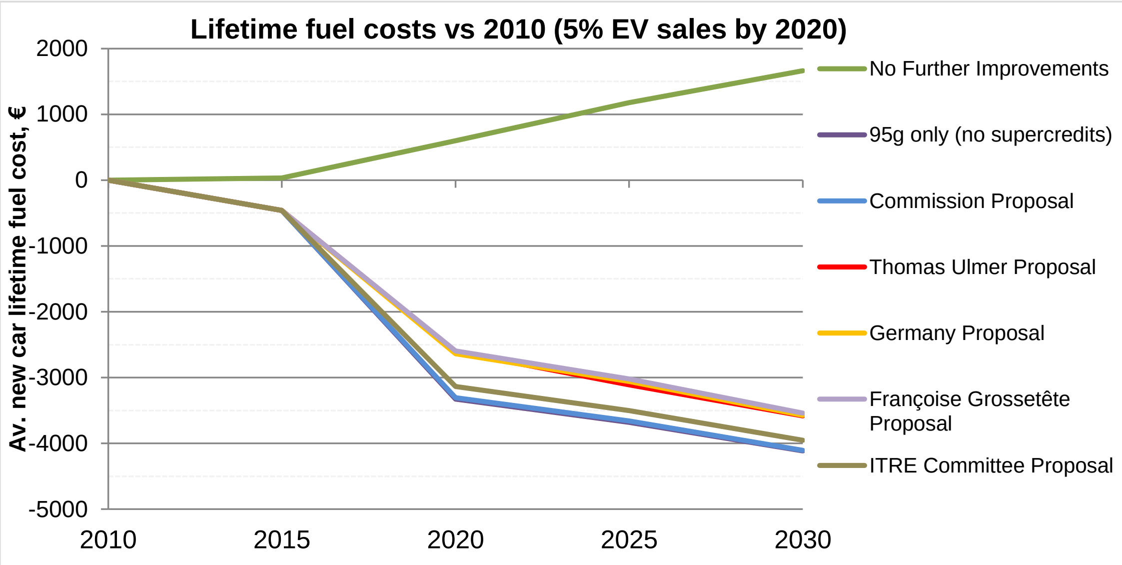


Figure 2-30: Estimated impact on average new car lifetime fuel costs for different proposals, based on EV sales at 15% by 2020, difference vs 2010 costs

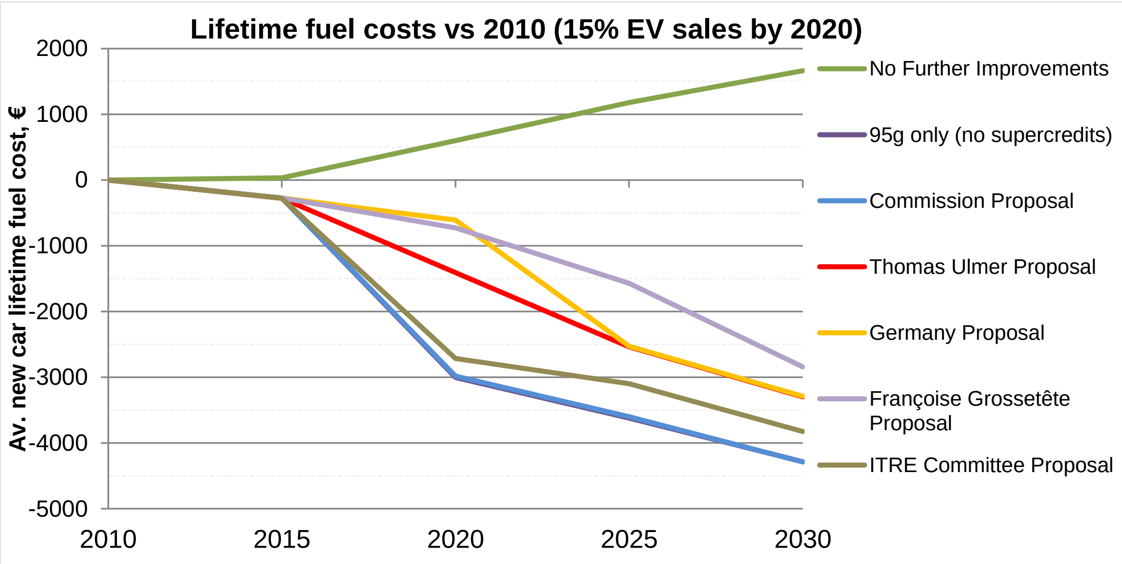


Figure 2-31: Estimated impact on average new car lifetime fuel costs for different proposals based on EV sales at 5% by 2020, difference vs no supercredits

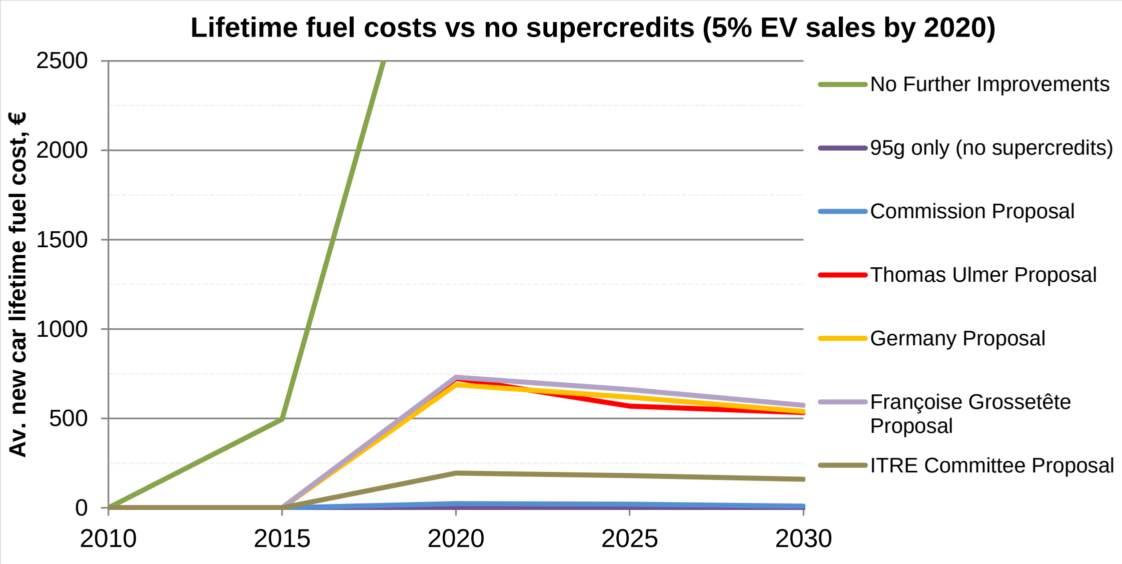
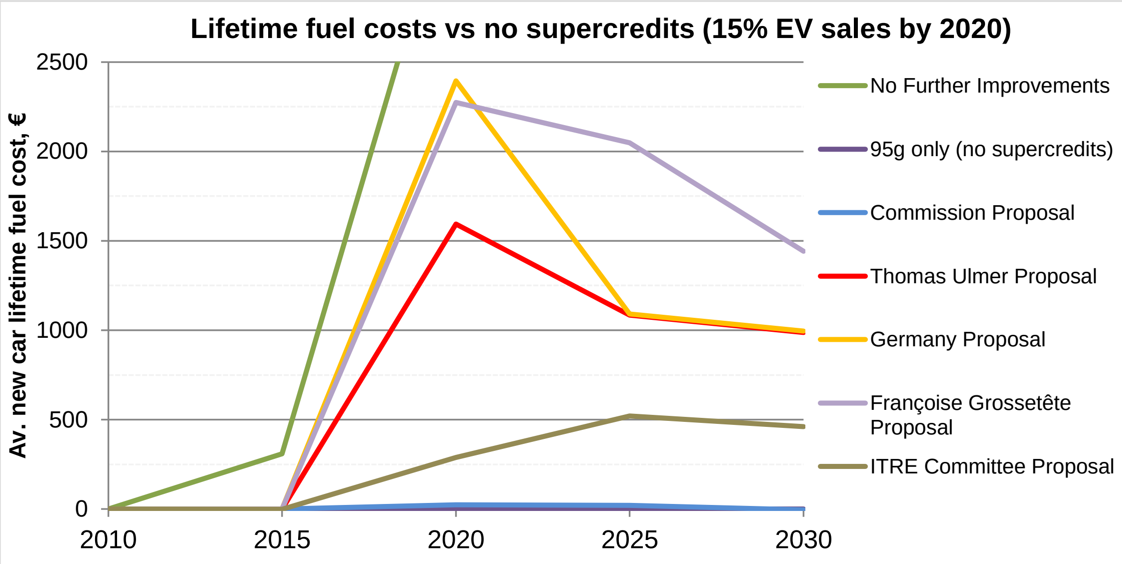


Figure 2-32: Estimated impact on average new car lifetime fuel costs for different proposals based on EV sales at 15% by 2020, difference vs no supercredits



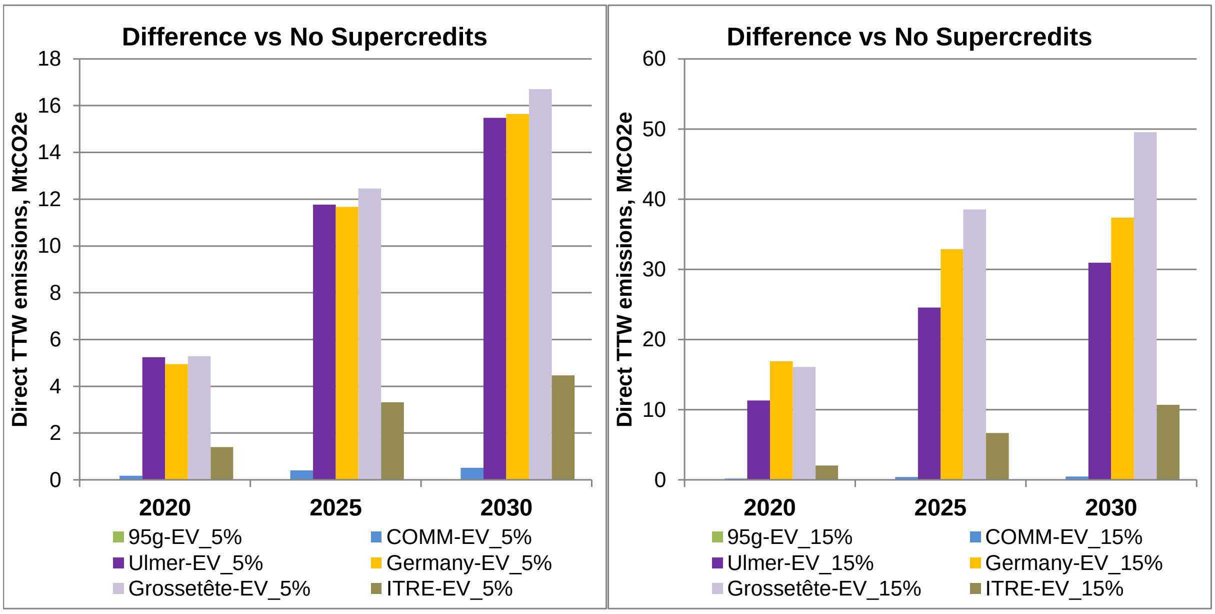
2.3.2 Impacts on GHG emissions from the EU car fleet

The potential impacts on overall fleet-wide emissions from EU cars are illustrated for different scenarios in comparison to the no supercredits case in Figure 2-33 (direct CO_2 emissions only) and Figure 2-34 (complete WTW GHG emissions from fuel production and use).

These charts show that for the 5% EV deployment scenario direct CO_2 emissions could be 5.0-5.3 $MtCO_2e$/yr higher than for the no supercredits case in 2020 and 15.5-16.7 $MtCO_2e$/yr by 2030 under the Ulmer/Germany/Grossetête proposals. (These figures represent ~1.0%-1.1% additional GHG emissions from cars for 2020 vs no supercredits, and ~4.4%-4.7% for 2030). In comparison, the Industry Committee recommendation would limit this increase to a 1.4 $MtCO_2e$/yr in 2020 and 4.5 $MtCO_2e$/yr by 2030, over the no supercredits case (0.3% and 1.3% of total GHG emissions respectively). Full fuel WTW GHG emissions are correspondingly higher in all cases (by ~10-20%) for 2020 and 2030.

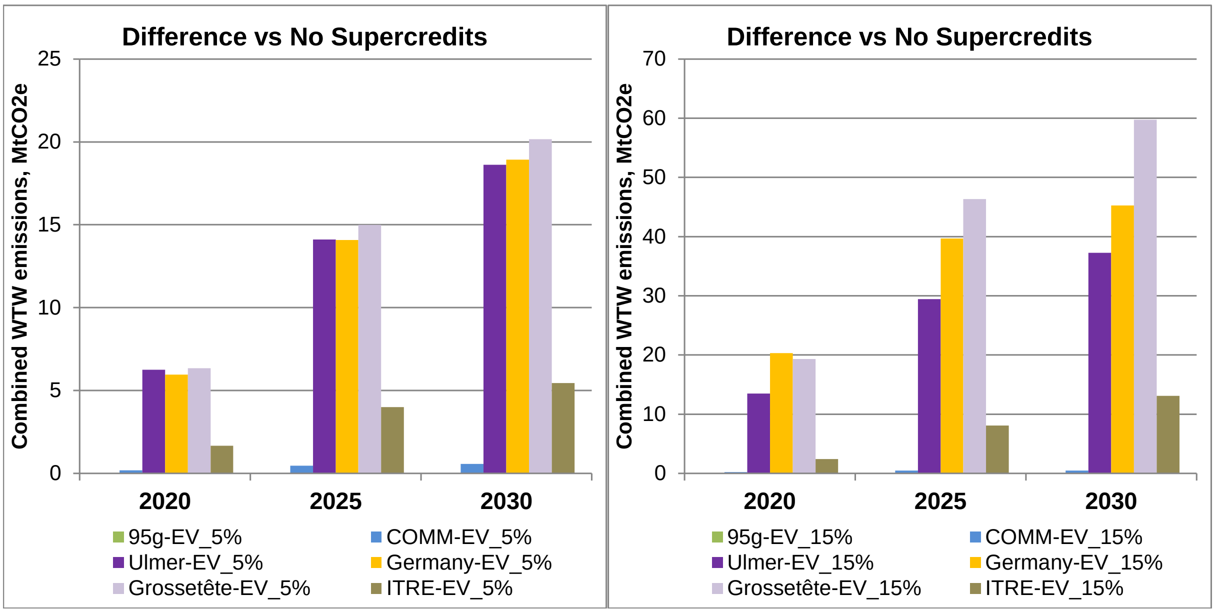
For the 15% EV deployment scenario, the differences between the different proposals is further magnified, with direct CO_2 emissions being ~50 $MtCO_2e$/yr higher than for the no supercredits case in 2030 in the most extreme case (and WTW emissions ~60 $MtCO_2e$/yr). This figure represents an additional 14.5% on top of the total GHG emissions from cars in 2030 for the no supercredits case (~341 $MtCO_2e$/yr).

Figure 2-33: Summary comparison of the potential impacts on total direct TTW CO_2 emissions from the EU car fleet for different proposals compared to the no supercredits case, assuming 5% or 15% sales of EVs by 2020



5% EV Sales by 2020 **15% EV Sales by 2020**

Figure 2-34: Summary comparison of the potential impacts on total fuel WTW GHG emissions from the EU car fleet for different proposals compared to the no supercredits case, assuming 5% or 15% sales of EVs by 2020



5% EV Sales by 2020 **15% EV Sales by 2020**

2.3.3 Impacts on fleet-wide fuel costs to drivers

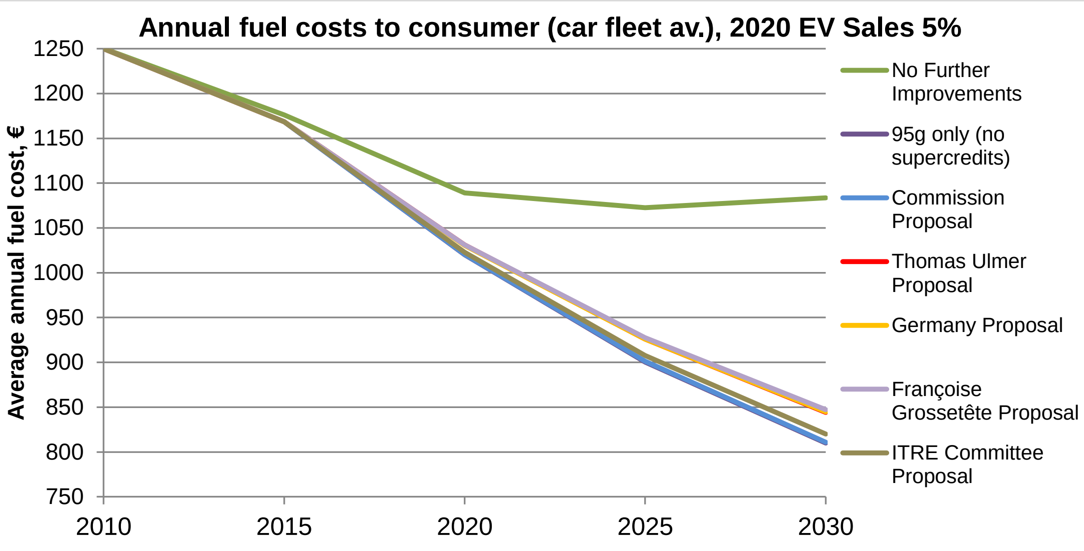
The following Figure 2-35 and Figure 2-37 provide a summary of the potential impacts of the different scenarios/proposals on the average annual fuel bill for car owners in the EU for the 5% and 15% 2020 EV sales cases respectively – i.e. including taxes at their current levels but factoring in anticipated increases to the cost of oil (from EC, 2012a). An assessment of the potential impacts on lifetime consumer fuel costs for new cars only is provided in an earlier section (see Figure 2-29 to Figure 2-32).

The charts show that even under the no further improvements scenario, fleet-wide annual fuel bills per car are expected to decline to 2025 due to the removal of older, less efficient vehicles from the fleet over time. After 2025, the annual fuel bill would be expected to rise as the vast majority of the older vehicles will have been removed from the fleet and oil prices continue to rise.

In all scenario cases analysed the potential reduction in the average annual fuel bill is calculated to be substantial. Under the 5% EV sales case by 2020 fuel bills could be up to €230 lower than 2010, and ~€70 lower than if there were no further improvements. The corresponding figures for 2030 are €440 lower than 2010, and €275 lower than for no further improvements.

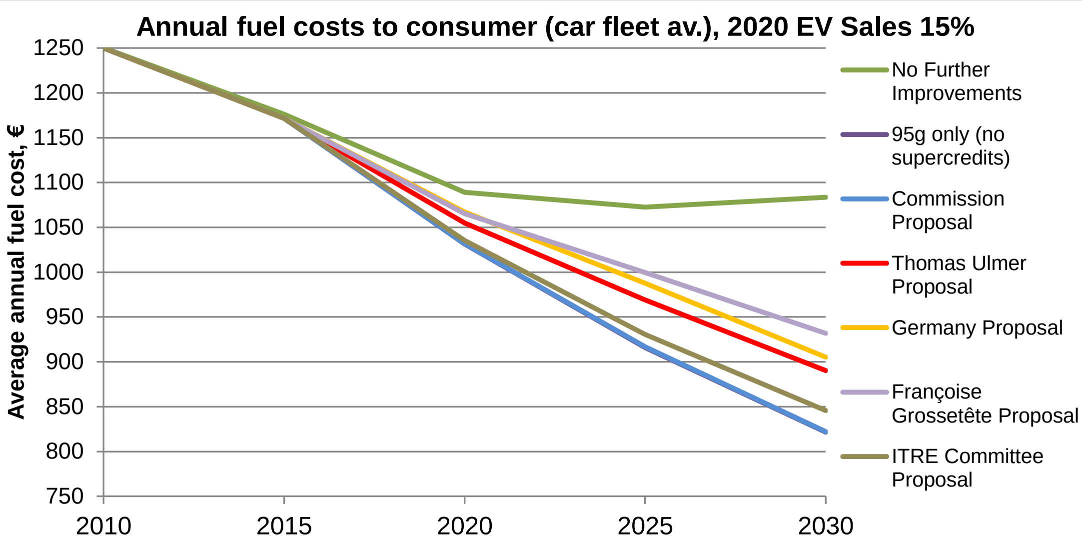
For the 5% EV deployment scenario, the difference in the average annual fuel bill between the various proposals is limited to around €11/yr in 2020 and €37/yr by 2030. However, as the proportion of new EV sales is increased, the differences between the different scenarios become more significant, reaching €36/yr in 2020 and €110/yr by 2030 for the 15% EV deployment scenario. In this case the savings in annual fuel bills for the Grossetête proposal vs no further improvements in vehicle efficiency are only around 41% of those from the 5% EV deployment scenario by 2020 and 64% by 2030.

Figure 2-35: Summary of the potential impacts on average annual fuel costs to the consumer (for the whole car fleet) for different proposals, for 5% EV sales by 2020



Average annual fuel cost,€	2010	2015	2020	2025	2030
No Further Improvements	€ 1,250	€ 1,176	€ 1,089	€ 1,073	€ 1,084
95g only (no supercredits)	€ 1,250	€ 1,168	€ 1,020	€ 900	€ 810
Commission Proposal	€ 1,250	€ 1,168	€ 1,020	€ 901	€ 811
Thomas Ulmer Proposal	€ 1,250	€ 1,168	€ 1,031	€ 926	€ 844
Germany Proposal	€ 1,250	€ 1,168	€ 1,031	€ 926	€ 845
Françoise Grossetête Proposal	€ 1,250	€ 1,168	€ 1,031	€ 927	€ 847
ITRE Committee Proposal	€ 1,250	€ 1,168	€ 1,023	€ 908	€ 820

Figure 2-36: Summary of the potential impacts on average annual fuel costs to the consumer (for the whole car fleet) for different proposals, for 15% EV sales by 2020

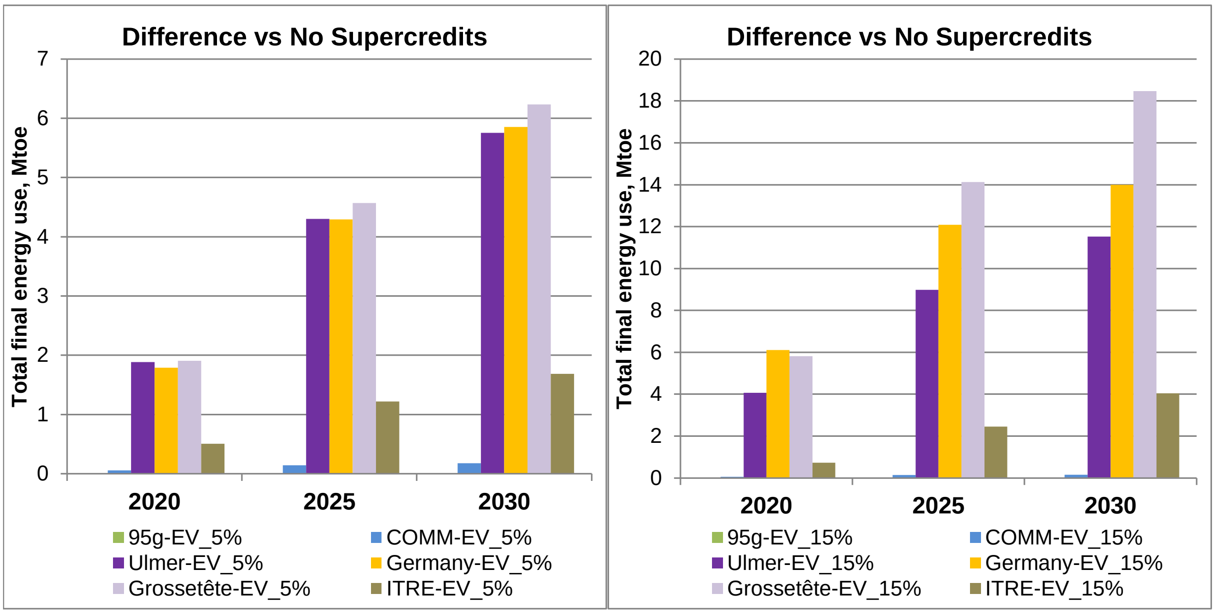


Average annual fuel cost,€	2010	2015	2020	2025	2030
No Further Improvements	€ 1,250	€ 1,176	€ 1,089	€ 1,073	€ 1,084
95g only (no supercredits)	€ 1,250	€ 1,172	€ 1,031	€ 916	€ 821
Commission Proposal	€ 1,250	€ 1,172	€ 1,032	€ 917	€ 822
Thomas Ulmer Proposal	€ 1,250	€ 1,172	€ 1,055	€ 969	€ 890
Germany Proposal	€ 1,250	€ 1,172	€ 1,067	€ 988	€ 905
Françoise Grossetête Proposal	€ 1,250	€ 1,172	€ 1,065	€ 1,000	€ 932
ITRE Committee Proposal	€ 1,250	€ 1,172	€ 1,035	€ 931	€ 846

2.3.4 Impacts on fuel consumption and oil import costs

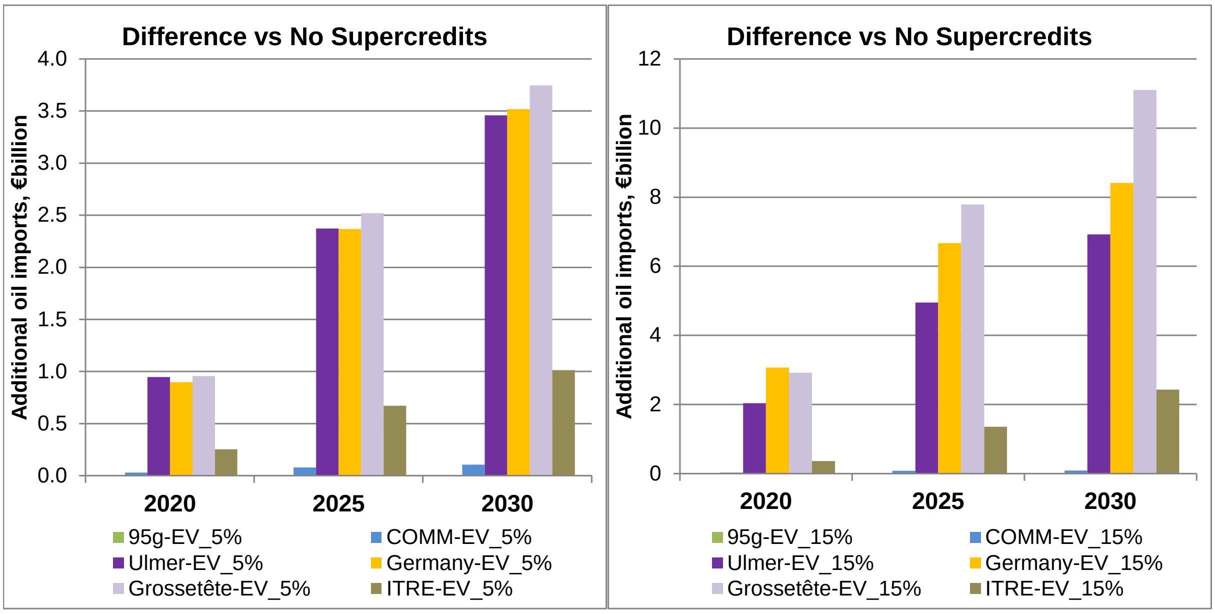
The following Figure 2-37 and Figure 2-38 provide a summary for the 5% and 15% EV 2020 sales cases on the estimated impacts of different proposals on total annual EU car fuel consumption and the corresponding cost of oil imports into the EU in comparison to the no supercredits case. The results of the analysis show that the additional costs of oil imports (compared to no supercredits) resulting from the Thomas Ulmer, Germany, or Grossetête proposals could range from €0.90-€3.06 billion/yr (1.8-6.1 Mtoe of energy) for 2020 across the range of 5%-15% EV 2020 deployment scenarios (equivalent to an additional ~1%-3.5% on the total car energy consumption of ~171 Mtoe with no supercredits). The equivalent figures for the year 2030 are €3.46-€11.10 billion/yr (5.8-18.5 Mtoe of energy, equivalent to an additional ~4.3%-13.7% on the total car energy consumption of ~151 Mtoe with no supercredits). In comparison, the Industry Committee's (ITRE) recommendation could limit this increase to €0.25-€0.36 billion/yr by 2020 (+0.3%-0.4% on the total for no supercredits) and €1.01-€2.43 billion/yr by 2030 (+1.3%-3.0% on the total for no supercredits).

Figure 2-37: Summary of potential impacts on total energy consumption of the EU car fleet for different proposals vs the no supercredits case, for 5% sales of EVs by 2020



5% EV Sales by 2020 **15% EV Sales by 2020**

Figure 2-38: Summary of potential impacts on in-year cost of oil imports for different proposals vs the no supercredits case, for 5% and 15% sales of EVs by 2020



5% EV Sales by 2020 **15% EV Sales by 2020**

Notes: Based on projected oil import costs from the EC's impact assessment for the proposed amendments to the car CO_2 regulations (EC, 2012a) and assuming a currency conversion of 1.3 $/€.

3 Summary and Conclusions

This study analysed the potential impacts of different supercredit and flexible mandate measures that have been proposed for the EU's car CO_2 regulation, and the sensitivities around key design parameters for supercredit-based systems.

A general overall finding is that most of the proposals assessed (and all of the super-credit proposals) by themselves do not effectively provide an incentive for higher levels of ULEV uptake. In fact, only the flexible mandate proposal from Kathleen van Brempt appeared to provide a clear/strong incentive to target intermediate EV sales over lower level sales, when only considering the marginal manufacturing costs. This is because in general the other proposals don't lower the additional manufacturing costs sufficiently so that greater shares of EVs become more attractive than smaller shares. In addition, in all the proposals assessed the estimated increase in lifetime fuel costs to the consumer resulting from the effective weakening the target very significantly outweighed the corresponding estimated reductions in manufacturing costs. Therefore on this basis it would seem prudent to avoid ULEV system designs that could potentially lead to significant weakening of the CO_2 target. Another key overall conclusion is that most proposals for supercredits carry a greater risk of weakening the effectiveness of the 2020 target than the flexible mandate schemes.

The following is a summary of additional findings and conclusions that may be drawn from the analysis performed:

Design of measures:

- In terms of supercredit designs, the possibility of banking supercredits earned before 2020 can have by far the greatest negative impact in their potential to undermine the 2020 targets – this can effectively double the impact of other design parameters.
- Supercredit multipliers are the next most important design aspect: at multiplier levels below 1.5 there is only a relatively small amount of weakening, as the multiplier increases above of 1.5 there is a progressively much greater impacts on the effectiveness of the 2020 target if no cap is applied to the number of eligible vehicles or the weakening of manufacturer targets.
- Another key parameter is the absence or presence, and the design of a cap. Whilst the European Commission has proposed a cumulative cap on each manufacturers' number of qualifying vehicles to limit the weakening of the 2020 target, MEPs have proposed both cumulative sales caps and annual caps on the weakening of each manufacturers' target in terms of gCO_2/km.
- The basis of the ULEV qualifying threshold appears to have a lower-level impact on the effective weakening of the CO_2 target for new cars. Higher thresholds might potentially allow smaller full HEVs to qualify for supercredits, however.
- Flexible mandate based measures and supercredit measures with caps on ULEV sales (such as the Commission proposal) generally result in a much lower level of weakening of the 2020 CO_2 target (depending on the level of the cap).
- For both supercredits and flexible mandate measures their period of application determines the level of weakening as it defines the point in time at which, in the absence of further targets, the 2020 target effectively needs to be reached.

Wider EU-impacts of key proposals:

- The wider EU-impacts of key proposals were also evaluated for the period to 2030. Here the duration of the measures is particularly important, since those that are set over a longer period have the potential for greater longer-term impacts. These impacts were estimated for 5% and 15% EV sales shares by 2020 in terms of EU-wide GHG emissions, the costs of oil imports and the annual fuel bill of EU car owners. In general, increasing the 2020 sales share for EVs significantly increases the absolute differences observed between the different assessed proposals in the analysis (i.e. in levels of weakening to the CO_2 target, lifetime fuel costs to the consumer, and in manufacturing costs).

- The wider impacts analysis has indicated that the proposals from Thomas Ulmer [AM 6], Germany and Françoise Grossetête [AM 100] could potentially result in significant negative impacts by 2030. The impact on average new vehicle CO_2 emissions from these proposals is expected to narrow between 2020 and 2030, but could still be up to 12 g/km TTW (17 g/km WTW) higher by 2030 (via a 15% EV sales share at 2020, versus no supercredits). The estimated increase in lifetime fuel costs to the consumer by 2030 for these proposals (up to €570-€1,440 per car via a 2020 EV sales share of 5%-15%) also significantly outweigh the corresponding estimated reductions in average vehicle manufacturing costs (up to €125-€210 per car), versus the case with no supercredits.
- In terms of EU-wide GHG emissions the Thomas Ulmer [AM 6], Germany and Françoise Grossetête [AM 100] proposals could result in an increase in fuel WTW emissions of up to 59.7 $MtCO_2e$/yr (via a 15% EV share at 2020) by 2030 versus the case without any supercredits. Correspondingly, by 2030 the costs of oil imports could increase by up to €11 billion/yr, and the average annual fuel bill of all EU car owners could increase by up to 110 €/yr per car (via a 15% EV share at 2020) by 2030.
- The compromise proposal voted by the Industry (ITRE) Committee (and similar to that also voted by the TRAN Committee), caps the degree to which the 2020 target can be weakened. This results in significantly lower-level increases (versus the no supercredits case) in WTW emissions, consumer fuel costs and oil import costs – at ~25%-30% of those of the Thomas Ulmer, Germany and Françoise Grossetête proposals. The Commission proposal results in minimal negative impacts versus no supercredits.

In summary, the different supercredit and flexible mandate options assessed all offer the potential to lower the costs to manufacturers (in terms of marginal manufacturing costs) of ULEV uptake, compared to the case where there are no ULEV incentives. However, their ability to incentivise uptake purely on the basis of reduced overall marginal costs appears limited, since in every case lower manufacturing costs can be achieved with lower deployment levels of EVs. Additionally, there are other factors like consumer fuel costs (and the overall total cost of ownership, TCO) that are also important in this equation. It is important to highlight that there is a trade-off between lower manufacturer costs, higher CO_2 emissions, oil imports and consumer fuel costs. Whilst the car manufacturing costs are lower, this is counter-acted by a greater increase in costs elsewhere. This is illustrated in the following Table 3-1 which provides a comparison of the change in estimated marginal manufacturing costs and lifetime fuel costs to the consumer for the key proposals analysed.

Table 3-1: Summary of the potential impacts on estimated manufacturing costs and lifetime fuel costs to the consumer for different proposals, versus no supercredits

Change in average cost per vehicle, €	5% EV sales by 2020			15% EV sales by 2020		
	2020	2025	2030	2020	2025	2030
Marginal manufacturing cost versus no supercredits case						
Commission Proposal	-€5	-€5	-€5	-€4	-€4	-€4
Thomas Ulmer Proposal	-€146	-€121	-€118	-€213	-€167	-€161
Germany Proposal	-€139	-€129	-€118	-€266	-€166	-€159
Françoise Grossetête Proposal	-€147	-€137	-€125	-€260	-€253	-€210
ITRE Committee Proposal	-€43	-€40	-€36	-€51	-€89	-€82
Lifetime fuel cost to consumer versus no supercredits case						
Commission Proposal	+€23	+€21	+€9	+€23	+€21	-€4
Thomas Ulmer Proposal	+€724	+€570	+€534	+€1,594	+€1,084	+€988
Germany Proposal	+€689	+€620	+€539	+€2,395	+€1,092	+€995
Françoise Grossetête Proposal	+€731	+€661	+€574	+€2,274	+€2,049	+€1,442
ITRE Committee Proposal	+€194	+€180	+€160	+€288	+€520	+€460

Change in average cost per vehicle, €	5% EV sales by 2020			15% EV sales by 2020		
	2020	2025	2030	2020	2025	2030
Total change in manufacturing costs + lifetime fuel costs to the consumer versus no supercredits						
Commission Proposal	+€18	+€16	+€5	+€19	+€17	-€8
Thomas Ulmer Proposal	+€578	+€449	+€416	+€1,381	+€917	+€827
Germany Proposal	+€550	+€491	+€422	+€2,129	+€926	+€836
Françoise Grossetête Proposal	+€584	+€524	+€449	+€2,014	+€1,796	+€1,232
ITRE Committee Proposal	+€151	+€140	+€124	+€237	+€431	+€378

Applying a cap on either the numbers of qualifying vehicles or, preferably, on the degree of weakening of the 95 g/km target for 2020 would seem to be a useful way to limit the potential negative impacts of high EV sales and also provide for a greater degree of predictability in targeting necessary improvements to conventional ICE vehicles. It should also be noted that in reality the degree to which any effective weakening might be realised (even without an early target for 2025) is dependent on the confidence manufacturers have in achieving a given level of sales of EVs by 2020 and the impact of this on their forward planning.

This analysis did not include any scenarios in which further emission reduction targets are set beyond 2020. However, it is safe to conclude that there will also be a strong interaction between ULEV schemes and those further targets. Setting a suitably strong CO_2 target for 2025 would limit the degree to which the 2020 target might be weakened by the different proposals.

4 References

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Appendices

Appendix 1: Summary of additional assumptions used in the scenario analysis

Appendix 2: Summary and definition of proposed amendments to the car regulations relating to ULEV incentives

Appendix 3: Expanded summary of results from the study analysis

Appendix 1 - Summary of additional assumptions used in the scenario analysis

As indicated in the main sections of this report, the analysis performed used a combination of MS Excel based calculation frameworks and the SULTAN tool.

The different powertrain categories assessed using the developed calculation frameworks and in the SULTAN modelling:

- **ICEs**: Internal combustion engines, as used in conventional vehicles powered by petrol, diesel, LPG and natural gas.
- **HEVs**: Hybrid electric vehicles. Powered by both a conventional engine and an electric battery, which is charged when the engine is used. There is no external charging (i.e. no option to plug the vehicle in to top up the battery).
- **Advanced electric vehicles (EVs):**
  - **PHEVs (parallel)**: Plug-in hybrid electric vehicles. Powered by both a conventional engine and an electric battery, which can be charged from the electricity grid. The battery is larger than that in an **HEV**, but usually significantly smaller than that in a battery electric vehicle (**BEV**). These vehicles can be designed with the ICE and electric motor in parallel configurations, or in series (where they are often referred to as range-extended electric vehicles, **REEVs**).
  - **REEVs (series PHEVs).** Range-extended electric vehicles. These are a sub-type of PHEV where the ICE and electric motor operate in a series configuration.
  - **BEVs**: Battery electric vehicles, also referred to as a pure electric vehicle. Runs on electricity only and does not have a conventional engine.
  - **FCEVs**: Fuel cell electric vehicle. A vehicle powered by a fuel cell, which uses hydrogen as an energy carrier.

To simplify the analysis, FCEVs are not explicitly included in the scenario analysis performed, because (a) for the purposes of the CO_2 regulations their impact is similar to BEVs, (b) currently they are not anticipated to be deployed at as significant levels as other advanced EVs by 2020.

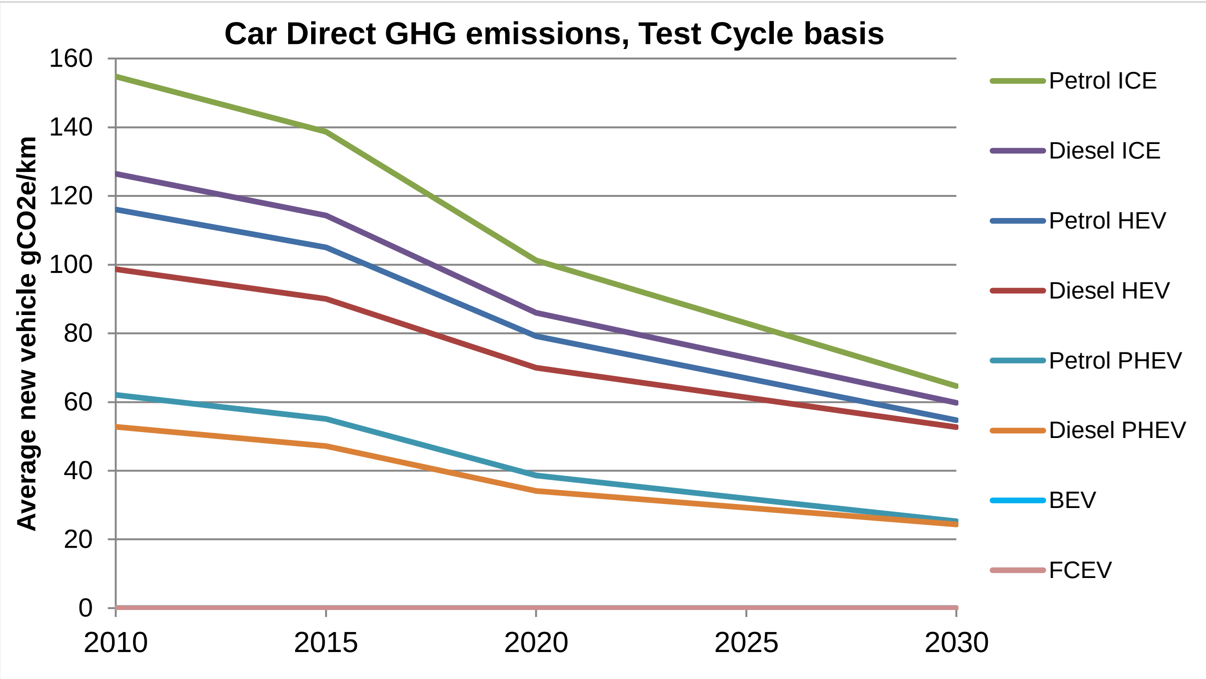
In addition to the assumptions outlined in the main body of the report, other key design choices and assumptions made in the analysis are summarised as follows below:

- Figure A1-1 provides an illustration of the trajectory in relative performance of different powertrains (in gCO_2/km) to 2030 that has been used in the analysis. A summary of the methodological basis, assumptions and datasets used to derive these figures is provided in Appendix 1 of Ricardo-AEA (2012).
- The distribution of both total numbers of vehicles and of conventional ICE vehicles (petrol, diesel, LPG, natural gas) is assumed to be constant from 2010 onwards.
- It is assumed in the calculations that the relative % share of petrol and diesel fuelled vehicles remains constant from 2010 onwards (i.e. for ICE but also for HEVs, PHEVs and REEVs). It is assumed that the sales % of LPG and natural gas fuelled vehicles remains constant from 2010 onwards.
- No special accounting is made in the calculations for derogations/special arrangements for low volume / niche manufacturers. Provisions in the regulations set reduction targets consistent with those of large volume manufacturers and therefore this is unlikely to significantly affect the overall results.
- For the purposes of modelling caps to sales numbers from individual manufacturers in terms of overall EU-level cap, it is assumed that there will be 25 manufacturer

'groups' in 2020. (The number of manufacturers selling >10,000 cars per year in 2010 was 23).

- The marginal capital costs and gCO_2 per km (versus 2010 vehicles) of full HEVs, PHEVs, REEVs and BEVs are assumed to follow the same trajectories as those used in previous analysis by Ricardo-AEA for Greenpeace and T&E exploring possible car and van CO_2 emission targets for 2025 in Europe (Ricardo-AEA, 2012).
- The relative performance Full HEVs, PHEVs, REEVs and BEVs in terms of gCO_2/km savings versus conventional equivalent vehicles is assumed to be constant across different weight categories. This is a necessary simplification for the analysis, but in reality there is likely to be a degree of variation.
- The cost curves for medium sized cars from TNO et al (2011) were used to estimate average vehicle marginal capital costs for conventional ICE vehicles (petrol, diesel, LPG and natural gas). The default assumption was to use the Scenario C cost curves provided in Annex D of TNO et al (2011), since these were most consistent with the basis of the analysis from Ricardo-AEA (2012), taking into account the potential of weight reduction to reduce emissions. Scenario A cost curves from Annex B of TNO et al (2011) were used as a sensitivity comparison. These curves were also used in the Commission's Impact assessment for the proposed amendments to the car CO_2 regulations (EC, 2012a).
- The default assumption for the basis of credits (in gCO_2/km) given to qualifying ULEVs is a weighted average based on the mix of qualifying vehicles. Sensitivities were also carried out on the basis of two alternate assumptions (i) all qualifying vehicles are ZEVs (i.e. BEV or FCEV), (ii) all qualifying vehicles exactly meet the average qualifying threshold).

Figure A1-1: Car direct CO_2 emissions (g/km) by powertrain type, test cycle basis



Notes: Direct CO_2 emissions are measured on the NEDC test cycle and do not include accounting rules such as super credits. Direct emissions from battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV) are zero.

Appendix 2 – Summary and definition of proposed amendments to the car regulations relating to ULEV incentives

A summary and definition of the various proposed amendments to the car regulations relating to ULEV incentives is provided in Table A2-1 to Table A2-4.

In some proposals the ULEV qualification criteria are related in some form to the modality limit value curve, which provides for different average targets for different manufacturers based on their different average characteristics. A summary explanation of the basis and reason for the limit value curve is provided in the Commissions Impact Assessment (EC, 2012a):

"The targets in the Regulations are set according to the limit value curves expressed as formulae (in annexes I to the Regulations). The limit value curves differ for cars and vans and are designed in such a way that heavier cars/vans are allowed higher emissions than lighter cars/vans while preserving the overall fleet average. This means that only the fleet average is regulated, so manufacturers are still able to make vehicles with emissions above their indicative targets if these are offset by other vehicles which are below their indicative targets. In order to comply with the regulation, a manufacturer will have to ensure that the overall sales-weighted average of all its new cars or vans does not exceed the relevant limit value curve."

Table A2-1: Summary definition of individual proposals for supercredit-based ULEV incentives, part 1

	Commission	Thomas Ulmer	VDA	Germany	ACEA / Jan Březina / Grossetête	Francisco Sosa Wagner	Alejo Vidal-Quadras	Evžen Tošenovský
Amendment No	N/A	6	N/A	N/A	62, 100	58	59	64
Eligibility	<35 g	<50 g or 40 km electric drive range	50% of weight-based CO_2 limit	< 50% of weight-based CO_2 limit, < 65 g, no hybrids	<50 g or 50% of weight-based CO_2 limit <70 g	<50 g	<45 g	<50 g or 50% of weight-based CO_2 limit <70 g
Limit curve gradient from 2020*	New (a = 0.0333)	New (a = 0.0333)	Original (a = 0.0457)	Original (a = 0.0457)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)
Multiplier								
2016	1	2.5	2.5	3.5	2	1	2	1.5
2017	1	2.5	2.5	3	2	1	2	1.5
2018	1	2	2.5	2.5	2	1	2	1.5
2019	1	2	2.5	2	2	1	2	1.5
2020	1.3	2	2.5	1.5	2	2	1	1.5
2021	1.3	1	1	1	2	1.7	1	1.5
2022	1.3	1	1	1	2	1.5	1	1.5
2023	1.3	1	1	1	2	1.3	1	1.5
2024	1	1	1	1	2	1	1	1.5
2025	1	1	1	1	2	1	1	1.5
Application Period	2020-2023	2016-2023	2016-2023	2016-2023	2016-2025	2020-2023	2016-2019	2016-
Banking	NO	YES	YES	YES	YES	NO	NO	NO
Savings Phase	N/A	2016-2020	2016-2020	2016-2020	2016-2025	N/A	N/A	N/A
Use Phase	N/A	2016-2023	2020-2023	2020-2023	2016-2025	N/A	N/A	N/A
Non-compliance upper limit	N/A	15% of emissions target	N/A	N/A	N/A	N/A	N/A	N/A
Sales Cap	Applies up to 20,000 cumulative sales per manufacturer.	NO	NO	NO	NO	Applies up to 2% of cumulative sales per manufacturer.	NO	NO

* Weight based limit curve Specific emissions of CO_2 = 95 + a × (M – M0); Where:
M = mass of the vehicle in kilograms (kg), M_0 = the average mass value adopted pursuant to Article 13(2), a = 0.333 (from 2020).

Table A2-2: Summary definition of individual proposals for supercredit-based ULEV incentives, part 2

	Kent Johansson	Silvia-Adriana Ţicău	Adina-Ioana Vălean	Bernd Lange	Chris Davies	Weisgerber / Ferber	Florenz / Groote / Liese	Jo Leinen
Amendment No	65	67	72	71	85	86	87	88
Eligibility	<35 g	<50 g	<35 g	<35 g	<35 g	<50% of weight-based CO_2 limit	<50 g	<35 g
Limit curve gradient 2020 onwards*	New (a = 0.0333)	Original (a = 0.0457)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)
Multiplier								
2016	1	1	1	1	1	2.5	2.5	1
2017	1	1	1	1	1	2.5	2.5	1
2018	1	1	1	1	1	2	2	1
2019	1	1	1	1	1	2	2	1
2020	2	1.3	1.3	1.3	1.3	2	1	1.3
2021	2	1.3	1.3	1.3	1.3	1	1	1.3
2022	2	1.3	1.3	1.3	1.3	1	1	1.3
2023	2	1.3	1.3	1.3	1.3	1	1	1.3
2024	1	1	1	1	1	1	1	1
2025	1	1	1	1	1	1	1	1
Application Period	2020-2023	2020-2023	2020-2023	2020-2023	2020-2023	2016-2023	2016-2020	2020-2023
Banking	NO	NO	NO	NO	NO	YES	YES	NO
Savings Phase	N/A	N/A	N/A	N/A	NA	2016-2020	2016-2019	NA
Use Phase	N/A	N/A	N/A	N/A	NA	2016-2023	2016-2019	NA
Non-compliance upper limit	N/A	N/A	5 g cap per manufacturer	N/A	2 g cap per manufacturer	Applies only if manufacturers' do not exceed their target by more than 15%.	Applies only if manufacturers' do not exceed their target by more than 2g	2 g cap for each manufacturer
Sales Cap	Applies up to 20,000 cumulative sales per manufacturer.	Applies up to 20,000 cumulative sales per manufacturer.	Applies up to 20,000 cumulative sales per manufacturer.	Applies up to 1% of cumulative sales per manufacturer.	NO	NO	NO	NO

* Weight based limit curve Specific emissions of CO2 = 95 + a × (M – M0); Where:
M = mass of the vehicle in kilograms (kg), M_0 = the average mass value adopted pursuant to Article 13(2), a = 0.333 (from 2020).

Table A2-3: Summary definition of individual proposals for supercredit-based ULEV incentives, part 3

	Leinen / Van Brempt	Christofer Fjellner	Elena Oana Antonescu	Cristian Silviu Buşoi	De Veyrac / Vlasto	ITRE Committee	TRAN Committee
Amendment No	89	98	101	102	103	CA1	
Eligibility	<35 g	<50 g	<50 g	<50 g or <50% of weight-based CO_2 limit, <70 g	<50 g	<50 g	<50 g
Limit curve gradient from 2020*	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)	New (a = 0.0333)
Multiplier							
2016	1	1.5	2	1.5	1	1.5	1
2017	1	1.5	2	1.5	1	1.5	1
2018	1	1.5	2	1.5	1	1.5	1
2019	1	1.5	2	1.5	1	1.5	1
2020	1.3	1.5	2	1.5	1.3	1.5	1.5
2021	1.3	1.5	2	1.5	1.3	1.5	1.5
2022	1.3	1.5	2	1.5	1.3	1.5	1.5
2023	1.3	1.5	2	1.5	1.3	1.5	1.5
2024	1	1.5	2	1.5	1	1	1
2025	1	1.5	2	1.5	1	1	1
Application Period	2020-2023	2015-2025	2016-	2016-	2020-2023	2020-2023	2020-2023
Banking	NO	YES	NO	NO	NO	NO	NO
Savings Phase	NA	2016-2025	NA	NA	NA	NA	NA
Use Phase	NA	2016-2025	NA	NA	NA	NA	NA
Non-compliance upper limit	NA	NA	NA	NA	NA	2.5 g cap per manufacturer/per year	2.5 g cap per manufacturer/per year
Sales Cap	NA	NO	NO	NO	NO	NO	NO

* Weight based limit curve Specific emissions of CO_2 = 95 + a × (M – M0); Where:
M = mass of the vehicle in kilograms (kg), M_0 = the average mass value adopted pursuant to Article 13(2), a = 0.333 (from 2020).

Table A2-4: Summary definition of individual proposals for flexible mandate based ULEV incentives

<table>
<tr><th></th><th>T&E</th><th>Fiona Hall</th><th>Kathleen Van Brempt</th><th>Josefa Andrés Barea</th><th>Eider Gardiazabal Rubial</th><th>Judith Merkies</th></tr>
<tr><td>Amendment No</td><td>N/A</td><td>8</td><td>60</td><td>61</td><td>8</td><td>93</td></tr>
<tr><td>Eligibility</td><td></td><td><35 g</td><td><35 g</td><td><50 g</td><td><50 g</td><td></td></tr>
<tr><td>Market share</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>0-0.9%</td><td>1 g target reduction</td><td>2 g target reduction</td><td>4 g target reduction</td><td rowspan="4">1 g target reduction</td><td rowspan="4">1 g target reduction</td><td rowspan="7">N/A</td></tr>
<tr><td>1-1.9%</td><td></td><td>1 g target reduction</td><td>3 g target reduction</td></tr>
<tr><td>2-2.9%</td><td>N/A</td><td>N/A</td><td>2 g target reduction</td></tr>
<tr><td>3-3.9%</td><td rowspan="4">1 g target increase</td><td>1 g target increase</td><td>1 g target reduction</td></tr>
<tr><td>4-4.9%</td><td rowspan="3">2 g target increase</td><td>2 g target increase</td><td>NA</td><td>NA</td></tr>
<tr><td>5-5.9%</td><td rowspan="2">3 g target increase</td><td rowspan="2">2 g target increase</td><td rowspan="2">2 g target increase</td></tr>
<tr><td>>6%</td></tr>
<tr><td>Less than EU average</td><td></td><td></td><td></td><td></td><td></td><td>2g reduction per each 1%</td></tr>
<tr><td>More than EU average</td><td></td><td></td><td></td><td></td><td></td><td>2 g increase per each 1%</td></tr>
<tr><td>Application Period</td><td>From 2020 onwards</td><td>From 2020 onwards</td><td>From 2020 onwards</td><td>From 2020 onwards</td><td>From 2020 onwards</td><td></td></tr>
</table>

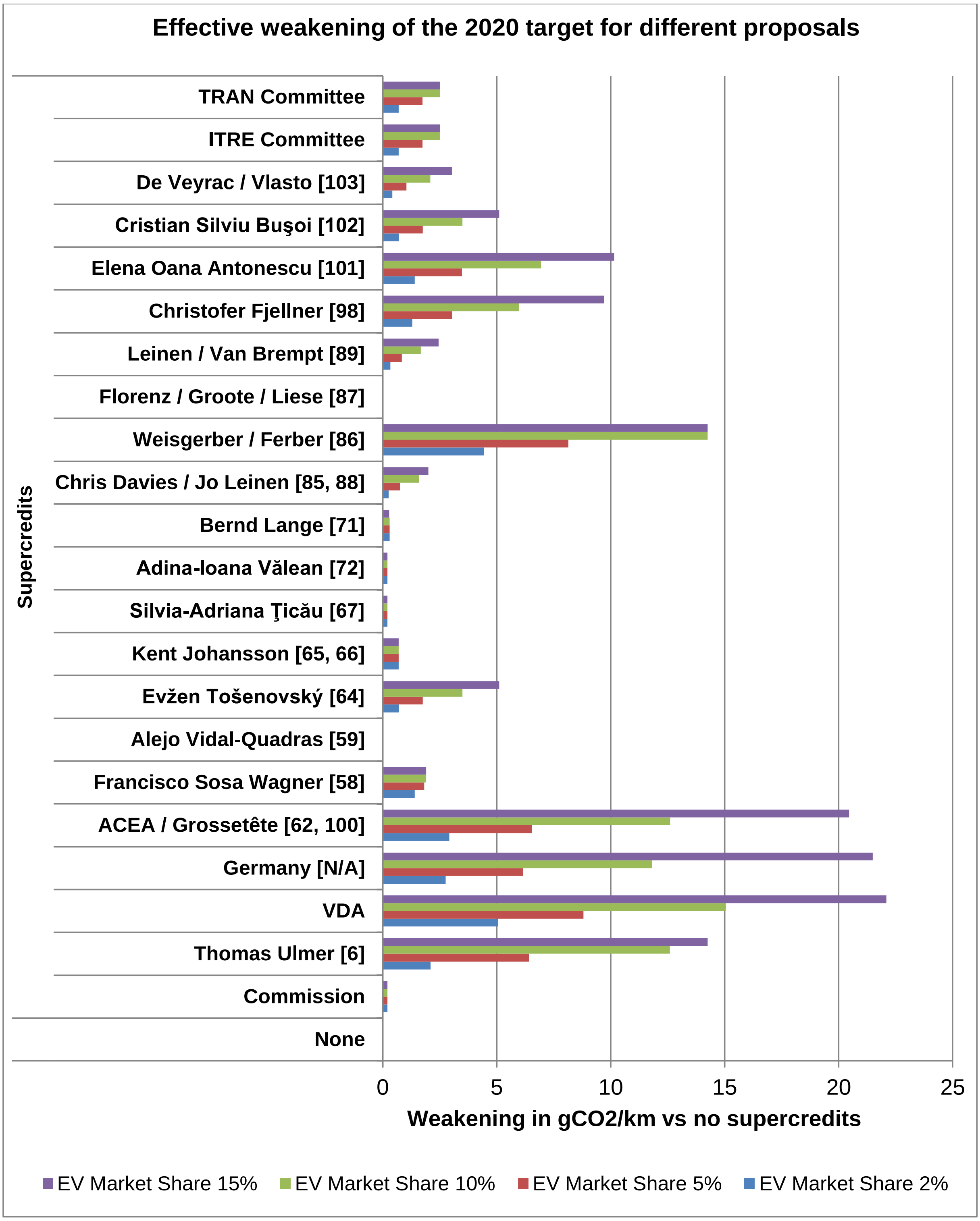
Appendix 3 – Expanded summary of results from the study analysis

This Appendix provides (a) an expanded summary of potential impacts of supercredit proposals, and (b) an expanded assessment of the sensitivity on cost assumptions.

Expanded summary of potential impacts of supercredit proposals

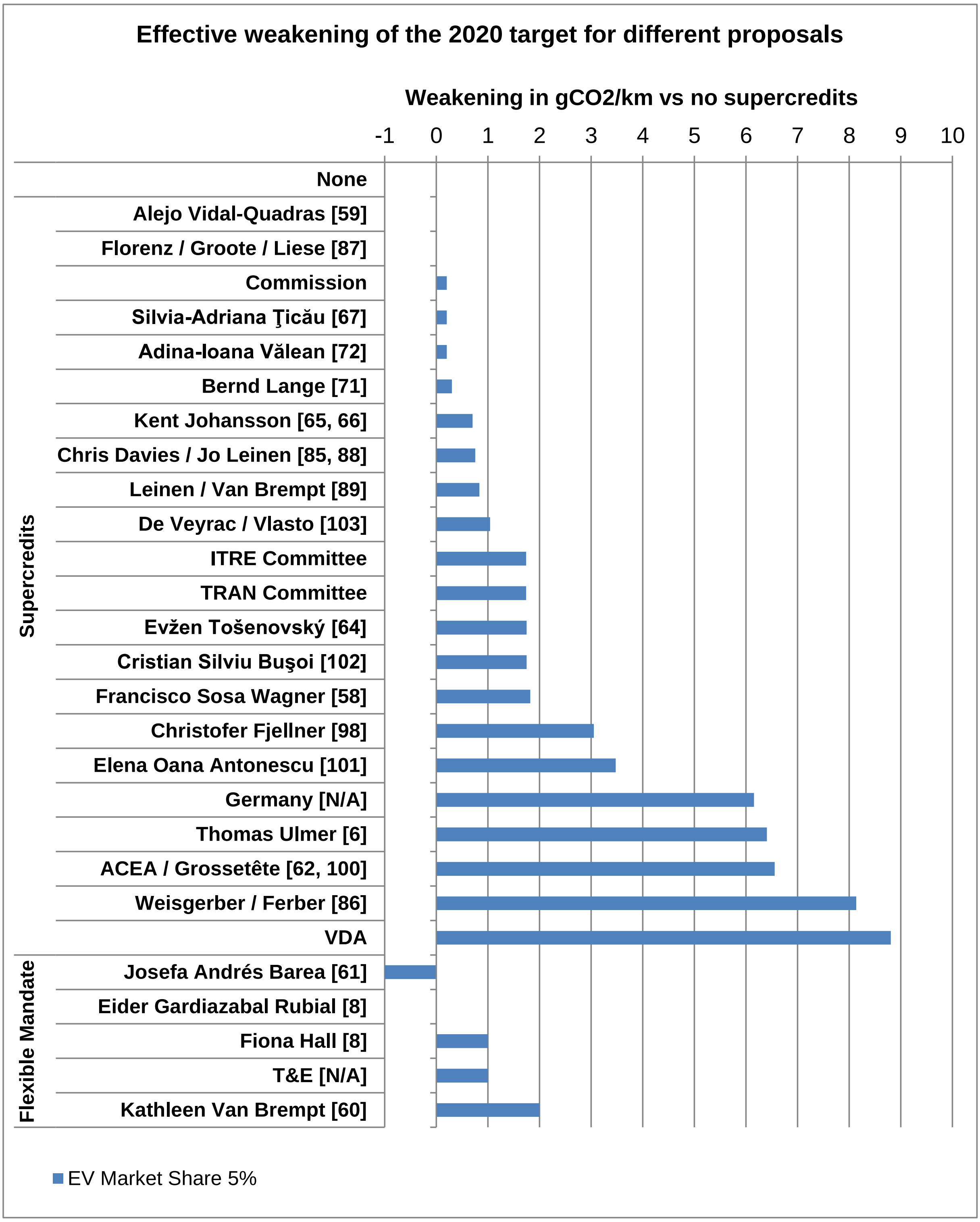
This Appendix provides expanded summary charts showing comparisons of weakening of the 2020 CO_2 target and marginal manufacturing costs for the full range of supercredit proposals evaluated as part of this project.

Figure A3-1: Summary comparison of the effective weakening of the 2020 target for different supercredit proposals and for alternate 2020 EV % sales scenarios



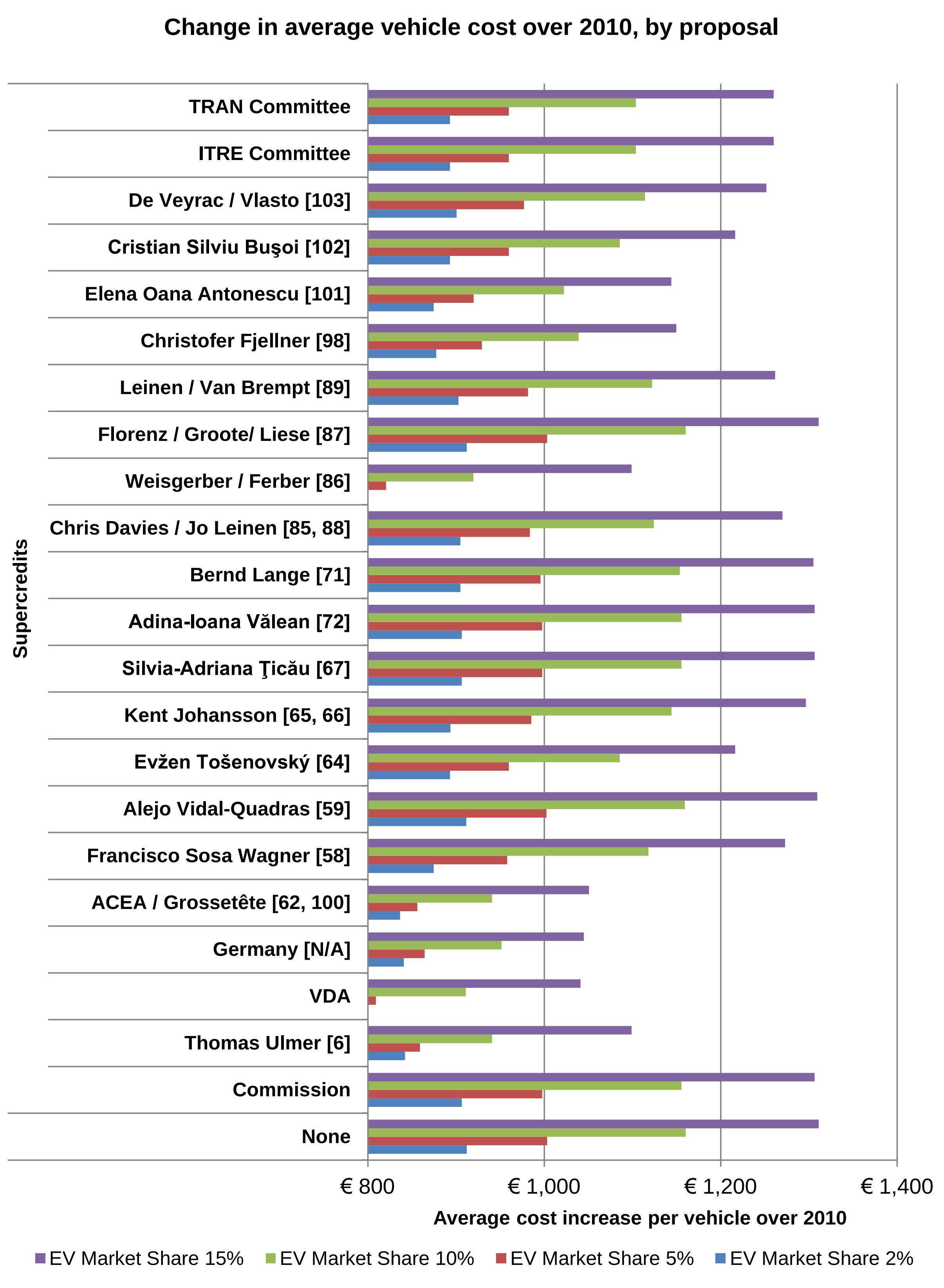
Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c).

Figure A3-2: Effective weakening of the 2020 target for different ULEV incentive proposals ranked in order of impact, 5% EV sales scenario for 2020



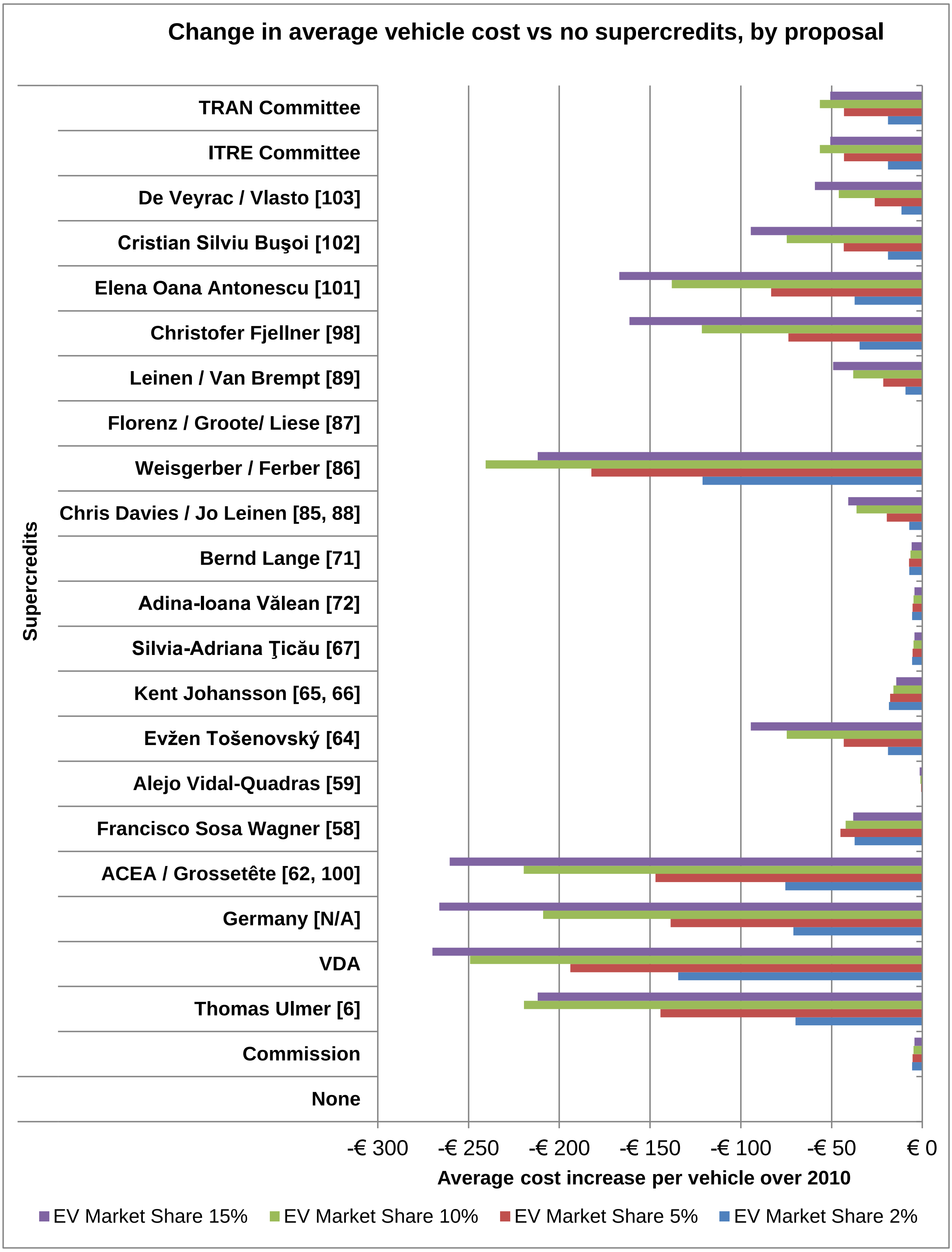
Notes: The numbers of officially proposed amendments in the ENVI, ITRE and TRAN Committees are indicated in square brackets where relevant (EP, 2013a), (EP, 2013b), (EC, 2013c), (EP, 2013d).

Figure A3-3: Summary comparison of the estimated impact on marginal manufacturing costs for different supercredit proposals and for alternate 2020 EV % sales scenarios



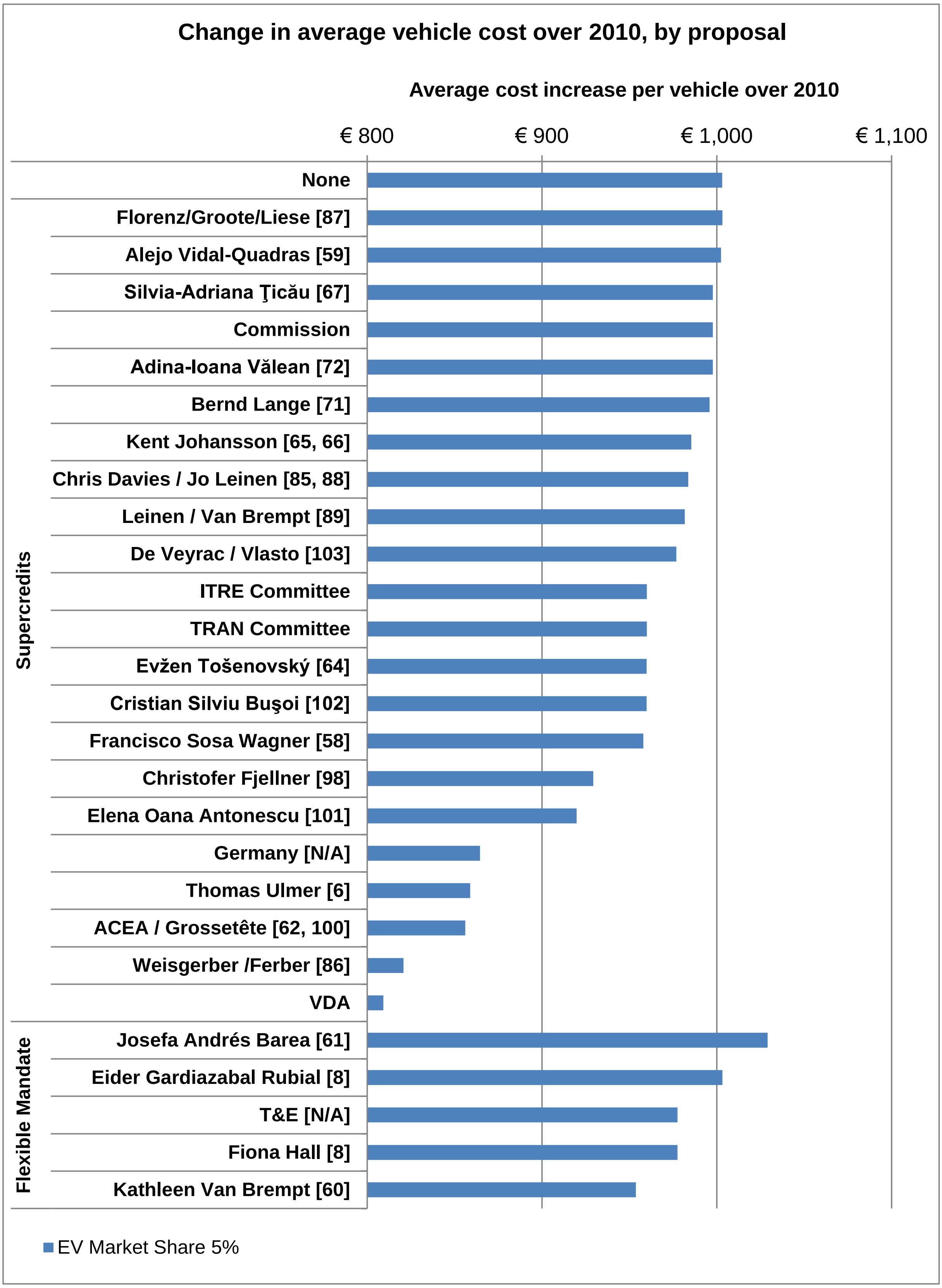
Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c). Marginal capital costs for conventional petrol and diesel ICE vehicles based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

Figure A3-4: Summary comparison of the estimated impact on marginal manufacturing costs for different supercredit proposals and for alternate 2020 EV % sales scenarios, change vs no supercredits case



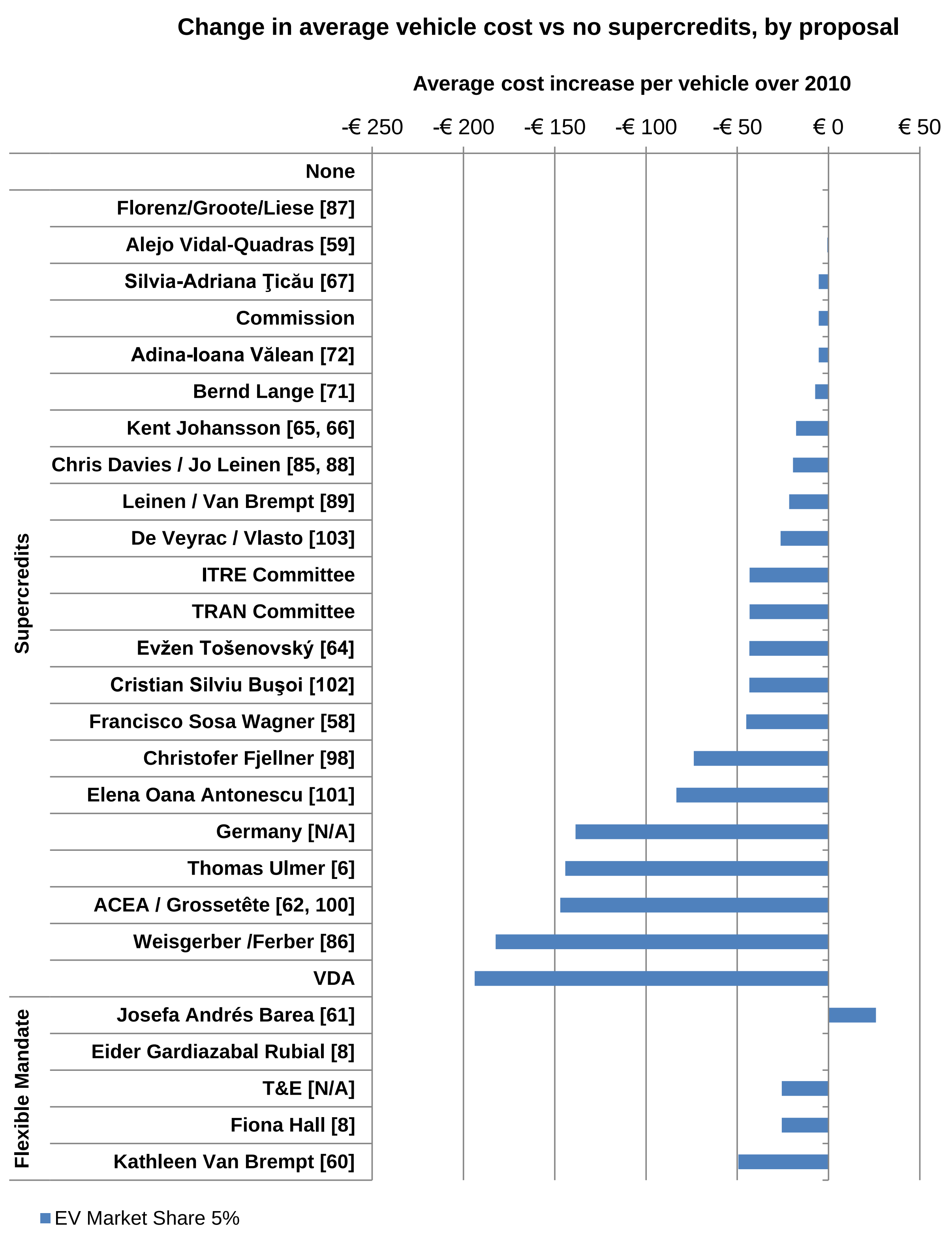
Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c). Marginal capital costs for conventional petrol and diesel ICE vehicles based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

Figure A3-5: Estimated impact on marginal manufacturing costs for different ULEV incentive proposals ranked in order of impact, 5% EV sales scenario for 2020



Notes: The numbers of officially proposed amendments in the ENVI, ITRE and TRAN Committees are indicated in square brackets where relevant (EP, 2013a), (EP, 2013b), (EC, 2013c), (EP, 2013d). Marginal capital costs for conventional petrol and diesel ICE vehicles were estimated based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

Figure A3-6: Estimated impact on marginal manufacturing costs for different ULEV incentive proposals ranked in order of impact, 5% EV sales scenario for 2020, change vs no supercredits case



Notes: The numbers of officially proposed amendments in the ENVI, ITRE and TRAN Committees are indicated in square brackets where relevant (EP, 2013a), (EP, 2013b), (EC, 2013c), (EP, 2013d). Marginal capital costs for conventional petrol and diesel ICE vehicles were estimated based on Scenario C cost curves from TNO et al (2011) for medium sized-vehicles. Marginal capital costs for full HEV, PHEVs, REEVs and BEVs were estimated based on figures from Ricardo-AEA (2012).

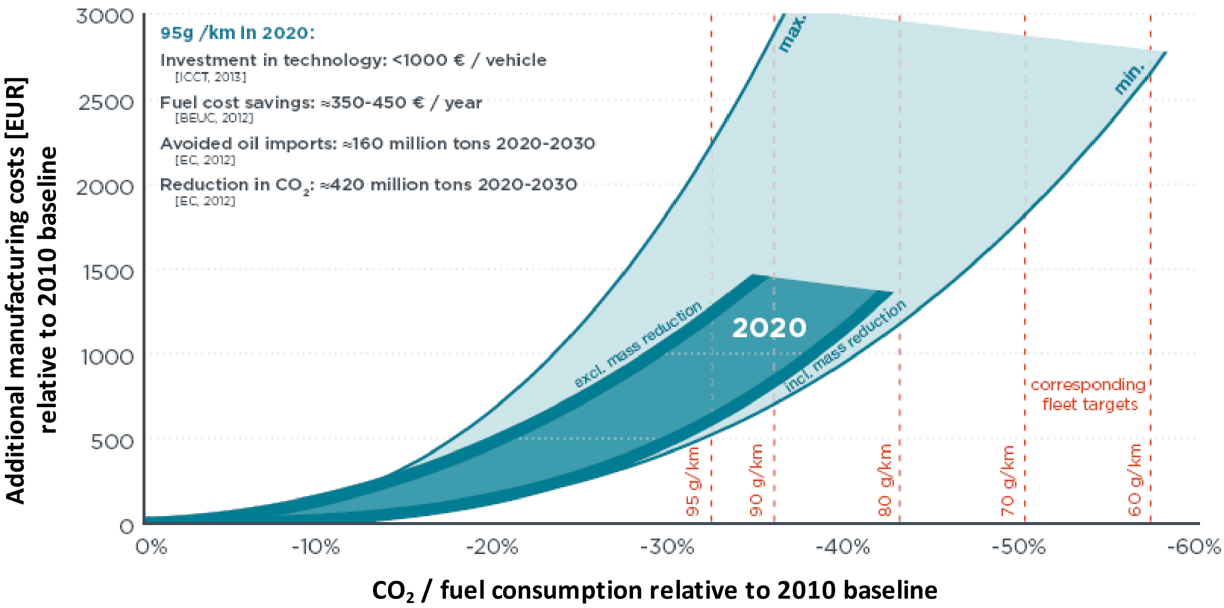
Expanded assessment of the sensitivity on cost assumptions

The cost curves for medium sized cars from TNO et al (2011) were used to estimate average vehicle marginal capital costs for conventional ICE vehicles (petrol, diesel, LPG and natural gas). The default assumption was to use the Scenario C cost curves provided in Annex D of TNO et al (2011), scaled to be consistent with the previous analysis for Greenpeace and T&E by Ricardo-AEA (2012). This analysis is broadly consistent with the lower end of the cost curves developed for ICCT (2013), illustrated in Figure A3-7, where the benefits of significant weight reduction potential are more fully realised. However, a significant transition to lighter-weight vehicles may be significantly restricted unless current policy disincentives are removed. For example current the weight-based standard for CO_2 limits ideally needs to be replaced with a size-based standard (e.g. footprint) to provide a sufficiently strong incentive for the full lightweighting potential to be achieved.

Therefore the Scenario A cost curves from Annex B of TNO et al (2011) were used as alternative sensitivity comparison where a more limited potential for weight reduction is included for conventional ICE vehicles. These costs fall in the mid-upper range of likely 2020 marginal manufacturing costs from ICCT (2013) presented in Figure A3-7. Because of the knock-on benefits in terms of reduced cost/battery size requirements in EVs, it is anticipated that weight reduction will still be used to a significant extent in these vehicle types. A summary comparison of the alternate basis for the cost calculations is provided in Figure A3-8 below for a selection the proposals.

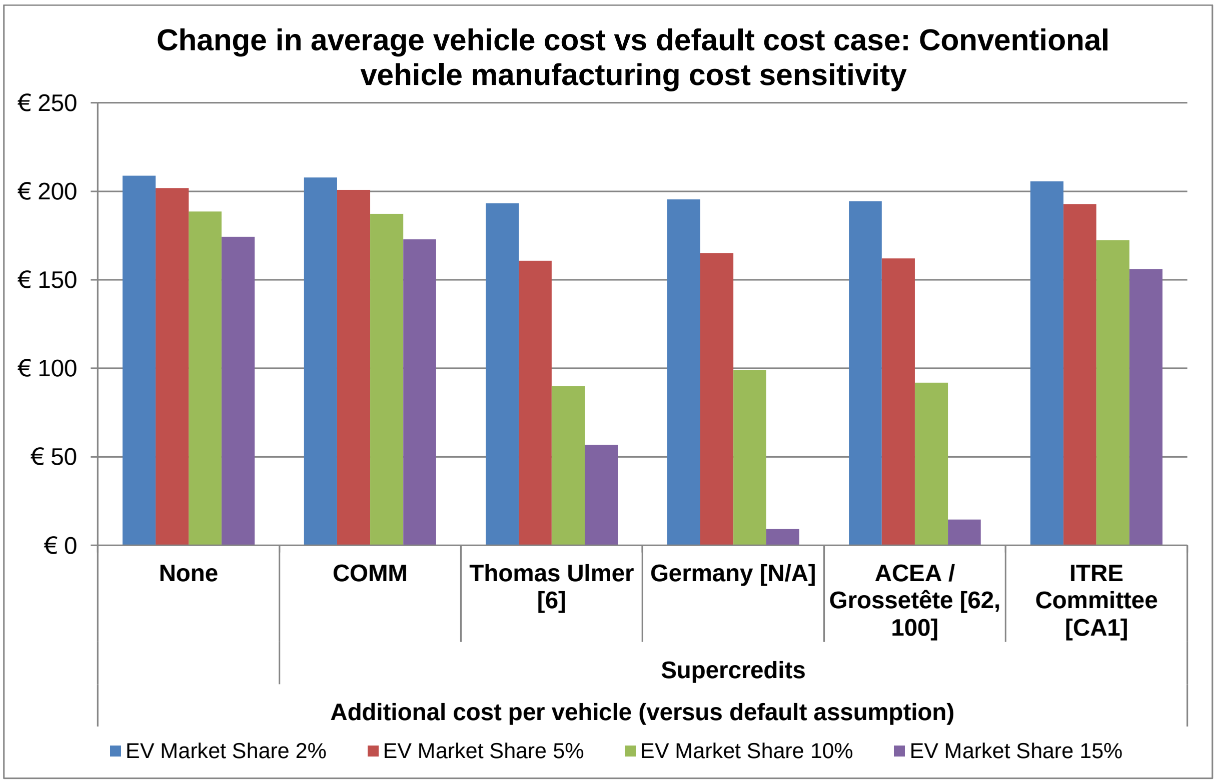
The sensitivity analysis seems to suggest that in the case that it is more costly than expected to improve conventional ICE vehicle efficiency, the relative costs for different levels of 2020 EV sales could be more similar – particularly for proposals with higher levels of supercredits/weakening of the CO_2 target. In addition, the average manufacturing costs of the different proposals relative to the no supercredits case will be further reduced in absolute terms. However, it may be expected that weight reduction for vehicles of other powertrain types would also be more costly as a result of lower overall volumes of vehicles deployed / improvements being limited to platforms that are not common also to ICE vehicles. If the costs of EVs are higher than currently anticipated, for this reason, or if battery (and other) costs do not reduce to the degree expected, then the relative differences between the different EV deployment scenarios may be more similar to the default assumption.

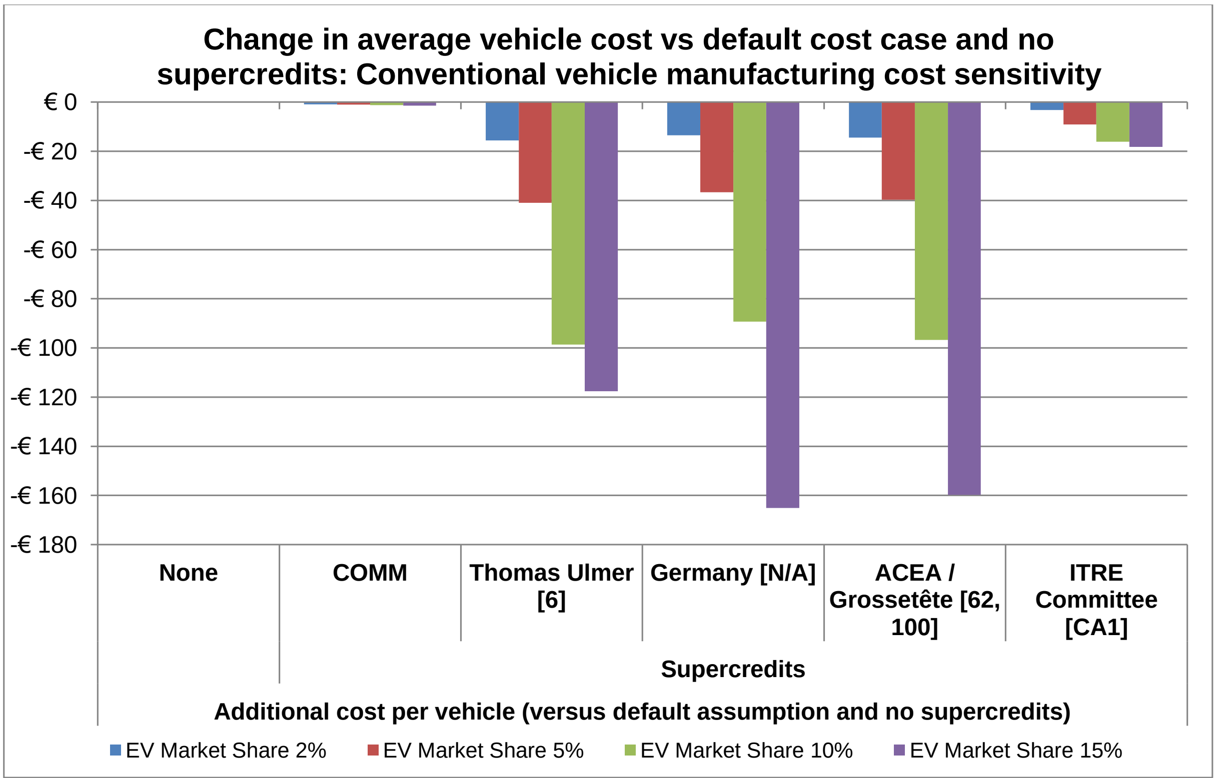
Figure A3-7: CO_2 reduction cost curve for the European passenger cars market, based on vehicle computer simulation and tear-down cost assessments (ICCT, 2013)



Notes: Reference year is 2010 - costs for reference year 2015 (130 g/km) are lower (ICCT, 2013)

Figure A3-8: Sensitivity on the marginal manufacturing cost basis





Notes: The numbers of officially proposed amendments in the ENVI Committee are indicated in square brackets where relevant (EP, 2013c). In all cases the values for parameters not being varied for the purposes of the sensitivity are set at the same level as the Commission proposal (COMM), but without the cap in the number of qualifying ULEV sales. Default = ICE vehicle marginal capital costs estimated using Scenario C cost curves from TNO et al (2011). Alt. = Alternative assumption where the Scenario A cost curves from TNO et al (2011) are used instead.

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