The fine line between fact and fiction

A critical assessment of the Aachen study on the CO2 reduction potential for light commercial vehicles

In 2010 the EU reached an agreement on CO_2 emission standards for light commercial vehicles (vans). The final outcome was a significant weakening of the initial Commission proposal of 135g CO_2/km. Misinformation about technological potential and inflated cost estimates convinced policy makers that the proposed target levels had to be weakened. In the end it was agreed that by 2017, average van emissions need to be reduced to 175g CO_2/km and by 2020 to 147g CO_2/km.[1]

A study which was instrumental in influencing policy makers was the 2010 Aachen (IKA) study.[2] It had been commissioned by the German ministry of economy to inform its position and concluded that CO_2 emission reductions from vans are extremely difficult and very expensive. Despite the availability of new and more up-to-date studies, today the same study continues to be used[1] to assert that 147g is an "over-ambitious"[3] target.

This briefing analyses how the IKA study came to its results and assesses the credibility of these results.

Comparison of the IKA study with other studies

A range of studies have looked at the technological feasibility and cost of achieving a target of around 147g in 2020.

Consultancy	Target level	Absolute retail price increase	Requires full hybridisation?	Maximally achievable target level
AEA-TNO (2009)[4]	150g CO2/km	€1961-€3045 (2020)	No	125g CO2/km in 2020
IKA-Aachen (2010)	**148g CO2/km**	**€5000-€8800 (2030)**	**Yes**	**148g CO2/km in 2030**
TNO (2012)[5]	147g CO2/km	€605 (2020)	No	Not available
ICCT (2012)[6]	147g CO2/km	€500 (2020)	No	Not available

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:145:0001:0018:EN:PDF
[2] http://www.fka.de/consulting/studien/2010-09-studie.php
[3] In his draft report on the review of the vans Regulation, MEP Holgher Krahmer calls the 147g target "overambitious" and refers to "other studies that that conclude that the 147g target is too ambitious" The report can be found here: http://www.europarl.europa.eu/sides/getDoc.do?type=COMPARL&reference=PE-502.271&format=PDF&language=EN&secondRef=01
[4] http://ec.europa.eu/clima/events/0019/final_report_lcv_co2_250209_en.pdf
[5] http://ec.europa.eu/clima/policies/transport/vehicles/vans/docs/report_co2_lcv_en.pdf
[6] http://www.theicct.org/sites/default/files/publications/ICCT_CostCurveSummary_wkp20121102.pdf

How did IKA come to its results?

The estimations of IKA clearly differ from what other consultancies have found. This raises questions as to the methodology used by the different studies. The methodology used by TNO-AEA (2009) and TNO (2012) has been established practice since 2006 and was used for the adoption of the CO_2 targets for cars and vans. In TNO 2012, cost estimates for CO_2 reduction technologies are largely based on in-house expertise from TNO and consortium partner Ricardo. The ICCT work is based on a new methodology which mirrors the automotive industry's own methodology for future costs of technology.[7]

Unfortunately, the Aachen study reveals little about its methodology or assumptions. It can however be deduced from the study that:

- It is based on a German, not a European sales database and the mass of vans in Germany appears to be significantly higher than in EU27;
- The assumed reduction potentials per technology are lower than the estimates in other studies;
- Costs are not specified per technology, but based on the specified costs for technology packages, the IKA estimates that the estimated costs of technologies appear to be significantly higher than the estimates in other studies;
- IKA assumes that in early stages of market introduction the new technologies cannot yet yield their maximum reduction potential and uses a **very high safety margin**;

The trick with the safety margin

Studies estimating the potential of different technologies use a safety margin when combining different technologies. This is because technologies may not be immediately fully mature and because the arithmetical combination of the different reduction potentials does not necessarily fully correspond to their real potential. When analysing IKA's different scenarios (see p12 of the study) the divergence between the combined effect of the technologies and the IKA estimates is clear. **IKA neither specifies nor justifies its safety margin but it can be deduced that a margin of 50% or more is used.**

	Combined effect of technologies, simple calculation	Reduction potential according to IKA
Scenario D3	20%	11%
Scenario D5	34%	15%
Scenario D6	50%	19%

The argument that technologies, when not fully mature, do not deliver their full reduction potential immediately may have some validity for complex powertrain technologies (e.g. downsizing, hybridisation, waste heat recovery), but definitely is not applicable to vehicle body technologies such as improved aerodynamics, weight reduction and low rolling resistance tyres. Assuming that all technologies except those last three would only deliver half of their full potential by 2020, would still lead to a combined reduction potential of 23% (from 181 g/km to 142 g/km) for D5 rather than the 15% claimed by IKA.

[7] for more info see: http://www.theicct.org/blogs/staff/assembling-vehicle-technology-cost-data-european-market

What if we were to use a a more realistic safety margin?

Scenario D5 (p12) illustrates how IKA comes to its conclusions. According to IKA's calculations, the effect of the measures listed for package D5 could reduce emissions by only 15% or 27 g/km.

If we combine the full potentials, while assuming a realistic safety margin of 5%[8] to account for the fact that combined technologies may have a lower potential than the arithmetic combination of individual reduction potentials, **reductions of up to 31% to a level of 123g are possible.**

The cost of achieving this reduction would be €2700-€4500 but since IKA opts for lower technology potentials and higher costs per technology this is probably an exaggeration as well.

D5 - feasible in 2020	**IKA**		
	CO2-red.	**$1-\delta_i$**	
reduced friction	5.0%	95%	
medium downsizing	4.0%	96%	
improved cooling + electrical water pump	1.5%	99%	
waste heat recovery	1.5%	99%	
automated gear box	3.0%	97%	
mild hybidisation	10.0%	90%	
improved aerodynamics	3.0%	97%	
strong weight reduction	6.0%	94%	
LRRT	2.0%	98%	
electrified auxiliaries	4.0%	96%	
$\Pi(1-\delta_i)$		66%	
combined reduction potentials	34%		
combined effect according to IKA	15%		
	IKA	**alternative**	
2010 average	181	181	g/km
reduction	15%	34%	
reduction	27	61	g/km
safety margin		5%	
corrected reduction	27	58	g/km
2020 value	**154**	**123**	**g/km**

Conclusions

IKA uses conservative assumptions for both technology reduction potentials and costs. In addition to this, by assuming, without clear proof, that technologies can only deliver a fraction of their potential by 2020, IKA reinforces the impression that CO_2 reductions from light commercial vehicles are extremely difficult and expensive.

When applying a more realistic safety margin to IKA's different scenarios, reduction potentials are similar to those found in other studies. A number of recent studies (TNO, ICCT 2012), using various methods, have concluded that the 147g proposed for 2020 is by no means 'over-ambitious' and that much steeper reductions could be achieved with a relatively limited cost.

Whether or not the results are deliberately presented in a misleading manner, it must be clear from the above analysis that the Aachen (IKA) study is not a sound base for policy making and that its claims should be treated with care.

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1 Extract from industry presentation January 2013

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8 Similar to the method used in TNO 2012.

CO_2 147@2020 – Aachen study

RWTH Aachen study recommends a 2020 LCV fleet target of 156 – 158 g/km meaning a reduction potential: 14% (158 g/km) with related costs being min: 2.050 EURO/vehicle - max: 2.900 EURO/vehicle

Maßnahme	Max. Einsparpotenzial [%]	Entwicklungsszenarien D1	D2	D3	D4	D5	D6
Reduzierung der Reibungsverluste	3	✓					
Reduzierung der Reibungsverluste (verstärkt)	5		✓	✓	✓	✓	✓
Downsizing (leicht) mit Turboaufladung	2		✓	✓			
Downsizing (mittel) mit Turboaufladung	4					✓	✓
Downsizing (stark) mit Turboaufladung	10				✓		
Optimierter Kühlkreislauf	1,5		✓				
Erweiterter Kühlkreislauf + elektrische Wasserpumpe	1,5			✓	✓	✓	✓
Abgaswärmerückgewinnung	1,5				✓	✓	✓
Automatisiertes Getriebe	3			✓	✓	✓	
Start-Stop-Betrieb	3		✓	✓			
Micro Hybrid	6				✓		
Mild-Hybrid	10					✓	
Full-Hybrid	18						✓
Verbesserte Aerodynamik	3	✓	✓	✓	✓	✓	✓
Leichtbau (gering)	1		✓				
Leichtbau (mittel)	2			✓			
Leichtbau (stark)	6				✓	✓	✓
Stofflicher Leichtbau	20						✓
Reibwertverringerung Reifen	2	✓	✓	✓	✓	✓	✓
Weitere Elektrifizierung der Nebenverbraucher (EPS, EHPS)	4				✓	✓	✓
CO_2-Einsparpotenzial [%]		-6%	-9%	-11%	-14%	-15%	-19%
Kosten [€]	Min	140	550	1.000	2.050	2.700	5.000
	Max	180	750	1.300	2.900	4.500	8.800
Potenzielle Markteinführung		2013		2018		2020	2030
Aktuelles Entwicklungsstadium		Entwicklung		Vorentwicklung		Forschung	

Conclusion : 147@2020 is already extremely challenging from technical and affordability point of view

Source : RWTH Aachen: "Short-Study of CO2-Reduction Potential of LCV (N1) until 2020", Bericht 103140 – April 2010

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