



## Retrofit of HDV and/or LDV – Different aspects to be respected


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*Zukunft  
Gewissheit geben.*



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- 5 directives published for retrofit of Nox-reduction certification
- National German Type Approval directives
- Truck, bus, light commercial vehicle and passenger car application
- For truck and bus: coupled with financial aid not be paid back, for companies and municipal service vehicles
- Approval testing with PEMS measurement in real traffic operation ✓
- Control with:  

  - In-Service-Conformity tests very year
  - End-User has to proof purchase/consumption of Adblue

# Overview 5 retrofit directives in Germany



Retrofit	HD /LD	Vehicles	Emission Class	Incentive	Limit	Tests	Incentives for	Comment
Public Transport Bus	HD	ECE-R107 Class I,II,A >5to. >8seats	EURO III, IV,V,EEV	Subsidy, not to be paid back, Max 20.000€/Bus	~ 85% Nox reduction	Bus line test	5000 vehicles	
Trucks in municipal service	HD	N2, N3 > 3.5to	EURO I,II,III, IV,V	Max 15000 €	~ 85% Nox reduction	ISC test Temp. Drive	6500 vehicles	12000 garbage collection trucks in D
Skilled trades / delivery truck	HD	N1, N2 3.5...7.5to	EURO I,II,III, IV,V	5000 €	~ 85% Nox reduction	ISC test Temp. Drive	75000 vehicles	
Skilled trades / delivery truck	LD	N1, N2 2.8....3.5to	EURO 3,4,5,6	3800 €	~ 75% Nox reduction	ISC test Temp. Drive		
Passenger car, Light commercial vehicle	LD	M1, M2, N1 <2.8to	EURO 4,5,6	No driving ban	270 mg/km RDE	RDE	0	



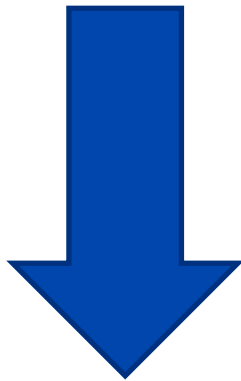
- EURO V in D was mostly SCR only without DPF
- Retrofit DeNox-systems for EURO V requires wall-flow DPF
- Retrofit evolves into emission upgrade
- With financial aid: retrofit becomes a real option to new EURO VI clean vehicles
- Retrofit vehicles are expected to be low PN, Low NOx
- TÜV welcomes this solution ✓



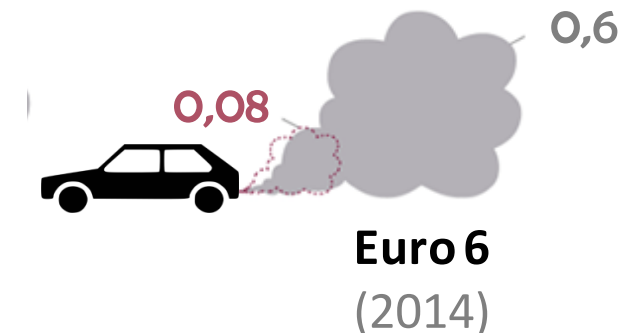
- Financial aid for investment in retrofit system not to be paid back
- 40...60% of cost, max. 4000€ per vehicle
- Higher percentage for SME
- 1000€ more incentive for retrofit and application before end of May 2019
- Vehicle has to be owned for two more years, scrappage is not allowed
- Requirement: location of company or 25% of work contracts in most 65 polluted cities and districts
- Proof of Adblue consumption and purchase
- Exemption from „diesel city ban“
- Application at central authority office



- EURO 6 is not EURO 6, EURO 6 letter to be respected
- EURO 6a not sold any more: NEDC tested, not RDE tested
- EURO 6d-TEMP or 6d is WLTP tested and RDE with limits: now reached low Nox (and PN) emissions

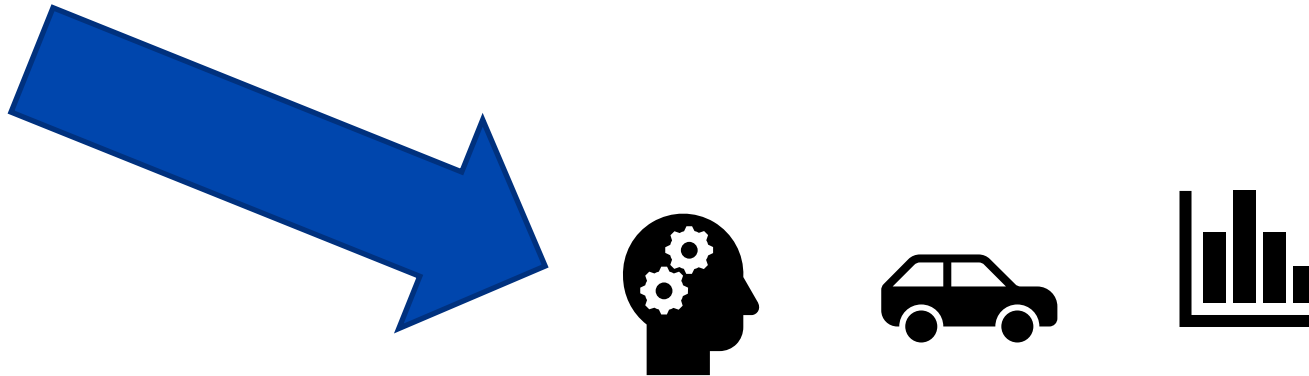


- Early EURO 6 Car Retrofit makes sense ✓



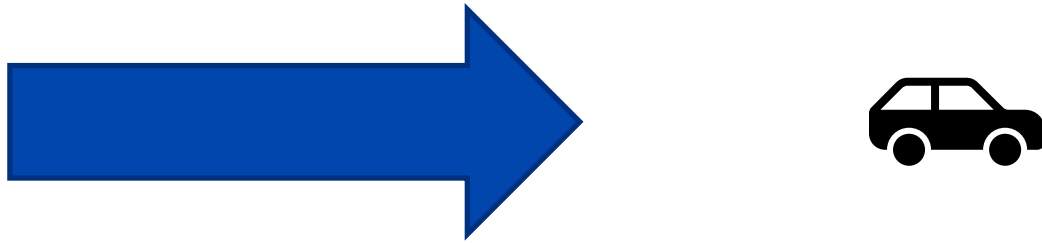
- Messungen während Realfahrten (Carslaw, 2011/ICCT, 2014e)
- ... Schadstoffklasse (Euro 3 – Euro 6)

- Retrofit of Hardware for Nox-Control can be certified
- Update of Engine Control Software can be certified
- Update of Hardware- and Engine Control Software can be certified
- Vehicles with low RDE emissions can be requalified: e.g.: non RDE tested EURO 6a vehicles



- We think: vehicle OEM's will review their fleets of car types to identify those that can reach 270 mg/km Nox emission on street with requalification of software update first

- Much time is lost through discussion of about last two years: residual value of EURO 5 car has dropped and mileage has increased
- Still ongoing as mass retrofit did not start yet



- Our Impression: for passenger cars the concept / situation of retrofit vs. incentive or ban for retrofit did not create the big breakthrough yet
- Our view: there is enough mass and niche market vehicles for viable business case for retrofit to make sense: please start now





- 270 mg/km Nox should not scare anybody in 2019
- We see 10mg/km Nox in RDE and below now for EURO 6d-TEMP cars
- Technology and knowledge in 2019 to reduce NOx can make it feasible to achieve 270 mg/km RDE NOx
- Limit has be met for total trip and for combined city and rural drive

# Special Case: Light Commercial vehicle

- In General: Legislation is one year behind Passenger Cars
- New vehicle today is still NEDC with no RDE
- EURO 6d-TEMP Vehicles with WLTP and RDE will start in July 2019
- Also EURO 6 NOx Limit is not 80mg/km like for passenger car, but 125 mg/km ( N1 Group III)
- EURO 5 NOx Limit was 280 mg/km



EURO 5 and EURO 6 Retrofit  
with NOx reduction around 75% in real world and down to -7 deg.C > 2,8to  
with NOx reduction to 270 mg/km in real world and down to -3 deg.C < 2,8to ✓

- Compare to EURO 6d-TEMP RDE Nox Limit of 262 mg/km Nox for LCV
- For >2.8to with financial aid of 3000€, we estimate still around 2000€ invest for a low Nox vehicle

- Is considered
- No additional measurement
- NH<sub>3</sub>: slip catalyst of 0,8 Ltr/100kW with 3..5 g/ft<sup>3</sup> Pt loading required

- Full range of national German Nox Reducing Retrofit systems certifications available from EURO I truck to EURO 6 passenger car
- Retrofit for citybuses active with certified systems
- Certified retrofit systems for municipal, delivery and skilled trades trucks awaited
- Examples like (OEM SCR only) EURO V HD truck and (OEM DPF) light commercial vehicles promise real emission upgrade to top low levels for PN and Nox
- Financial aid gives an attractive proposal for a better relationship between invest and residual vehicle value for a commercial reasonable decision on retrofit for commercial vehicles
- Whereas the commercial vehicle is a tool, with decisions upon by business planning, the passenger car is valued by emotions and a broad range of expectations and treatments
- For private owned passenger cars the retrofit concept created now, did not start the mass retrofit yet



**Discussions are welcome**  
**Thank you for your attention**

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