全球对于在用车实际排放的重点关注：
问题正在解决中
The Global Focus on Actual In-Use Emissions: A Work in Progress

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欧洲正在思考如何改善排放不合规的问题
从欧1到欧5的情况
Europe is Wrestling with Upgrading Compliance Developments for Euro 1 – Euro 5

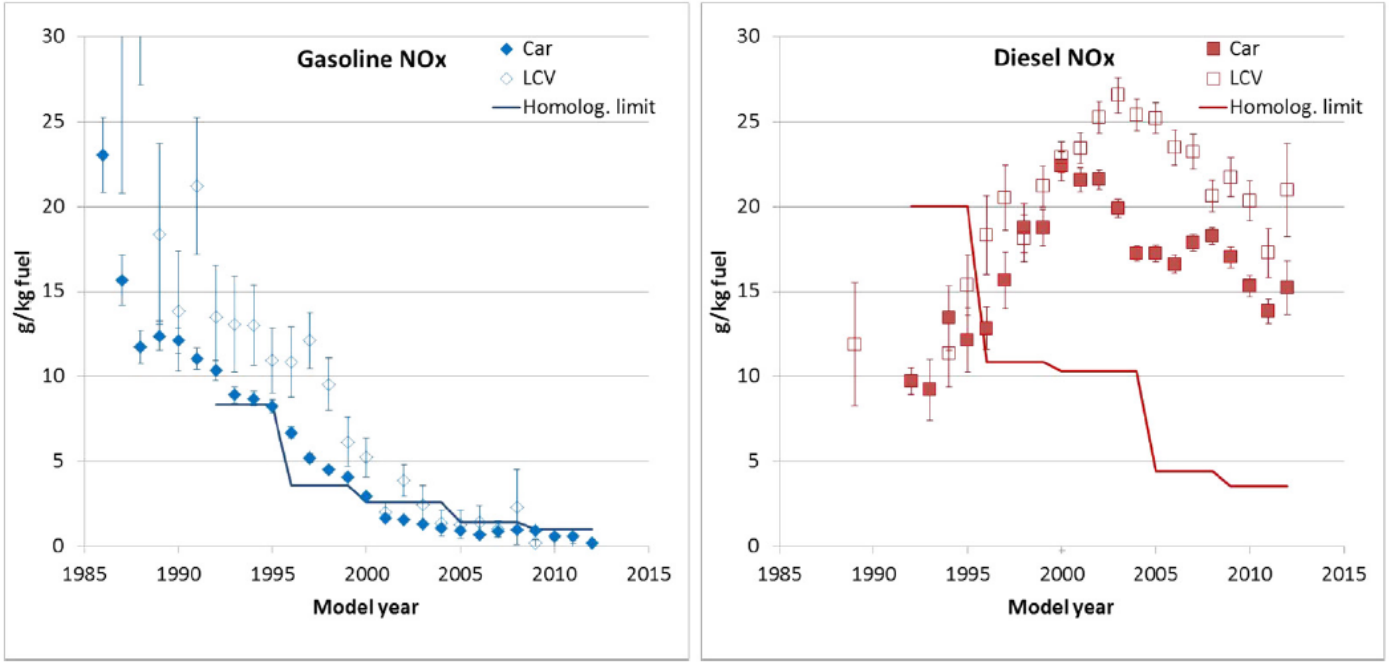
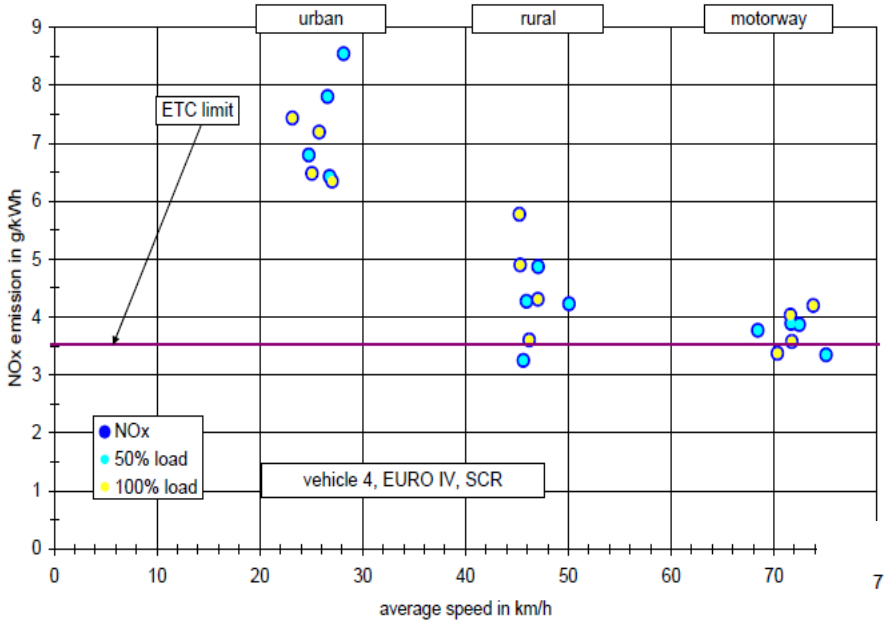


Fig. 4. Mean hot NO_x emission factors of gasoline (left) and diesel (right) passenger cars and light commercial vehicles as a function of model year. Whiskers represent the 95% confidence interval over the mean. Added are the type approval limit values for Euro 1 to Euro 5 passenger cars over the homologation test cycle in force in the respective year. For conversion from limit values in g per km see SI (using measured fuel consumption rates from Hausberger (2010)). For color plot consult online version.

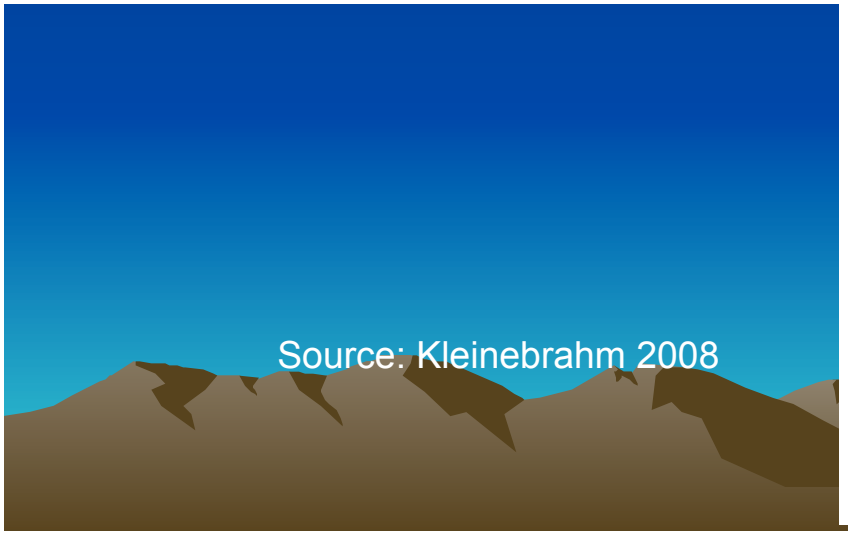
Chen, Y., Borken-Kleefeld, J. (2014). Amospheric Environment 88 (2014) 157-164

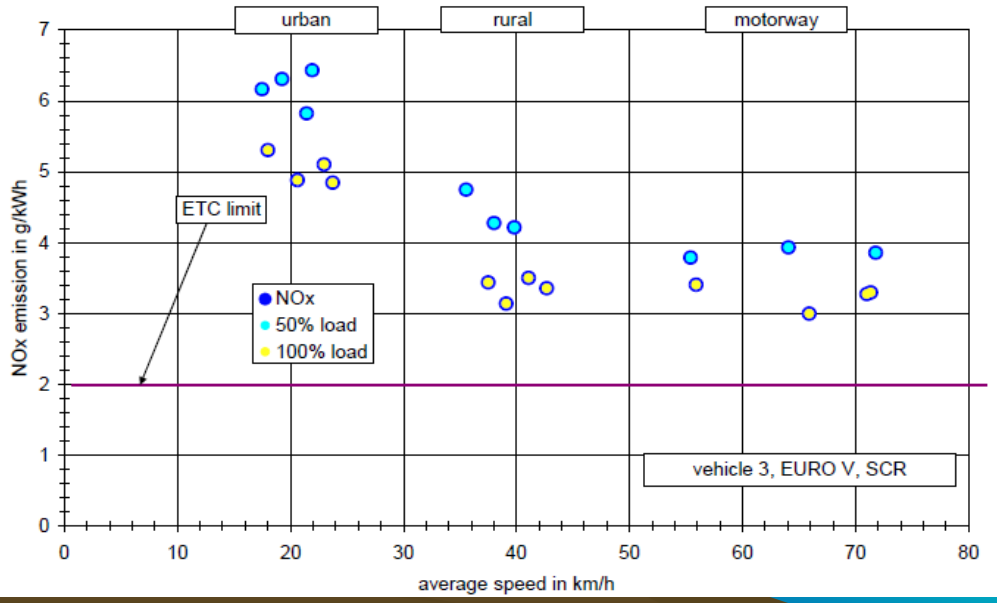
重型车情况也类似
问题：城市车辆工况外NOx排放过高
Similar Issues With Heavy Duty Vehicles
The problem: High off-cycle NOx emissions in urban applications



荷兰利用PEMS检测对欧IV和欧V卡车进行了测试，发现在城市行驶条件下排放会高于标准限值 ！

In-use PEMS testing of Euro IV and Euro V trucks in The Netherlands found emission well above standard in urban driving!





欧盟在用车达标的历史问题
Historical Problems with EU Compliance In Use

- 型式核准认证流程不完善
- 没有关注工况外排放（仅能在工况上达标）
- 耐久性要求较短
- 保修和缺陷报告的局限性
- OBD监管较弱
- 在用车检测和达标管理的责任机构不明确

- Poor Type Approval Test Procedure
- No Focus on Off Cycle Emissions (Cycle Beating)
- Shorter Durability Requirement
- Limited Warranty and Defect Reporting
- Weaker OBD
- No Clear Responsibility and Authority for In Use Testing and Compliance

从欧V到欧VI的经验
Euro V-VI lessons

- 要想实现空气质量目标，所制订的排放法规必须能控制实际行驶过程中的排放
- 不仅要关注排放限值，还需要关注：
  - 新的行驶工况 (WHDC)
  - 更长的车辆使用寿命
  - 工况外和在用车排放检测 (PEMS)
  - OBD要求
  - 防作弊要求或NOx控制
  - 颗粒物数量限值和新的测量流程

- To achieve air quality objectives emissions legislation has to meet high expectations on real world emissions
- Focus not only on emission limits but also on:
  - New driving cycle (WHDC)
  - Longer useful life of vehicles
  - Off-cycle and In-service testing (PEMS)
  - OBD requirements
  - Anti- tampering requirements or NOx –control
  - PN-limit and new measurement procedure

一种修正的办法：欧6 RDE-LDV流程
The Fix: Euro 6 RDE-LDV Process

1. 对欧6标准的修订之一是将PEMS道路测试作为型式核准的一部分。
2. 工作组定义了如何进行测试(边界条件）以及数据如何分析报告。
3. 从2015年开始试点推行，2017年开始实施。道路排放限值待定，大概会是底盘测功机限值的2倍。

1. An amendment to Euro 6 standards to make on-road testing with PEMS part of type-approval.
2. Stakeholder WG is defining how the tests should be conducted (boundary conditions), how the data should be analyzed and reported
3. Pilot phase to start in 2015, implementation in 2017. On-road emission limits TBD, likely 2X chassis dynamometer limits

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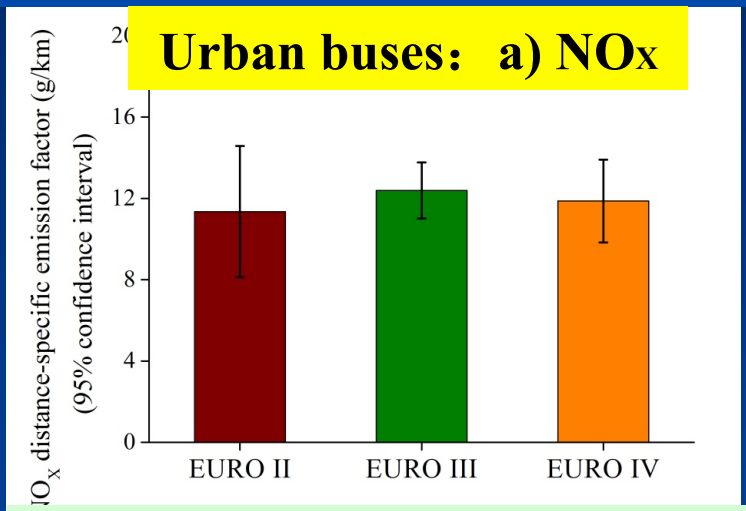
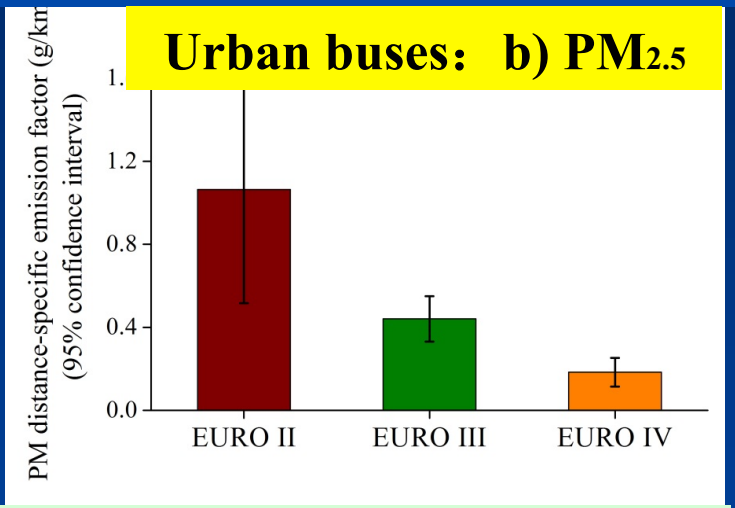
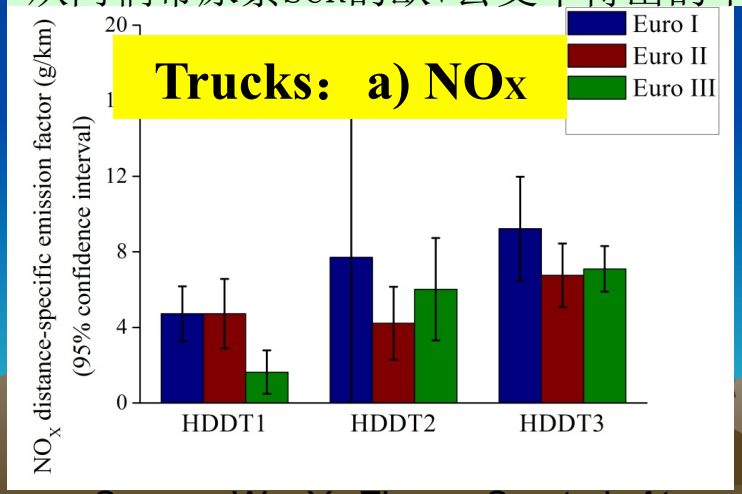
北京重型柴油车实际行驶排放因子
Real-world emission factors of HDDVs in Beijing

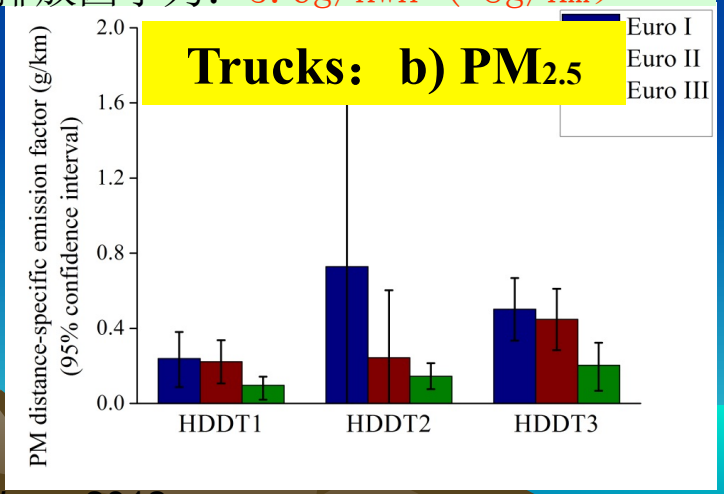




和$PM_{2.5}$ 排放不同，尽管实施了更严格的NOx排放标准，但重型柴油车在实际行驶过程中的NOx排放并没有明显改善 。

从两辆带尿素SCR的欧V公交车得出的平均的NOx排放因子为：5.6g/kWh （~8g/km）





Source: Wu, Y., Zhang, S., et al. *Atmos. Chem. Phys.*, 2012.

在用监管的总体原则
General Principles

- 在用车排放性能是空气质量的关键
- 有效的达标管理方案是美国/加州的重要成果之一
- 政府部门的责任从监管型式核准开始，但如果仅限于此是远远不够的：
  - 定义国家、省级和地方政府在在用车监管中的职责作用，确保提供充分的财政预算
  - 制定与车辆实际使用情况相一致的在用排放耐久性要求（车辆使用寿命）
  - 严格监控企业达标
  - 收集和分析生产企业提供的数据并予以相应的反馈
  - 利用可获得的信息有针对性的开展测试（PEMS和遥感检测）并有效利用政府部门的资源在企业自测基础上进行验证监测
  - 严厉处罚不达标行为

- In-use emissions performance is key to air quality
- A robust compliance program is one of the major accomplishments of US/CA effort
- Government responsibility starts with oversight of type approval but ending there is insufficient
  - Define roles and responsibilities of national, provincial and local governments with regard to in use performance and make sure adequate budget is provided
  - Set in use durability requirements (useful life) consistent with actual use
  - Provide careful oversight of manufacturers' performance
  - Collect and analyze manufacturer provided data and respond accordingly
  - Use available information to target testing (PEMS and Remote Sensing) and leverage government resources to selectively duplicate manufacturer testing

在用监管的总体原则(2)
General Principles (2)

- 生产企业必须对车辆在用期间排放控制性能负责并承担后续责任（罚款和召回）
  - 尽早发现并纠正问题从而将空气质量影响降低至最小程度（缺陷报告和修正）
  - 提供耐用的排放控制部件，可以在整个使用寿命周期都正常发挥作用
  - 在发生故障时，通过保修和召回来降低消费者需要担负的成本
  - 积极开展在用车测试

- Manufacturers must take responsibility for in-use performance and be held accountable (fines and recalls)
  - Find and remedy problems early so air quality impacts are minimized (Defects)
  - Provide durable emission components which perform throughout useful life
  - Minimize cost to consumers through warranty and recalls where failures occur
  - Proactively carry out In-use testing

美国2007年重型车排放标准有效降低了PM, CO, 空气有毒物质和HC排放
证明管理方案是行之有效的
The Program Seems To Be Working
U.S. 2007 HD Emission Performance Provides Significant Reductions in PM, CO, Air Toxic HCs

	2007 EPA Standard (g/hp-hr)	Average ACES Engine Emissions (g/hp-hr)	ACES Emissions % Reduction Relative to the 2007 Certification Standard
CO	15.5	0.33	98
NMHC	0.14	0.0064	95
PM	0.01	0.0011	89
NO_X	1.2 [a]	1.075	10

[a] Average value between 2007 and 2009, with full enforcement in 2010 at 0.20 g/hp-hr

Compounds	% Lower Than 2004 Engine Technology	
	16-Hour Cycle	CARBx-ICT
Single Ring Aromatics	82%	69%
PAH	79%	26%
Nitro-PAH	81%	49%
Alkanes	85%	84%
Polar	81%	12%
Hopanes/Steranes	99%	99%
Carbonyls	98%	78%
Inorganic Ions	38%	100%
Metals and Elements	98%	90%
Organic Carbon	96%	78%
Elemental Carbon	99%	100%
Dioxins/Furans[a]	99%	N/A

* Relative to 1998 Engine Technology

来源：CRC 1阶段 ACES 报告；

2010款以后的发动机所排放的有毒HC比2007款发动机更低


谢谢！
Thank you!