The starting point: History of the VW defeat device scandal and lessons learned

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Key Messages

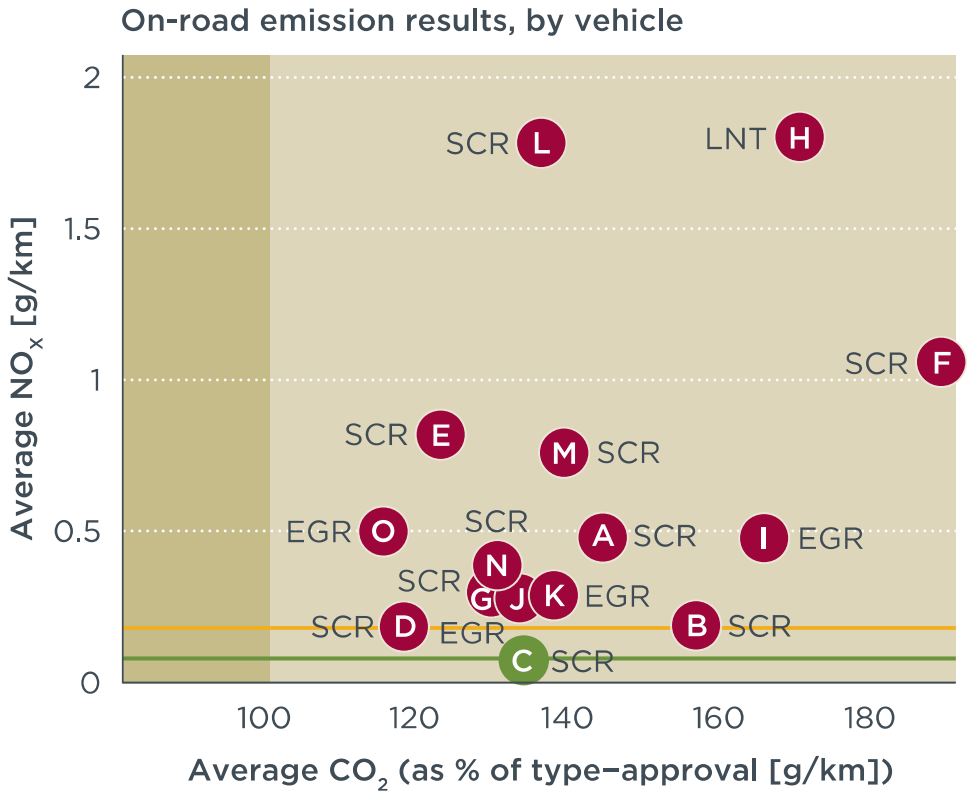
- Lack of adequate government resources and legal authority to ensure compliance with motor vehicle emission standards is a major challenge worldwide.
- This situation applies to real world emissions of all pollutants (e.g., NOx, CO_2), light and heavy-duty vehicles, and diesel and petrol vehicles.
- Dieselgate continues to be a “wake up call” - highlighting major deficiencies in government programs to ensure compliance with emission standards.
- For purposes of this presentation, non-compliance is used broadly to mean excessive real world emissions independent of legality with the law.
- Europe is highly relevant to these discussions because of its status as the de facto standard setter for most countries outside of the US and Japan.
- Much progress is underway in key markets, but there is much more to accomplish.

Research on real world emissions

- NOx and CO_2
- Light and heavy-duty
- Petrol and diesel
- Legal and illegal activities

ICCT White Paper - Real-world exhaust emissions from modern diesel cars: A meta-analysis of PEMs emissions data from US and EU passenger diesel cars (October 2014)

Average on-road emissions of NO_X and CO_2, by vehicle



Above type−approval
Below or equal to type−approval
Above Euro 5 limit
Above Euro 6, below Euro 5 limit
Below Euro 6 limit
Euro 5 limit
Euro 6 limit

15 test vehicles in total (6 manufacturers), with different NO_X control technologies:
- 10 selective catalytic reduction (SCR)
- 4 exhaust gas recirculation (EGR)
- 1 lean NO_X trap (LNT)

Average Euro 6 NO_X conformity factors (ratio of on-road emissions to legal limits):
- all cars: 7.1
- best performer (Vehicle C, SCR): 1.0
- bad performer (Vehicle H, LNT): 24.3
- worst performer (Vehicle L, SCR): 25.4

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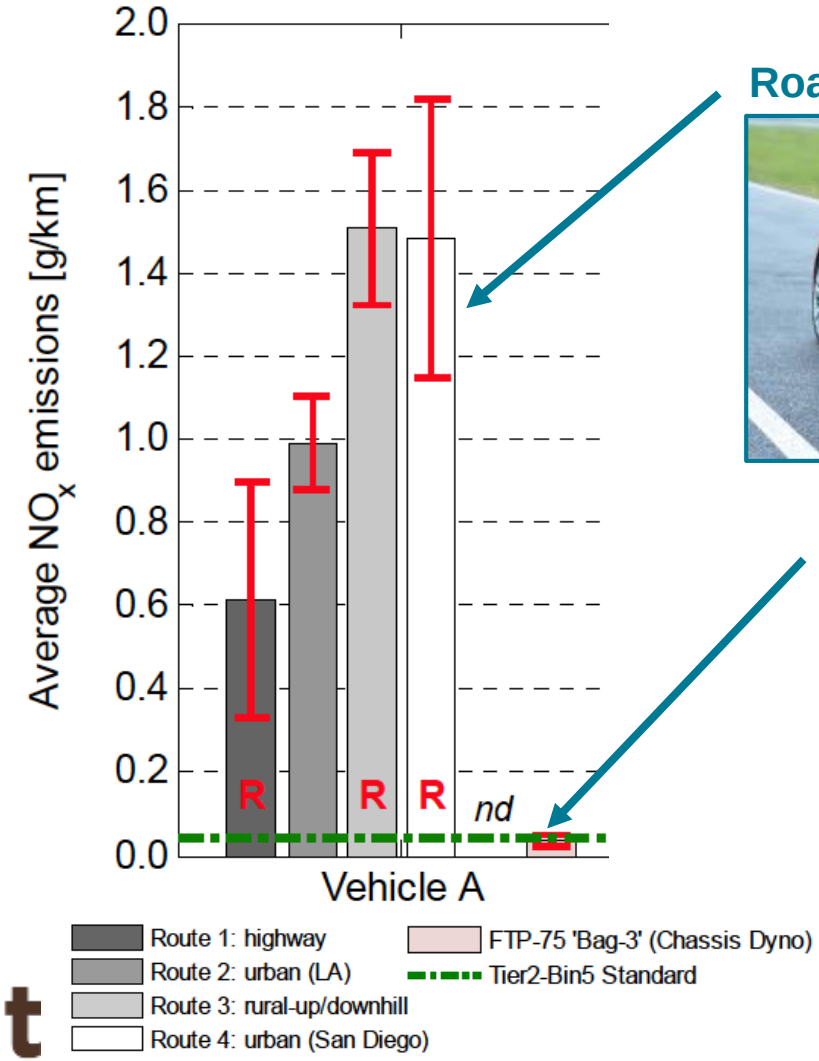
http://www.theicct.org/real-world-exhaust-emissions-modern-diesel-cars

Real world testing of light duty diesels in U.S. led to CARB / EPA investigations and legal action



Road tests with PEMS

Chassis dyno measurements

Photo credit: AVL / ERMES Group
Vehicle photos unrelated to the results shown

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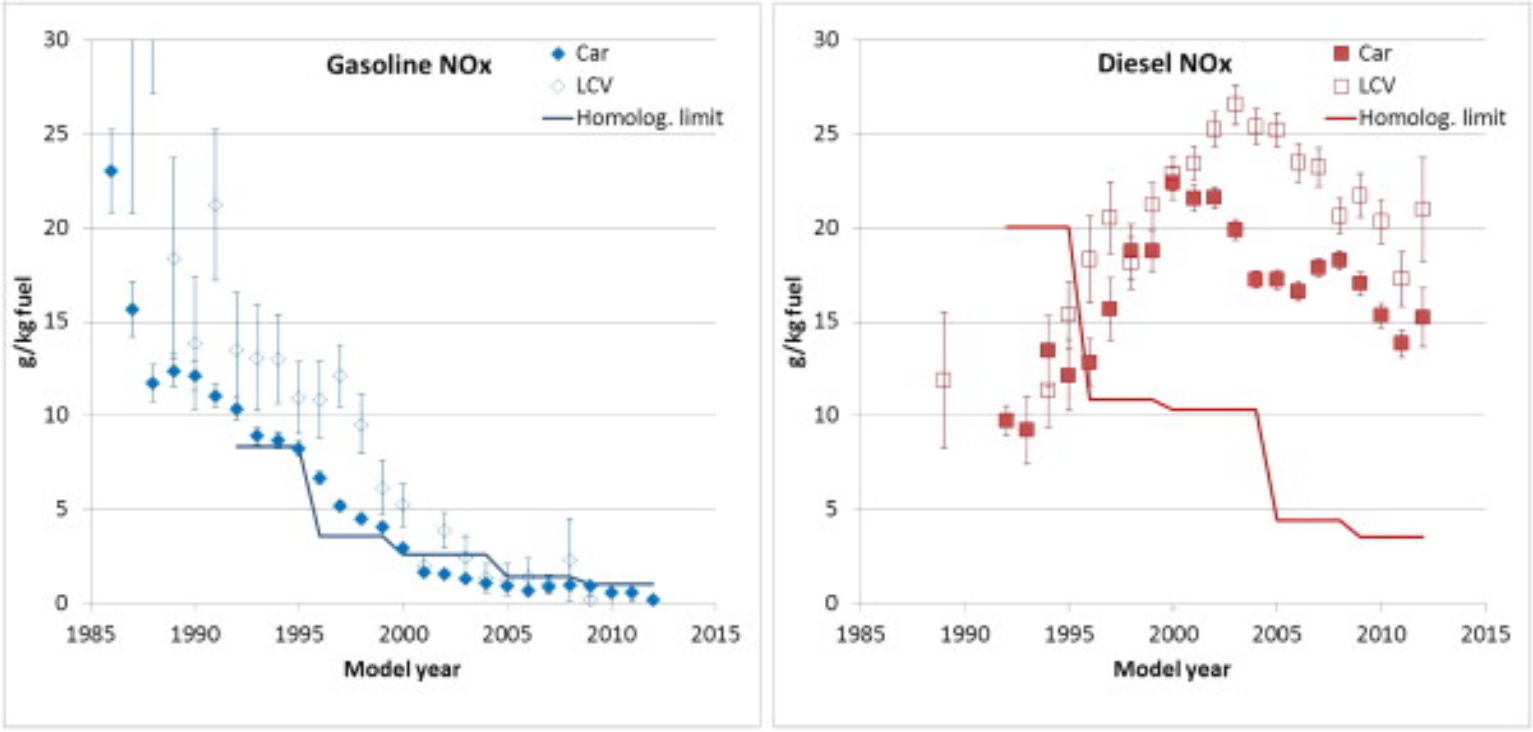
http://www.theicct.org/use-emissions-testing-light-duty-diesel-vehicles-us

Remote sensing data shows historic trends in NOx emissions from diesel and petrol cars in Switzerland



Chen & Borken-Kleefeld, Real-driving emissions from cars and light commercial vehicles - Results from 13 years remote sensing at Zurich/CH Atmospheric Environment, 88:157-164 (May 2014)

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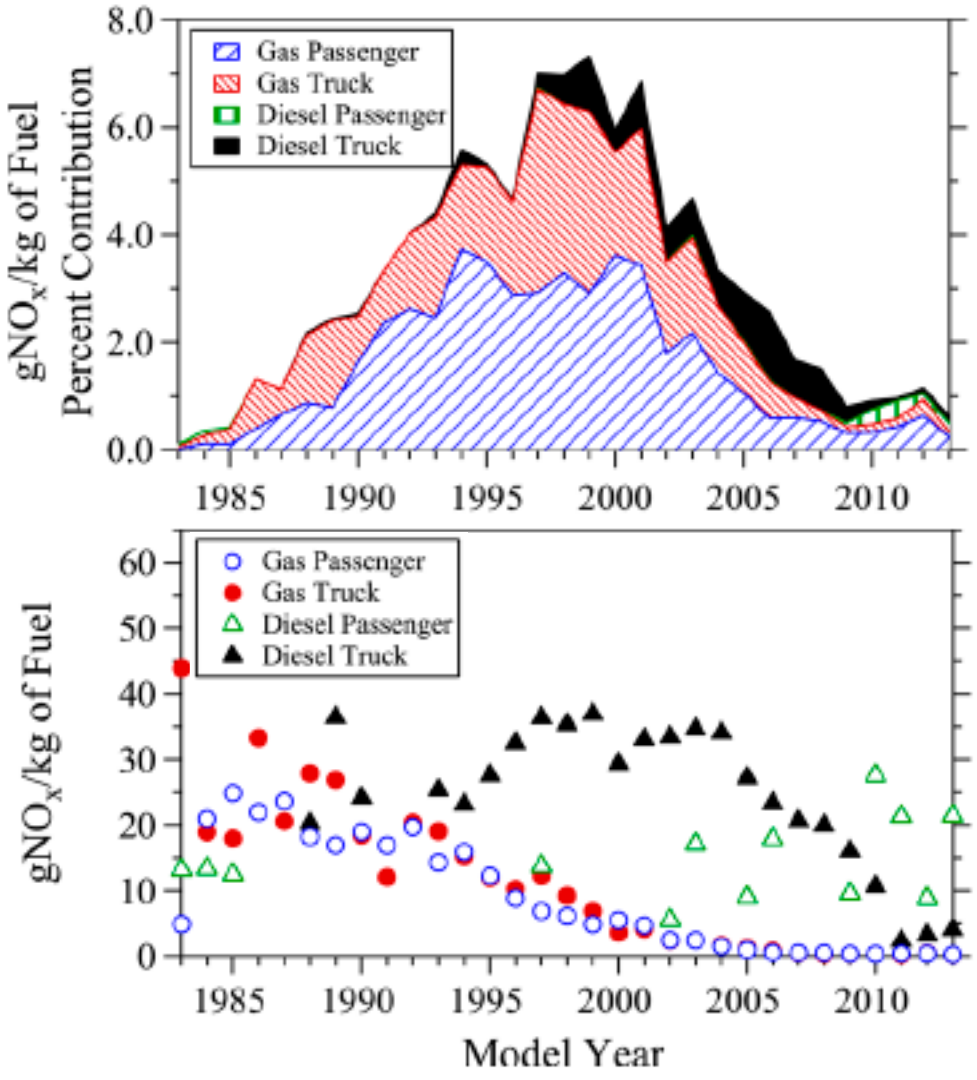
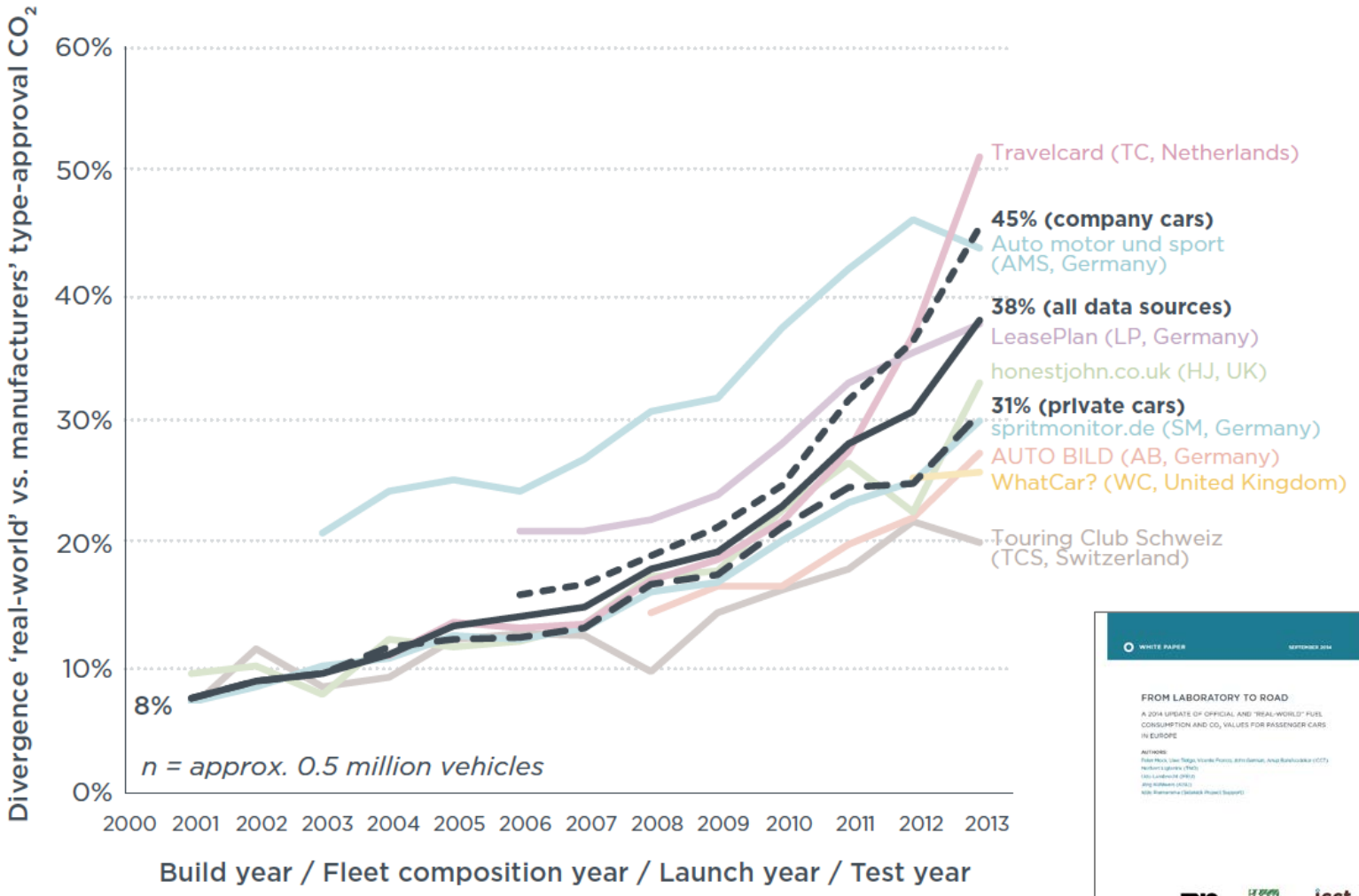
Remote sensing provided evidence of gross noncompliance by HDVs in U.S. in 1990s



Adapted from Bishop & Stedman. Env. Sci. and Technol. (2015)

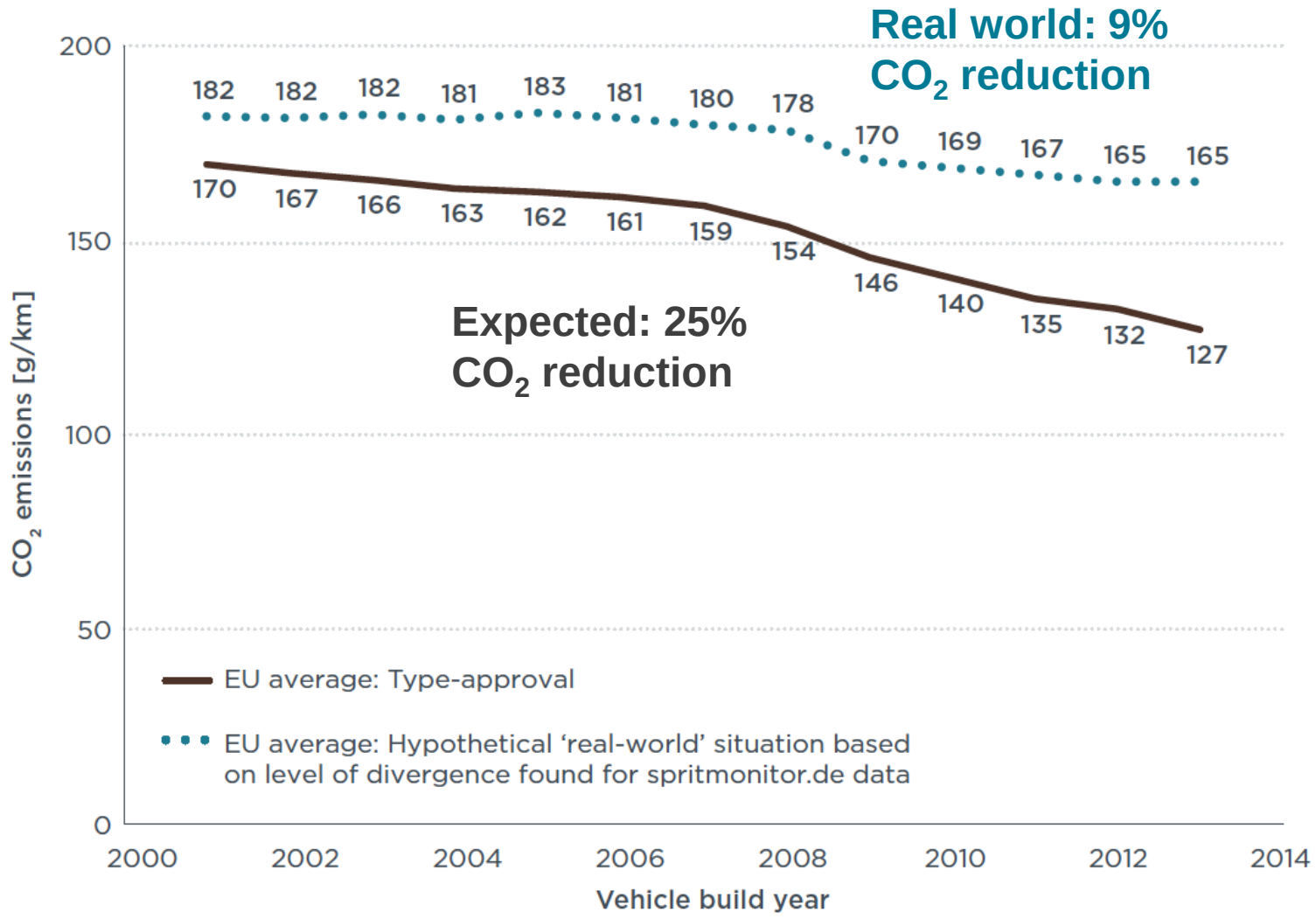
International Climate Agreement (Paris, 2015)

It's not just about NOx . . .
Real-world CO_2 in EU is 30+% higher than claimed



http://www.theicct.org/laboratory-road-2014-update

Growing gap in real world v. type approval emissions cut expected gains from European CO_2 standards more than half.



http://www.theicct.org/laboratory-road-2014-update

Compliance Regimes in the US and Europe

- **Test cycles and protocols**
- **Recall and penalty authority and actions**

Europe

ICCT White Paper - The future of vehicle emissions testing and compliance (November 2015)

- Objective is to compare and contrast the current vehicle testing and compliance schemes in the EU and the United States.
- The fundamental difference is not so much actual vehicle testing but the strong focus on independent conformity testing coupled with enforcement authority in the US.
- In the EU, by contrast, this element of independent re-testing is largely absent from the regulations, and the involved regulatory bodies are more restricted with respect to their enforcement authority.

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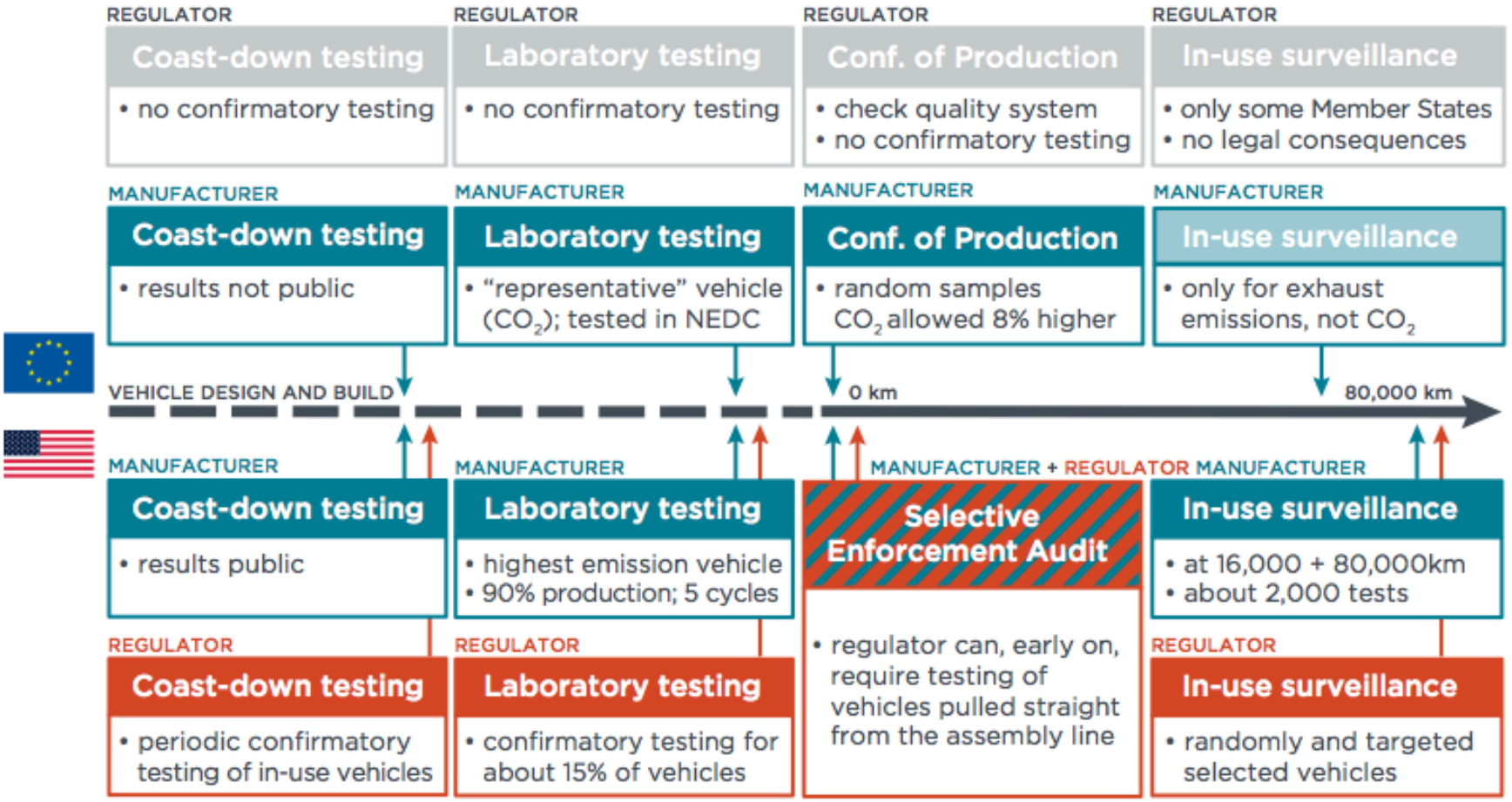
http://www.theicct.org/sites/default/files/publications/ICCT_future-vehicle-testing_20151123.pdf;

Europe
US v EU Compliance Systems



Historically, about 3 million recalls annually
in the US (~ 1% of total vehicle population @ 250 million)

China

Major reform of China Clean Air Law strengthens authority for compliance and enforcement

- Manufacturers are required to test vehicles to demonstrate compliance with emission standards to government and release test data to the public.
- Regulatory agencies can conduct random inspection at production line and sample test the production vehicles, or Conformity of Production tests.
- Per these standards, manufacturers must take appropriate actions to make sure their type-approved vehicles continue to meet the emissions standards during their useful life.
- There are two types of in-use compliance testing: initial tests by manufacturers and verification tests by the regulatory agency (VECC-MEP, the same agency that reviews type approval applications).

Where are we going?

ICCT research and outreach plan

Vision for the future

ICCT Compliance Research (2016)

- Research
  - Global baseline survey
  - Guiding principles
  - Public health assessments: Global and Europe
  - Meta-analysis: (1) European update, (2) China
  - Guidance on detecting defeat devices
  - Country-specific assistance
- Vehicle testing
  - Europe
  - China
  - India
- International Networks
  - FIA Foundation Seminar in London, June 8, 2016
  - Government to government compliance network

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ICCT Testing Projects (recent, active, and upcoming)

Country /Region	Description	Purpose
EU	Dynamometer and PEMs testing of 5 LDVs (diesel and GDI)	• Comparison of “real world” coastdown vs certification coastdown • Compare cold start vs hot start emissions and certification vs non-certification test cycles • Investigate dynamometer vs real world emissions
EU	PEMS testing of 6 LDVs (diesel and GDI)	• Comparison of different types of real world driving - RDE compliant, aggressive driving, additional payload, AC on, high grade, and high motorway speeds
EU	Dynamometer and real world testing of 1-2 Euro 6 diesel LDVs	• Defeat device screening to develop guidance for government testing programs
China	Testing of 50-100 new and in use LDVs (partnering with EF China and VECC)	• Understand the difference between certification test and real world emissions levels. • Investigate real world deterioration factor of catalyst. • Investigate functionality of OBD
India	Dynamometer and PEMs testing of 3 LDVs and 3 HDVs	• Begin to collect real world data for India vehicles (currently there is a lack of publically available data) • Understand the difference between certification test and real world emissions levels

Guidelines for Effective Compliance Programs (under development . . .)

1. **Certification testing** – The test cycle must be representative of real world driving, and test procedures must help ensure that test conditions match normal driving situations.
2. **Real world testing** – As a check on representative nature of the certification test, and to identify defeat devices, real world testing is essential. Europe is developing a "real world driving emission" test protocol and EPA and CARB now include random real world testing as part of certification testing.
3. **Vehicle recalls** – Recall authority is an essential element of effective enforcement. Historically, EPA issues 3 million recalls each year.
4. **Data transparency** – All certification test results, recalls and penalties should be publicly available. Most is available in the US, very little is available elsewhere.
5. **Warranty** – Manufacturers should be required to guarantee to the consumer that emission control technologies are effective and durable over vehicle lifetime (e.g., In the U.S., it's currently 8 years or 80,000 miles).
6. **Financial penalties** – Financial penalties should be large enough to deter illegal behavior (e.g., US and China – and proposed in Europe – penalties at $30 – 40,000 per vehicle).
7. **Political autonomy** – Government officials responsible for taking decisions that affect major corporations must be shielded from political influence.
8. **Resources** – US EPA and CARB have long-established compliance programs with substantial technical capabilities, expert staff, and strong legal authority that will be challenging to replicate in the rest of the world.

Contact Information
Background and Additional Reading

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Anup Bandivadekar, Program Director (San Francisco), anup@theicct.org

Background and Additional Reading:

- http://www.theicct.org/news/epas-notice-violation-clean-air-act-volkswagen-press-statement
- http://theicct.org/news/faq-use-nox-emissions-diesel-passenger-cars
- http://www.theicct.org/position-brief-oct2015-policy-solutions-real-world-emissions
- http://www.theicct.org/future-of-vehicle-testing
- http://www.theicct.org/european-real-driving-emissions-regulation
- http://www.theicct.org/blogs/staff/miseducation-diesel-car
- http://www.theicct.org/nox-control-technologies-euro-6-diesel-passenger-cars
- http://www.theicct.org/laboratory-road-2015-update

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