

HARMFUL EMISSIONS OF VEHICLES IN PRACTICE IN RELATION TO THE LEGAL REQUIREMENTS

WORKSHOPS ON THE FUEL CONSUMPTION GAP AND AIR QUALITY | Norbert Ligterink

TNO innovation
for life

HIGH EMISSIONS OF VEHICLES *AND THE AIR WE BREATHE*

- › **For now NO₂ and PM_{2.5} (particulate matter) as key components**
 - › diesel vehicles are the main cause, EU norms put focus on NO₂
- › **Again, high hopes with new emission legislation** (with the same system)
 - › for on-road vehicles, but other sources outside current perspective
- › **Ineffective current legislation, poor oversight, illegal products, or expired certifications?**
 - › can high NO_x emissions of Euro-5 diesel vehicles be stemmed?
- › **Limitations in Dutch air quality assessments, nitrogen deposition, and emission totals.** (“in the system”)
 - › Alternative reality from modelling for an “average exposure”.
 - › Limited validation by measurements.
 - › New risks and general robustness not investigated.
 - › Other sources: mobile machinery, ships, etc. poorly known.

TNO led H2020 project uCARE

(May 2019 - May 2022)



To reduce the **overall pollutant emissions** of the **existing vehicle fleet** by providing **vehicle users** with **simple, insightful, and effective tools** to decrease their individual emissions *and* to support **stakeholders** with an interest in local air quality in selecting feasible **intervention strategies** that lead to the desired user behaviour.



**We are here to inform, support and facilitate,
based on 30+ years of experience in emission testing**

VEHICLE EMISSIONS

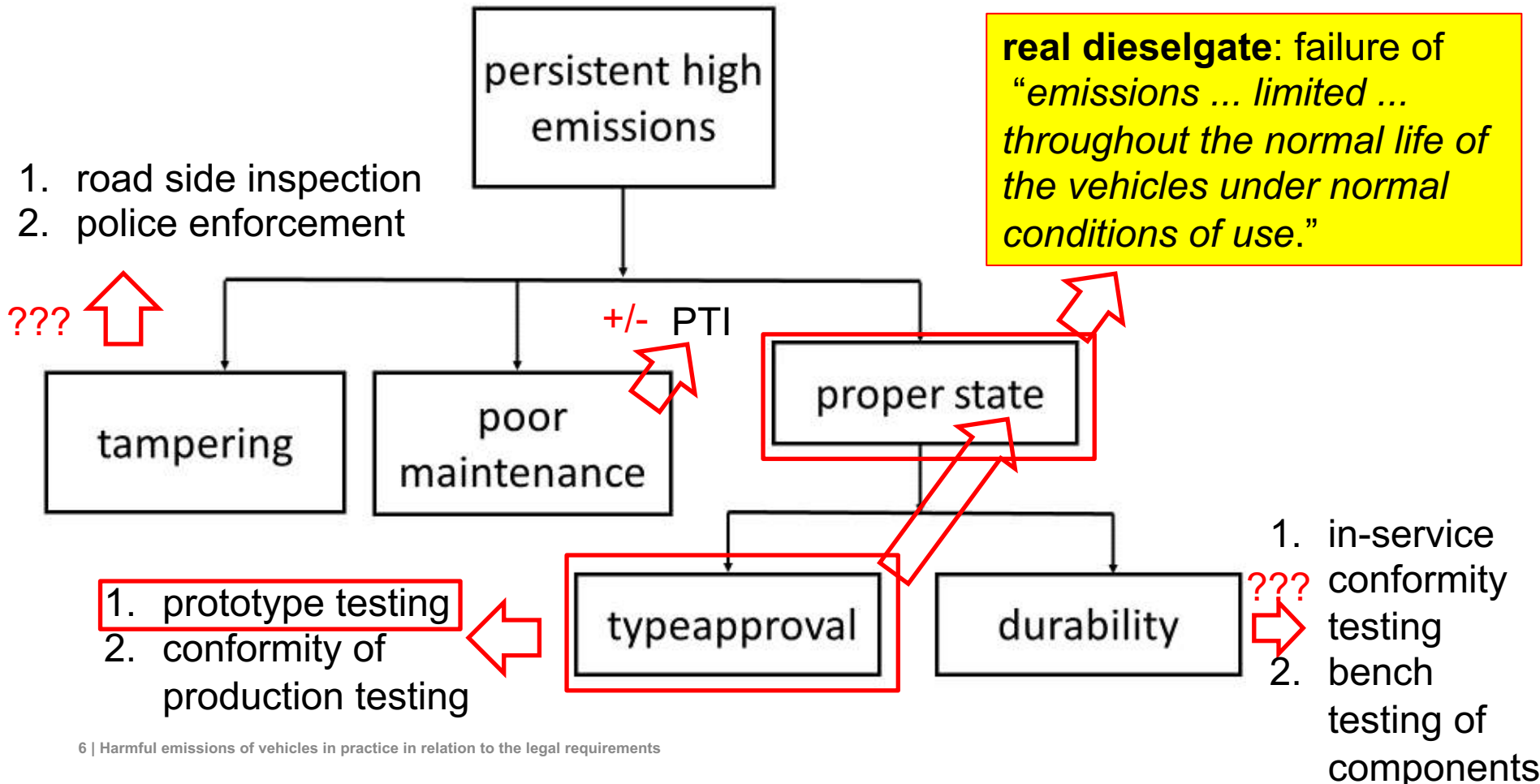
- › **Regulated exhaust pollutants:**
 - › **NO_x = NO + NO₂** → NO is converted to NO₂ in the air (with ozone + light)
 - › **PM:** all particulate matter mass, below 10 micron (typically 100 nm)
 - › **PN:** particle numbers > 23 nm (not conserved), “diesel particulate filter test”
 - › **HC:** hydrocarbons, unburned and partially burned fuel, e.g., polyaromatics
 - › including methane, **CH₄:** Green House Gas
 - › **CO:** carbon monoxide, lethal in high concentrations (e.g. parking garages)

- › **Non-regulated exhaust pollutants:** (mainly produced in catalysts)
 - › **NH₃:** important in nitrogen deposition (concentration limit in heavy-duty only)
 - › **HNCO:** isocyanic acid
 - › **PN < 23 nm:** small particles, below current PN limit
 - › **N₂O:** nitrous oxide, strong Green House Gas
 - › **NO₂:** separately, apart from NO_x limit, for local air quality

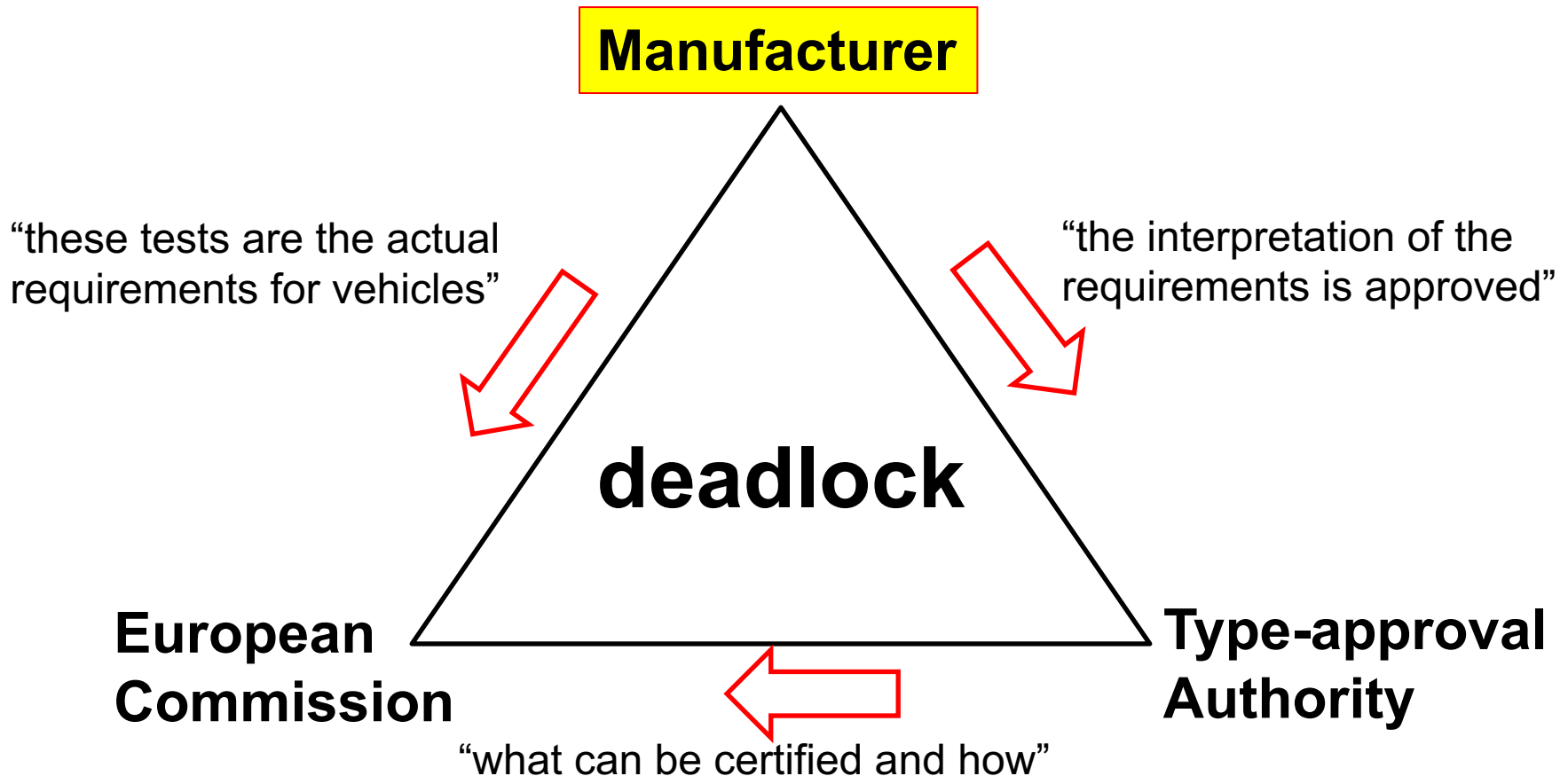
10 YEARS OF EURO-5/6 VEHICLE LAW “EU/715/2007”

- › The framework of approvals: EU/2007/46 (soon: EU/2018/858)
- › **The requirements for vehicles: EU/715/2007**
 - › The implementation and protocols: EC/2008/692, EC/2018/1115, R83, etc.
- › *“The Commission should keep under **review** ... the basis of EC type approval emissions regulations. ... Revisions may be necessary to ensure that **real world emissions correspond to those measured at type approval**. The use of portable emission measurement systems and the introduction of the ‘not-to-exceed’ regulatory concept should also be considered.”* → mandate for RDE
- › *“In addition, the technical measures taken by the manufacturer must be such as to ensure that the tailpipe and evaporative **emissions are effectively limited**, pursuant to this Regulation, **throughout the normal life of the vehicles under normal conditions of use.**”*
- › **RDE + market surveillance:** independent on-road emission testing of vehicles

DIFFUSE RESPONSIBILITIES



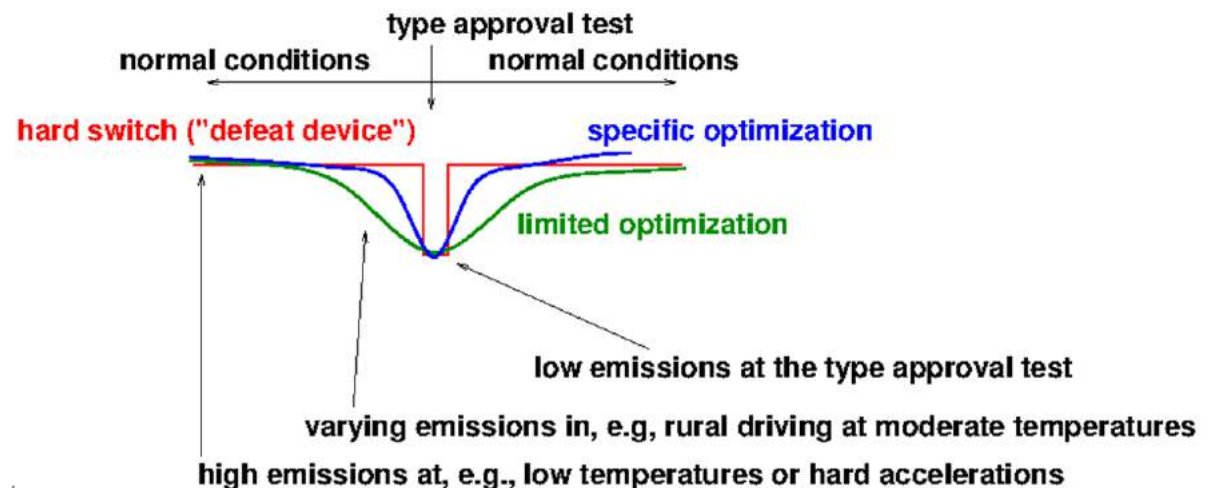
“WHAT CANNOT BE TESTED, CANNOT BE AN ACTUAL REQUIREMENT”



EURO-5 DIESEL NOX EMISSIONS *4 TIMES OR MORE THAN THE LIMIT*

- › Persistent urban NO₂ air-quality problems noted since 2008
 - › Drastic measures by cities, regions, and countries to meet European limits
 - › Diesel vehicles as cause was well known, but not addressed.
- › All brands vehicle models, since 2009, exhibit the similar problems:
 - › the motivation is difficult to establish: fraud, ill-will, incompetence, specifically optimized, focus on durability, etc.

In 2012 it was clear that most vehicles from all manufacturers had high NOx emissions in all other tests than the type-approval test.



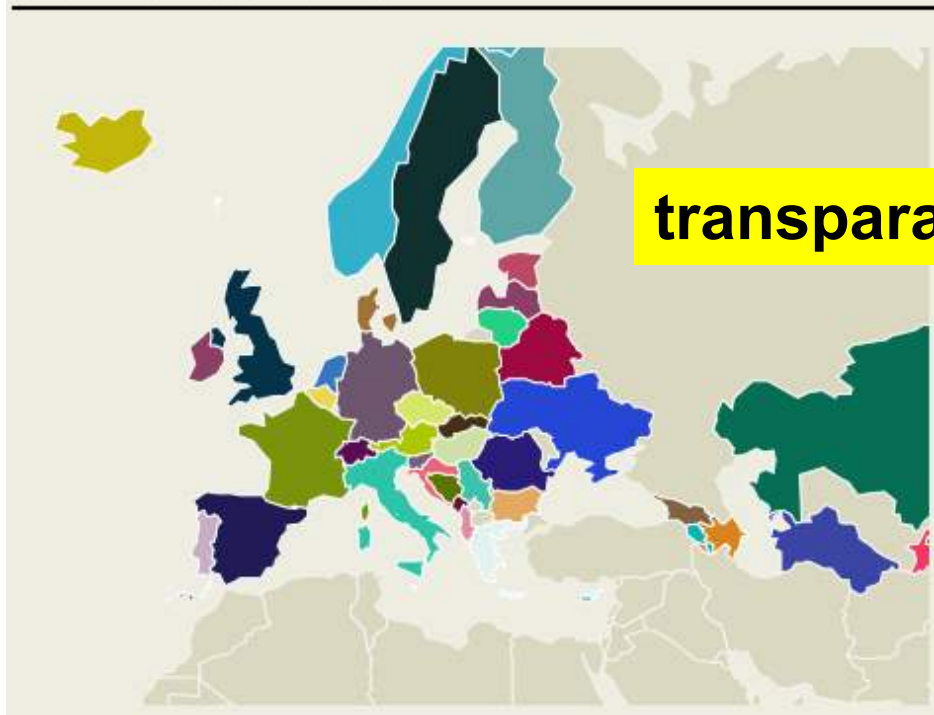
SHORT OF A CONFESSION ESTABLISHING A DEFEAT DEVICE

- › **NEDC test yield low emissions and vehicles “comply” formally**
 - › proof that the emission control technology can work
- › **ISC conformity requires more than 40% with 95% confidence** (See R.83)
 - › Testing for evidence of type-approval compliance is lengthy and complex
- › **Type-approval authorities revisiting Euro-5 and Euro-6 certified vehicles**
 - › United Kingdom, France, Germany, the Netherlands tested vehicles
 - › “Variants of the NEDC test” with 5x higher emissions are only an “indication”
 - › follow-ups proved very difficult: voluntary “software adaptations”

- › **KBA and Volkswagen**
 - › outside public scrutiny
 - › settlements rather than the new standard for good practice

TNO'S PUBLIC TASK

Parties to the Aarhus Convention and their dates of ratification



transparency

Parties to the Protocol on PRTRs and their dates of ratification

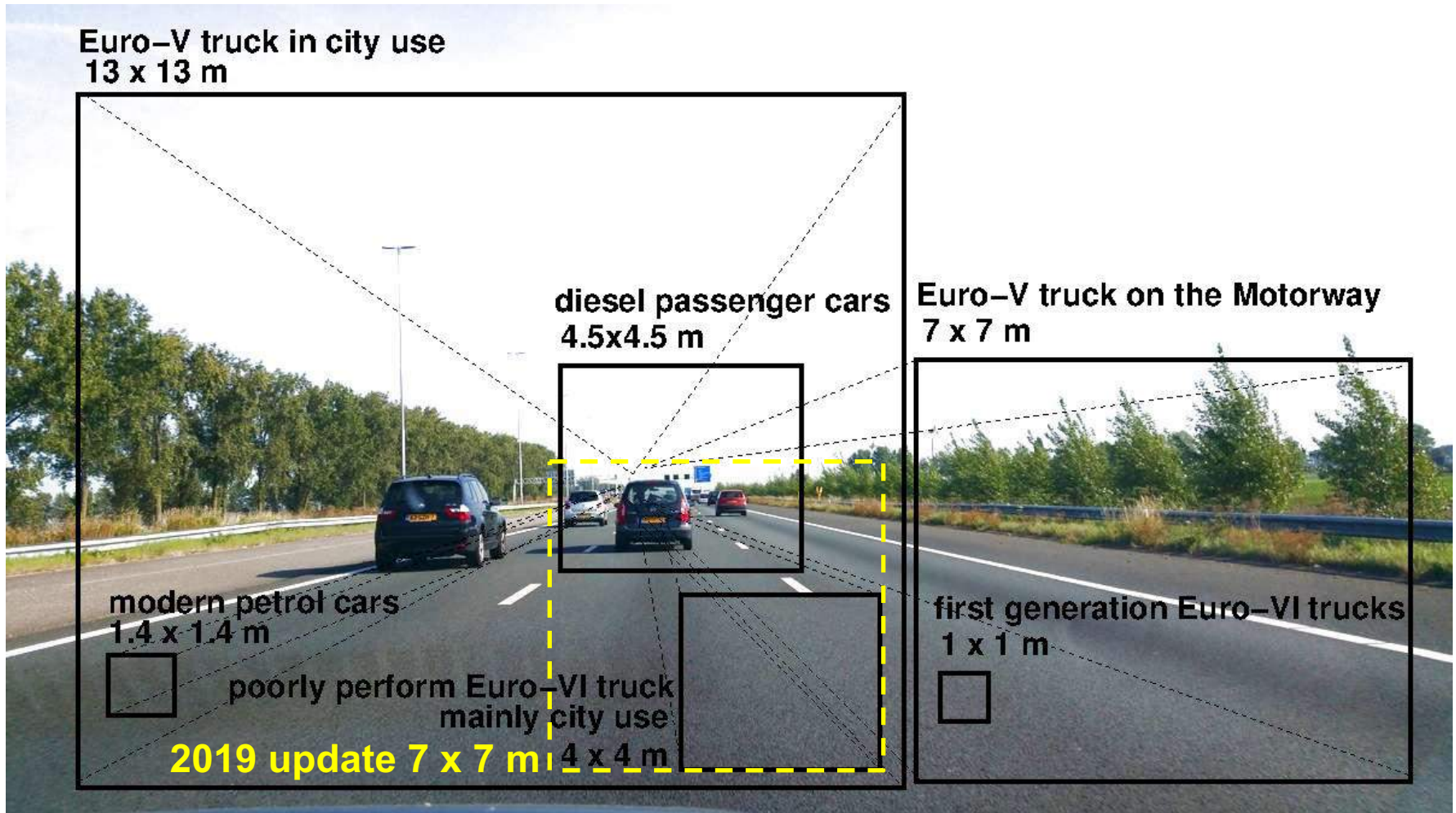


reporting



NECESSARY DILUTION PER VEHICLE

WITH CLEAN AIR TO REACH 40 $\mu\text{g}/\text{m}^3$ AIR-QUALITY STANDARD



FROM

Staatscourant 2006, 215 pag. 20

Meet- en rekenvoorschrift bevoegdheden luchtkwaliteit

Regeling van de Staatssecretaris van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer van 23 oktober 2006, nr. LMV 2006.309882, houdende regels voor het meten en berekenen van de gevolgen voor de luchtkwaliteit, bedoeld in artikel 7 van het Besluit luchtkwaliteit 2005 (Meet- en rekenvoorschrift bevoegdheden luchtkwaliteit)

De Staatssecretaris van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, Gelet op artikel 6 van het Besluit luchtkwaliteit 2005;

Besluit:

§ 1. Algemene bepalingen

Artikel 1

In deze regeling wordt verstaan onder: Besluit: Besluit luchtkwaliteit 2005;

Artikel 3

Vóór 15 maart van ieder kalenderjaar worden de volgende gegevens bekendgemaakt:

- a. een overzicht van de grootschalige concentratiegegevens van zwaveldioxide, stikstofdioxide, stikstofoxiden, zwevende deeltjes (PM₁₀), lood, koolmonoxide, ozon en benzeen van het voorafgaande kalenderjaar;
- b. een overzicht van de prognoses van de grootschalige concentratiegegevens van zwaveldioxide, stikstofdioxide, stikstofoxiden, zwevende deeltjes (PM₁₀), lood, koolmonoxide, ozon en benzeen van het tiende kalenderjaar volgend op het voorafgaande kalenderjaar en de jaren 2010 en 2020;
- c. een overzicht van de emissiefactoren van zwaveldioxide, stikstofoxiden, zwevende deeltjes (PM₁₀), lood, koolmonoxide en benzeen van het voorafgaande kalenderjaar;

Artikel 5

1. De gevolgen voor de luchtkwaliteit, bedoeld in artikel 2, eerste lid, worden op een zodanige wijze bepaald dat afwijkingen van de berekende concentraties ten opzichte van de werkelijke jaargemiddelde concentraties niet meer bedragen dan:

- a. 30 procent voor stikstofdioxide bij wegen;
- b. 50 procent voor zwevende deeltjes (PM₁₀);
- c. 50 procent voor benzeen, en
- d. 50 procent voor lood.

2. De gevolgen voor de luchtkwaliteit worden voorts op een zodanige wijze bepaald dat afwijkingen van de berekende concentraties voor:

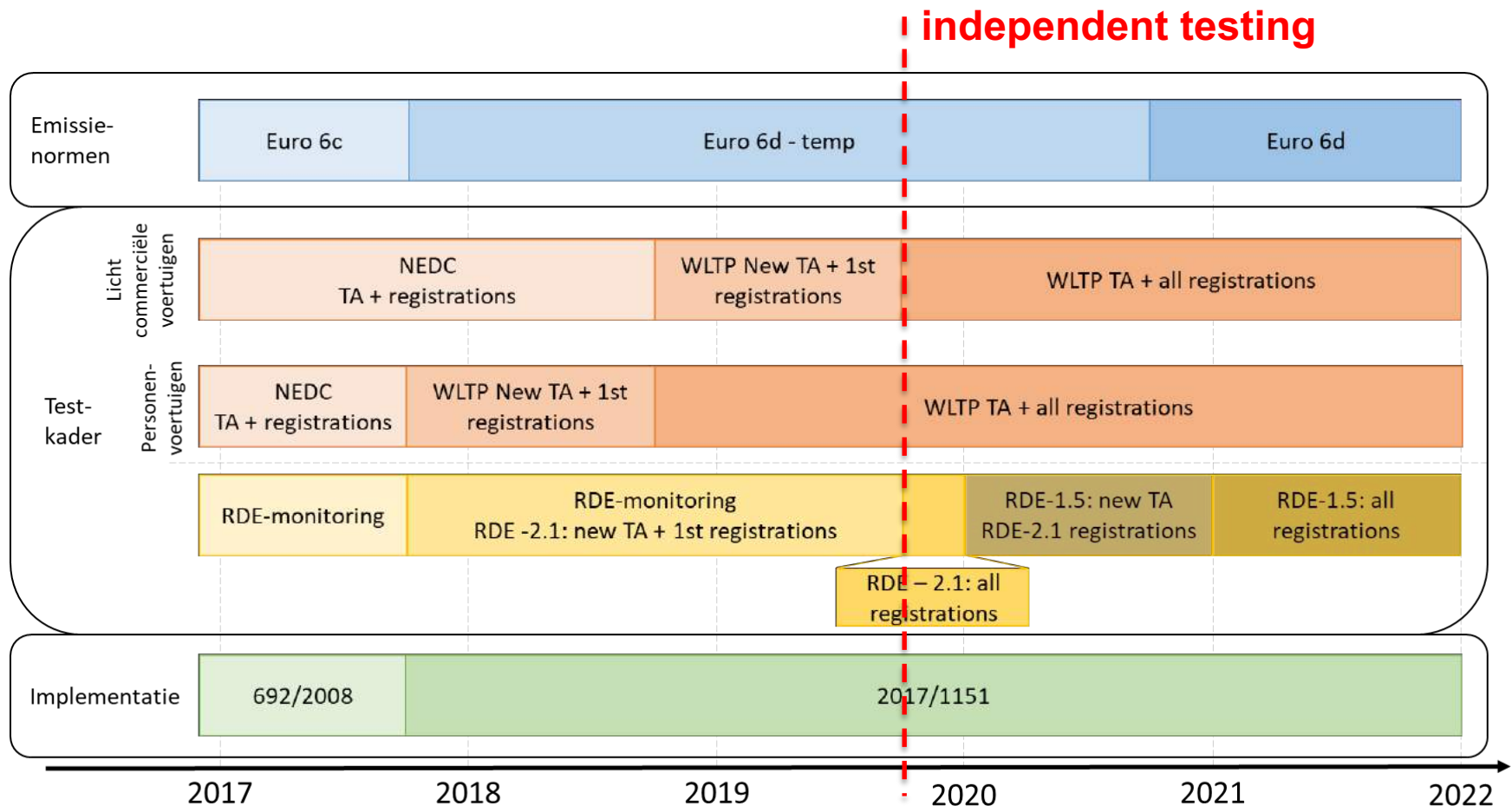
- a. stikstofdioxide bij inrichtingen ten opzichte van de werkelijke uurgemiddelde concentraties niet meer bedragen dan 60 procent;
- b. zwevende deeltjes (PM₁₀) ten opzich-

Prognoses for 2030 are not updated, and 2030 air-quality model is now lagging with current knowledge on emissions of different sources. On this basis it may be decided that air-quality assessments are no longer needed to the same extent as decided in 2006.

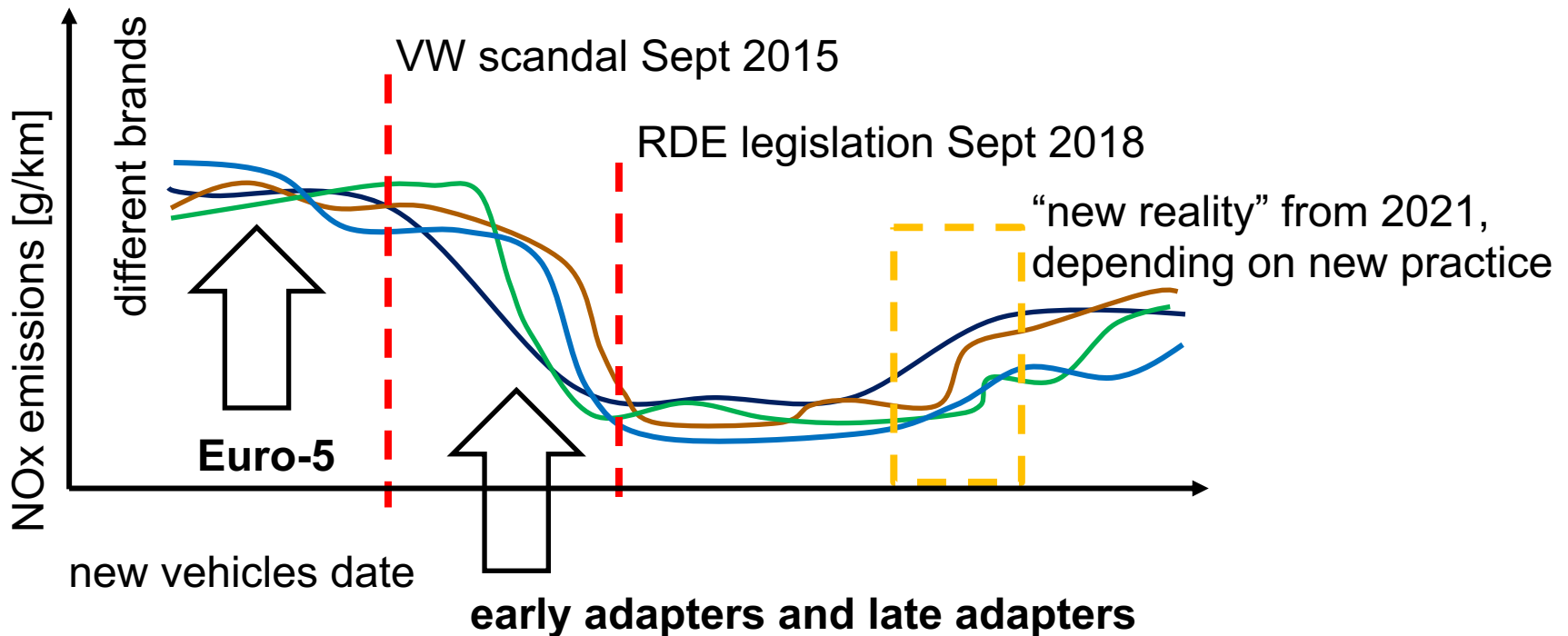
- filling up the margins with “130 km/h” and more roads, up to levels of uncertainty
- model of 30 years old, fixated, not openly reviewed, not properly updated
- “passive openness” by the government, at odds with Aarhus convention
- very limited number of air-quality measurements, poor understanding of local effects

EMISSION LEGISLATION CHANGES

From 1 September 2019 + 6 months independent parties can check compliance of type-approval of new vehicles in in-service conformity



LIKELY SCENARIO FOR DEVELOPMENT OF VEHICLE EMISSIONS



INDEPENDENT IN-SERVICE CONFORMITY TESTING ...

an expensive hobby, with no friends

- › follow up on “evidence from monitoring”
- › accreditation costs (ISO 17025 and ISO 17020)
 - › PEMS
 - › chassis dynamometer
 - › annual audit
- › statistical procedure, up to 10 RDE tests with different vehicles needed, the minimum is 3 vehicles, (open-ended) testing costs
- › follow-up by GTAA and OEM (“investigation by GTAA” is well known from defeat devices: hardly any conclusion yet)
- › delayed reporting: “red tape till a year after the facts”

- › **Misleading product information:**
 - › The “clean diesel” claims when buying a car
- › **Consumer information:**
 - › Why is my vehicle allowed on European roads, where are the documents?
- › **Improper approval:**
 - › On what ground is the vehicle allowed on the road by the authorities?
- › **Failed inspection and market surveillance:**
 - › Are consumers protected by national authorities against inferior products and illegal adaptations?
- › **Independent testing:**
 - › Establishing incompliance of new vehicles from 2020 onwards
- › **Deferred costs of meeting air quality limits:**
 - › Who will pay for mitigation (e.g. low emission zones) and health costs?
- › **Severe environmental risk:**
 - › Are vehicles environmentally roadworthy?
- › **Need for transparency (Aarhus convention):**
 - › Why are we not informed about environmental risks, as we are entitled to?
- › **The quality of the Dutch air quality model:**
 - › Is the air-quality model good enough? Do we need better evidence? What is the use of “average exposure” for the health of individual citizen?

» **THANK YOU FOR YOUR ATTENTION**



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