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# Reflections After 'Dieselgate': Economic Measures or Regulations for Improving Energy Efficiency?

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**Theodoros Zachariadis**

Associate Professor and Dean

Faculty of Geotechnical Sciences and Environmental Management

Cyprus University of Technology

e-mail: [t.zachariadis@cut.ac.cy](mailto:t.zachariadis@cut.ac.cy)

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# Background

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- In September 2015 the U.S. Environmental Protection Agency started investigations against Volkswagen for illegally installing software that allowed diesel car models to pass stringent nitrogen oxides (NO<sub>x</sub>) emission tests
- More allegations were made later about: a) other auto companies; b) carbon dioxide emissions
- Fact: Vehicle emission tests are conducted with outdated test procedures that do not reflect today's actual driving conditions

# Laboratory testing of vehicle exhaust emissions on a chassis dynamometer



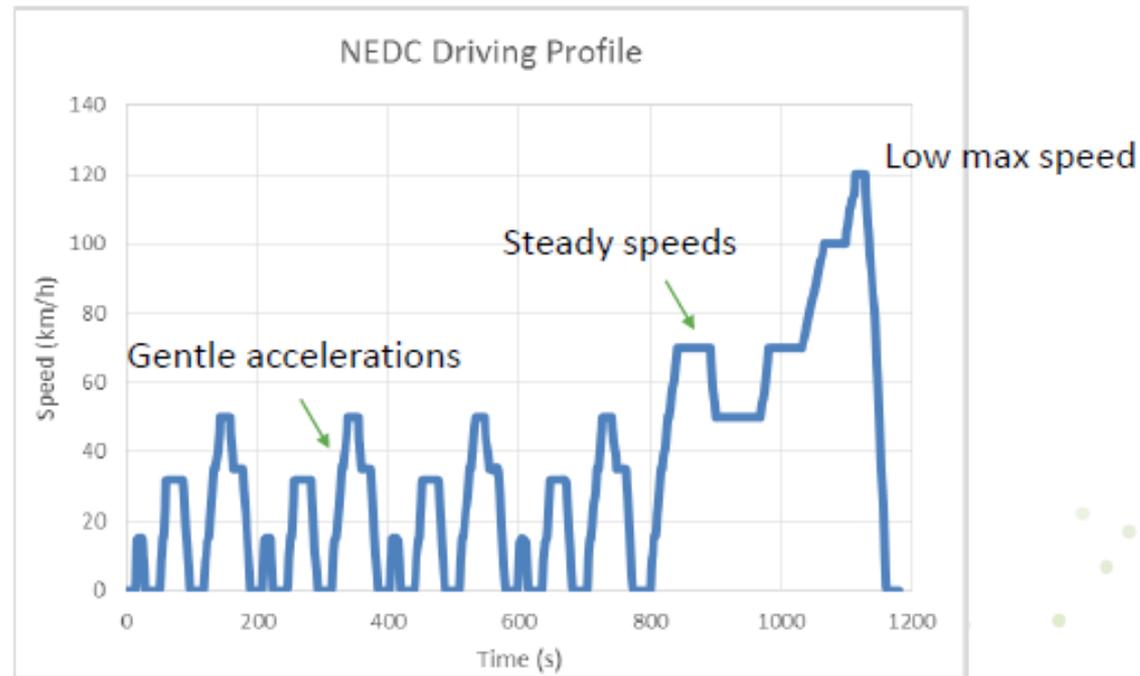
Source: [www.imeche.org](http://www.imeche.org)

A car has to overcome 3 forces when driven:  
Inertia, rolling resistance, wind resistance

# 'Driving cycle' on a chassis dynamometer

## Europe – New European Driving Cycle (NEDC)

### Type approval driving cycle



- 'Gentle' driving profile accused of causing deviations to real world emissions

# The vehicle has many 'hints' to realise it is being tested on a chassis dynamometer

Non powered axle is stationary

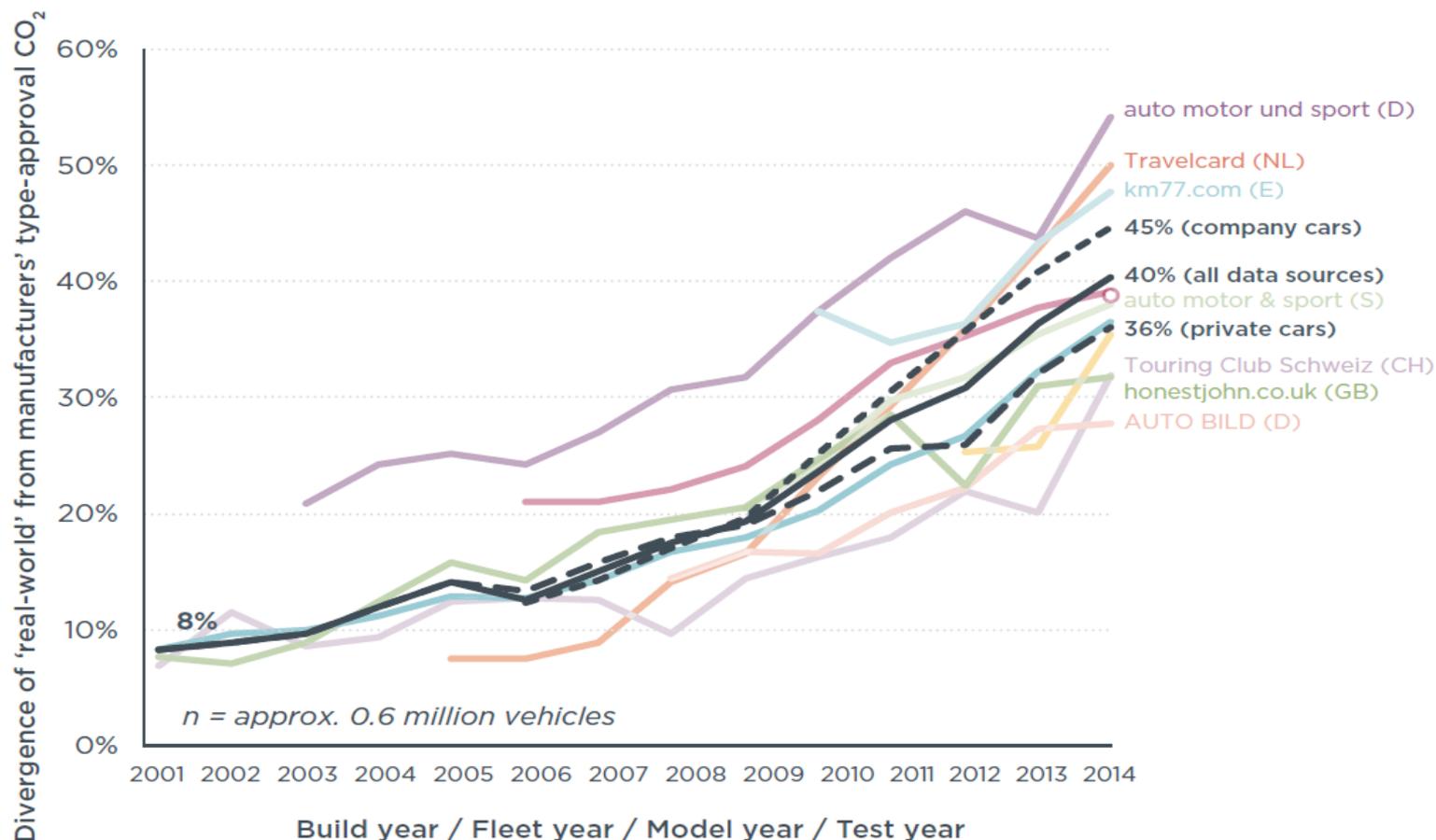
Rollers used to simulate actual road load



No steering

1. Temperature is set to up to 22-28°C
2. Vehicle is pre-conditioned with given profiles and soaked to start with a cold-start

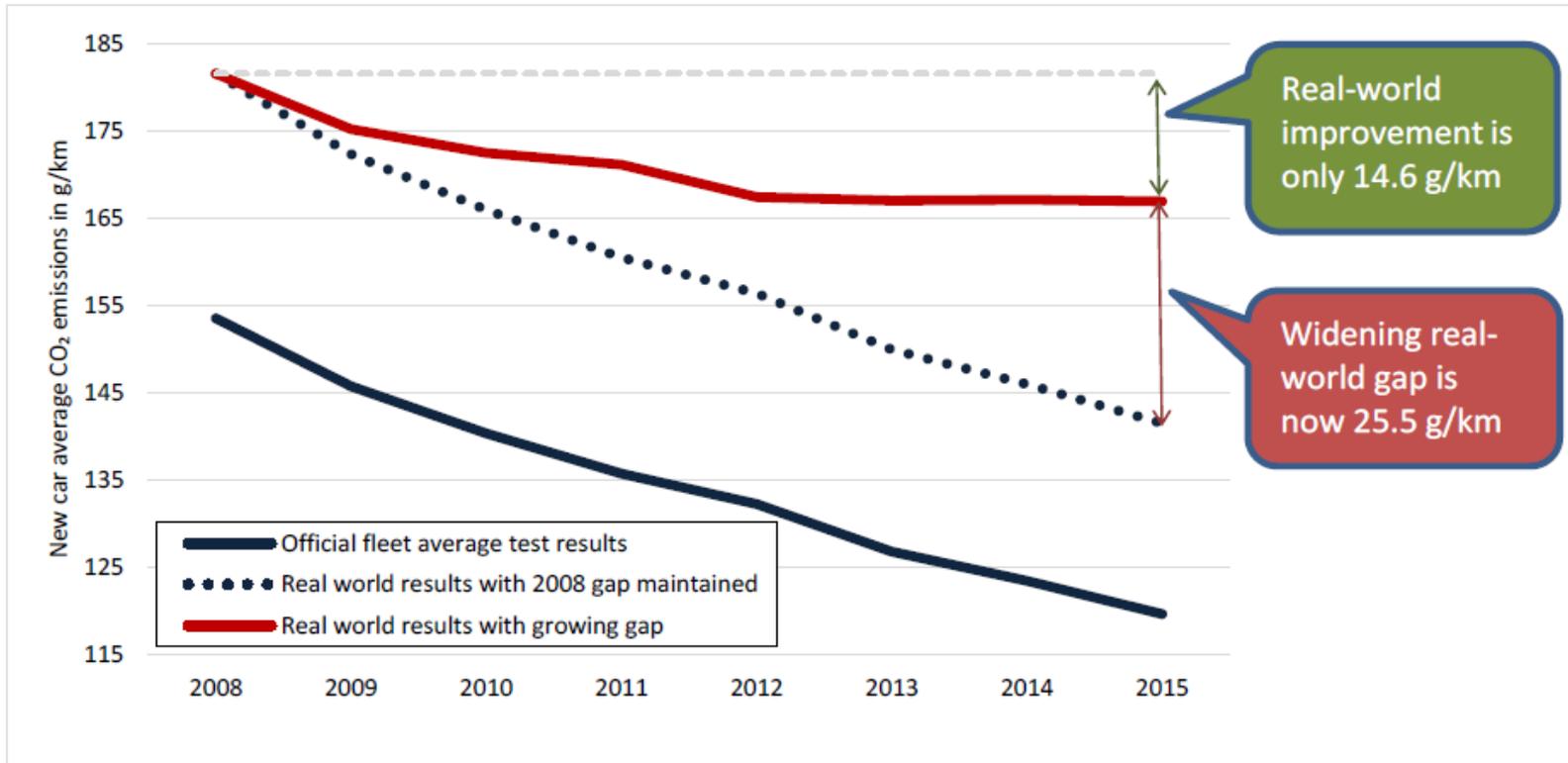
# The gap is growing over the years – and with tightening regulations



Source: International Council on Clean Transportation, 'From laboratory to road: A 2015 update', Berlin, September 2015;  
<http://www.theicct.org/laboratory-road-2015-update>.



# Environmental benefits are much lower than officially reported



**Fig 3: Official CO<sub>2</sub> test results versus the real world outcomes in 2014 for private motorists (derived from ICCT, 2016 and EEA official CO<sub>2</sub> data)**

Source: Transport & Environment, 'Mind the Gap 2016 - Fixing Europe's flawed fuel efficiency tests', Brussels, December 2016;  
<https://www.transportenvironment.org/publications/mind-gap-2016-report>.

# Proposed solution: Real-World Driving Cycle with Portable Emissions Monitoring System



## Plus:

Continuous monitoring of in-use emissions of cars during their lifetime  
(to account for quality of maintenance, retrofits etc.)

Source: Transport & Environment,  
<http://www.transportenvironment.org>

# But... isn't this monitoring too costly?

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- Sophisticated equipment necessary
- Continuous monitoring required
- How are emission standards determined?  
By bureaucrats in governmental agencies?  
How do they know what is technologically feasible by the industry?
- How much can industry lobbying affect the standards?
- What flexibilities are allowed in driving cycles?

# It's not only about vehicles...

- Similar regulatory problems are observed for tests on energy using appliances
- NGOs announced in September 2016 “Smart Testing of Energy Products (STEP)” programme ([coolproducts.eu](http://coolproducts.eu))
- Aim: Test home appliances (TVs, refrigerators, dishwashers) under real-world operation
  - Compliance tests at odds with real world conditions (e.g. vacuum cleaner tests use empty bags)
  - Evidence that TV sets change behaviour when identifying that they are tested according to US DOE procedures ([www.nrdc.org](http://www.nrdc.org))
  - Industry representatives dominating the standardisation bodies that write those tests
  - Weak enforcement of the rules

# Do 'command-and-control' policies work?

- Yes, they do! Very substantial air/water quality improvement thanks to environmental legislation
- Policymakers and engineers like them – also the industry if they provide clear investment signals
- But... at what cost? Do we really know?
- Can we achieve the same environmental targets more cheaply?
- Economists believe so... through 'market based instruments'!

# 'Market-based policy instruments'

- Give/impose an economic incentive, and let the market adjust
- Economic incentives may be:
  - Taxes/charges/levies on emissions of pollutants or on resource consumption (e.g. Euros/tonne of carbon emitted, Euros/cubic metre of water consumed)
  - Distance-based charges (e.g. road pricing)
  - Emissions-based taxes/subsidies (e.g. tax or subsidy depending on CO<sub>2</sub> emissions of a car, currently applied across Europe and partly in Cyprus)

# Why do economists prefer market-based instruments?

- They are transparent (e.g. a clear price per litre of fuel or per cubic metre of water)
- They provide incentives for continuous improvement – not just ‘meeting’ a standard
- They are cheaper because easier to enforce
- They can influence both:
  - Technology
  - Human behaviour (this is unaffected by legislation)
- You cannot ‘cheat’ (well... almost)

# Shall we remove environmental laws and replace them with economic measures?

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Reality is always more complicated:

- Regulations/laws are often the only politically acceptable policy – people dislike taxes!
- Humans are not perfectly informed or rational  
→ ‘paternalistic’ laws/regulations may be justified
- Taxes/charges are also sometimes prone to cheating or political bargaining
- Cars cause multiple social problems (congestion, accidents, pollution, noise)  
→ there is no single ‘optimal’ price to impose

# How to fix our environmental problems – With the Law or with Money?

Every scientific discipline has its 'idée-fixe':

- Engineers → Technology
  - Economists → Price
  - Political scientists → Institutions
  - Organization theorists → Decision processes
  - Teachers → Education
- More emphasis should be given in the future to economic incentives for phasing out high-carbon and highly polluting fuels and technologies
- But: In a complex and imperfect world, we need a mix of regulatory and economic measures to solve our environmental problems

# Barriers in the communication between economists and engineers

*Atmospheric Environment* 138 (2016) pp. 1-3;  
& Policy Brief of European project 'Odyssee-Mure', [www.odyssee-mure.eu](http://www.odyssee-mure.eu)

- Economists focus too much on energy demand & carbon emissions to support a fuel/carbon tax
  - But are silent on health-related pollution abatement where market instruments more challenging to employ
- Engineers do not understand what is the cost of emission standards
  - Consumer surplus, deadweight loss etc. difficult for non-economists to understand
  - Could economists be exaggerating about the magnitude of such costs?

# Epilogue:

## We need polycentric approaches

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“... Waiting for effective policies to be established at the global level is unreasonable. Rather than only a global effort, it would be better to self-consciously adopt a polycentric approach to the problem of climate change in order to gain the benefits at multiple scales as well as to encourage experimentation and learning from diverse policies adopted at multiple scales”.

*Elinor Ostrom, Economics Nobel Laureate 2009*

Ostrom E., A Polycentric Approach for Coping with Climate Change. Background Paper to the 2010 World Development Report, Policy Research Working Paper 5095, The World Bank, Washington, DC, 2009, pp. 31–32

