

The role of in-use PEMS testing
to ensure regulatory compliance
and policy effectiveness
... and to avoid another Volkswagen crisis.

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Emissions Analytics' credentials



- Founded in 2011
- Headquartered in UK, with operations in London, Los Angeles and Stuttgart
- Specialist in PEMS testing and data analysis
- 1200+ vehicles tested
- Largest commercially available database of real-world emissions data
- Works with OEMs, Tier 1/2 suppliers, fuel and chemical companies, regulators, consultancies, consumer media

Equipment

- SEMTECH-DS and -LDV
- Portable Emissions Measurement System connects to tailpipe
 - Captures emissions for CO₂, CO, NO, NO₂, total hydrocarbons
 - At 1 Hertz
- Air temperature, pressure, humidity
- GPS for speed and altitude
- Engine data via CANBUS
- Fuel economy derived via carbon balance
- Weight addition 100-250 pounds



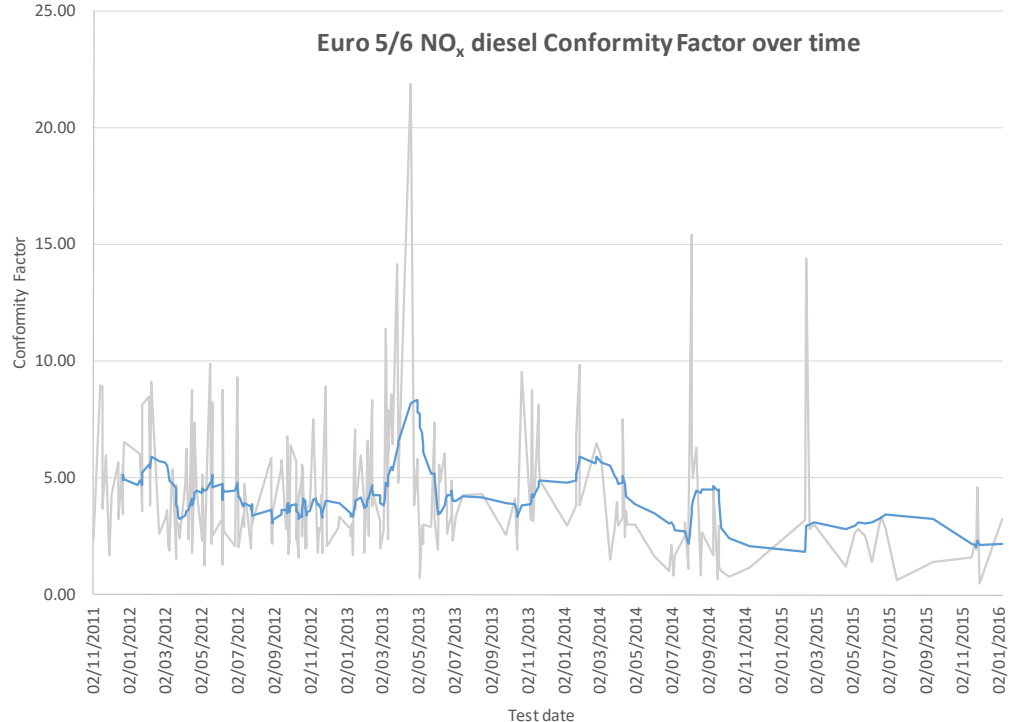
Objectives

- Rolling in-service surveillance programme of production vehicles
- Target to test 500+ vehicles per year
- To complement type approval
- And ensure efficacy of regulations
- Air quality, greenhouse gases, fuel economy
- Independent, making data available to all
- Top-level ratings for marketing
- Benchmark rankings
- Deep-dive analysis for manufacturers

TRACKING POLICY EFFECTIVENESS

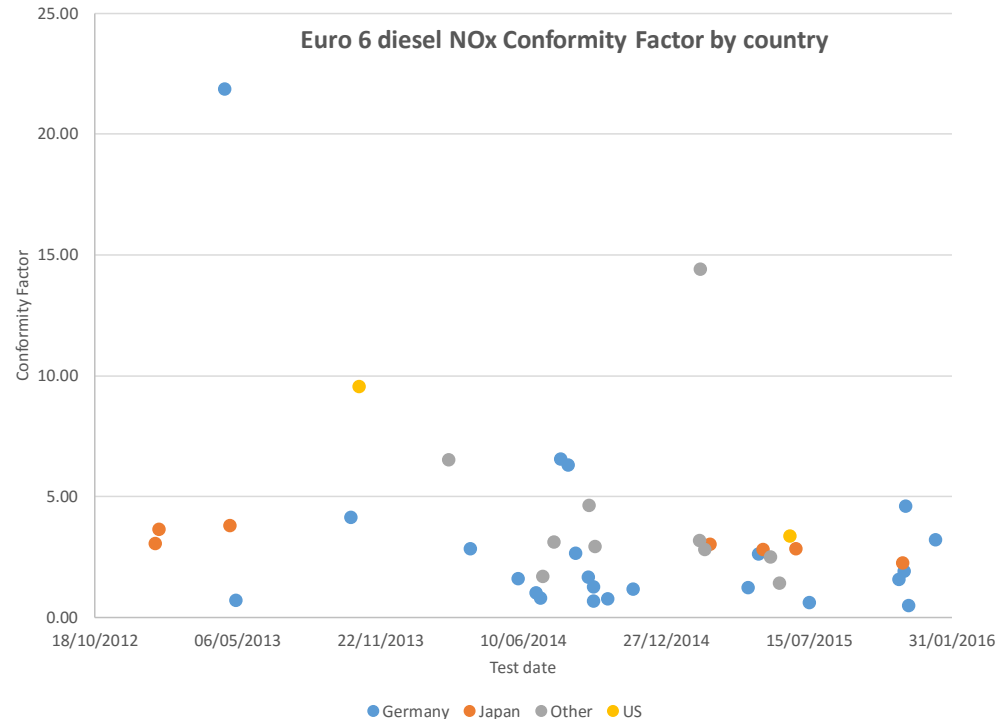
NO_x latest trends (1)

- Rolling 12-month average of exceedance factor in blue
- Step-change technology launched Q2 to Q3 2014
- No further reduction in Conformity Factor since then
- Average CF dipped to 2.7 in 2014, but risen to 3.5 since then



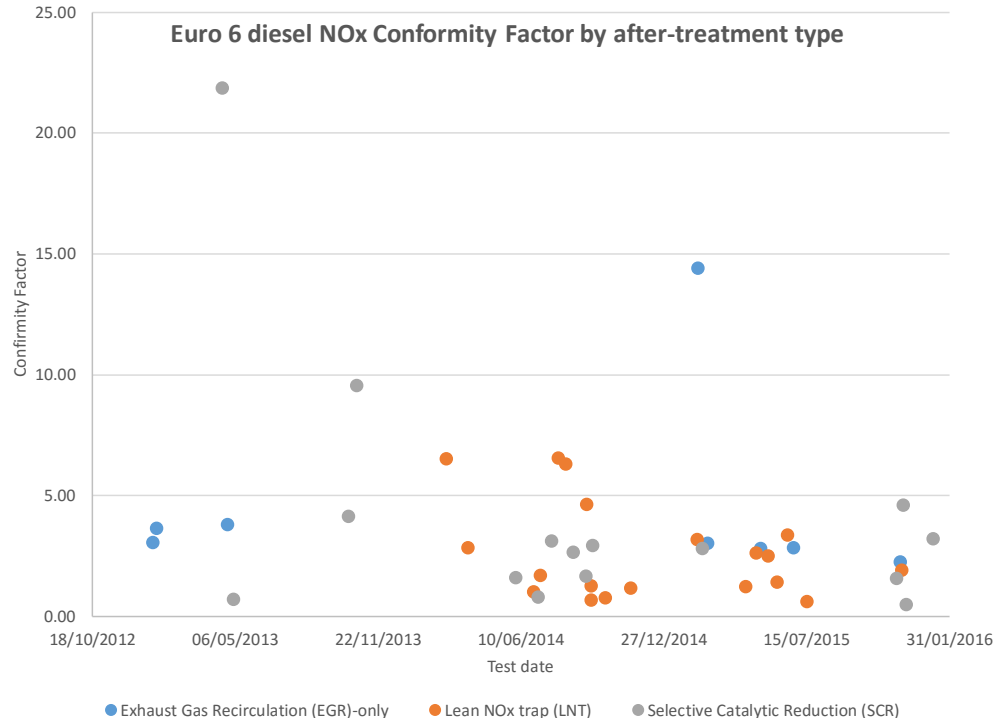
NO_x latest trends (2)

- German manufacturers leading introduction of Euro 6 vehicles
- And offer the cleanest
- US manufacturers slow to bring Euro 6 vehicles to market
- Japanese very consistent around market average conformity factor



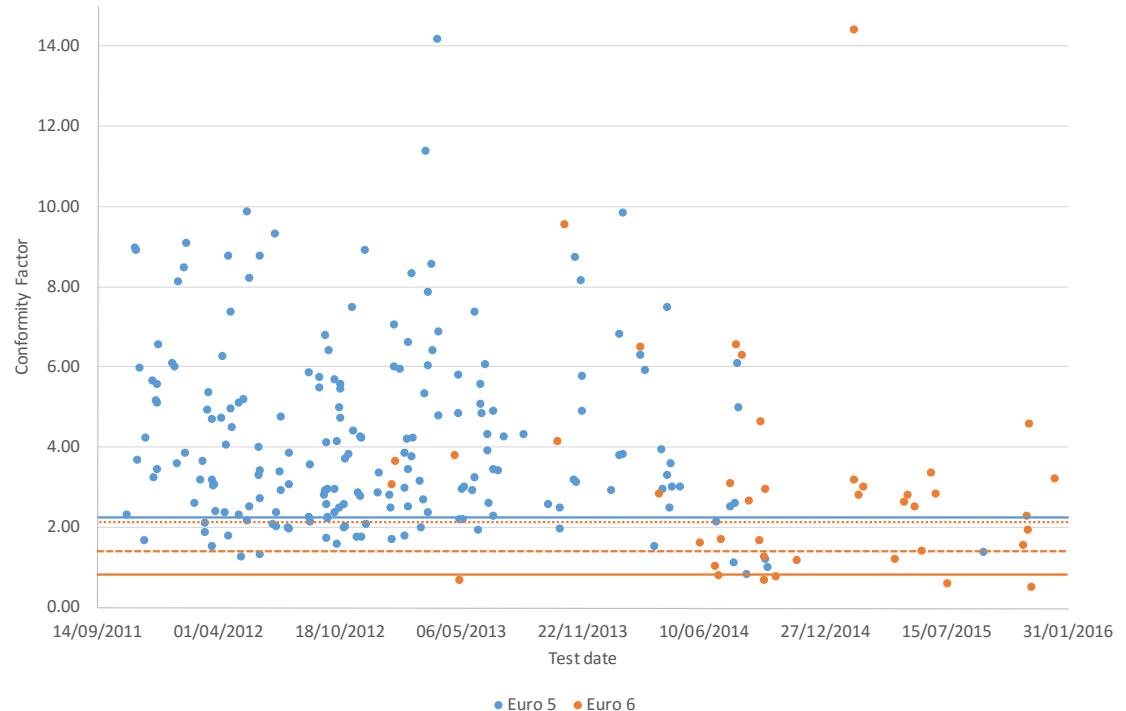
NO_x latest trends (3)

- Earliest Euro 6 vehicles were LNT and EGR-only, but LNT quickly became dominant technology
- More recent switch to SCR
- Nevertheless, good performance achieved by many LNT systems
- Similarly wide spread of performance between LNT and SCR

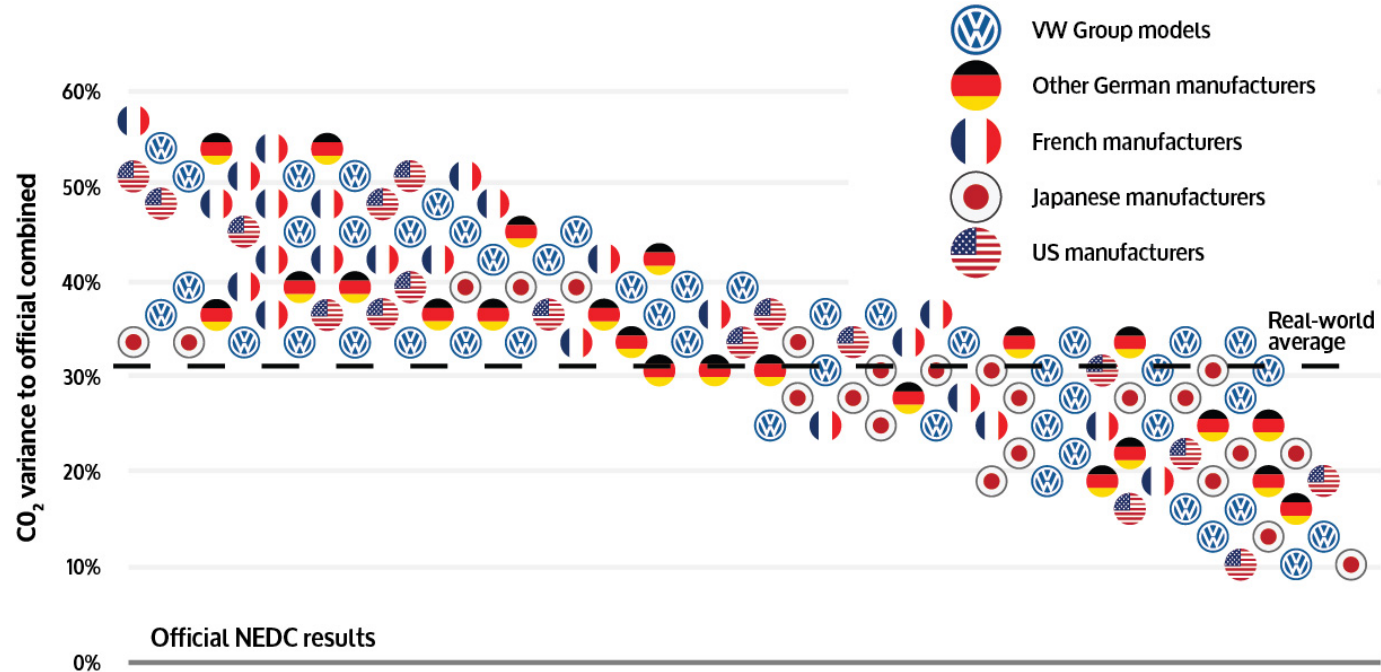


Will Real Driving Emissions help?

- Conformity factor initially 2.1 – 168 mg/km
- Further increased by exclusions due to boundary conditions – details TBD
- PEMS test-to-test variability of 30%, so OEMs will need to target ~129 mg/km to avoid getting caught by in-service surveillance



Fuel economy by country



TRACKING VEHICLE PERFORMANCE

Segment/fuel ranking

Home / AQ Ranking / Segments

All Tests Euro 5 Only Euro 6 Only

Mini Car (A)
Large Car (D)
Sport Utility/Off-road Vehicle (J)

Small Car (B)
Executive Car (E)
Multi-purpose Car (M)

All Segments

Medium Car (C)
Luxury Car (F)
Sports Coupe (S)

NO_x Official NO_x Exceedance Factor Urban fNO₂ Rural fNO₂ Motorway fNO₂ Combined fNO₂ Cold Start Uplift DPF Regen Uplift

Gasoline

#	Manufacturer	NO _x	MoM	YoY
1	Honda*	0.003	1 →	1 →
2 =	Mitsubishi*	0.009	2 →	2 →
2 =	Nissan*	0.009	2 →	7 ▲
4	Volvo*	0.011	4 →	
5	Mazda	0.012	5 →	5 →
6	Peugeot	0.020	7 ▲	6 →
7	Volkswagen	0.021	8 ▲	8 ▲

Diesel

#	Manufacturer	NO _x	MoM	YoY
1	Mitsubishi*	0.274	1 →	1 →
2	Mazda	0.293	2 →	2 →
3	Mercedes-Benz	0.406	3 →	15 ▲
4	Audi	0.422	4 →	10 ▲
5	Volkswagen	0.458	6 ▲	16 ▲
6	Honda	0.484	5 ▼	3 ▼
7	Citroen	0.503	7 →	4 ▼

Hybrid

#	Manufacturer	NO _x	MoM	YoY
1	Toyota*	0.005	1 →	1 →
Market Average		0.050		
2	Mercedes-Benz*	0.094	2 →	

Drill-down to individual datasets

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Included Tests

Award	Test Date	Test Description	Regulatory Stage	NO _x	Official NO _x	Exceedance Factor	Urban fNO ₂	Rural fNO ₂	Motorway fNO ₂	Combined fNO ₂	Cold Start Uplift	DPF Regen Uplift
	2015-02-26	Mazda 6 2.2L Diesel 5DR	Euro 6	0.242	0.080	3.025	32.9	32.0	35.5	33.9	1.00	
	2013-04-25	Mazda 6 2.2L Diesel 4DR	Euro 6	0.305	0.080	3.813	36.8	39.2	45.9	42.1		
	2013-01-10	Mazda 6 2.2L Diesel 4DR	Euro 6	0.245	0.080	3.063	20.3	20.0	32.3	26.1		

NO_x Official NO_x Exceedance Factor Urban fNO₂ Rural fNO₂ Motorway fNO₂ Combined fNO₂ Cold Start Uplift DPF Regen Uplift

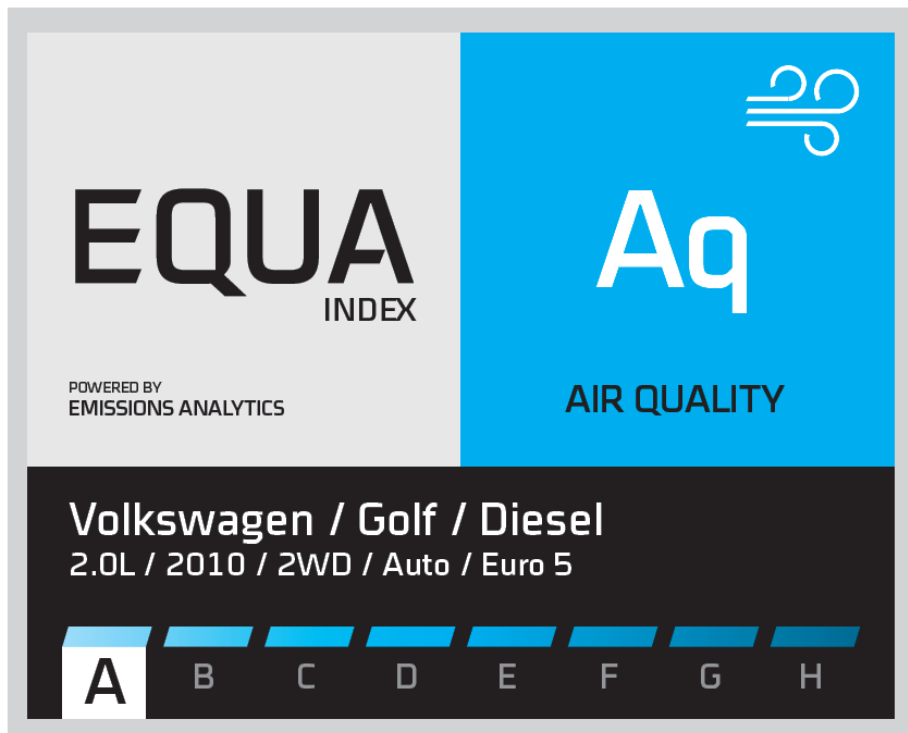
Gasoline					Diesel					Hybrid				
#	Manufacturer	NO _x	MoM	YoY	#	Manufacturer	NO _x	MoM	YoY	#	Manufacturer	NO _x	MoM	YoY
1	Mercedes-Benz*	0.068			1	Volvo*	0.113			1	Mercedes-Benz*	0.094		

INDEPENDENT AIR QUALITY RATINGS

Vehicle rating scheme



- Vehicle rating scheme based on their real-world NO_x emissions, launching in April 2016
 - Initially on cars, but shortly to extent to light commercial vehicles
 - Non-statutory complement to new Real Driving Emissions regulations
 - But will also
 - Discriminate between high and low emitters, rather than just pass/fail
 - Be updated for each model year to keep up with new calibrations
 - Ratings will be published and put in the public domain
 - Manufacturers and consumer media can adopt as independent, voluntary standard
 - Similar to New Car Assessment Programme (Euro NCAP, Global NCAP)
- Robust, independent standard needed to measure and incentivise actions to bring about air quality improvements



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