

EQUA

real-world
test database



RDE Surveillance and Compliance

Independent test database

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Our Belief

When it comes to the pursuit for improved air quality, we believe in the power of clarity, transparency and integrity. With real-world data we can meet emissions challenges – instilling trust and confidence in our industry partners and public.

It's with our commitment and independence we are able to make a significant contribution toward positive change and to achieve enduring results.

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Assured

Emissions testing in real-world conditions brings challenges that experience anticipates and expertise overcomes. We deliver.

Independent

Objectivity and candour are the driving forces in all our work, so you know the facts.

Responsive

We're fast on our feet so we can conduct emissions testing when and where we're needed.

Introduction

- Founded in 2011
- Headquartered in the UK
- Operations in UK, Germany, USA and South Korea
- Independent testing house specialising in real-world emissions testing
- Over 2,500 vehicles/ machines PEMS tested across passenger, commercial and off-road
- Largest commercially available database of real-world emissions data
- We work with regulators, OEMs, Tier 1/2 suppliers, fuel and chemical companies, fleets, consumer media

Database Principles

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EQUA

real-world
test database

NEWS

Database process

Independently source vehicle

Test on standardised normal cycle:
urban, rural, motorway

Test in range of extended conditions

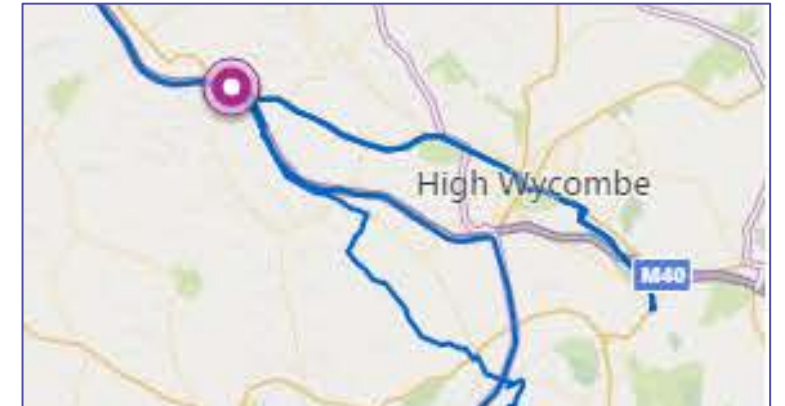
Top-line results, analysis, raw data and meta data
added to database within 48 hours

Scope

- Separate passenger car databases for EU, US, Korea
- 1,200+ vehicles for EU, 800+ vehicles for US
- ~150 new vehicles each year in both locations
- For Europe, additional light commercial, heavy commercial and off-road
- Wide range of powertrain types
- All data owned by Emissions Analytics

Light-duty test cycles

- Normal cycle defined geographically
- With multiple repetitions
- And dynamic boundary condition verification
- Extended cycle driven flexibly to take in range of operating conditions
- Inside RDE boundaries
- Outside RDE boundaries, especially for $v^*a_{pos@95}$ and RPA
- No extreme altitudes, gradients and temperatures
- Total length ~4 hours
- Exact cycle not published



Test conditions (typical)

- Odometer at least 2,000 miles/3,000 km (average 5,000km)
- Predominant driving mode – usually 'Normal'
- Predominant transmission mode
- Ambient temperature 5-25 °C

Powertrains

- Standard ICE gasoline and diesel
- Mild hybrid
- Full hybrid
- Plug-in hybrid – conceptually, an weighted average of ICE and BEV
- Battery electric

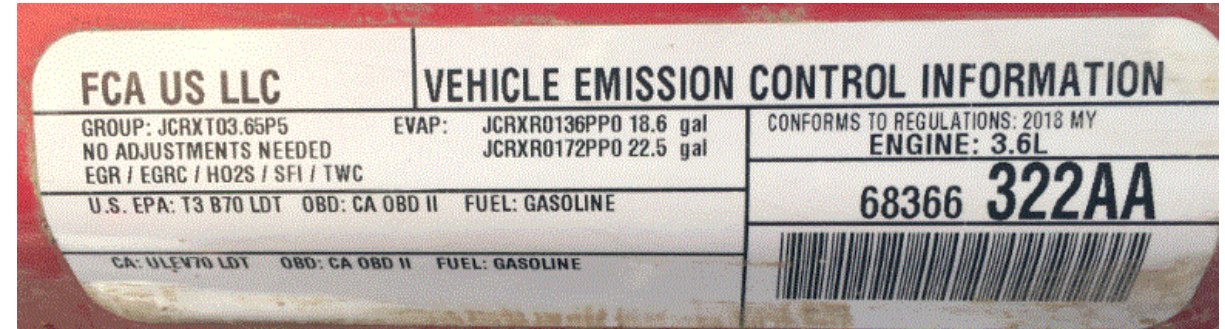
Measurements available

- Core: CO₂, CO, NO, NO₂, NO_x, exhaust temperature
- Using regulatory-grade PEMS, measurements at 1Hz
- Derived air/fuel ratio
- Weather station: temperature, humidity, pressure
- OBD: typically speed, rpm, coolant temperature, engine load, throttle position, manifold pressure
- PN, particularly for EU gasoline and hybrids
- NH₃, particularly for diesels with SCR



Meta data

- Vehicle variant identifications
- Detailed Euro stage
- Official fuel economy and CO₂ certification values
- Powertrain and transmission
- Battery size
- Tyres
- After-treatment system
- Vehicle weight
- Climatic conditions
- Vehicle Emission Control Information – US vehicles





Compliance risk

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Compliance Risk Rating

- Empirical approach to risk management
- Simulate large number of RDE cycles, for EU vehicles
- Using EQUA normal and extended driving, cold start and regeneration events
- Proportion of cycles in exceedance of CFs, and average exceedance
- Red/Amber/Green risk classification

Conformity Factor	Exceedance Ratio	Exceedance NO _x	Risk Factor
	%	g/km	g/km
1.0	100.0	0.228	0.228
1.43	100.0	0.194	0.194
2.1	99.8	0.140	0.140

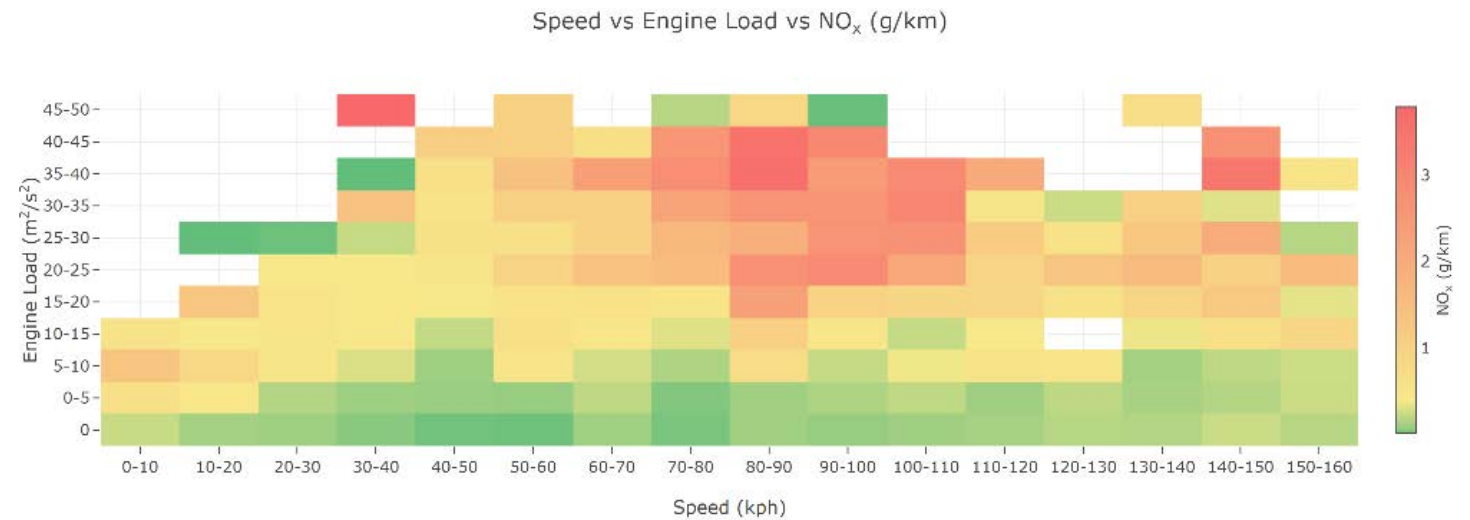
Key	Risk Factor
	g/km
Low	RF < 0.05
Medium	0.05 <= RF < 0.1
High	RF >= 1

Results are calculated after running **1248** permutations of the constituent factors below in varying proportions.

Minimum / Average / Maximum NO_x across all permutations is **0.163 / 0.308 / 0.474** g/km.

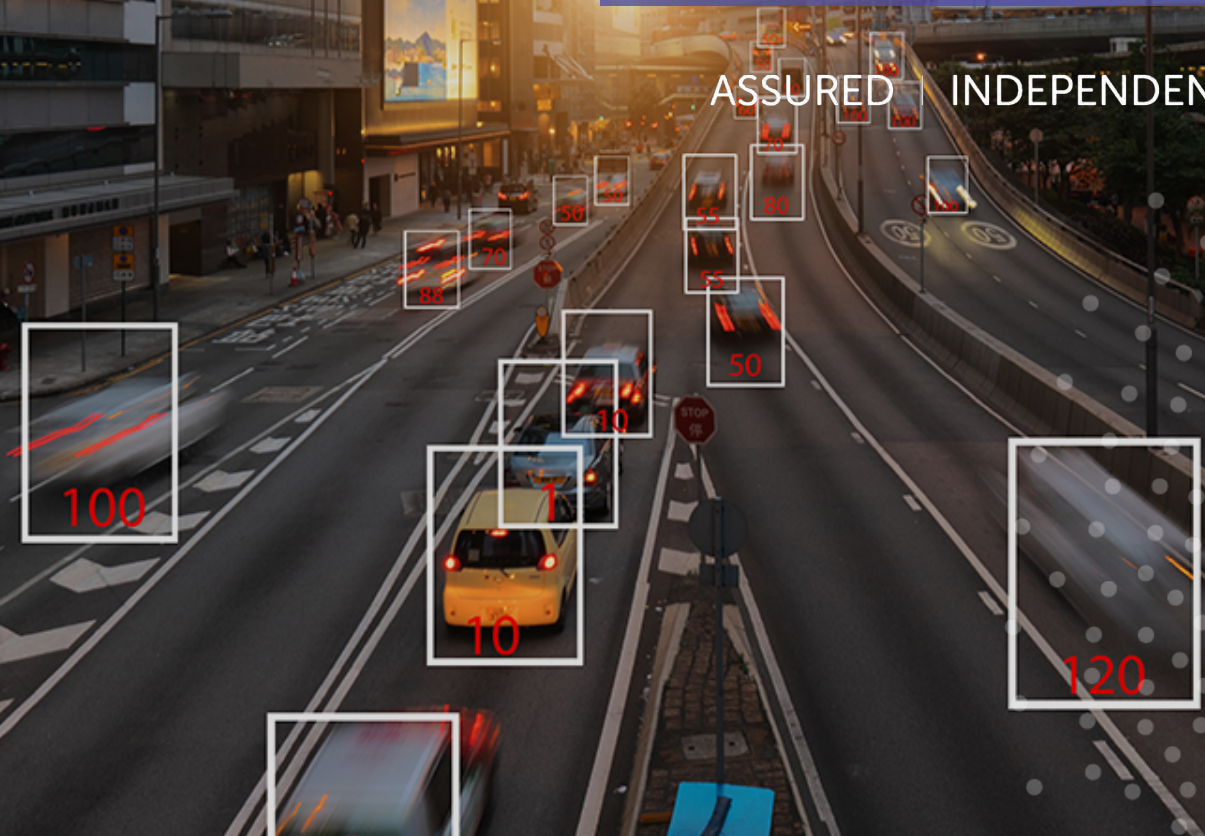
Diagnostic

- Emissions engine maps to diagnose sources of compliance risk
- Multi-dimensional analysis to identify hot spots



Performance intelligence

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Access

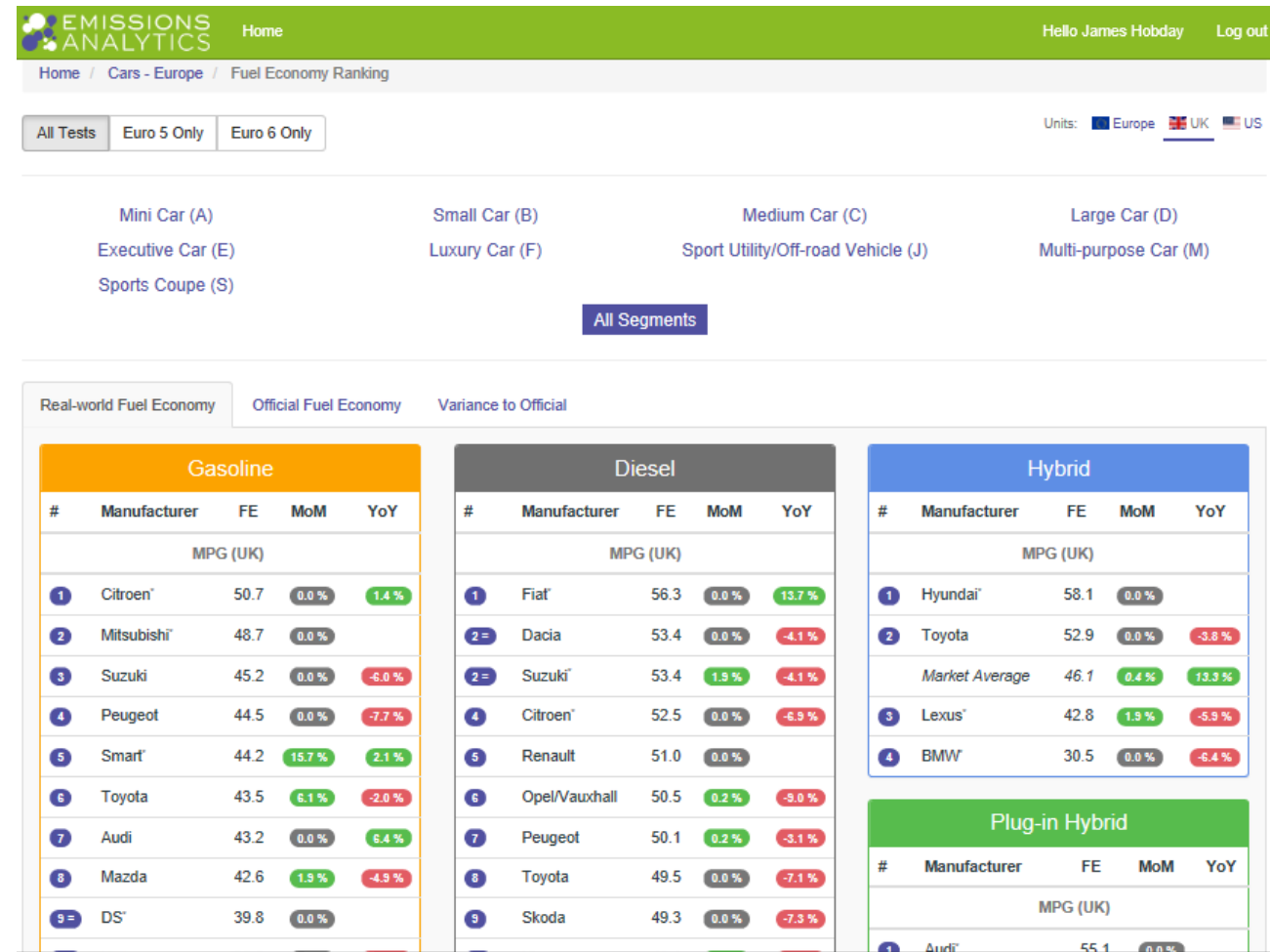
- Annual subscription
- Unlimited users within client entity
- Rankings for each pollutant and drill-down
- Raw data to custom request
- Plus premium services

The screenshot displays the Emissions Analytics web application. At the top, there is a navigation bar with the logo, 'Home', 'Vehicles', a search bar, and user information. Below the navigation, there are tabs for 'Cars - Europe', 'Vans - Europe', and 'Cars - US'. The main content area is divided into two sections: 'Rankings' and 'Recent Activity'. The 'Rankings' section features five large colored buttons: Fuel Economy (orange), Air Quality (blue), CO (grey), CO₂ (green), and Cabin Air Quality (red). The 'Recent Activity' section is a table listing test results with columns for date, vehicle model, and image thumbnails.

Date	Vehicle Model	Image
2019-07-23	Mercedes-Benz V-Class 2.0L Diesel 5DR	
2019-07-15	Mercedes-Benz E-Class 2.0L Super 5DR	
2019-07-09	Mercedes-Benz E-Class 2.0L Diesel 5DR	
2019-07-04	Ford Focus 1.5L Super 5DR	
2019-07-03	Toyota Corolla 2.0L Super 5DR	
2019-07-02	Ford Focus 1.0L Unleaded 5DR	
2019-07-02	Dacia Duster 1.3L Super 5DR	
2019-06-27	Honda HR-V 1.5L Super 5DR	
2019-06-25	Mercedes-Benz C-Class 2.0L Diesel 5DR	
2019-06-25	Volkswagen Golf 1.5L Unleaded 5DR	

Fuel economy

- Manufacturer league table
- By fuel type
- Urban/extra-urban
- Filter by regulatory stage, vehicle segment
- 'Variance to Official' showing gap between official and real-world
- Similar structure for CO₂ rankings



FE details

- Specific test results than make up manufacturer average
- Vehicle meta data
- Regulatory stage
- Climatic information

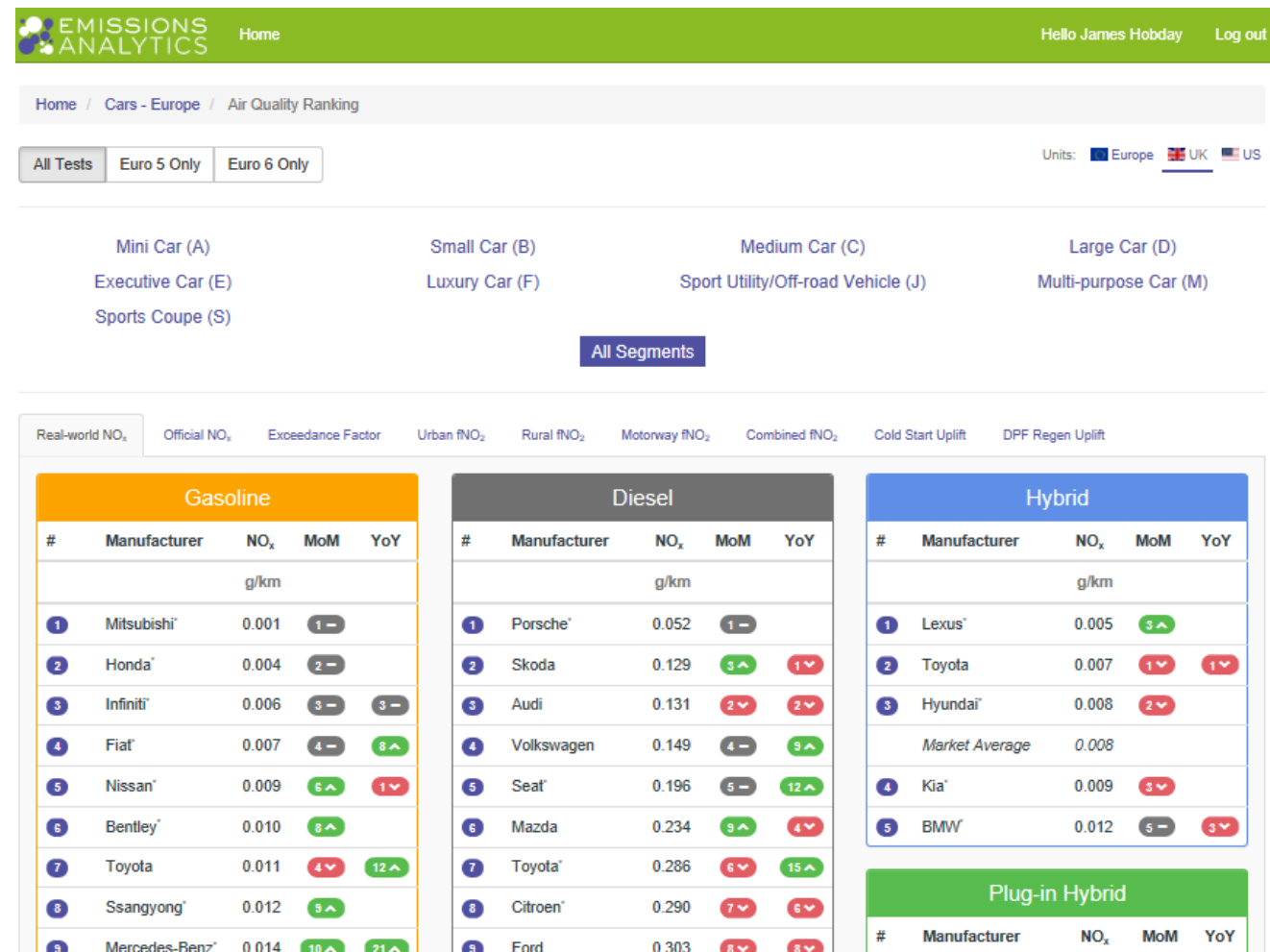
Included Tests

Award	Test Date	Test Description	Regulatory Stage	Real-world Fuel Economy	Official Fuel Economy	Variance
				MPG (UK)	MPG (UK)	%
>	2017-02-14	Mazda Mazda3 2.0L Super 5DR	Euro 6	42.0	55.4	-24.3
>	2015-08-20	Mazda MX-5 1.5L Unleaded 2DR	Euro 6	43.4	47.1	-7.9
>	2015-08-13	Mazda MX-5 2.0L Unleaded 2DR	Euro 6	38.1	40.9	-6.9
>	2015-06-23	Mazda CX-3 2.0L Unleaded 5DR	Euro 6	41.9	47.9	-12.5
>	2014-11-28	Mazda Mazda2 1.5L Unleaded 5DR	Euro 6	47.3	62.7	-24.5
>	2014-07-21	Mazda Mazda3 2.0L Unleaded 5DR	Euro 5	36.2	46.7	-25.8
>	2013-10-15	Mazda Mazda3 2.0L Unleaded 5DR	Euro 5	39.0	55.4	-29.6
>	2013-02-05	Mazda MX-5 2.0L Unleaded 2DR	Euro 5	37.9	40.9	-7.3
>	2012-09-21	Mazda CX-5 2.0L Unleaded 5DR	Euro 5	37.9	40.9	-7.3
>	2012-09-14	Mazda Mazda2 1.3L Unleaded 5DR	Euro 5	37.9	40.9	-7.3
>	2012-08-07	Mazda MX-5 1.8L Unleaded 2DR	Euro 5	37.9	40.9	-7.3
>	2012-03-07	Mazda MX-5 1.8L Unleaded 2DR	Euro 5	37.9	40.9	-7.3

2015-04-23		Honda CR-V 1.6L Diesel 5DR		Euro 6		41.3		53.3		-22.5	
Vehicle Attributes			Tyres			Test Attributes					
Full Description	Honda CR-V EX i-DTEC			Vehicle Segment	Sport Utility/Off-road Vehicle (J)						
Fuel Type	Diesel			Regulatory Stage	Euro 6						
Body Style	Estate			NO _x Control Technology	Lean NO _x Trap (LNT)						
Doors	5			Official Kerb Weight	1858 kg						
Engine Size	1800 cc			Official Combined FE	53.3 MPG (UK)						
Power	180 bhp			Real-world Urban FE	36.5 MPG (UK)						
Battery Size	N/A			Real-world Extra-urban FE	47.7 MPG (UK)						
Transmission	Automatic			Real-world Combined FE	41.3 MPG (UK)						
Gears	9			Official NO _x	0.080 g/km						
Driven Wheels	4			Real-world NO _x	Not Available						
Drive Train	AWD			Ex-AC Real-world Combined FE	44.0 MPG (UK)						
Fuel Delivery	Common Rail										

Nitrogen oxides

- Manufacturer league table
- By fuel type
- Urban/rural/motorway split
- Filter by regulatory stage, vehicle segment
- 'Exceedance factor' of real-world over official
- NO₂-fraction
- Cold start, DPF regeneration
- Similar structure for CO rankings



AQ details

- Specific test results than make up manufacturer average
- Vehicle meta data
- Regulatory stage
- Climatic information

Included Tests

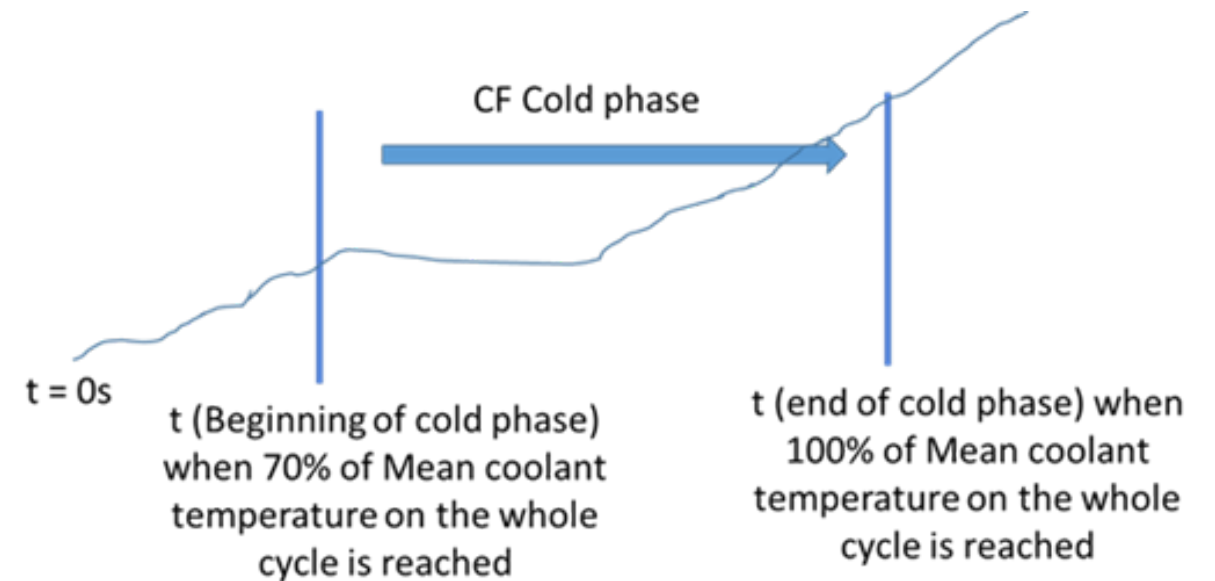
Award	Test Date	Test Description	Regulatory Stage	Real-world NO _x	Official NO _x	Exceedance Factor	Urban fNO ₂	Rural fNO ₂	Motorway fNO ₂	Combined fNO ₂	Cold Start Uplift	DPF Regen Uplift
				g/km	g/km							
>	2016-04-26	Jaguar XJ 3.0L Diesel 4DR	Euro 6	0.197	0.080	2.463	62.7	57.5	69.0	65.1		
>	2016-04-26	Jaguar F-Pace 2.0L Diesel 5DR	Euro 6	0.491	0.080	6.138	84.7	52.5	72.4	76.4		
>	2015-12-16	Jaguar XE 2.0L Diesel 4DR	Euro 6	0.179	0.080	2.238	81.2	49.8	56.6	67.2		
>	2015-11-10	Jaguar XF 2.0L Diesel 4DR	Euro 6	0.289	0.080	3.613	72.6	54.2	69.0	69.7		
>	2015-10-28	Jaguar XE 2.0L Diesel 4DR	Euro 6	0.295	0.080	3.688	84.8	64.0	67.4	66.0		
>	2015-10-22	Jaguar XF 3.0L Diesel 4DR	Euro 6									
>	2012-10-31	Jaguar XJ 3.0L Diesel 5DR	Euro 5									

Award	Test Date	Test Description	Regulatory Stage	Real-world 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
				g/km	g/km							
▼	2016-07-29	Ssangyong Tivoli 1.6L Super 5DR	Euro 6	0.012	0.060	0.200	2.5	0.1	0.0	0.9		

Vehicle Attributes	Tyres	Test Attributes
Full Description	Ssangyong Tivoli e-XGi	Vehicle Segment
Fuel Type	Super	Regulatory Stage
Body Style	SUV	NO _x Control Technology
Doors	5	Official Kerb Weight
Engine Size	1597 cc	Official Combined FE
Power	130 PS	Real-world Urban FE
Battery Size	N/A	Real-world Extra-urban FE
Transmission	Automatic	Real-world Combined FE
Gears	6	Official NO _x
Driven Wheels	4	Real-world NO _x
Drive Train	AWD	Ex-AC Real-world Combined FE
Fuel Delivery	Multi Point Fuel Injection	

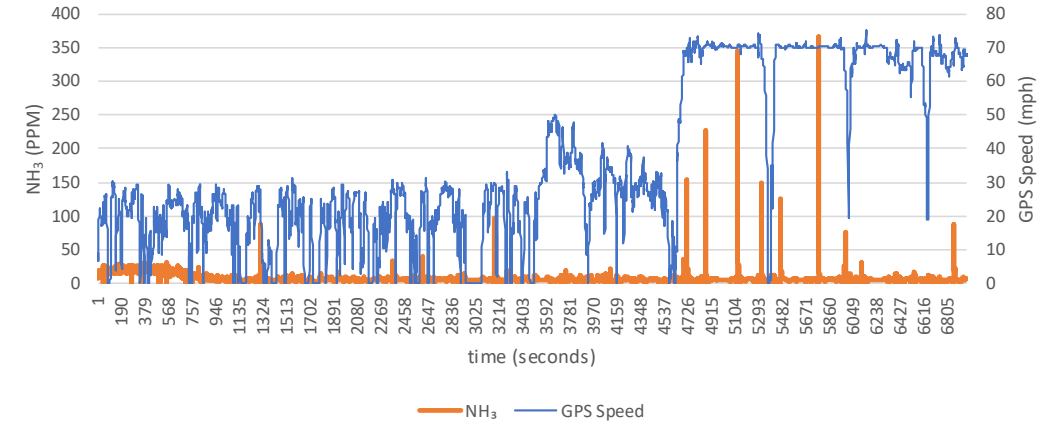
Extended driving

- Standard cold start definition, but is flexible
- DPF regeneration events are extracted and analysed
- High speed driving conducted on German Autobahns or UK test track



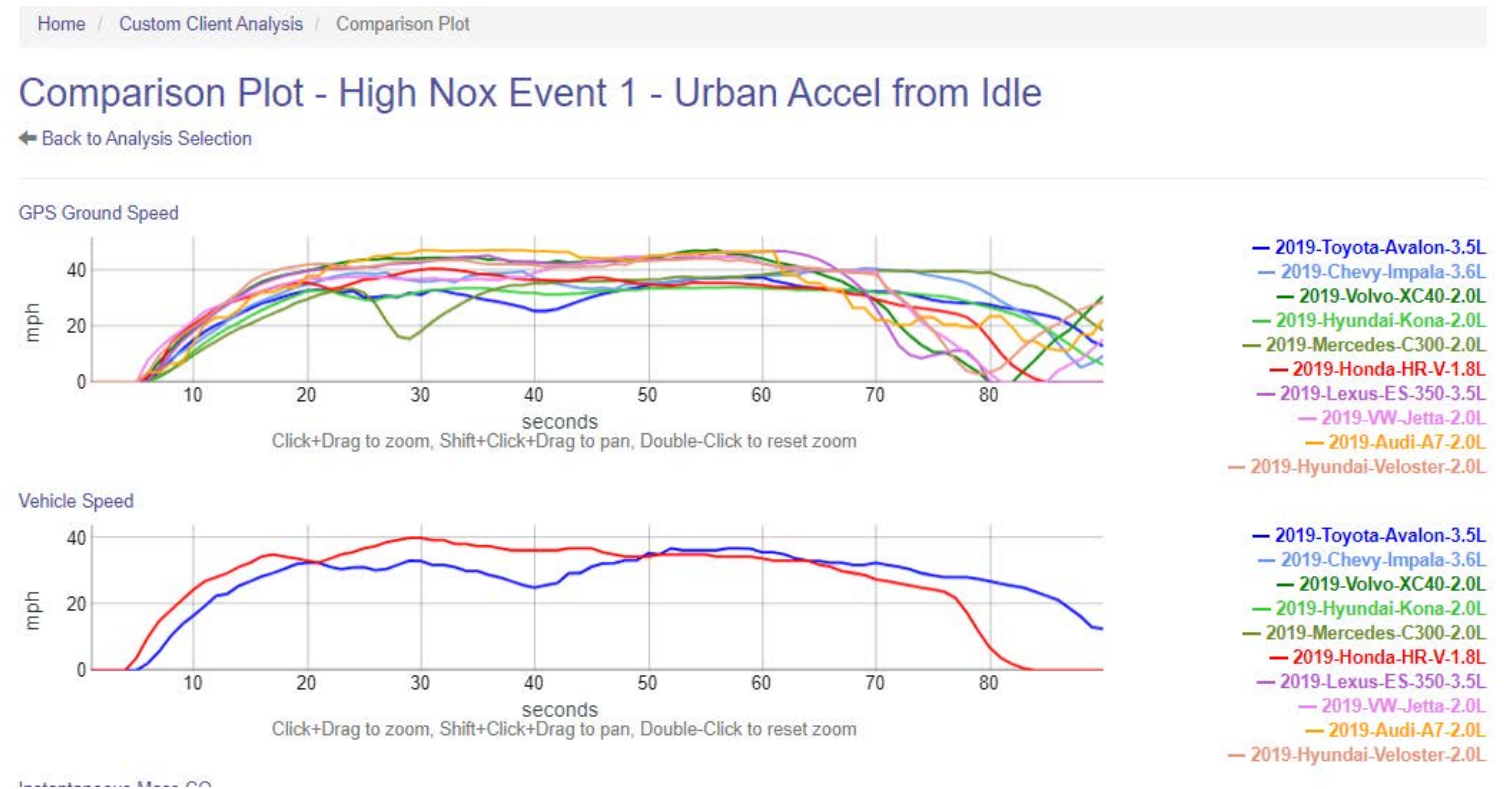
Ammonia

- Candidate for regulation under 'Euro 7'
- Air quality impact, including secondary particle formation
- Integrated in future EQUA tests
- Ceramic NH₃ sensor on hot exhaust
- Initial results show large variations between vehicles
 - 2020 diesel SUV 6.1 mg/km
 - 2018 diesel van 18.7 mg/km



Raw data analysis tool

- Raw test data is sent to the client upon request in csv file
- We offer comparison tool to accelerate the analytical process and save you time



Additional data

- **After-treatment configuration**
 - NO_x control: LNT, SCR
 - Particle control: GPF, DPF
- Exhaust temperature
- Engine coolant temperature

Premium intelligence

- For most vehicles, identification of individual components
 - Engine manufacturer
 - Transmission manufacturer
 - Fuel injection type and supplier
 - Turbocharger type and supplier
 - After-treatment type and supplier
- Bespoke pricing on application



Thank you.

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