Engine Lubricants

EU - 2nd VegOil. Lyon, France

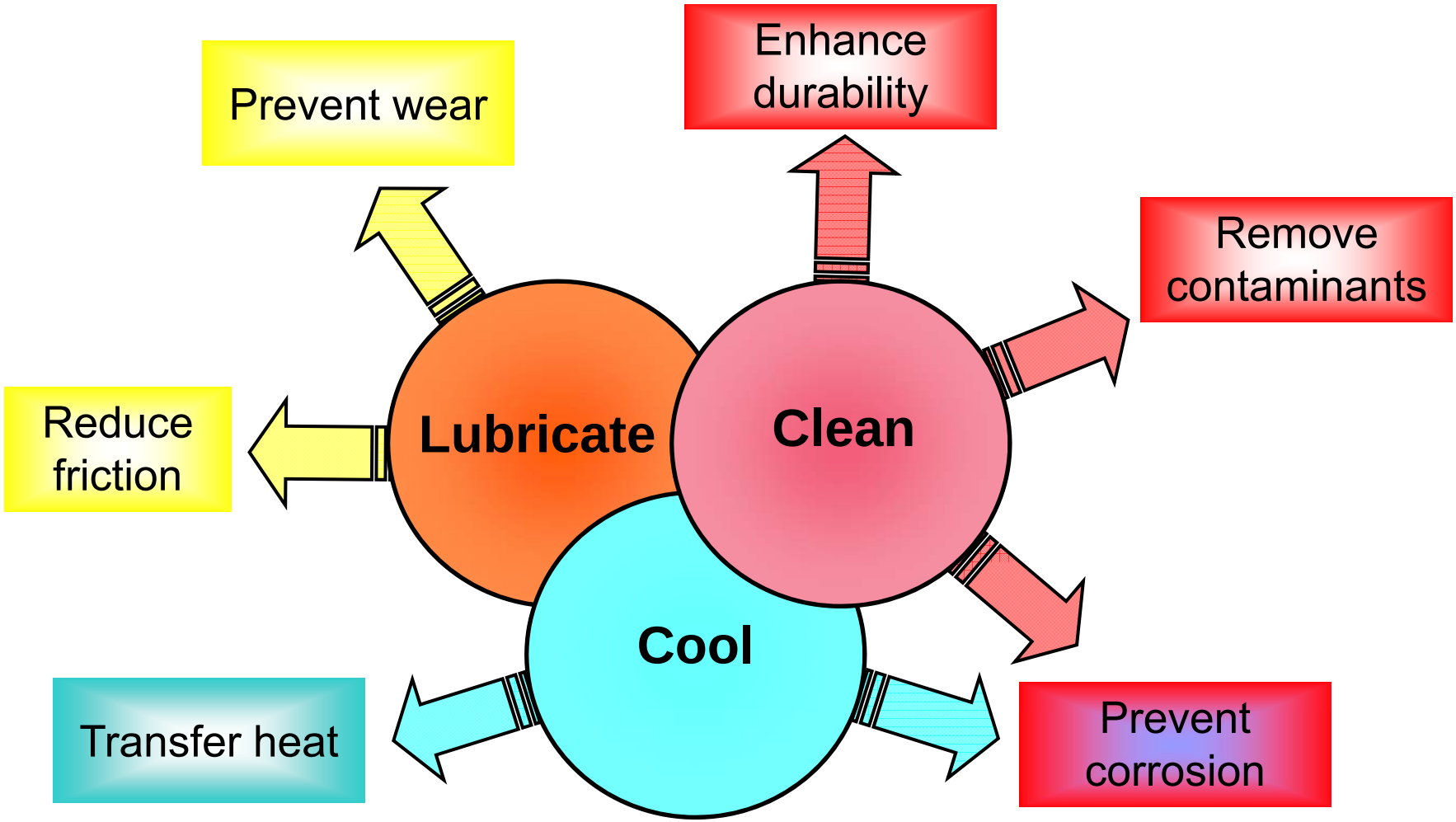
26th January 2010

Engine Lubricants

- Formulating An Engine Lubricant
- Engine Lubricant Drivers
- Heavy Duty Diesel: European Engine Lubricant Market Structure

Formulating an engine lubricant

What does an engine oil need to do?



Where these phenomena occur

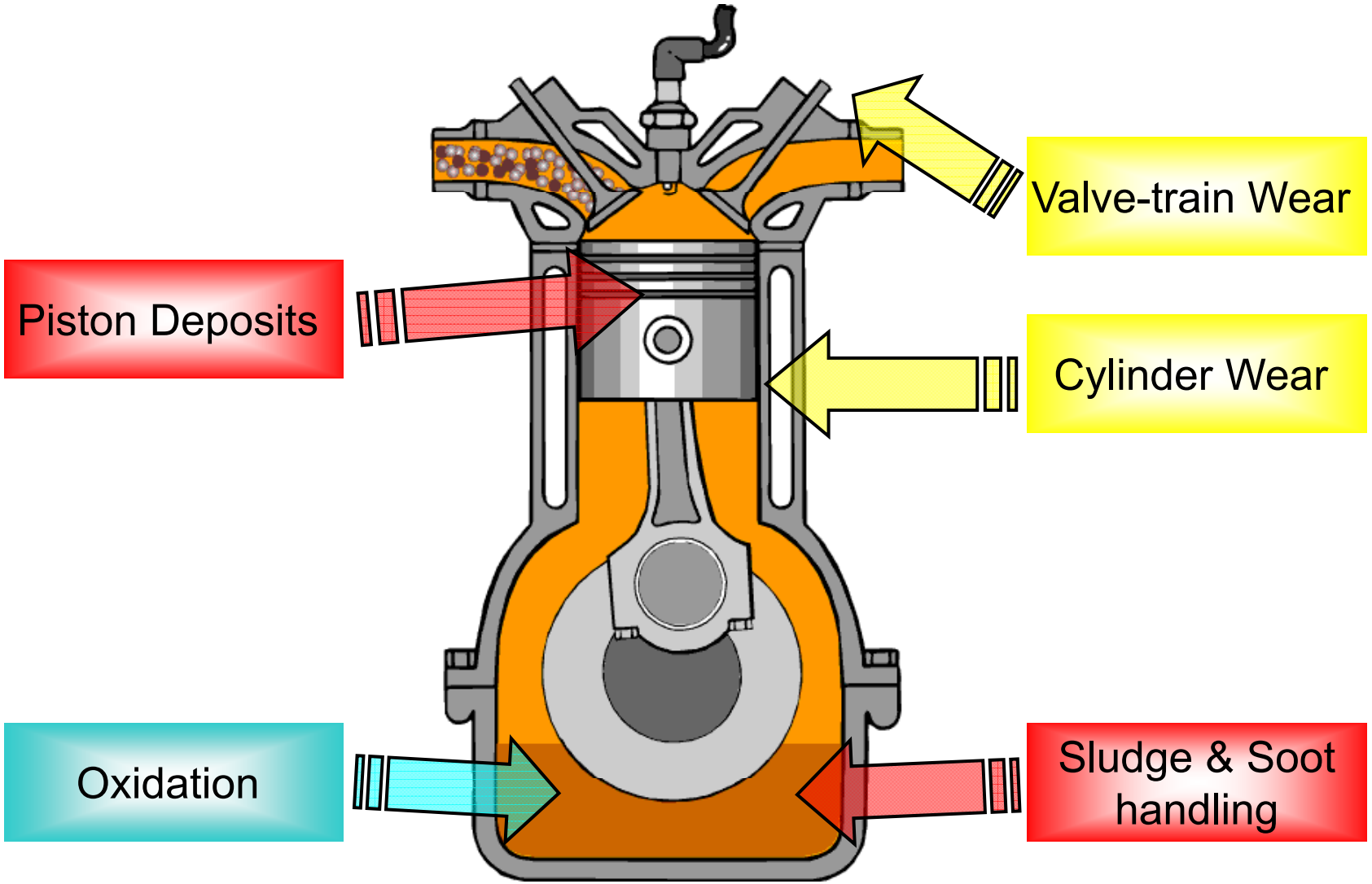


Image Source : How Stuff Works Inc. www.howstuffworks.com

What is a ‘Formulation’?

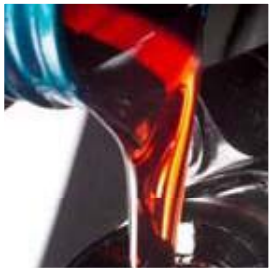
- A formulation is a recipe for making an oil and includes a number of ‘ingredients’
  - Base oils
  - Additive components
  - Viscosity modifiers
  - Pour-point depressants
- And will have specific properties
  - Viscosity grade
  - Performance
  - Approvals

Oil Code	**123456**
Viscosity Grade	10W-40
Formulation (%wt)	
Additive package	12.0%
Performance booster	1.0%
Viscosity modifier	7.0%
Pour point depressant	0.2%
Base oil 1	40.0%
Base oil 2	9.8%
Base oil 3	30.0%
Performance claim	
ACEA 2004	A3/B3-04
API	SL/CF
Daimler	229.1
Volkswagen	50500

Measuring Performance

- A typical “top-tier” oil will be supported by over 20 engine test results
  - Good Oil Co.’s ***Slippery Extra*** would need at least 22 engine test results to support its performance claims:
    - ACEA A3/B4 — 7 tests
    - API SL & CF — 5 tests
    - VW50200 & 50500 — ACEA + 4 tests
    - MB229.3 — ACEA + 6 tests
  - Many specifications use the same engine tests, but may set different pass / fail requirements
    - Seq. VG — in ACEA A3/B4 and API SL
    - VW TDI — in ACEA A3/B4, VW50500 and MB229.3

Engine Lubricant Drivers









Engine Lubricant Market Drivers

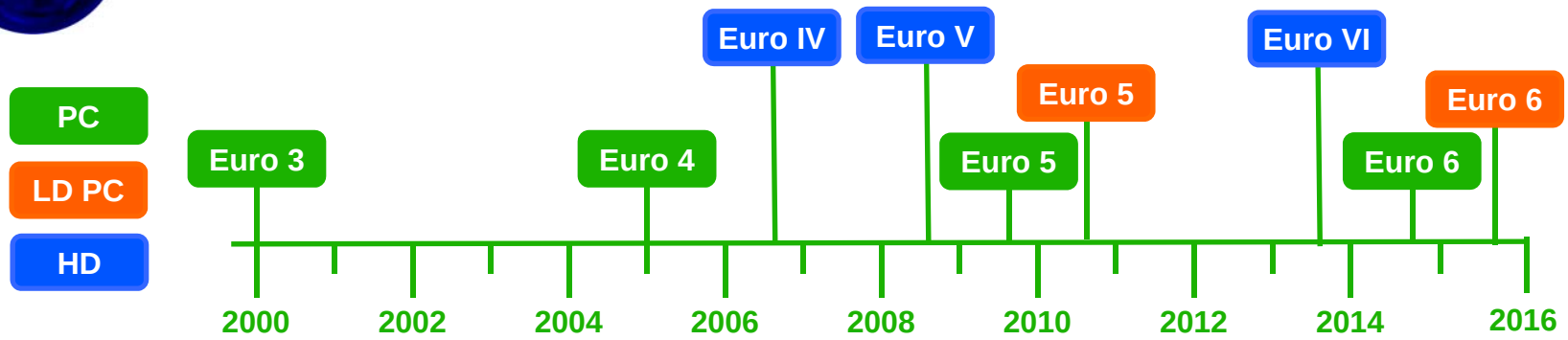
- Three main factors are acting to drive change in engine lubricant requirements and create the market we have today

1. Changing emissions legislation

2. Increased fuel economy requirements

3. Durability under severe operating conditions

1. Changing Emissions legislation



- Measures taken against air pollution from vehicles.
- Different requirements and adoption dates exist for passenger cars, light commercial vehicles and heavy-duty trucks.
- The next HD standard, Euro V, will be mandatory by the end of 2010
  - October 2008 for Heavy-duty trucks
  - September 2009 for Passenger cars
  - September 2010 for Light Duty Passenger Cars

1. Changing Emissions legislation

Impact of engine lubricants on aftertreatment devices

- A mix of data has been published regarding the impact of engine oils on aftertreatment devices

Aftertreatment device		Fluid-related constraint		
		Ash	Phosphorus	Sulphur
Diesel Particulate Filter	DPF	✓	-	-
Three-way Catalyst	TWC	-	✓	-
Diesel Oxidation Catalyst	DOC	-	✓	✓
Lean NOx Catalyst	LNC	-	-	✓
NOx Adsorber	NOx	-	-	✓
Selective Catalytic Reduction	SCR	-	?	?

2. Increased Fuel Economy requirements

- Fuel economy has been a requirement for many years
  - Embedded in ACEA and many OEM requirements
  - Led to the use of “low HTHS” passenger car engine oils
  - Led to the use of new friction modifier technologies
- Demand to increase fuel economy on many fronts
  - CO_2 emissions legislation (passenger car)
    - Requirement for OEMs to produce new vehicles which emit less CO_2
  - Taxation (passenger car)
    - Changes in taxation to encourage purchasing and usage of lower CO_2 emitting cars
  - Cost of operation (commercial vehicle)
    - Opportunity to lower truck and fleet operating costs by increasing fuel efficiency

The Role of Engine Oils

- Enabler
  - Providing high performance robustness that allow changes to engine design & aftertreatment technology to meet fuel economy requirements
- Direct Contributor
  - Providing a direct contribution to the overall fuel economy benefit by formulating to maximise fuel economy

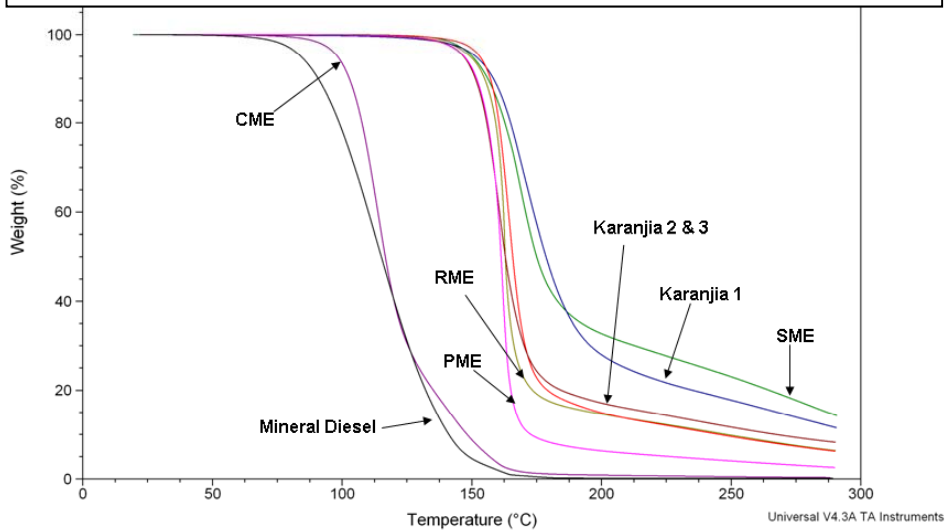
3. Durability under severe operating conditions

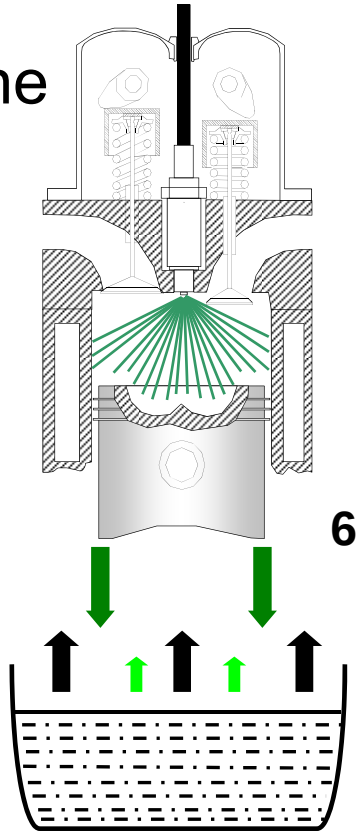
- Engine design changes
  - OEMs continue to “down size” engines to reduce weight and improve fuel economy
  - Increasing trend towards turbo charged gasoline engines
  - Increased operating temperatures expected to stress the engine oil and contribute to oxidation, nitration and sludge problems
- Fuel changes
  - Significant reduction in fuel borne sulphur in the last ten years
  - Increase in the use of alternative fuels, eg. biodiesel
- Changes in engine design and fuel have created a more severe environment for the engine lubricant to function in

Biodiesel and Fuel Dilution

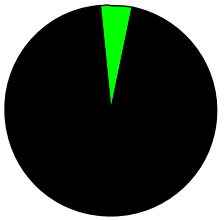
- Use of biodiesel can lead to increased levels of fuel dilution in the sump
- Vehicles using in-cylinder post injection are prone to high levels of fuel dilution
- Biodiesel tends to concentrate in the sump due to lower volatility

Thermogravimetric analysis (TGA) demonstrates difference in volatility between mineral diesel and biodiesel

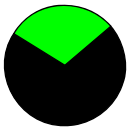




B05 in fuel tank

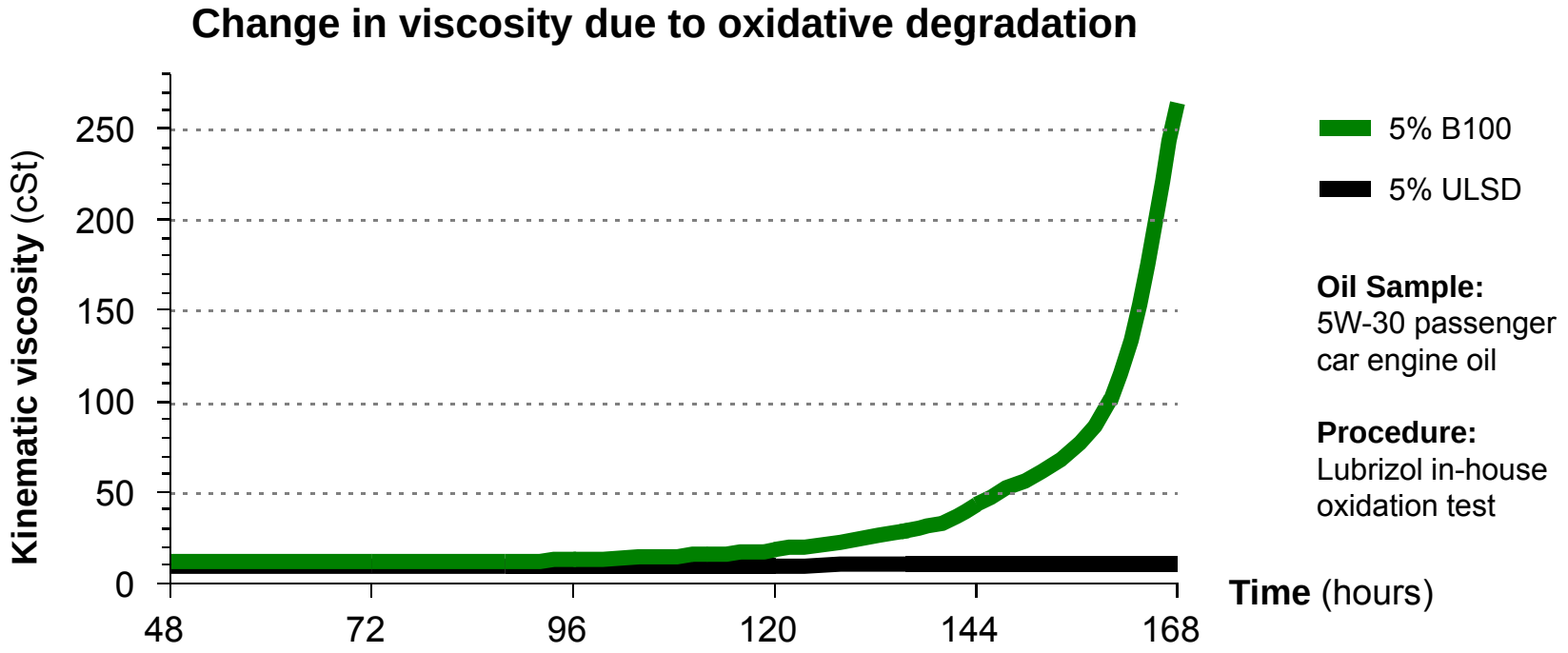


6 x concentration of biodiesel in sump



Example : Impact of biodiesel on durability

- Fuel dilution with biodiesel stimulates oxidative degradation



  - Fuel dilution with ULSD has little impact on the engine oil
  - Fuel dilution with biodiesel stimulates oxidative degradation

Summary

- The engine lubricant market continues to change
  - Emissions, durability & fuel economy continue to drive lighter viscosity grades, higher quality base oils and new innovative additive chemistry

Emissions *will continue to drive demand for lower SAPS engine lubricants*

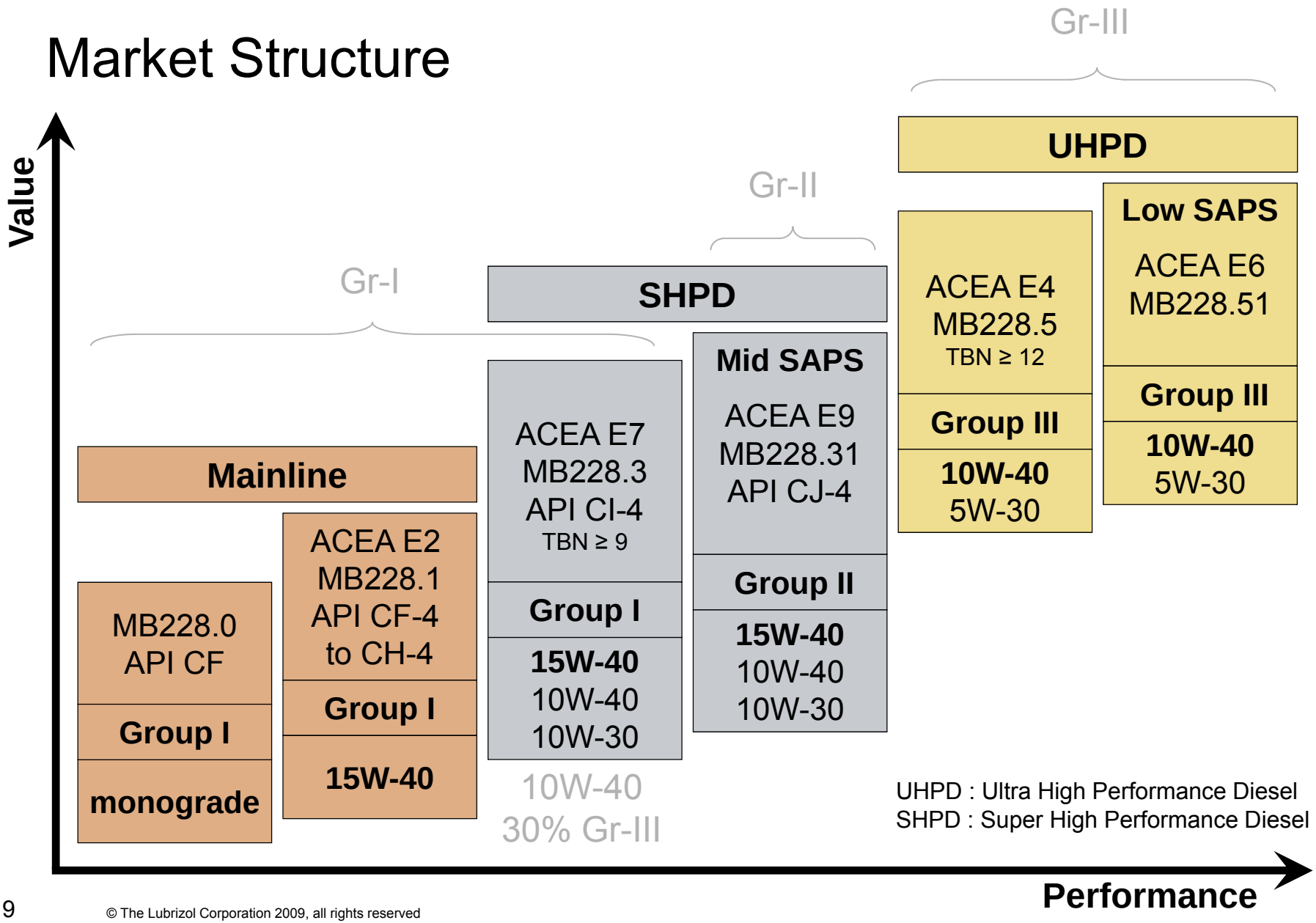
Fuel Economy *will become the major driver in engine lubricant development*

Durability *will continue to drive increased engine lubricant performance to cope with new engine design, aftertreatment and alternative fuels*

Heavy Duty Diesel:

European Engine Lubricant Market Structure

Market Structure



UHPD : Ultra High Performance Diesel
SHPD : Super High Performance Diesel

ACEA 2008 ‘E’ Sequences

				
	2008	2008	2008	2008
Engine Tests	OM646LA Mack T-8E - OM501LA ISM Mack T-12	OM646LA - Mack T-11 OM501LA ISM Mack T-12	OM646LA Mack T-8E - OM501LA - Mack T-12	OM646LA Mack T-8E - OM501LA - -
%SA	≤ 2.0	≤ 1.0	≤ 1.0	≤ 2.0
%P	-	≤ 0.12	≤ 0.08	-
%S	-	≤ 0.4	≤ 0.3	-
TBN	≥ 9 (>9.00)	≥ 7	≥ 7	≥ 12
	High-SAPS	**Mid-SAPS**	**Low-SAPS**	**High-SAPS**

Market Tiers

For diesel engines meeting Euro I → Euro V emission requirements

	Hi SAPS	Low/Mid SAPS	
UHPD	 **Some EGR engines some SCR units without DPF**	 **EGR engines SCR units with/without DPF with low S diesel**	Extended drain performance (ACEA: significantly extended oil drain interval)
SHPD	 **most EGR engines most SCR units without DPF**	 **most EGR engines most SCR units with/without DPF with low S diesel**	Standard drain performance (ACEA: extended oil drain interval)
	SCR/EGR (Euro V)	DPF (Euro V/VI)