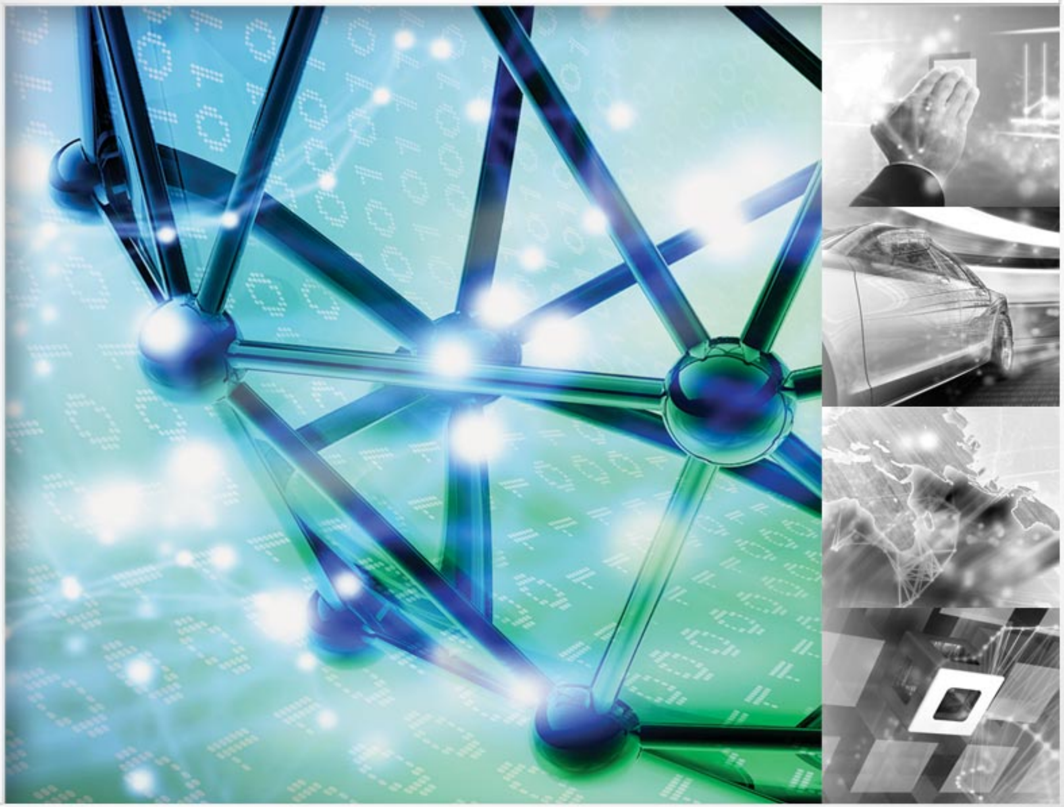

Driving Efficiency In
Commercial Vehicle Engine Lubricants

Nigel Britton, Technical Manager

5th April 2017

Topics

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The drivers for greater efficiency
in heavy duty commercial vehicles

Why fuel economy is fundamentally
changing lubricants

How higher performance formulations are
being developed to deliver greater efficiency

Why the drive to greater efficiency is not
‘business as usual’

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The Importance of Heavy Duty Vehicles

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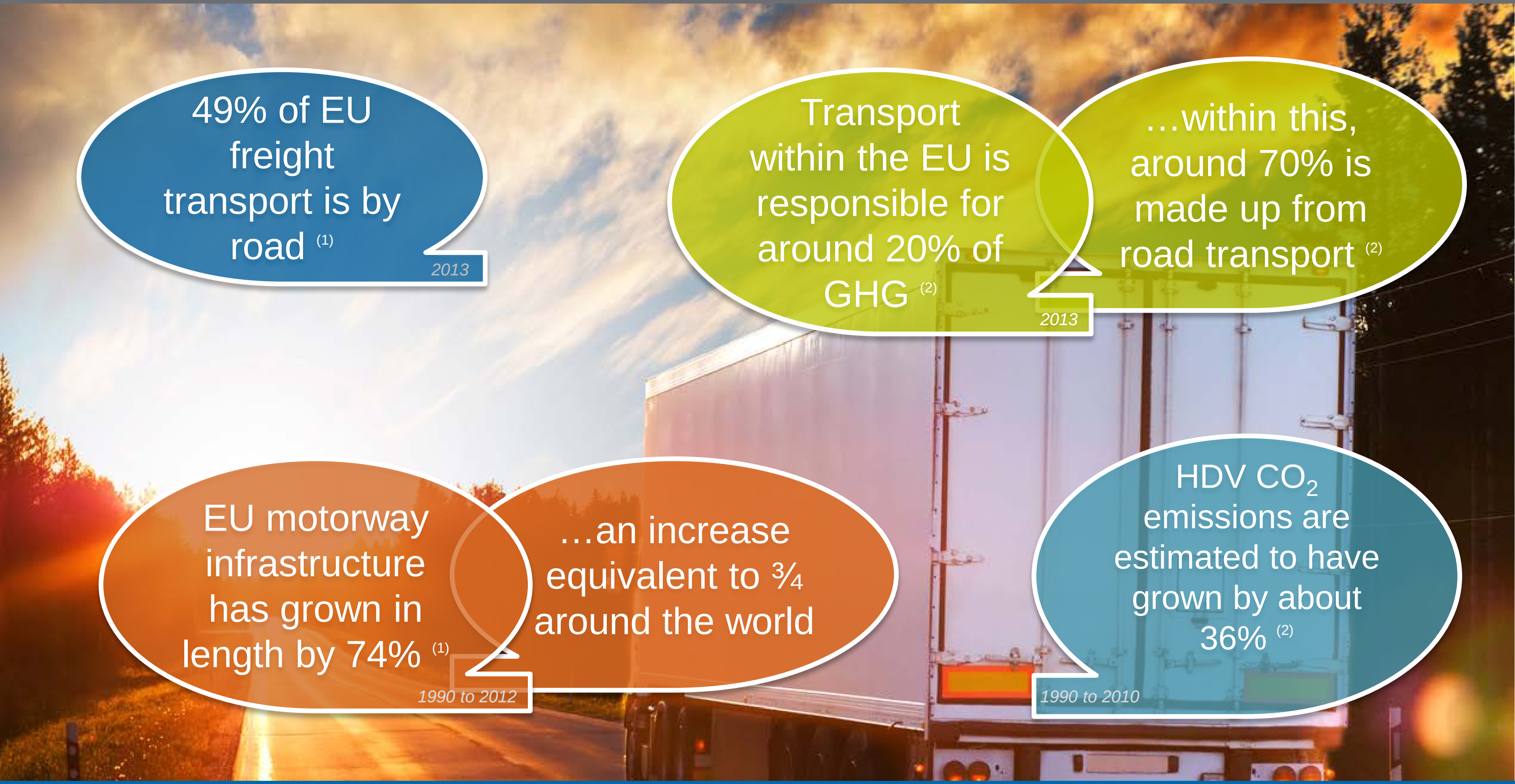

49% of EU freight transport is by road [(1)]
2013

Transport within the EU is responsible for around 20% of GHG [(2)]
2013

…within this, around 70% is made up from road transport [(2)]

EU motorway infrastructure has grown in length by 74% [(1)]
1990 to 2012

…an increase equivalent to ¾ around the world

HDV CO_2 emissions are estimated to have grown by about 36% [(2)]
1990 to 2010

Heavy Duty Vehicles continue to play a vital role in the economy as well as having a significant impact on the environment

GHG is an acronym for Greenhouse Gas
HDV is an acronym for Heavy Duty Vehicle

Sources:
(1): European Commission Statistical handbook 2015
(2) European Commission 8th Forum on Energy Efficiency in Transport: "Energy Efficiency Regulation for Heavy-Duty (HD) Vehicles" September 2015

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The Continuing Drive Toward Lower CO_2 And Increased Fuel Efficiency

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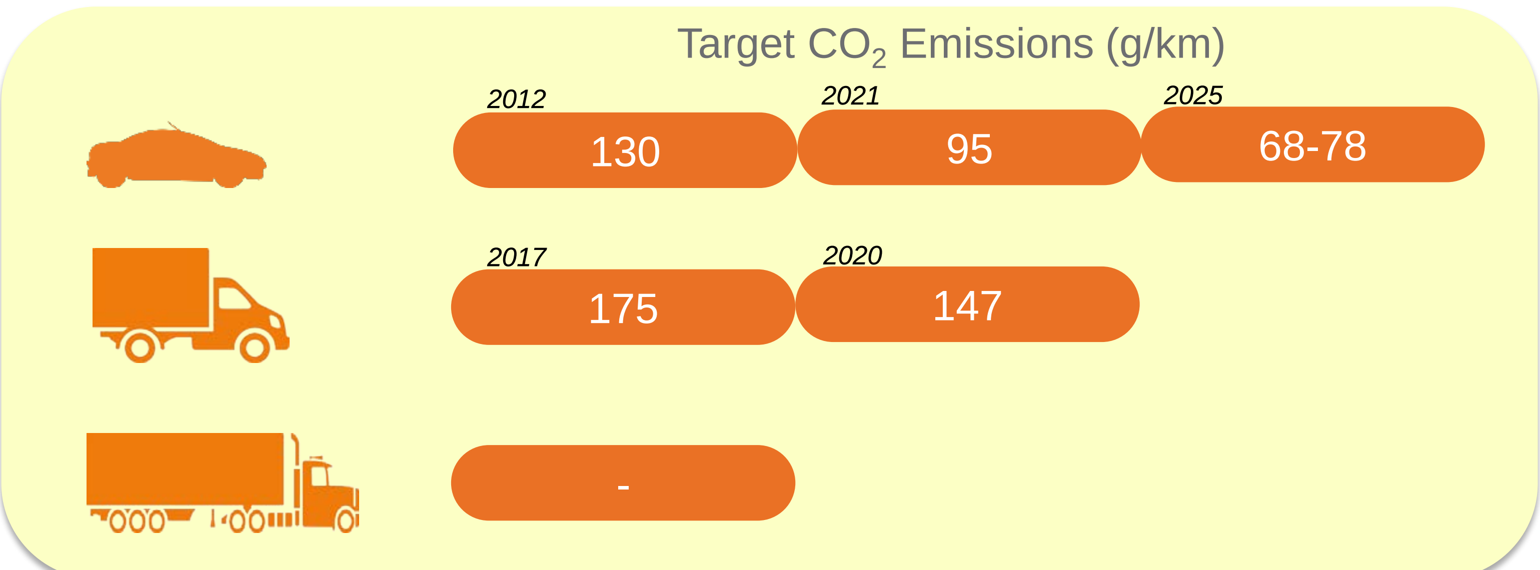
European CO_2 limits are in force for passenger cars and light commercial vehicles. Currently there is no measurement system for heavy duty vehicles

The European Commission has adopted a communication "Strategy for reducing Heavy-Duty Vehicles' fuel consumption and CO_2 emissions"



Whilst not here today, legislation for Heavy Duty Vehicle CO_2 emission limits can be expected

For Lubricants, It Is Not Just About Lower Viscosity

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Durability protection cannot be compromised in the move to increased efficiency

Example:

Piston stroke length
130 mm

Average engine speed
1,400 RPM

Vehicle haul per year
150,000 km

Life of vehicle
12 years

Each piston travels

> 780,000 km during its life.

20 times around the world

All that separates the piston ring from the liner is the engine oil

A higher performance lubricant is essential throughout the vehicle lifetime, notably as oils move to thinner viscosity

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Lubricants Are Performing In More High Temperature High Shear Environments

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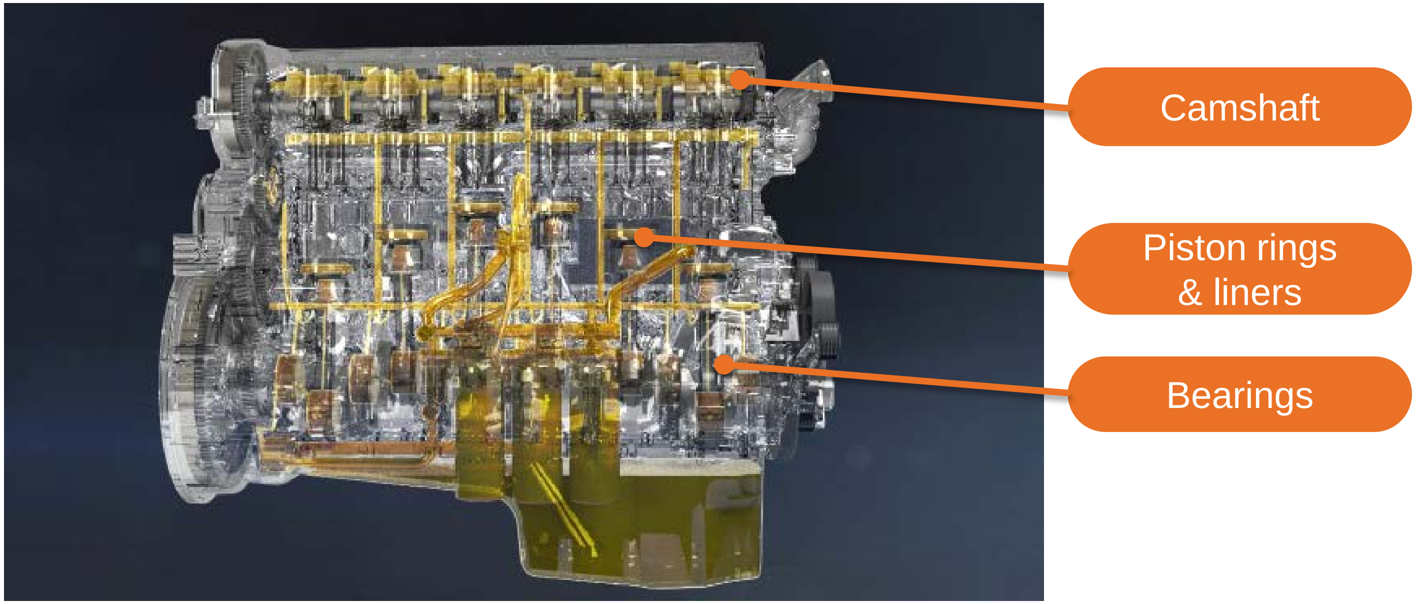
HTHS measures the temporary viscosity loss of a lubricant under high shear at elevated temperatures, representative of engine operating conditions

The number measures the resistance to flow of the oil, simulating the narrow tolerances and high speeds between moving parts in a hot engine

The lower the number, the lower the viscosity of the oil



HTHS viscosity is the current industry standard test that best predicts fluid behaviour in high temperature, high shear environments

HTHS is an acronym for High Temperature High Shear
measured at 150 °C in millipascal second (mPa·s) = centipoise (cP)

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The Relevance Of High Temperature High Shear Viscosity

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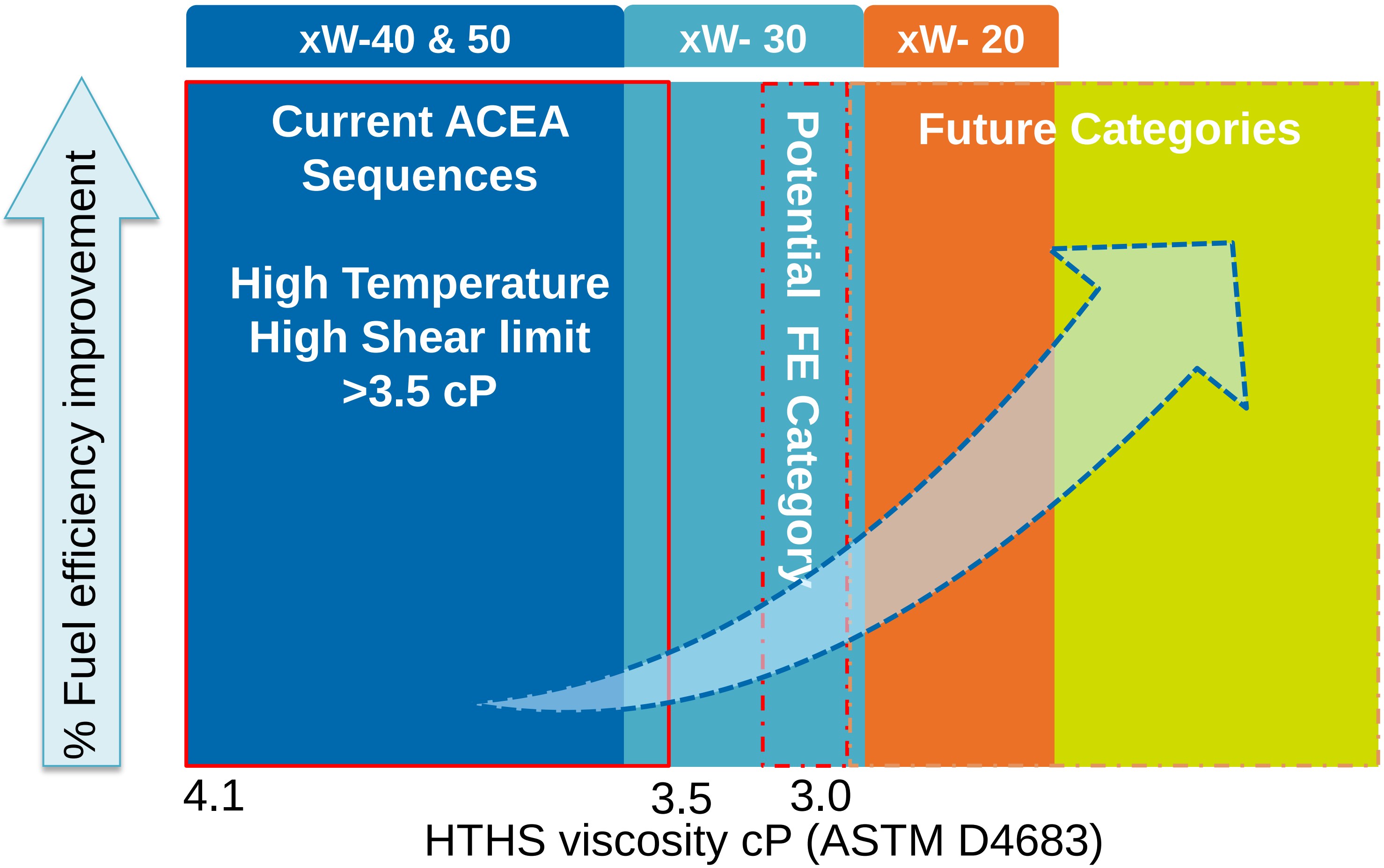

Increased fuel efficiency is delivered through lower HTHS viscosity. At a given viscosity the lubricant formulation can further increase fuel efficiency benefits, due to the additive chemistry

Diagram shows directionally the link between HTHS and fuel efficiency improvement

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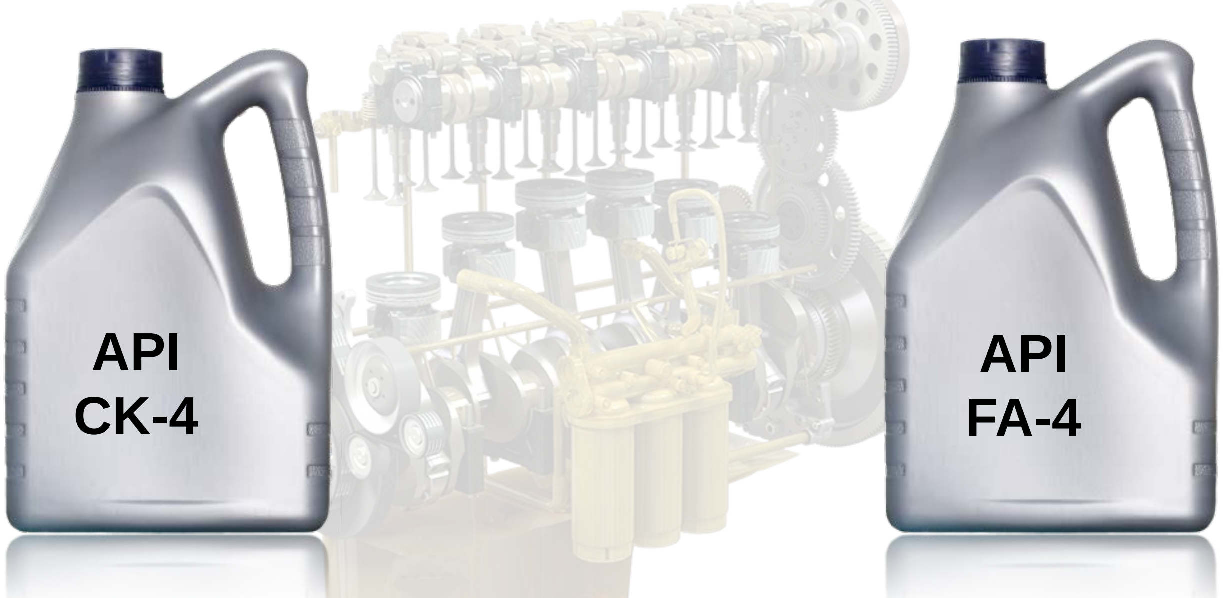
API: A New Low HTHS Viscosity Category

For the first time ever, the API 'C' category has been split into two



- Backward compatible, superseding API CJ-4
- SAE 15W-40, 5W-40, 10W-30, 5W-30
- **HTHS viscosity of 3.5 cP or above**

- For modern engines, with fuel economy benefits
- SAE 10W-30, 5W-30
- **HTHS viscosity of 2.9 to 3.2 cP**

The new 'fuel economy' category provides fuel efficiency savings of ~0.5 to 1.0% over higher HTHS viscosity counterparts

First license date: 1st December 2016

European OEMs Are Driving Toward Low HTHS Viscosity

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European OEMs are moving to low HTHS viscosity lubricant solutions alongside new hardware designs

Mercedes-Benz MB 228.61 is the first service fill 'low HTHS' viscosity European OEM specification for engine oils

- New DD13 Scuffing Test
- Increased piston cleanliness and sludge control
- Most stringent fuel economy limits
- API FA-4 (2.9 to 3.2 cP, increased aeration, oxidation control, shear stability)

Low HTHS viscosity specifications are coming from other OEMs

- Each OEM to confirm backward compatibility
- Unique requirements from OEMs may result in unique lubricant chemistries

HTHS viscosity of 2.9 to 3.2 cP may seem 'high' in a few years time

- Realistic to expect less than 2.6 cP in the future
- New formulation challenges and opportunities will exist

The lubricant has a fundamental role in supporting OEMs' drive to increased efficiency whilst maintaining durability

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ACEA: Proposed Fuel Economy Category

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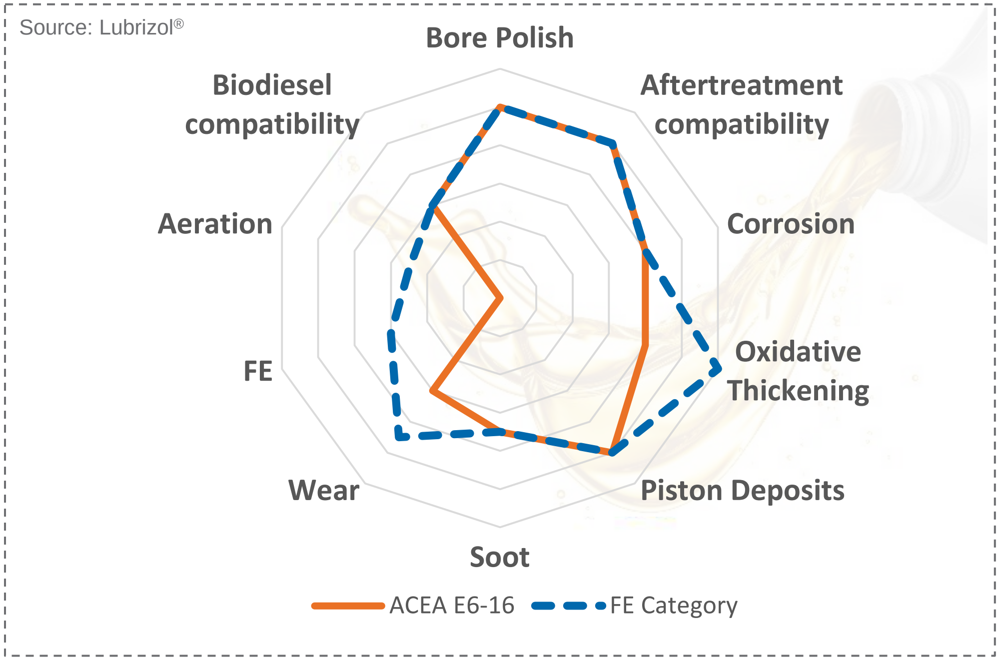
Driven by OEMs to support their move to lubricants that both enable and deliver lower CO_2 emissions (and in turn, increased fuel economy)

Upon introduction, suitable only for engines specified by the OEM



Directional indication of anticipated ‘fuel economy’ ACEA category parameters versus ACEA E6 2016

It is anticipated a fuel economy category will be introduced (2.9 to 3.2 cP) and deliver efficiency benefits with further durability protection

HTHS – Stribeck Curve
Changing Lubrication Chemistry

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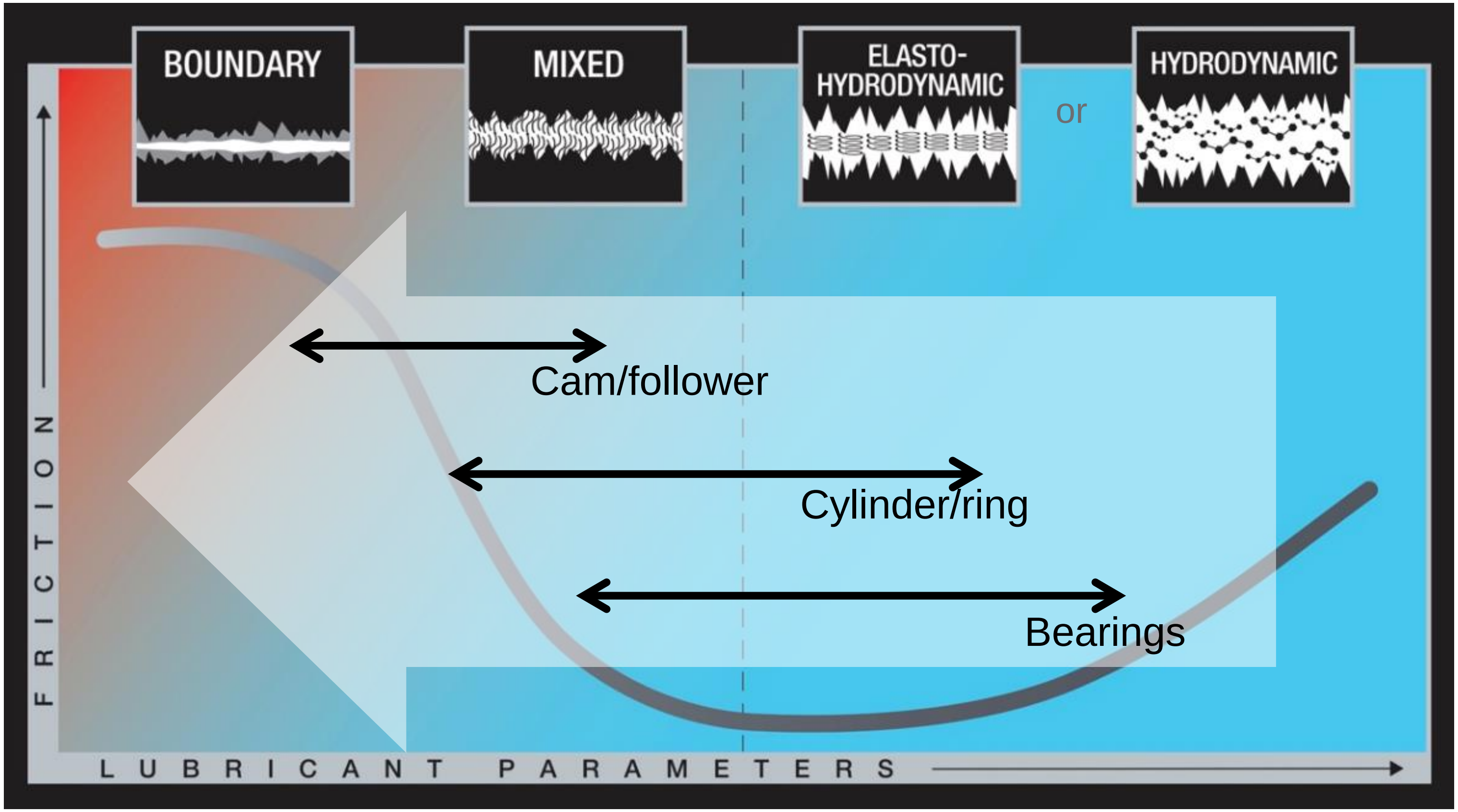

Hardware changes, down-speeding and using lower viscosity oils are increasing the time operating in the boundary regime

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The Formulation Challenge

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Engine oil consists of three fundamental elements:

- Additive package
- Performance polymer
- Base oil

For low HTHS viscosity oils, the durability protection delivered by HTHS viscosity is reduced

New additive technology is essential to enable the move to low HTHS viscosity engine lubricants

The additive package and the performance polymer have a much more significant role to play when moving to low HTHS viscosity lubricants

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Case Study: North America
Low HTHS Viscosity Heavy Duty Engine Oil

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Development of API FA-4 lubricants over the last five years

- Low HTHS viscosity (2.9 to 3.2 cP)
- Increased fuel efficiency
- Maintained durability protection

40 million km real world driving conditions and counting

Low HTHS viscosity technology must not sacrifice protection

- New additive technology is required
- Correct additive package, performance polymer and base oils must be developed in harmony

"This is the best looking 500,000 mile engine teardown I have ever seen"

Fleet Owner - North America - trialling API FA-4 lubricant with Lubrizol® performance additive and polymer formulation

New lubricant formulations are required to deliver low HTHS solutions. Correctly formulated low HTHS oils deliver fuel efficiency whilst maintaining protection

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Case Study: Demonstrating Wear Protection With The New DD13 Engine Scuffing Test

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New liners

47 hours

(API CJ-4, SAE 10W-30, high phos)

200+ hours

(API FA-4, SAE 5W-30, low phos)
Lubrizol® CV9602 additive package
& Lubrizol performance polymer,
with full API Group III base oil

Correctly designed and formulated higher performing lubricants maintain durability whilst delivering fuel efficiency benefits

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Summary

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The drive to increased efficiency is not ‘business as usual’

Continued drive to increased efficiency, without compromising durability is driving the need for more efficient lubricants

Updated industry specifications represent further upgrades in the market

OEMs continue to upgrade their service-fill specifications for their modern hardware requirements

It is Important to have an integrated approach between the hardware technology and the lubricant

- Lubricants enable hardware changes as well as directly contributing to increased fuel efficiency and lower emissions
- It is not just about lower viscosity grade oils. The move to lower HTHS viscosity oils require design, development and formulation changes
- Performance additives and polymers have a key and fundamental role when moving to lower HTHS viscosity solutions

The opportunity exists for all stakeholders to move to higher performing lubricants in the drive toward increased efficiency without compromising durability

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Working together, achieving great things

When your company and ours combine energies, great things can happen. You bring ideas, challenges and opportunities. We'll bring powerful additive and market expertise, unmatched testing capabilities, integrated global supply and an independent approach to help you differentiate and succeed.

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