Outline presentation

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- Sustainability through Fuel Economy and how lubricants play a role.
  - Passenger Car Engine Oils
- Lubrizol's approach to sustainability and role in Fuel Economy improvement / CO2 reduction
  - Commercial Vehicle Engine Oils
- Applicational examples from the world of lubricants

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Fuel Economy - PCMO
- Proposed EU Targets for CO_2 Emissions up to 2030

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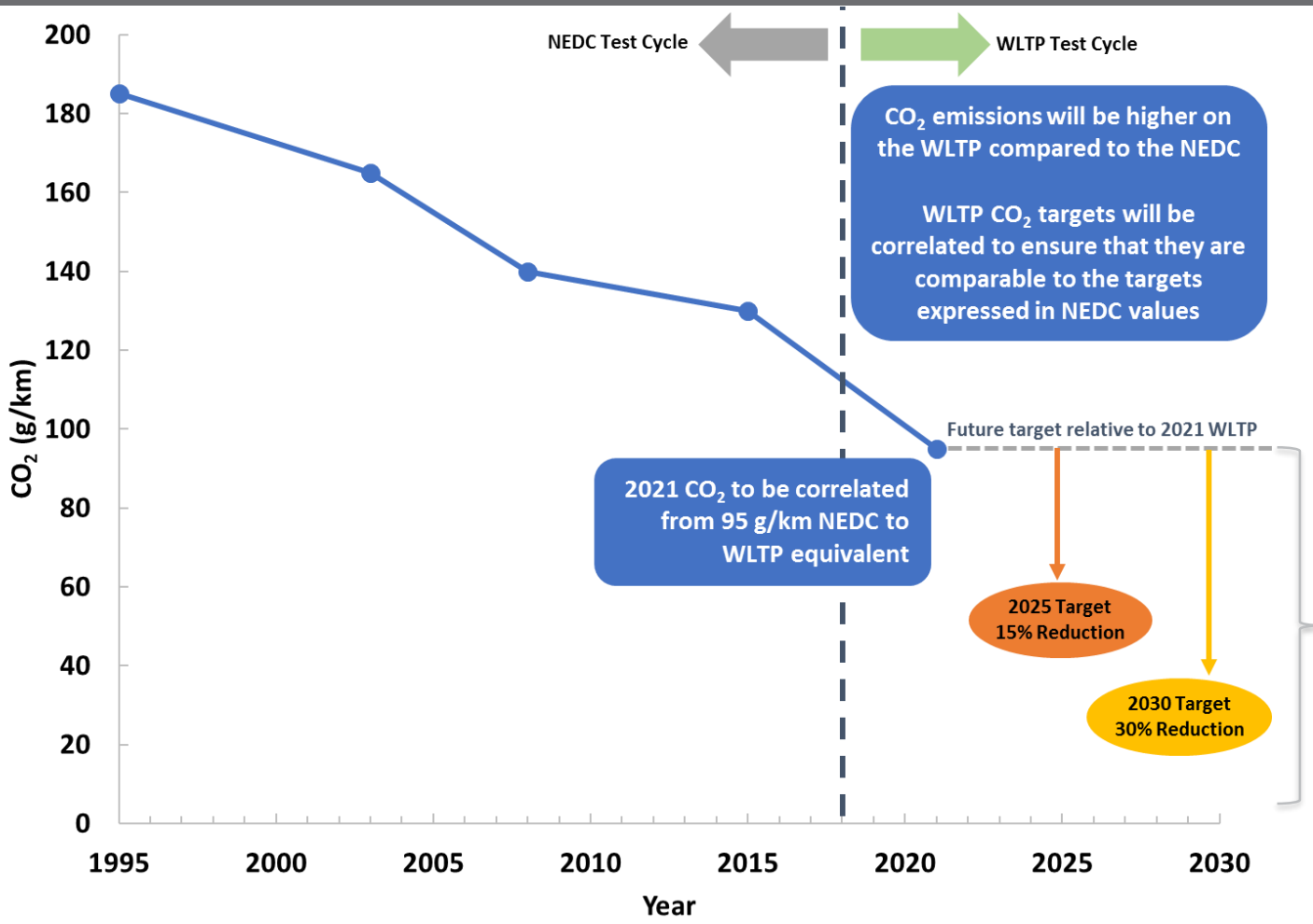

EU Commission continue to gather data to set equivalent WLTP values

Proposals only. EU debates are ongoing, including whether to introduce **RDE testing for CO_2**

Focus could shift from 'just tail-pipe' to vehicle life-cycle CO_2 emissions"

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Efficiency & Emissions | Hardware Changes

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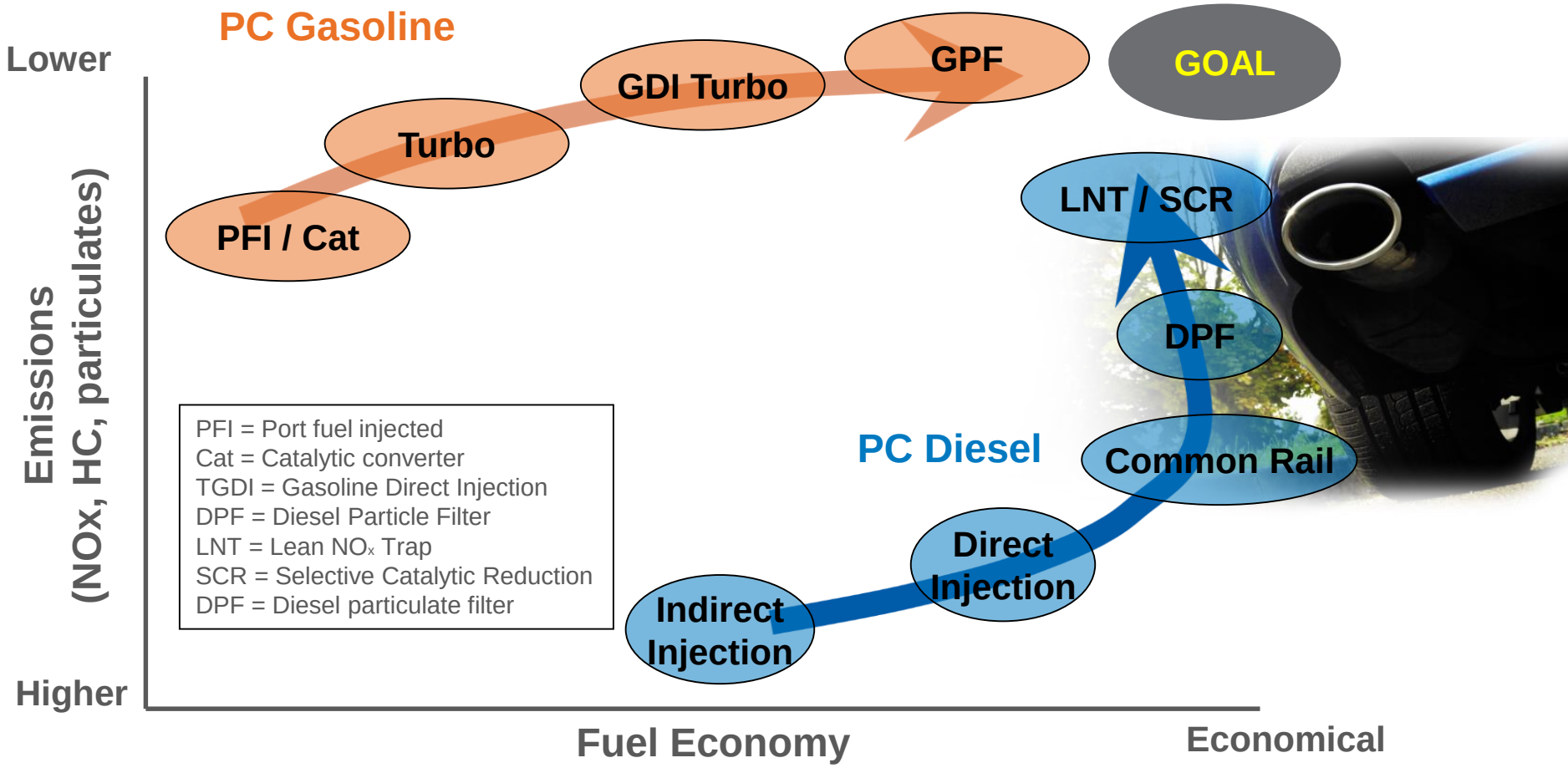

Changes in engine design to increase fuel economy and lower emissions

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How will OEMs meet the legislation?

Significant hardware changes, a technology race!

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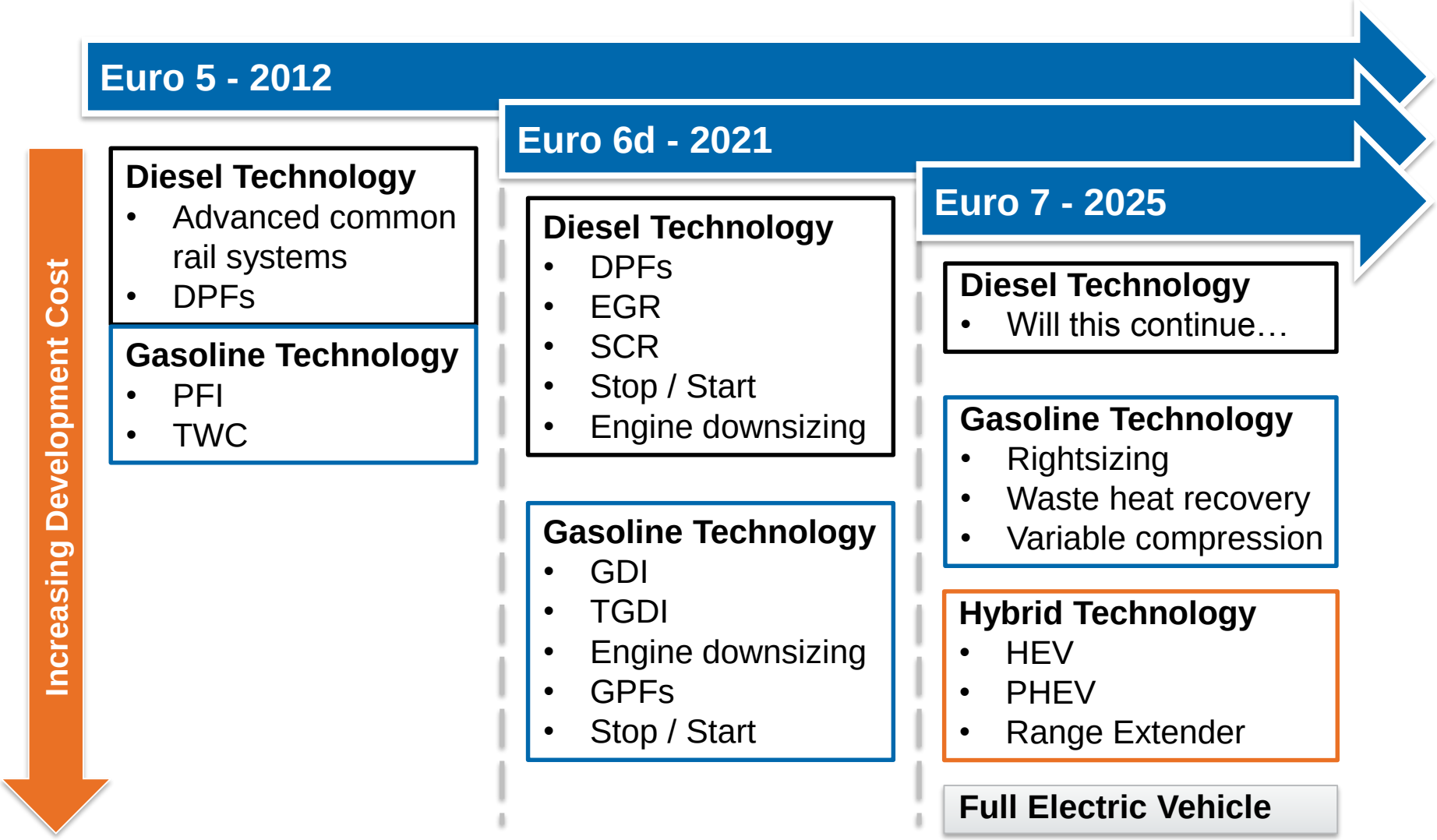

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New Durability challenges
Low Speed Pre Ignition (LSPI)

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- **LSPI is a durability concern for many European OEM's**
  - OEMs are aware that the lubricant has a role to play to help address potential increased LSPI tendencies
- **Some OEMs are taking steps to include LSPI performance tests in their own specifications, for example:**
  - Daimler, see latest V2016.1
  - PSA, see updated specifications (B71 2290, 2312, 2302)
  - GM-Opel, dexos1™: 2015
  - Ford
- **Some OEMs are also including chemical limits in their specifications**
  - PSA
- **Industry specifications will also include performance tests**
  - API SN PLUS (licensable from May 1st 2018)
  - Future ACEA and GF-6 updates likely to include LSPI tests

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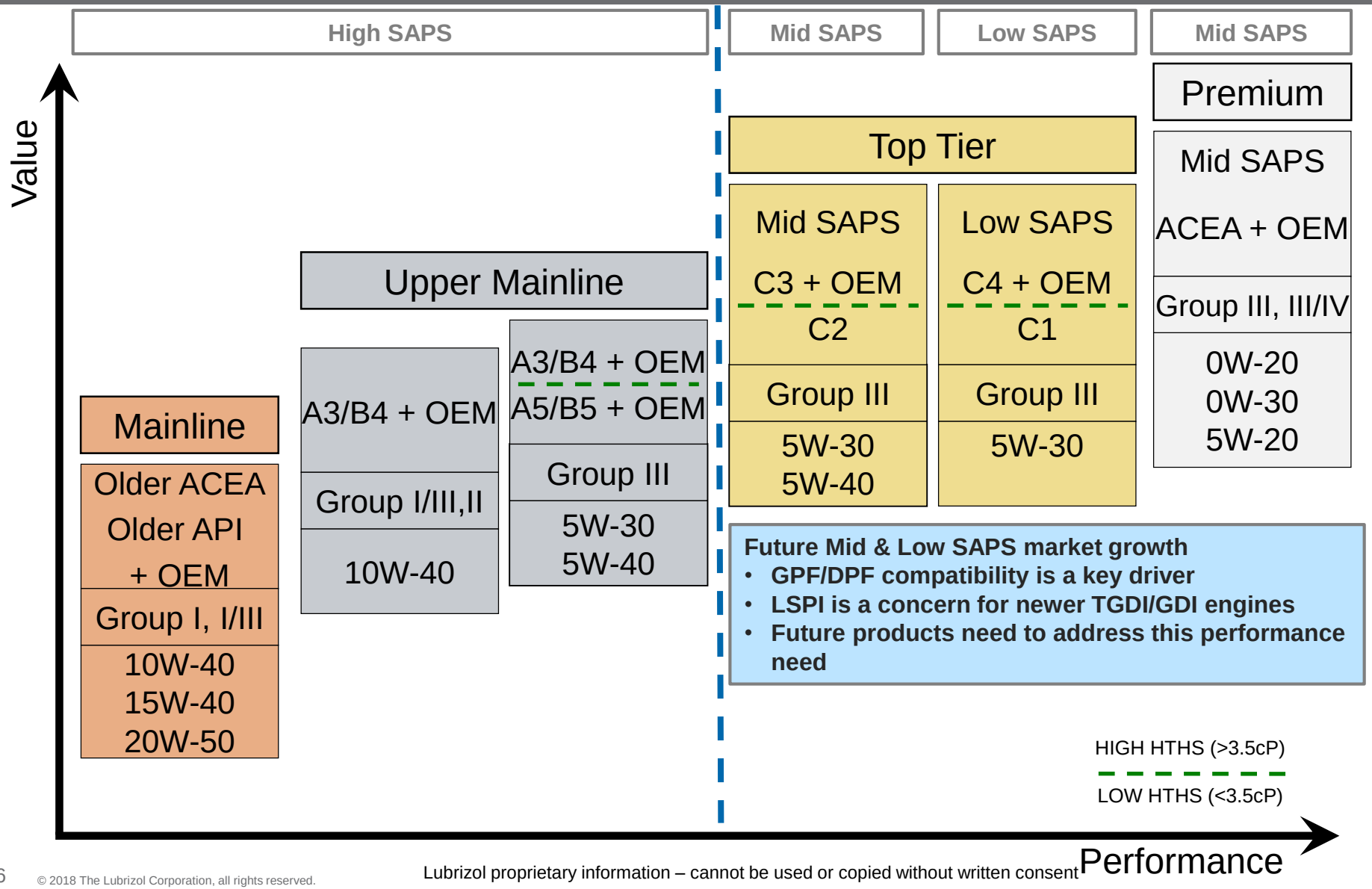
European Lubricants | Market Structure



- Lubrizol's approach to sustainability and role in Fuel Economy improvement / CO2 reduction
  - Commercial Vehicle Engine Oils

Sustainability of Lubrizol = ESG+E

We conduct business responsibly, maximizing environmental, societal and economic performance. This includes continuous improvement in our health, safety and environmental performance, supplying products that address some of the world's largest challenges, investing in our people and developing talent, and providing meaningful support for our communities.

Lubrizol Sets Goals

Our long-term, company-wide goals demonstrate our commitment to key drivers for operating responsibly

- Greenhouse Gases*
- Waste Generation
- Waste Disposal
- Energy Use

being essential

Lubrizol Achieves Results

Lubrizol mapped its global environmental footprint, measuring the progress toward improvement in additional environmental markers for 55 of the largest facilities across the globe

From 2010 to 2014, Lubrizol reduced its global carbon footprint by

6%

From 2010 to 2014, Lubrizol reduced its global fossil fuel footprint by

15.5%

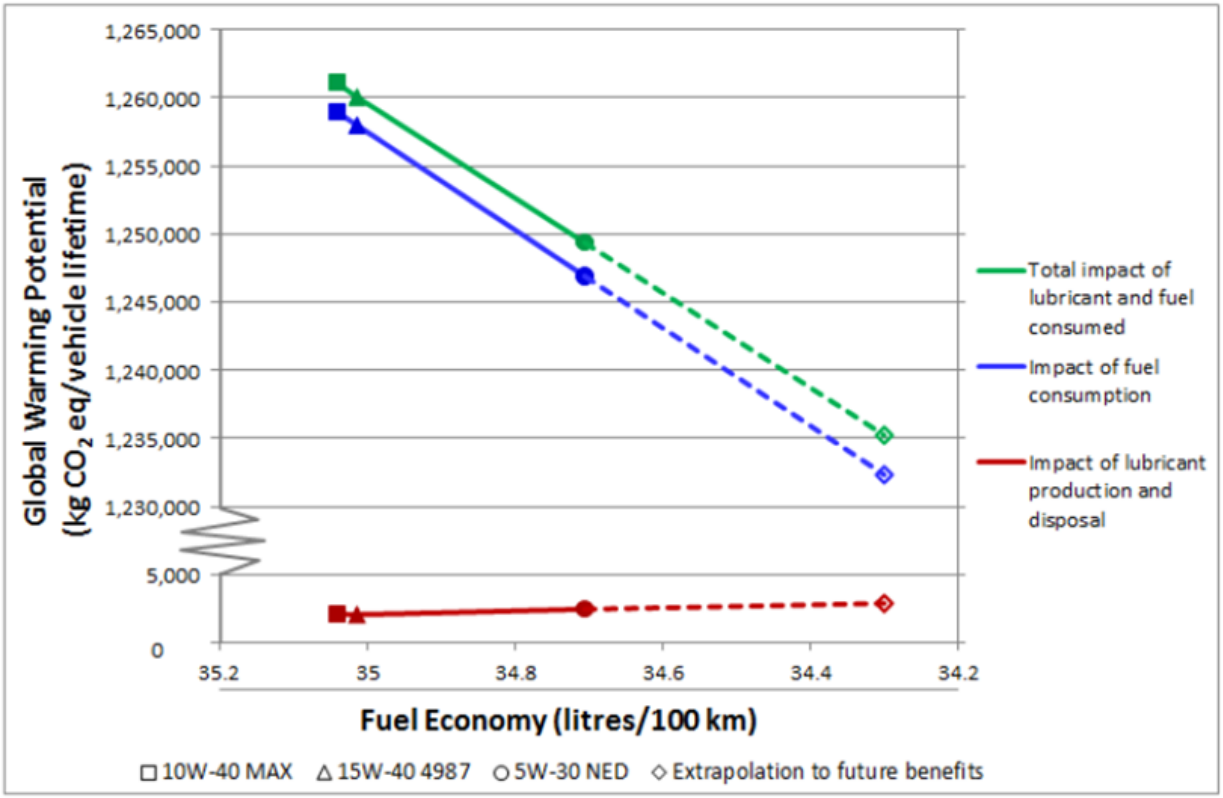
From 2010 to 2014, Lubrizol reduced its water use by

3.8%

Update to carbon footprint planned in 2019 (extended version)

being essential

Case Study – Heavy Duty Diesel Engine Oil



Lastly …..

…. the effect of engine design + lubricant technology have played

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European Commercial Vehicles – Efficiency Progress

Fuel consumption has been greatly reduced since 1965, in turn reducing CO_2 emissions

CO_2 emissions

Decreased 60% since 1965

This reduction has not been dri

Source: ACEA 2016

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European Emissions Progress

The evolution of EURO emissions

Emiss

Europe has som

Source: ACEA 2016

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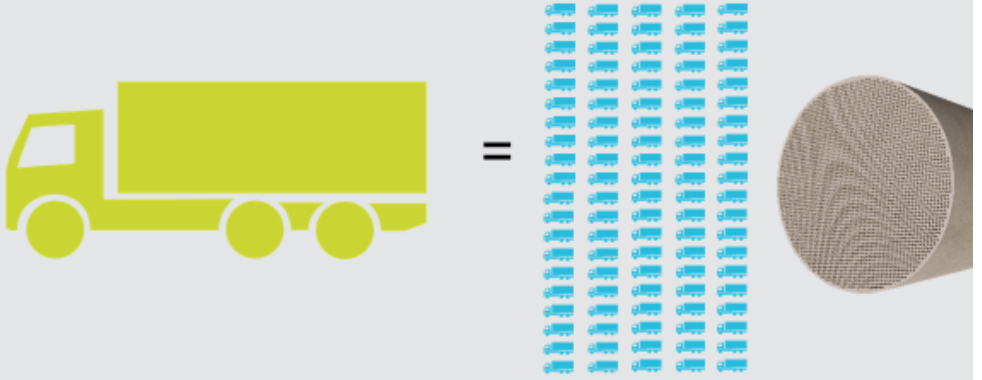
Emissions - Impact of Euro VI

30 years ago, **1** heavy on-highway truck produced the same level of particulate matter as **100** heavy good vehicles produced in 2017.



To make this possible, E6 Lubricants are required to Protect Diesel Particulate Filters

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