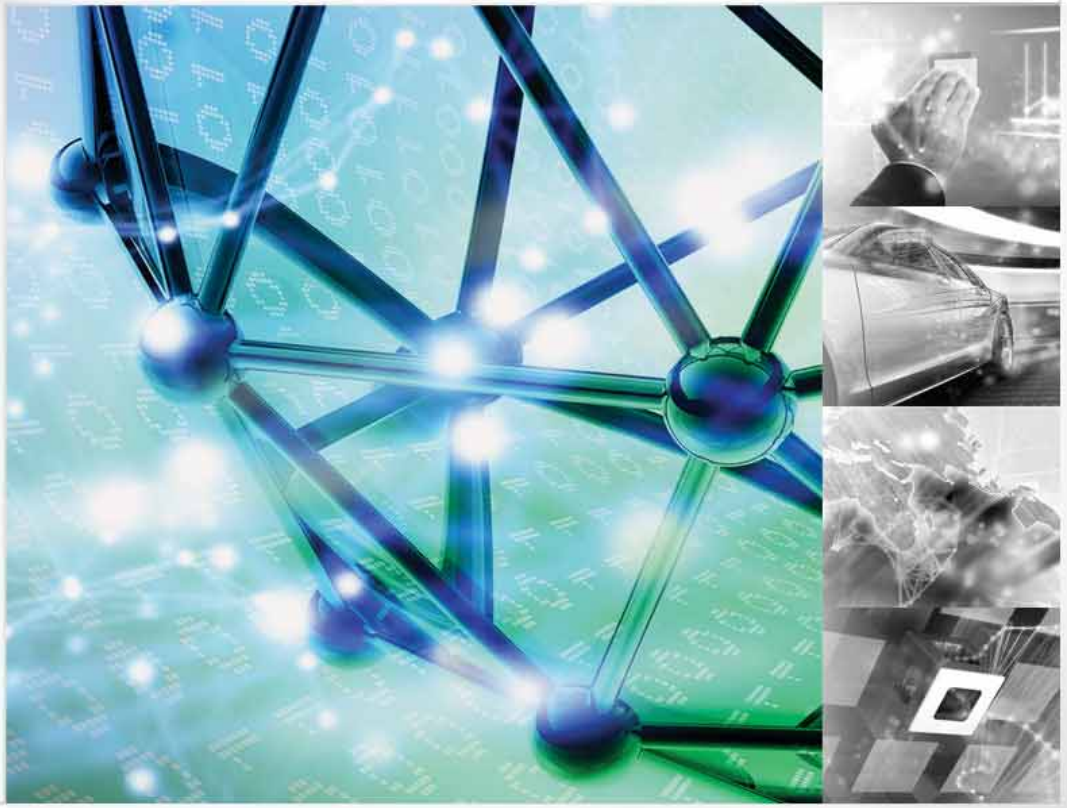

Unlocking Industry Innovation: Time to Change the Model?

Detroit Advisory Panel

April 19, 2016

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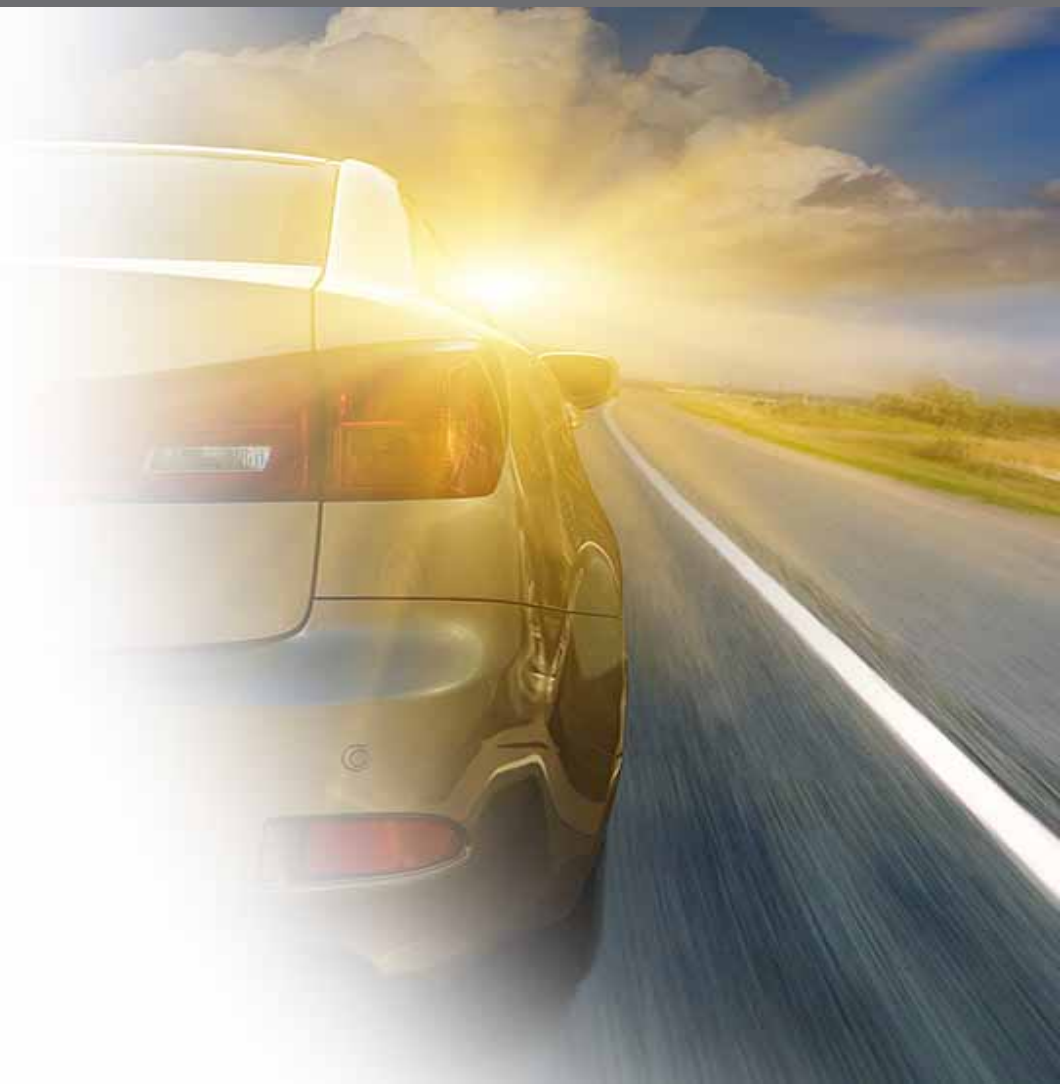
Outline

SUCCESS TOGETHER

- Global Drivers
- The Case for Changing the Industry Model
- Recommendations for Improvements



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Key Global Lubricant Drivers

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Global Vehicle Sales Will Grow

SUCCESS TOGETHER

1. Vehicle sales growth
2. Improving efficiency
3. Powertrain enablement
4. Lower viscosity oils

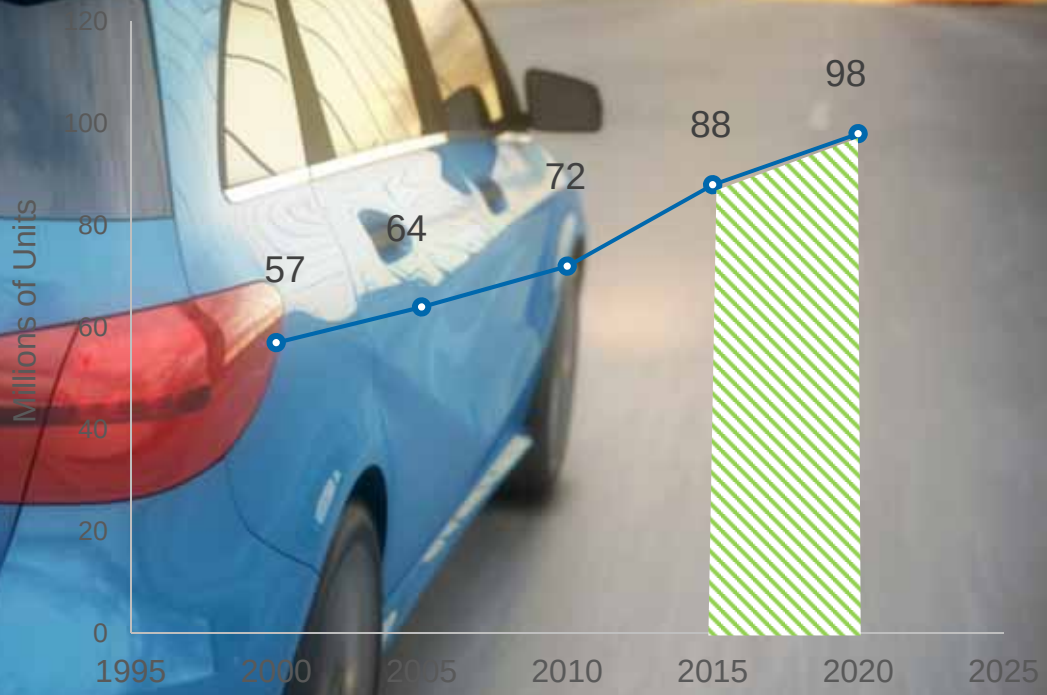
Global diversification – Example China:

- In 2000, 700K cars sold
- In 2020, 24 million projected

Total vehicle fleet grows from 1.1 B to 2 B in 2030

Annual worldwide vehicle sales

(Light, medium and heavy duty vehicles)



Asian markets lead growth

Sources : IHS AutoInsight, McKinsey, KPMG, Lubrizol www,greencarreports.com; www.Wikipedia.com

Demand grows for high performance lubricants and engineered solutions

Regulatory Impacts Are Not Incremental

PC sees substantial emission reductions

SUCCESS TOGETHER

1. Vehicle sales growth
2. Improving efficiency
3. Powertrain enablement
4. Lower viscosity oils

HD Segment follows

- New legislation leads to **efficiency improvements** in hardware and lubricants
- Tailpipe **emission reductions**
  - Beijing 6 standard in China
  - Phase in of Tier 3 in the US
  - BS VI in India by 2021
  - RDE[a] and WLTP[b] in the EU
- **CO_2 emission reductions**
  - 95 g/km[c] in the European Union by 2021
  - Phase III fuel economy legislation in China
  - **54.5 mpg in the US by 2025**

Sources ICCT, Dieselnet, China Ministry of Environmental protection

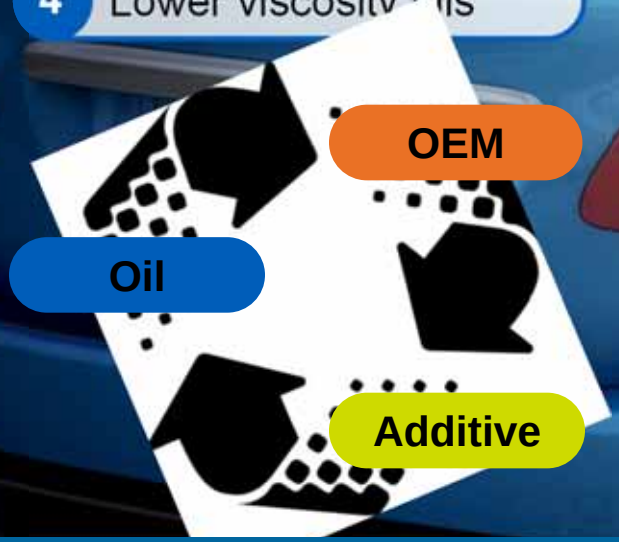
Notes a. RDE is an acronym for Read world Driving Efficiency, a test cycle for emissions performance which is conducted on the road
b. WLTP is an acronym for Worldwide harmonized Light vehicle Test Procedure which is expected to replace the New European Drive Cycle (NEDC) in the EU
c. Current limit based on the NEDC test cycle and this may be changed once the WLTP test cycle is adopted

This leads to lower viscosity lubricants and new additive technologies

Modern Lubricants Demand Integrated Design

SUCCESS TOGETHER

1. Vehicle sales growth
2. Improving efficiency
3. Powertrain enablement
4. Lower viscosity oils



- Engine and transmission systems will be optimized to deliver power more efficiently
  - Higher power density, smaller engines
  - Downspeeding of engines
  - Increasing the number of gears
  - Shift to automatic transmissions
  - Continued use of diesel particulate filters
  - Introduction of gasoline particulate filters
  - Greater use of SCR[4] systems on light duty diesel vehicles
  - Light weighting and many other options

Notes 4. SCR is an acronym for Selective Catalytic Reduction, an advanced exhaust aftertreatment system for the reduction of NOx emissions

The operating conditions get more severe and hardware more sophisticated

Enabling Efficiency Gains With Lubricants

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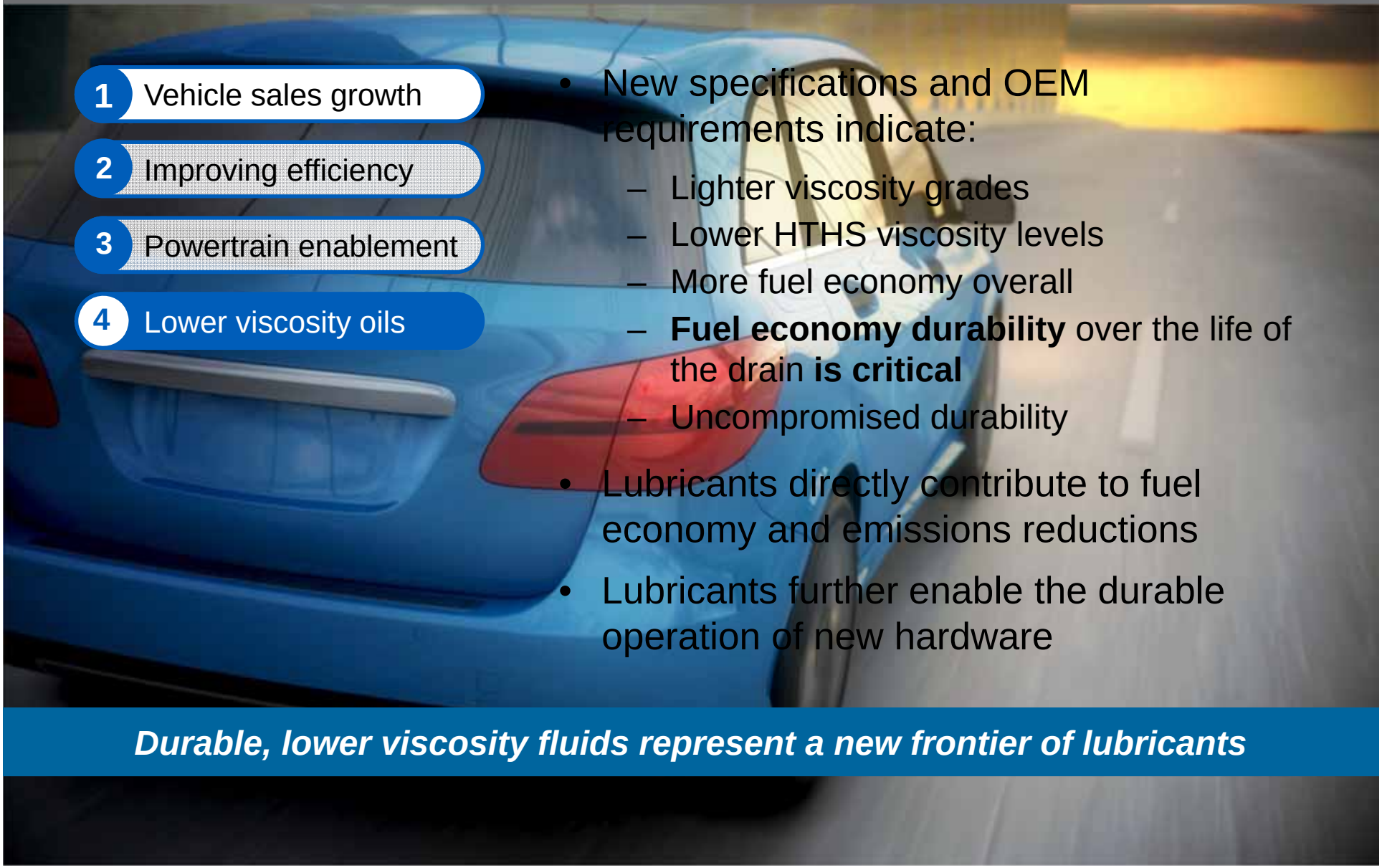

1. Vehicle sales growth
2. Improving efficiency
3. Powertrain enablement
4. Lower viscosity oils

- New specifications and OEM requirements indicate:
  - Lighter viscosity grades
  - Lower HTHS viscosity levels
  - More fuel economy overall
  - **Fuel economy durability** over the life of the drain **is critical**
  - Uncompromised durability
- Lubricants directly contribute to fuel economy and emissions reductions
- Lubricants further enable the durable operation of new hardware

Durable, lower viscosity fluids represent a new frontier of lubricants

Trends Heavy Duty Truck

More performance - less emissions

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Power	**430 HP**	**600 HP**	**40% more power**
Fuel Economy	**6.0**	**6.4**	**6% improved fuel economy**
Emissions Levels	**NOx 4.0 PM 0.11**	**NOx 0.2 PM 0.02**	**Over 90% reduction in emissions**
Aerodynamics (Cda)	**0.8**	**0.62**	**22% improved aerodynamics**
Emissions equipment	**Oxidation Catalyst**	**Oxidation catalyst SCR DPF Limp mode**	**More complex emissions systems**
Engine Lubricant	**CF-4 15W-40**	**CJ-4 10W-30**	**Low ash formulation**
Gear Oil	**MIL-L-2105D**	**SAE J-2360 + OEM**	**Higher performance**

Class 8 tractors are more powerful and less polluting – are we doing enough?

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How Do Industry Standards Come To Be?

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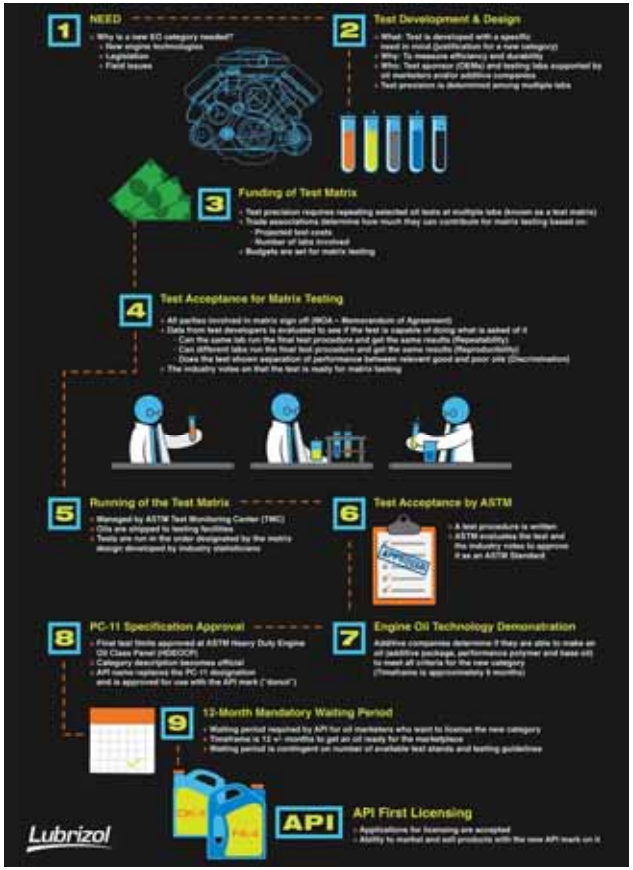
- Setting an Industry Standard requires several steps:
  - Establishing need
  - Test design, funding, and development
  - Spec acceptance
  - Formalization
  - Implementation
  - Licensing



Available on www.HDDEO.com

Our industry system requires numerous steps to set minimum quality levels

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Specification Developments Need Fresh Approach

Consensus-driven lowest common denominator process

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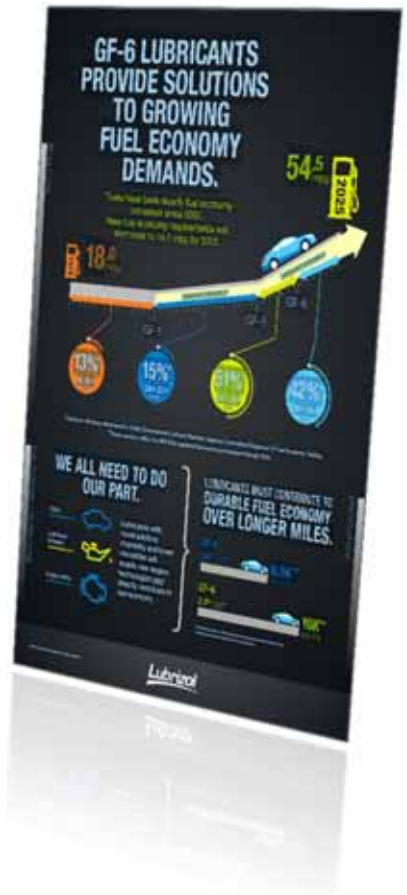
- Industry processes and committees are **complex**, **slow and unbalanced**
- Category development costs are **prohibitive for commercializing innovative products**
- Specifications mandate **minimum** lubricant quality levels
- Advertising rulings constrain marketers from **selling performance and differentiation**
- **Consumers and society deserve more** products that give more than minimum performance
- Our industry must take action to improve speed, flexibility, and **unlock innovation**



Our industry model locks out innovation and adaptability

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Five Forces: Barriers Working Against Innovation

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FORCE 1: Costs are accelerating

FORCE 2: “Dear Manufacturer”

FORCE 3: It takes too long

FORCE 4: A pass is a pass

FORCE 5: Performance convergence

These factors cumulatively are impacting all of us

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The First Force - Costs Are Accelerating

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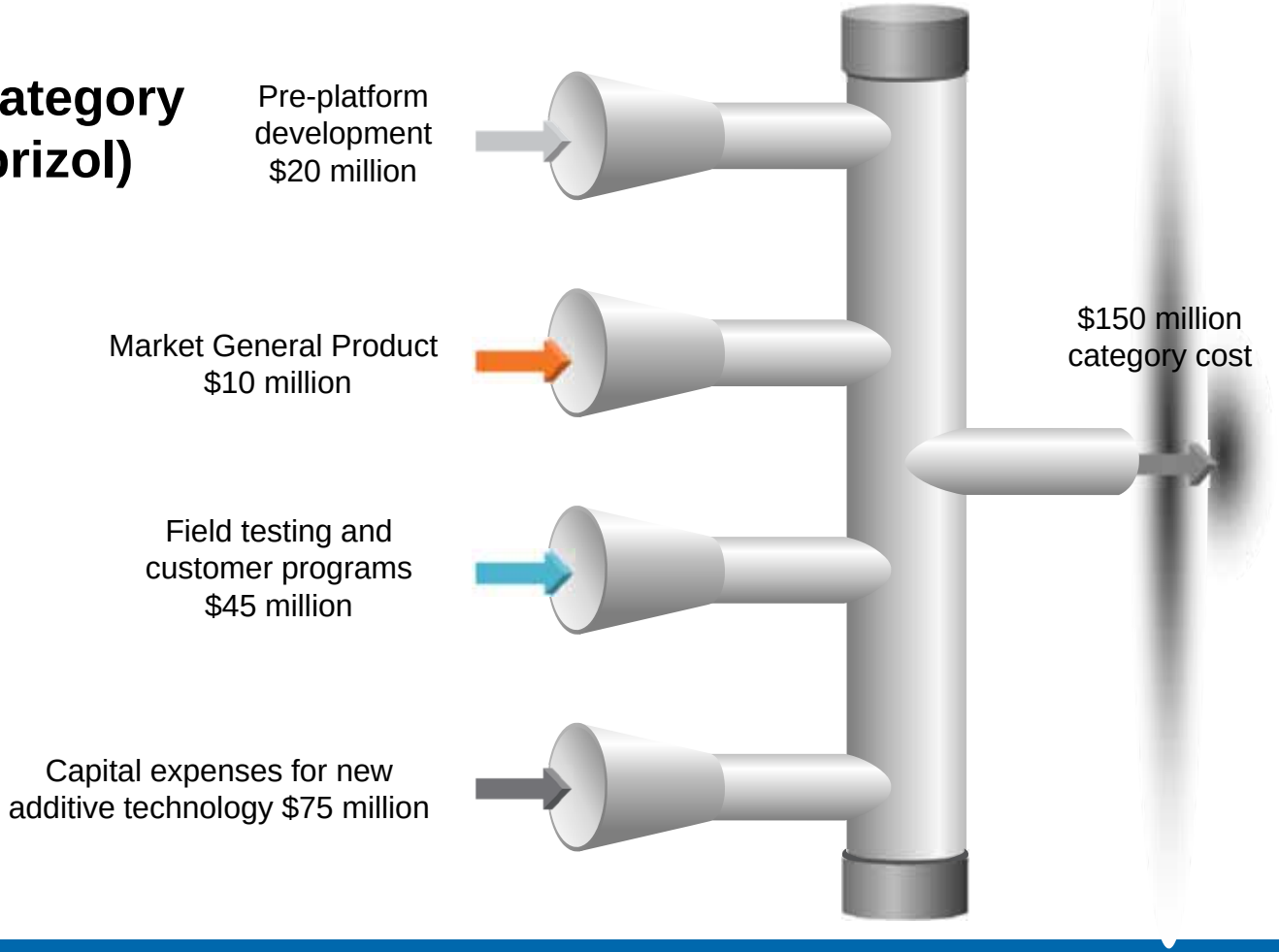
Example: PC-11 Category Development (Lubrizol)



The model and escalating costs make investments increasingly risky

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The Second Force — “Dear Manufacturer”

Technology must be readily available and backward compatible

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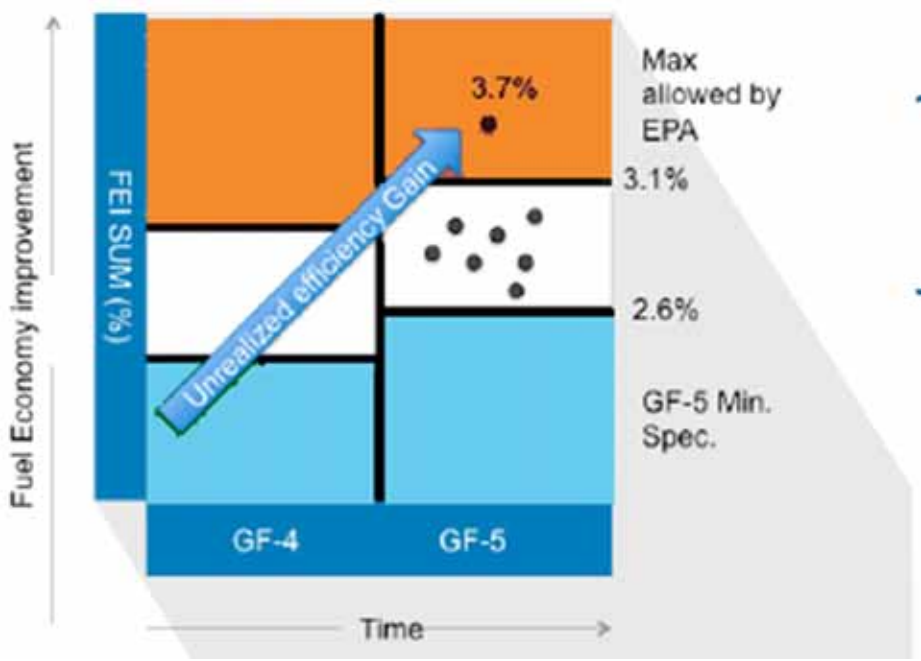
Sequence VID Results



EPA sets “typical limits” for fuel economy that OEMs can use to certify and further requires these oils to be readily available

Industry committees set the minimum standards that everyone can meet

Creates hurdles for marketers to bring step out products to market

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This Costs Everyone

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Examples: US fuel economy systemic losses and opportunities

PC: 0.5% More Lube FE

- FLEET
  - 685 MG saved
  - 6 MMT CO_2 saved
  - $1.5 billion in wasted fuel cost
  - = 1.2 million cars removed

HD: Regulate 10W-30 vs 15W-40

(1% FE savings for on-highway trucks)

- FLEET
  - 378 MG fuel saved
  - CO_2 – 1 MMT
  - $750 million in wasted fuel cost

HD: Use of Fuel Efficient Lubricants

(3% FE savings EPA SmartWay® Transport Partnership)

- FLEET
  - 2.4 billion gals total
  - CO_2 – 24.7 MMT
  - $5 billion in wasted fuel cost
- Per TRUCK
  - Diesel fuel – 485 gals
  - CO_2 – 4.93 MT
  - $1,680 fuel cost savings

- *CO2 calculations from EPA average Carbon Dioxide Emissions Resulting form Gasoline and Diesel*
- *EPA SmartWay Estimates of benefits*
- *EIA estimates of on highway distillates usages 2014*

These are things available NOW

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The Third Force – It Just Takes Too Long

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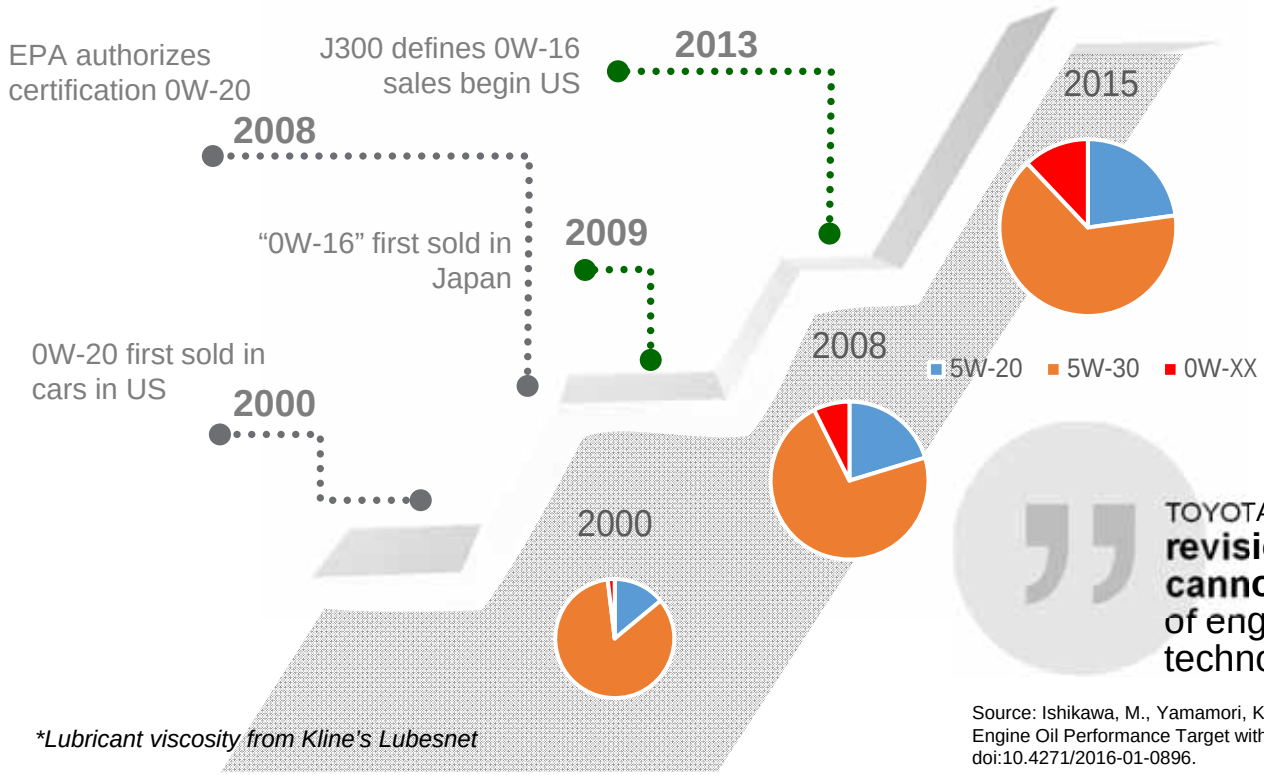
GF-6: 6 organizations and 11 sub-committees involved



**Lubricant viscosity from Kline's Lubesnet*

- 0W-20: **8 years** between product launch and EPA certification testing
- 0W-16: **4 years** for SAE J300 grade definition. EPA certification? 0W-8's **10+ years?**

TOYOTA: "It becomes obvious that the **revision of** engine oil **specifications cannot keep up** with the rapid change of engine hardware and engine oil technologies"

Source: Ishikawa, M., Yamamori, K., Hirano, S., Kowalski, T. et al., "Introduction of Fuel Economy Engine Oil Performance Target with New SAE Viscosity Grade," SAE Int. J. Fuels Lubr. 9(2):2016, doi:10.4271/2016-01-0896.

Innovations and step out products need faster routes to market

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The Fourth Force – “A Pass Is A Pass”

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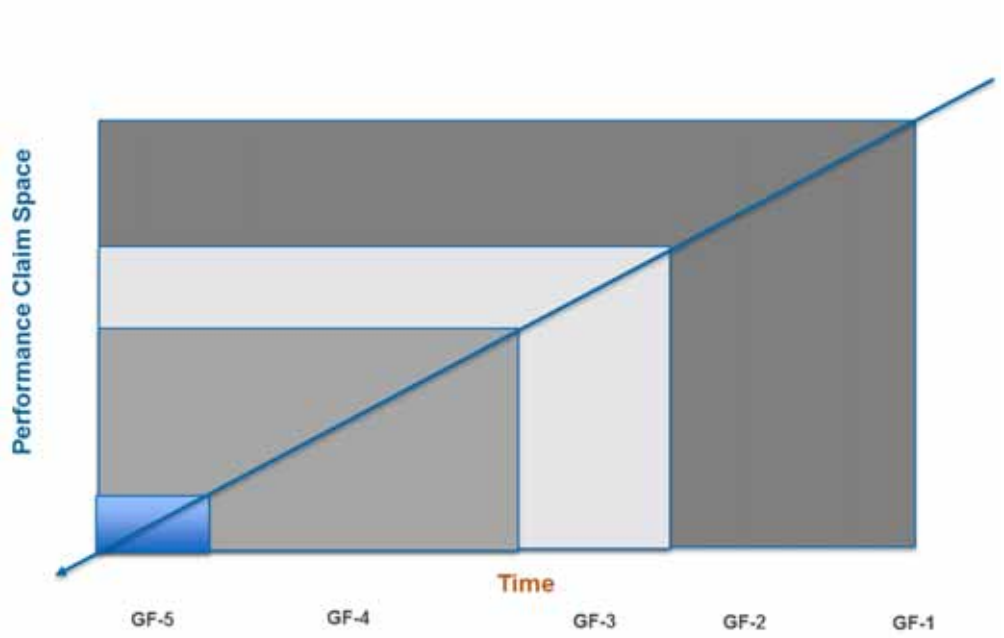
- Government, OEMs and consumers desire performance
- BUT litigations have generally guided differentiation substantiation to:
  - Specifications
  - Pass / Fail testing
  - Field testing and testing applicable to customer experience (no torture tests)
- Synthetics, typically positioned as top tier and generally featuring the basestock type



How can marketers articulate meaningful consumer benefits?

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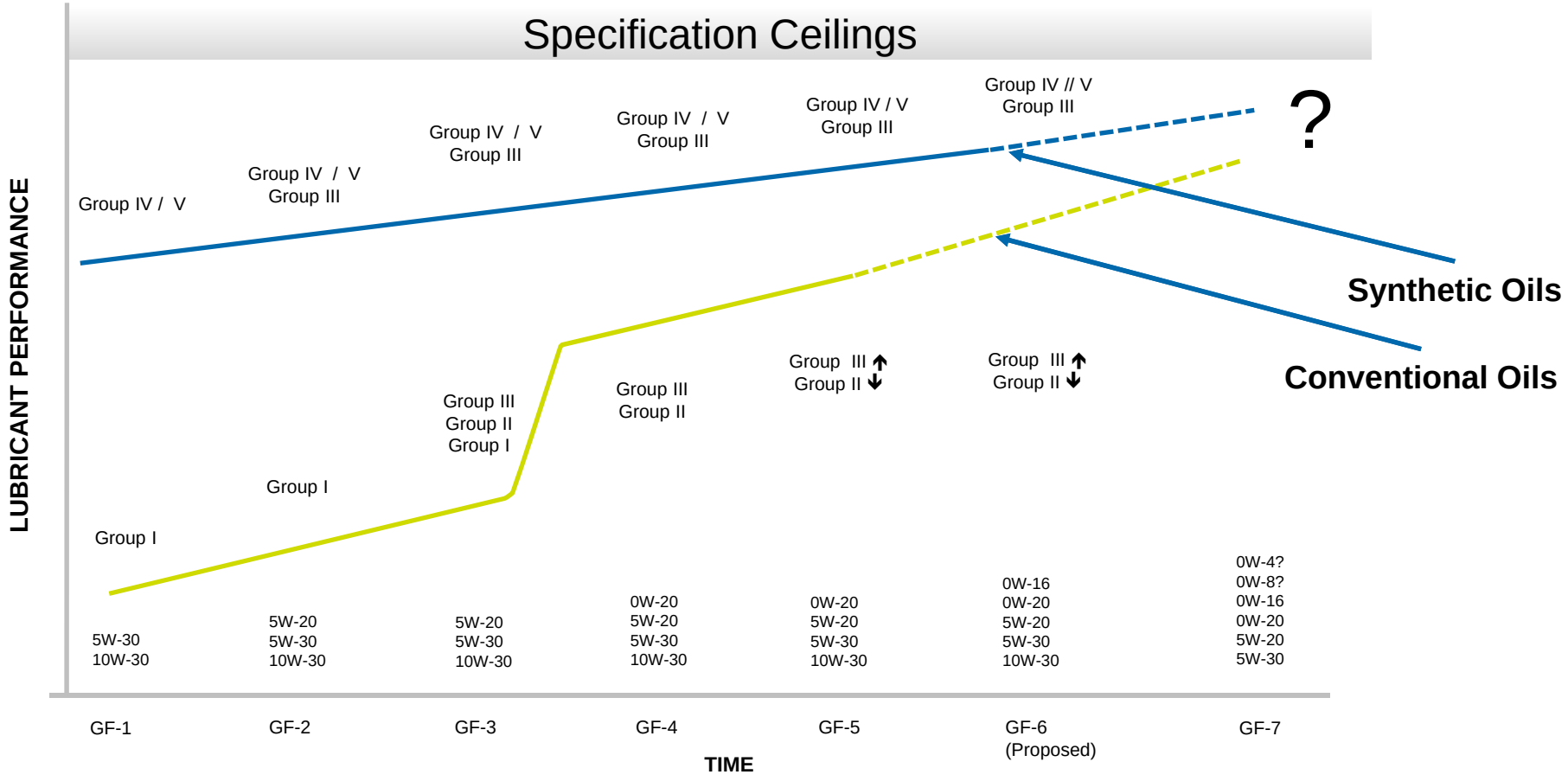
The Fifth Force — Performance Convergence

The Basestock Squeeze



Are we heading for commoditization?

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Today's Passenger Car Product Categories Are Generally Based on Basestock Type

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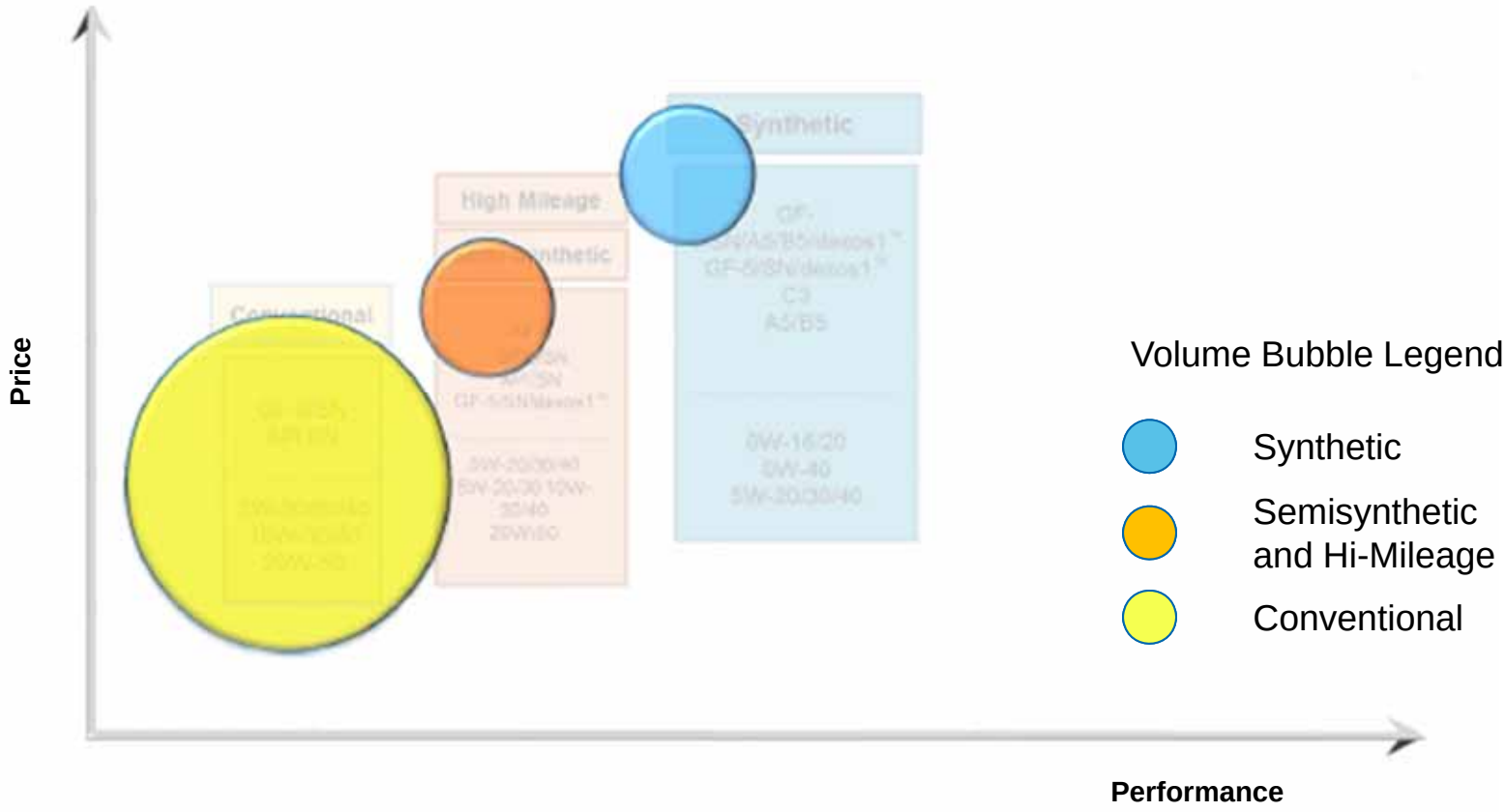
Sample PC Lubricant Product Architecture – North America



In a low viscosity world will basestocks still differentiate product categories?

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Hard Passenger Car Claims Enable Separation of Product Categories

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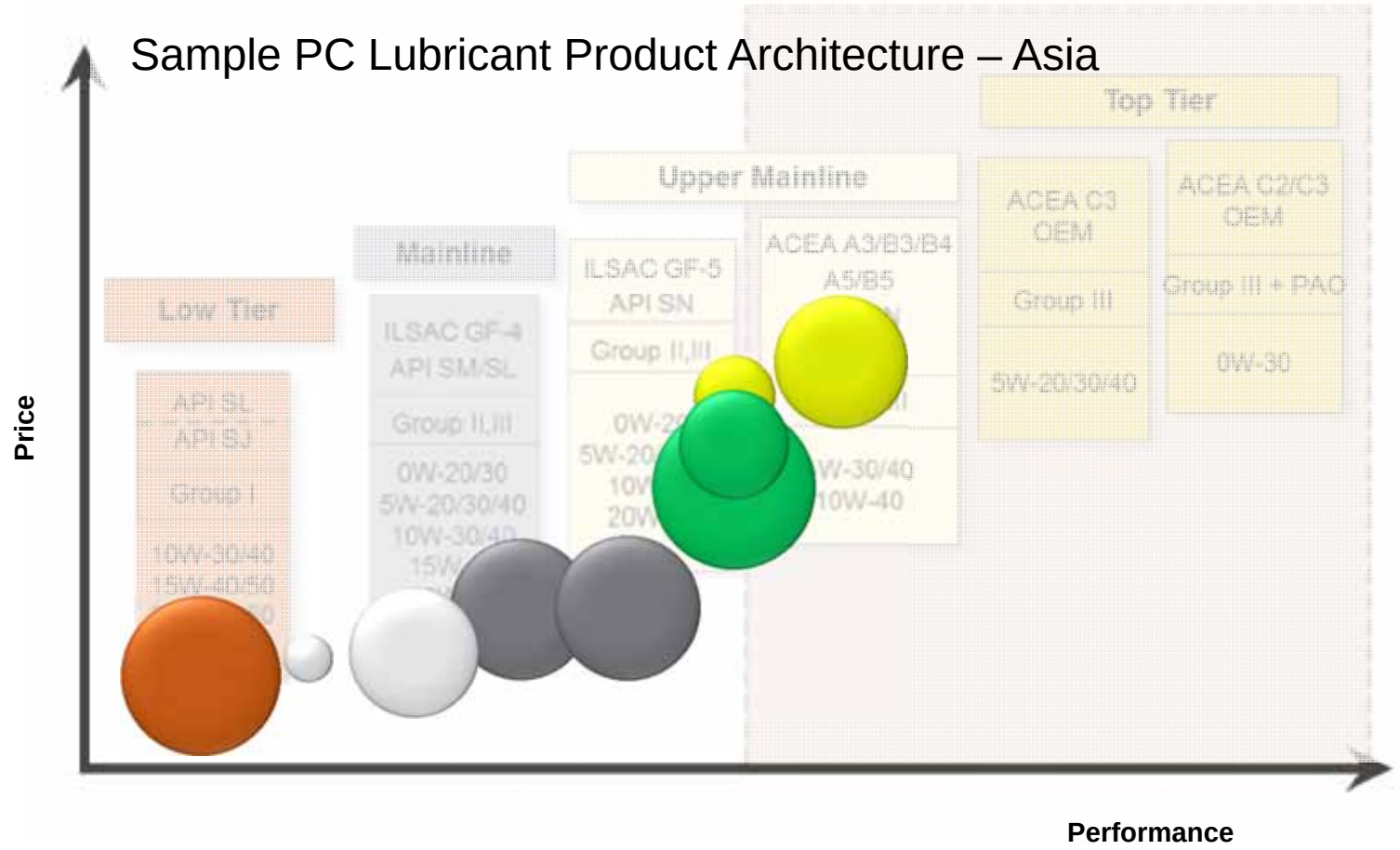

Tiering based on claims provides a pathway to commercialize performance

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Lubrizol's Proposal

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Form a Stakeholders Group that aims to:

- **Streamline specification development** to improve speed and cost
- Identify a **fast track** for new **technology**
- Form and fund an **evergreen test development** organization
- **Engage regulatory agencies** to incent products that deliver societal benefits today
- **Build tiered specification** to give consumers performance-based differentiated options
- Define paths to **educate** consumers on lubricant performance

As an industry can do better and the time to act is now

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Next Steps

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Start the Conversation

- Exchange perspectives with oil companies, OEMs, Regulatory Agencies, Testing Organizations, Additive Companies and End User Representative Groups
- Form Stakeholder Committee and agree on scope and governance
- Focus on forthcoming Passenger Vehicle mid-term reviews for 2025 CAFE targets
- Refine and agree, plan, fund, and test
- Implement learning and improvement post GF-6 and PC-11 first licensing

Let's work together and enable innovation for everyone

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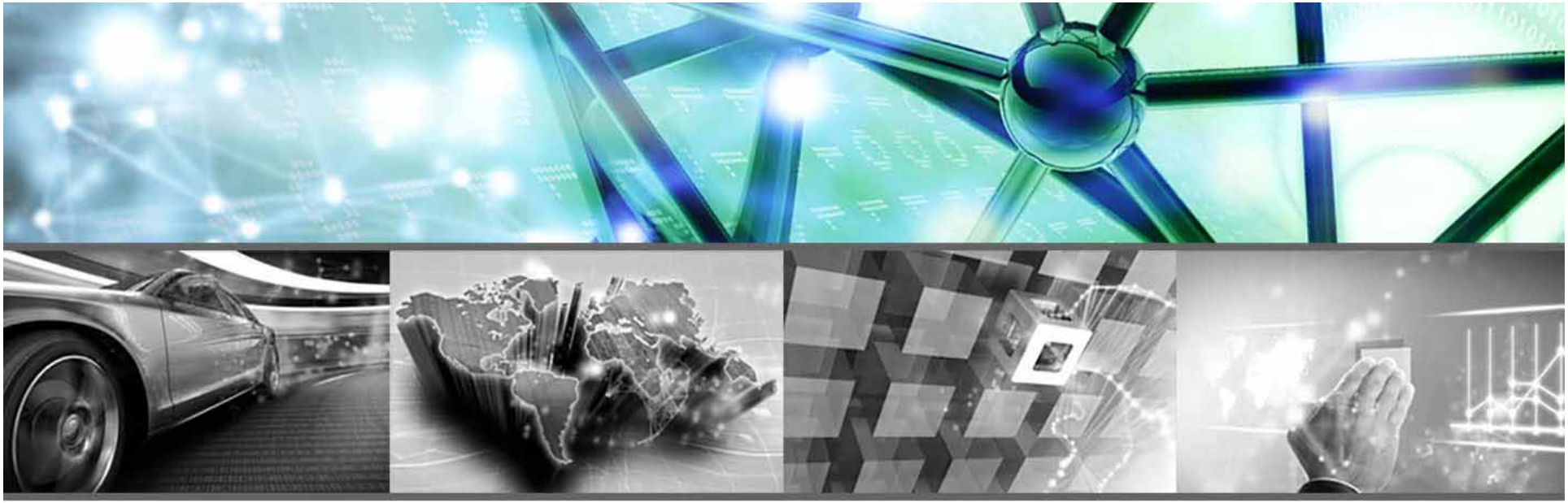

SUCCESS TOGETHER

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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