Lubricant Expo Europe
Düsseldorf, Germany

THE SUSTAINABLE FUTURE IS HERE!

It’s time for change

Leyla Alieva, CEO & Co-Founder
David Wilson, Head of Products

WHO IS NEOL?

NEOL Copper Technologies Limited is a hard-science company dedicated to developing and manufacturing revolutionary technical lubricants, which are better for machines, and kinder to our environment. These lubricants are formulated using synthetic base oils, additised with our proprietary copper filming technology, CuGlide™.

OUR MISSION

Our mission is to develop innovative technologies that not only preserve our resources, but also safeguard our natural environment. We aim to foster a higher quality of human life, in harmony with the natural world.

We aim to preserve RESOURCES for a SUSTAINABLE FUTURE

CREATING A SUSTAINABLE LUBRICANT: THE CHALLENGE

Pick your favourite!

Toxicity (ZDDP)	Wear	Oxidation	Waste	Pollution	TCO
Friction	Fuel efficiency degradation	Carbon footprint	Limited oil life	Sensor/Catalyst poisoning (P)	Excessive oil consumption
Vibration	Excessive resource consumption	Deposits/ Sludge	Unavoidable downtime	Limited asset life	DPF blockage (ash)

THE PROBLEM:

Lubricants still lose the fight against wear and loss of efficiency because of aging

THE LUBRICANT INDUSTRY CAN BE THE HERO!

The industry must think differently, unconventionally, and from a new perspective!

CREATING A SUSTAINABLE LUBRICANT: THE SOLUTION

Defining "sustainable additive solution" – it is something universal and versatile enough to address not one, but simultaneously several issues in different applications, both new and old, and simple rather than complicated to become future-proof

INNOVATION

Deep innovation is the key to unlocking the challenge of protecting the equipment parc throughout its lifetime

TRANSFORMATION

Unique transformative approaches are required for this challenge

REMEDY

Where scientific understanding meets technology:
- a 'magic bullet' can transform how we lubricate and maintain efficient longer-lasting equipment

REVOLUTION

Opportunities exist to change the formulating toolkit and revolutionise lubricants

THE LUBRICANT INDUSTRY CAN BE THE HERO!

Delivering such an achievement is no longer akin to finding a mythical treasure!

CONVENTIONAL LOW-ASH ENGINE OIL FORMULATION

Lubricant Additive

Base Oils

API Group
I, II, III, IV, V

Viscosity Modifier

Pour Point Depressant

Dispersants (multiple)

Detergents (multiple)

Antioxidants (multiple)

Antiwear ZDDP (1-2)

Friction Modifier (1-2)

Antifoam (1-2)

TYPICAL OIL PROPERTIES OF LOW-ASH OILS:

TBN	≥ 10 mgKOH/g
Sulphated Ash	1.0 %wt
Calcium	✓
Phosphorus	0.08 – 0.12 %wt
Zinc	✓
Sulphur	≤ 0.3 %wt

Low SAPS = 1.0 / 0.08-0.12 / 0.3

A complex recipe of 14+ components has a significant footprint

ACHIEVING A NO-SAPS ENGINE OIL FORMULATION

- Dispersants (multiple)
- Detergents (multiple)
- Antioxidants (multiple)
- Antiwear ZDDP (1-2)
- Friction Modifier (1-2)
- Antifoam (1-2)

→

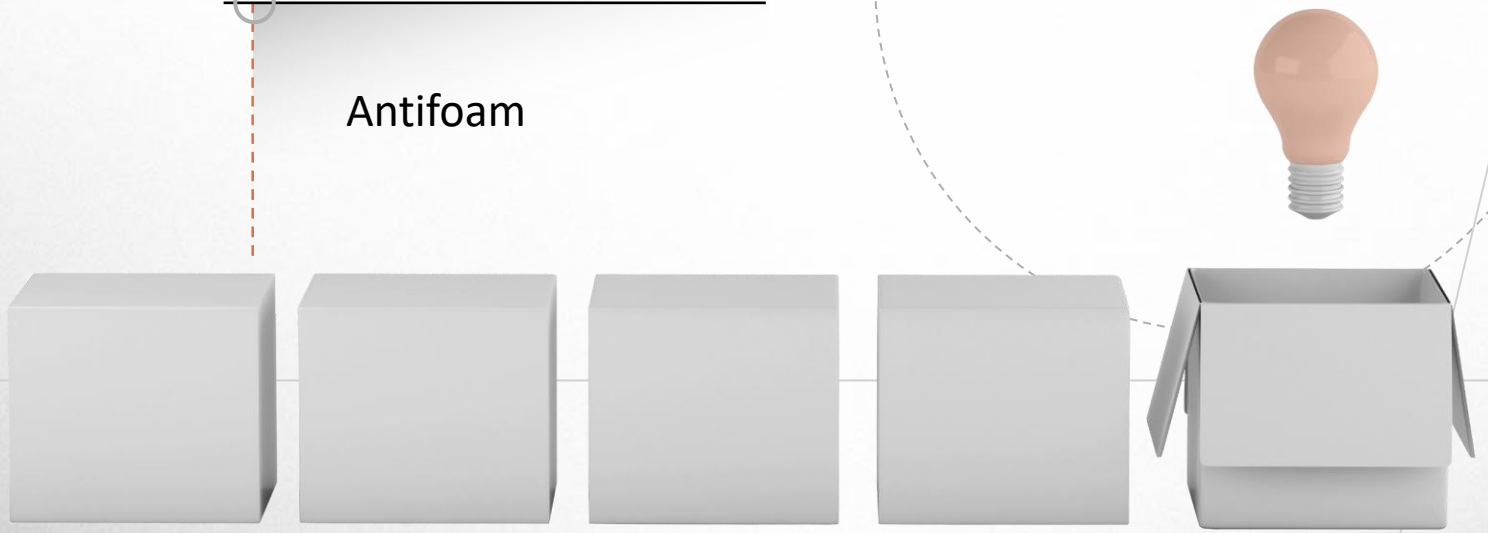
- Dispersant
- Antioxidant
- Antifoam

Remove:

- Ash containing detergents
- Sulphur containing AOs
- ZDDP

…and reduce product complexity (reduce footprint)

- Reduce # dispersants
- Reduce # AOs
- Remove FMs



THINK OUTSIDE THE BOX!

ACHIEVING A NO-SAPS ENGINE OIL FORMULATION

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→

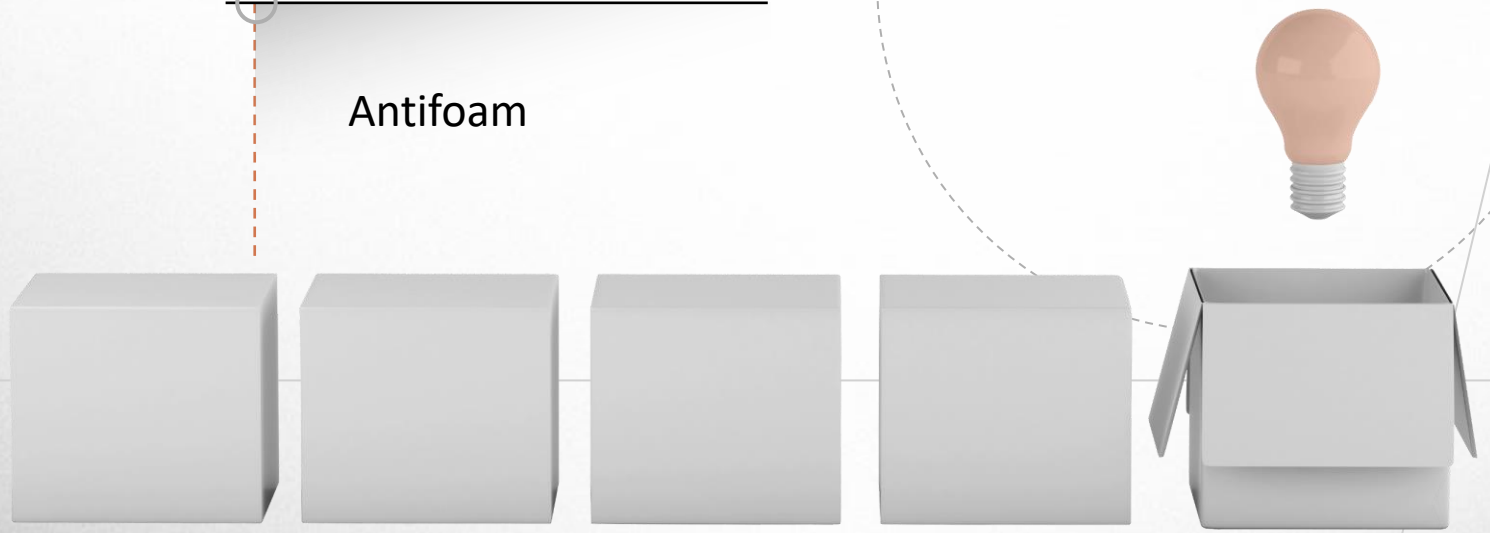
- Dispersant
- Antioxidant
- Antifoam

50% less components

+

Multifunctional Component Technology

Combines anti-wear, anti-corrosion, anti-oxidation, detergency, and friction-modification in a single chemistry



THINK OUTSIDE THE BOX!

ACHIEVING A NO-SAPS ENGINE OIL FORMULATION

- Dispersant
- Antioxidant
- Antifoam

MULTIFUNCTIONAL COMPONENT TECHNOLOGY

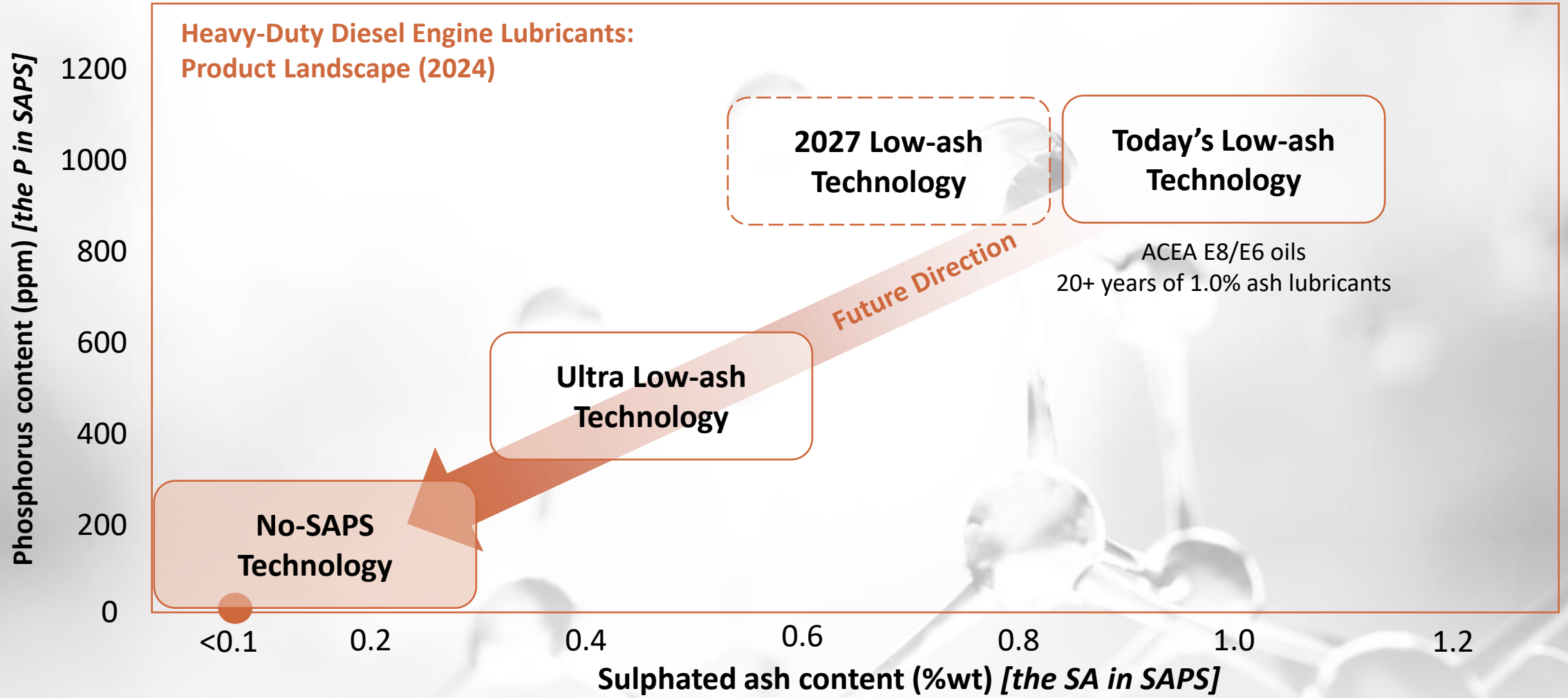
TYPICAL OIL PROPERTIES :

TBN	'Ultra-low'
Sulphated Ash	'Zero' (<0.1 %wt)
Calcium	Zero
Phosphorus	Zero
Zinc	Zero
Sulphur	'Ultra-low' <0.01 %wt
Copper	250-300 ppm

SAPS = <0.1 / 0 / <0.01

NO - SAPS

THE HDDEO INDUSTRY IS ON A RACE TO ZERO



Changing the DNA of a lubricant with new technologies can rapidly transform the HDDEO industry to ultra-low and zero ash product solutions

RESTORING FUEL EFFICIENCY

Big % fuel economy improvements are achievable!!

Years

Factory-fill	OEM Genuine Oil	Branded Oil	Sustainable Oil
0-1	1-3	3-8	8+

1.0 → If a vehicle may easily consume 10% more fuel after 8 years of continued use (1.5% loss per year) → 0.886 → 10% FEI → 0.975

Sustainable Oil (for life)

1.0 → 1.0

TECHNICAL CASE STUDIES | PORTFOLIO

A spectrum of successful case studies with innovative no-SAPS synthetic oils in a mix of real-world and laboratory-controlled tests in new and aged engines and machinery

TECHNICAL CASE STUDIES FOR NO-SAPS DIESEL ENGINE OILS

Diesel engine oil case studies with innovative no-SAPS synthetic oils in new and aged engines and machinery

NEW CUMMINS X12 | FORD TRANSIT 2.0L ECOBLUE | CATERPILLAR 777E

- New Cummins X12 engine. Euro/China VI. Turbocharged. 490HP
- SAE 10W-30 versus global OEM-approved brand
- 464 hours: Functional-Endurance-Functional testing protocol
- Functional: oil parameters, power, torque, BSFC, exhaust emissions
- Endurance: 300 hours cycle according to OEM protocol

CONCLUSION:

1. Comparable performance according to the engine type approval test limit:
2. Marginal power & torque increase (0.6%)
3. **'Preserved engineered performance'**

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Diesel engine oil case studies with innovative no-SAPS synthetic oils in new and aged engines and machinery

NEW CUMMINS X12 | FORD TRANSIT 2.0L ECOBLUE | CATERPILLAR 777E

10W-30 Oils	No-SAPS oil New	No-SAPS oil Post Endurance Test
KV100, cSt	10.4	11.9
VI	141	142
TBN, mgKOH/g	1.1	1.0
TAN, mgKOH/g	2.2	1.9
Sulphated ash, %wt	0.06	0.05
Oxidation, Abs/cm	-	<1
Nitration, Abs/cm	-	6

10W-30 Oils	No-SAPS oil New	No-SAPS oil Post Endurance Test
Soot content, %	-	0.7
Iron, ppm	-	90
Copper, ppm	251	258
Calcium, ppm	0	16
Sulphur, ppm	<100	<100
Phosphorus, ppm	2	10
Zinc, ppm	<1	12

CONCLUSION:

1. Excellent control of oxidation, nitration, and acidity with an ultra-low sulphated ash & TBN 10W-30
2. Excellent iron wear protection without harmful ZDDP and conventional ash-containing detergents

TECHNICAL CASE STUDIES FOR NO-SAPS DIESEL ENGINE OILS

Diesel engine oil case studies with innovative no-SAPS synthetic oils in new and aged engines and machinery

NEW CUMMINS X12 | FORD TRANSIT 2.0L ECOBLUE | CATERPILLAR 777E

- Ford Transit Custom "*Bob Van Go*". 2.0l Ecoblue
- Ex-commercial 100K km rental/hire vehicle
- SAE 0W-30 versus global OEM-approved brand
- Mounted in a UK-based powertrain test facility
- 12000 km multi-stage test program
- 6935 km fuel efficiency evaluation with 500 kg load following WLTC, FLDR, SS, & Baseline cycles
- 2880 km evaluation of 75W gear oil with 0W-30 engine oil

CONCLUSION:

1. **Enhanced fuel efficiency performance'**
2. Reduced fuel consumption by >2.5% for *white van* vehicles used by multi-drop local trades and national logistics with challenging driving conditions.
3. The potential to help the 36M vans operating in Europe today!

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Diesel engine oil case studies with innovative no-SAPS synthetic oils in new and aged engines and machinery

NEW CUMMINS X12 | FORD TRANSIT 2.0L ECOBLUE | CATERPILLAR 777E

Test Block (TB)					
WLTC	WLTC	FLDR	SS (0%)	WLTC	SS (5%)
23.3 km 0.5 hour	23.3 km 0.5 hour	185.5 km 5 hours	72.4 km 1 hour	23.3 km 0.5 hour	72.4 km 1 hour
400.2 km. 48.5 hours					

Mileage accumulation across matrix of selected drive cycles

Baseline (BS)
26.4 km. 0.5 hour

Performance evaluation

0W-30	TB.BS	TB x4. BS	TB x4. BS	TB x4. BS	TB x4. BS
6935.2km. 146.8 hours					

0W-30 + 75W	TB.BS	TB x4. BS	TB x2. BS	-
2880.6km. 60.9 hours				

Oil sample after every BS cycle

COMMENT:

1. WLTC – worldwide harmonised light vehicle test cycle
2. FLDR – fleet DNA Local Delivery Representative
3. Steady State – based on vehicle speed from both WLTC and FLDR
4. Test program designed to simulate typical LCV delivery business

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% FUEL ECONOMY IMPROVEMENT DATA

		Phase #1 (0→6935km)		Phase #2 (6935→9815km)
		NEOL 0W-30 @ 400 km	NEOL 0W-30 @ 6935 km	NEOL 0W-30 & 75W @ 9815 km
Baseline Cycle (Performance Eval.)	vs OEM-approved 0W-30	0.9%	**2.5%**	2.9-3.2%
WLTC (#1)		2.4%	**up to 4.85%**	4.55-5.0%
FLDR (25% into cycle)		-	up to 2.4%	up to 2.4%
Steady State (0% gradient)	vs NEOL 0W-30 @ 400km	-	up to 2.9%	up to 2.9%
Steady State (5% gradient)		-	up to 1.7%	up to 2.3%

CONCLUSION:

1. A rapid reduction in friction provides a quantifiable fuel saving benefit
2. Up to 4.85% FEI in WLTC
3. Lower friction and operating temperature in the gear box provides additional fuel saving performance

TECHNICAL CASE STUDIES FOR NO-SAPS DIESEL ENGINE OILS

Diesel engine oil case studies with innovative no-SAPS synthetic oils in new and aged engines and machinery

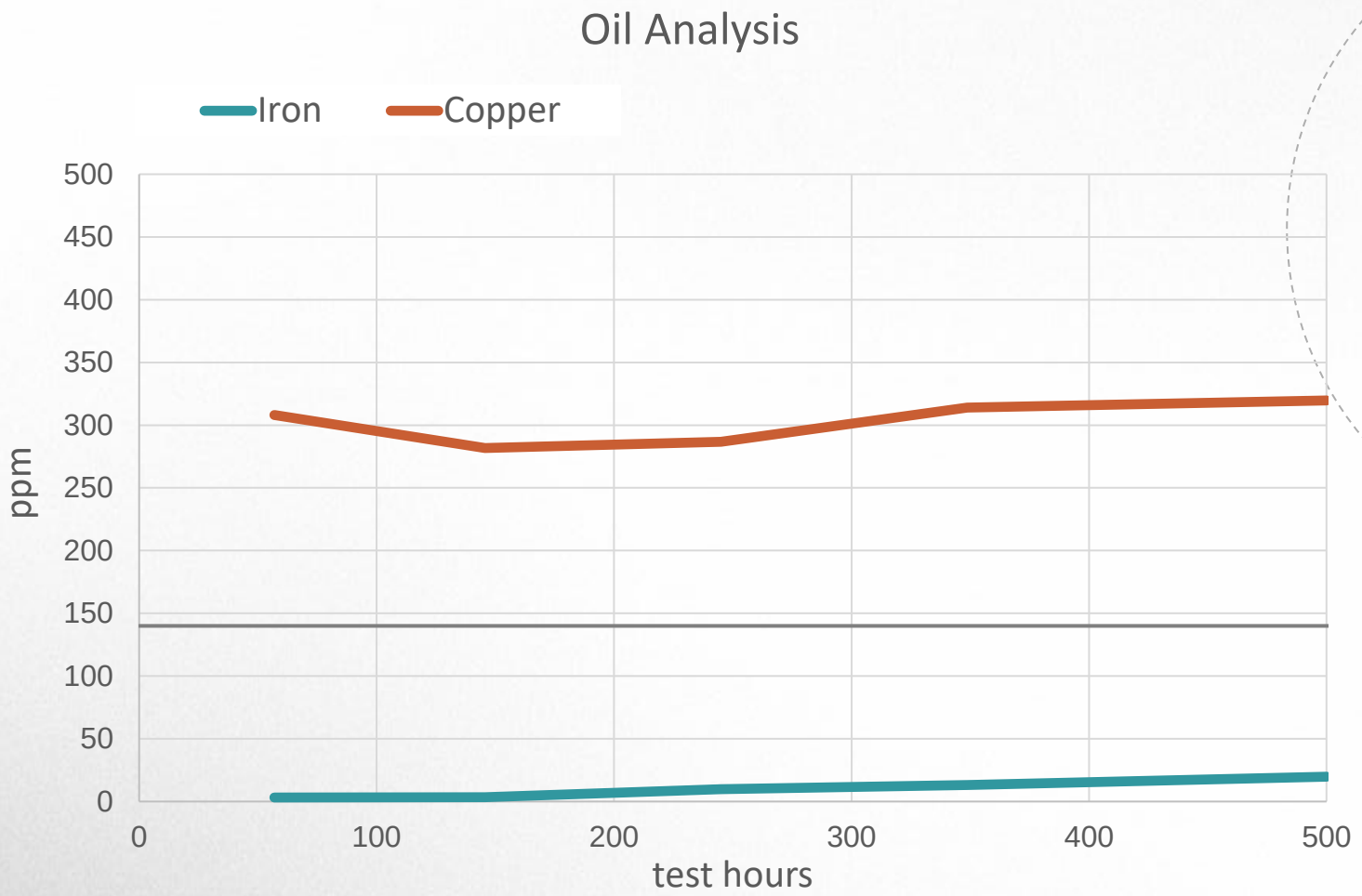
NEW CUMMINS X12 | FORD TRANSIT 2.0L ECOBLUE | CATERPILLAR 777E

- Three hard-worked Caterpillar 777E mine haul trucks
- Cat C32 engine: V12, 1000HP, 4700Nm
- 28,000-33,000 hours non-stop service = 55-65 standard ODIs! = ~7,000 litres of oil
- SAE 10W-40 versus global OEM-approved brand
- Inevitable wear and tear had deteriorated performance and fuel efficiency in harsh operating conditions
- 500-hour real-world field trial

CONCLUSION:

1. Protective copper film ‘flat-lined’ iron wear – 85% below limit
2. Effective solubilisation and removal of old immovable engine deposits
3. Rejuvenated operational performance and restored lost fuel efficiency

CAT 777E



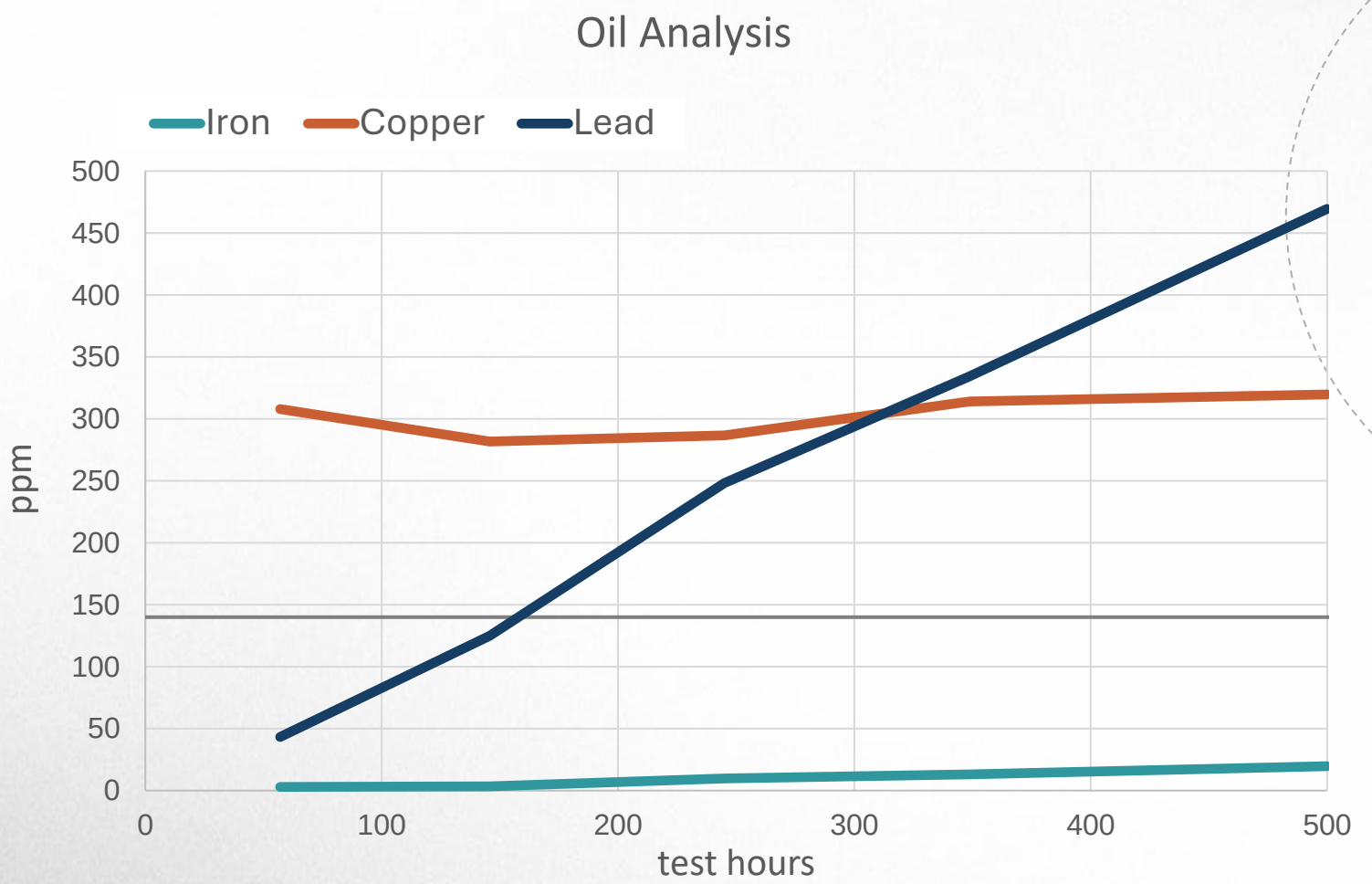
ANTI-WEAR

- Only 20 ppm iron @ 500 hours

COPPER COMPONENT

- Stable level during ODI
- Ultra-thin protective film

CAT 777E



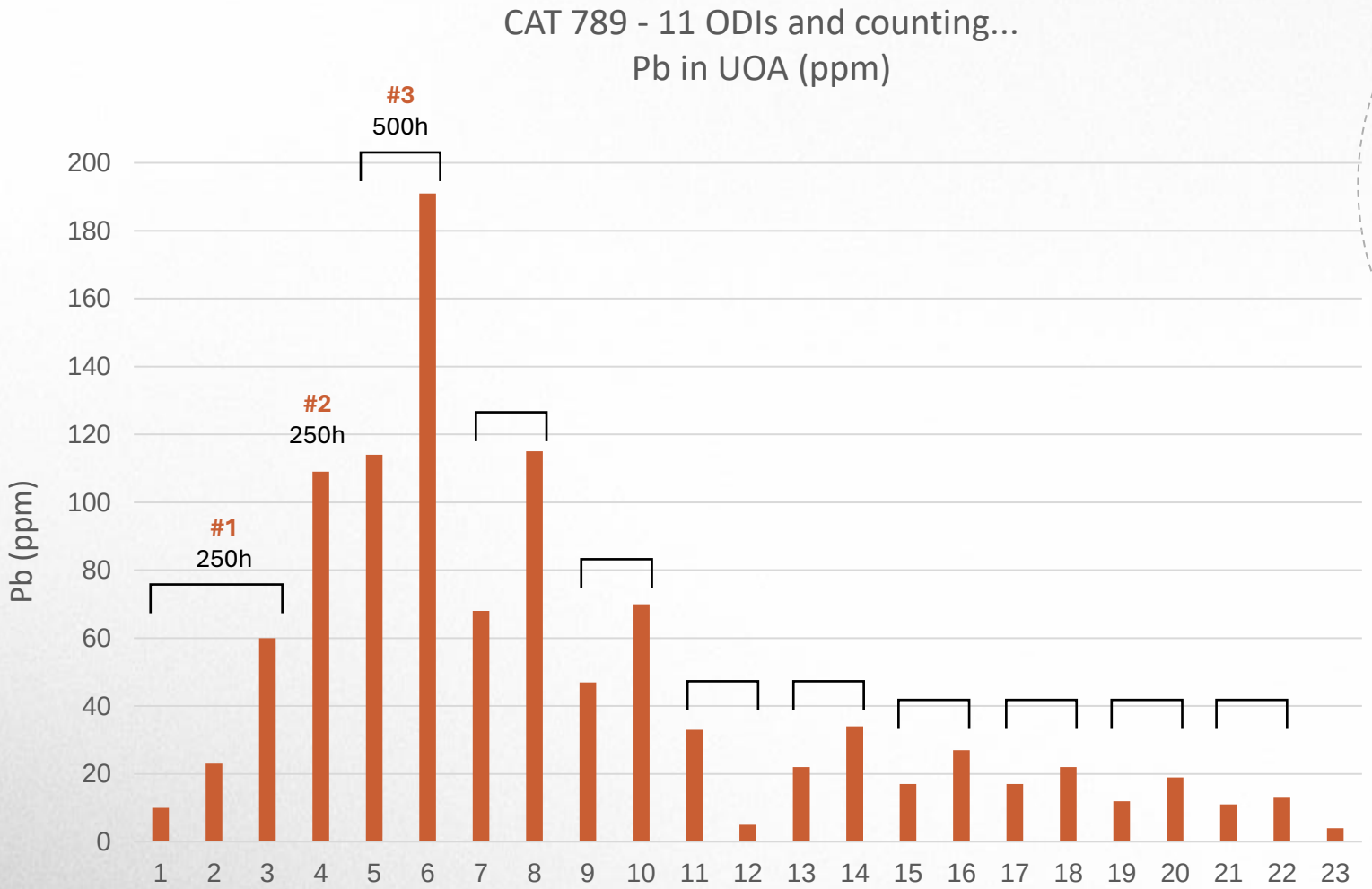
DETERGENCY

- Continuous removal of stubborn Pb-containing deposits

COPPER COMPONENT

- Stable level during ODI
- Ultra-thin protective film

CAT 777E → CAT 789



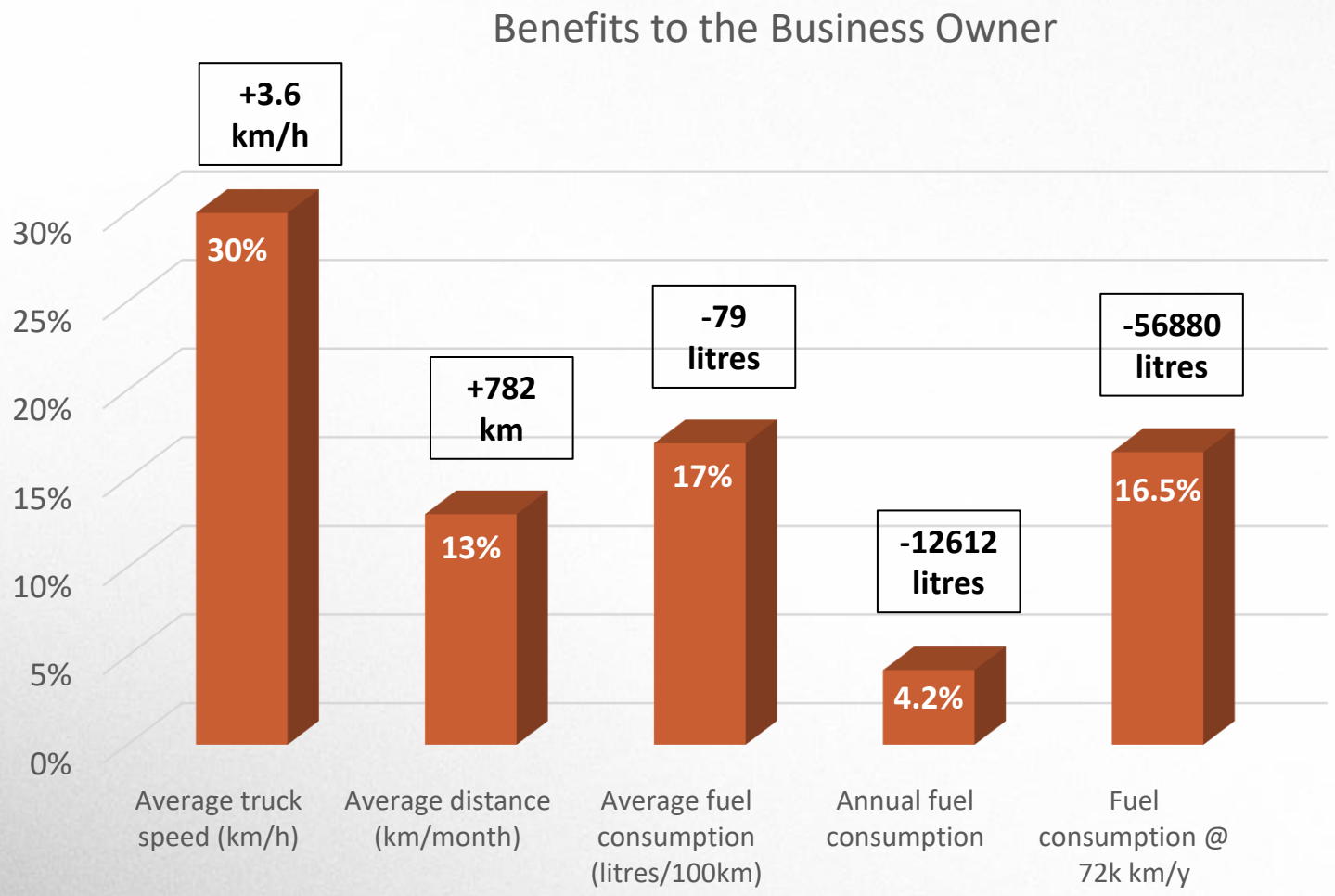
DETERGENCY

- Continuous removal of stubborn Pb-containing deposits

CAT 789 FIELD TRIAL

- With well-used dirty engines, the cleaning process takes place over multiple ODIs

CAT 777E



- Higher vehicle speed, less downtime, fewer stop-start events, less fuel
- *If* productivity target of 72,000 km/y, switching oil would save ~£82,000 per year per vehicle … *on fuel alone!*

  … and also, an instant impact in supporting climate change and preserving resources

Rejuvenated vehicle performance, productivity, and fuel efficiency

THE BENEFITS OF SUSTAINABLE LUBRICANT
PROTECTING THE VEHICLE PARC

	In-Service Diesel Engines	New Diesel Engines
Engine and After Treatment Device (ATD)		
Wear and tear	Repairs damaged surfaces (heals) and protects with an ultra-thin ionic Cu film	Protects against wear (friction↓, temperature↓, vibration↓)
Engine cleanliness	Cleans and keeps clean	Keeps clean
Fuel efficiency	Restores	Preserves (OEM design)
Aftertreatment systems	Extends service life	Prevents DPF blockage Prevents sensor & catalyst poisoning Extends in-use compliance
Environmental	Lower footprint. Low toxicity. Lower emissions. Biodegradability↑	
Financial	Reduces unplanned costly downtime. Longer service life. Reduced TCO. Business profitability	

Please contribute to this list via the Slido App

The Lubricant Industry can be the Hero!

All collective steps toward sustainability will make a significant impact towards climate and resource preservation

It's time for change **Neol** Innovative	29 63.546 **Cu** CuGlide™	New Chemistry **Tec** No-SAPS	Nature **Sc** It's Science!	Neol **D!** Disruptive!		
26 55.845 **Fe** Wears	1 1.008 **H** H-Wear	30 65.39 **Zn** No ZDDP!	Neol **Mf** Metal Film↑	Neol **Det** Detergency↑	Neol **Ct** Clean Tech!	Neol **Wr** No-Wear
Neol **KCl** Keep Clean↑	Neol **Fri** Friction↓	Neol **Rej** Rejuvenates!	Neol **Pow** Power↑	Neol **Spe** Speed↑	Neol **Fl** Fuel↓	Neol **Em** Emissions↓
Neol **Vib** Vibration↓	Neol **Noi** Noise↓	Neol **Prt** Protects!	Neol **LEx** Life Extension!	Neol **Pro** Productivity↑	Neol **Sus** Sustainable!	Neol **¥€$** Fuel Saver!

IT’S TIME FOR CHANGE!

neol
copper technologies

THANK YOU!