

A close-up, low-angle shot of a tire tread, showing the intricate patterns of the rubber. The tire is dark, and the background is a blurred, bokeh effect of light and dark spots, suggesting a road surface. A bright yellow rectangular box is superimposed over the center of the image, containing text.

Var det verkligen bättre förr?

Dagens nafteniska däcksoljor som ett bättre alternativ till gårdagens HA-oljor

*Kamyar Alavi, Nynas AB
Däckbranschdagen, 12 Dec 2018, Stockholm*

From a small national oil company to a global leader in specialist segments

- ▶ 1928 – Nynas builds the refinery in Nynäshamn and provides petrol
- ▶ 1950s – the economy recovers and Nynas' petrol station network grows
- ▶ 1960s – Nynas' bitumen business grows with the Swedish road network expansion
- ▶ 1970s – energy crisis makes oil prices skyrocket and crude supplies unreliable
- ▶ 1980s – Nynas sells all petrol stations and focuses on specialty products
- ▶ 1990s – investment in hydrotreatment technology starts to pay off and the export of specialty oils increases
- ▶ 2010s – growth through acquisition of the Harburg refinery

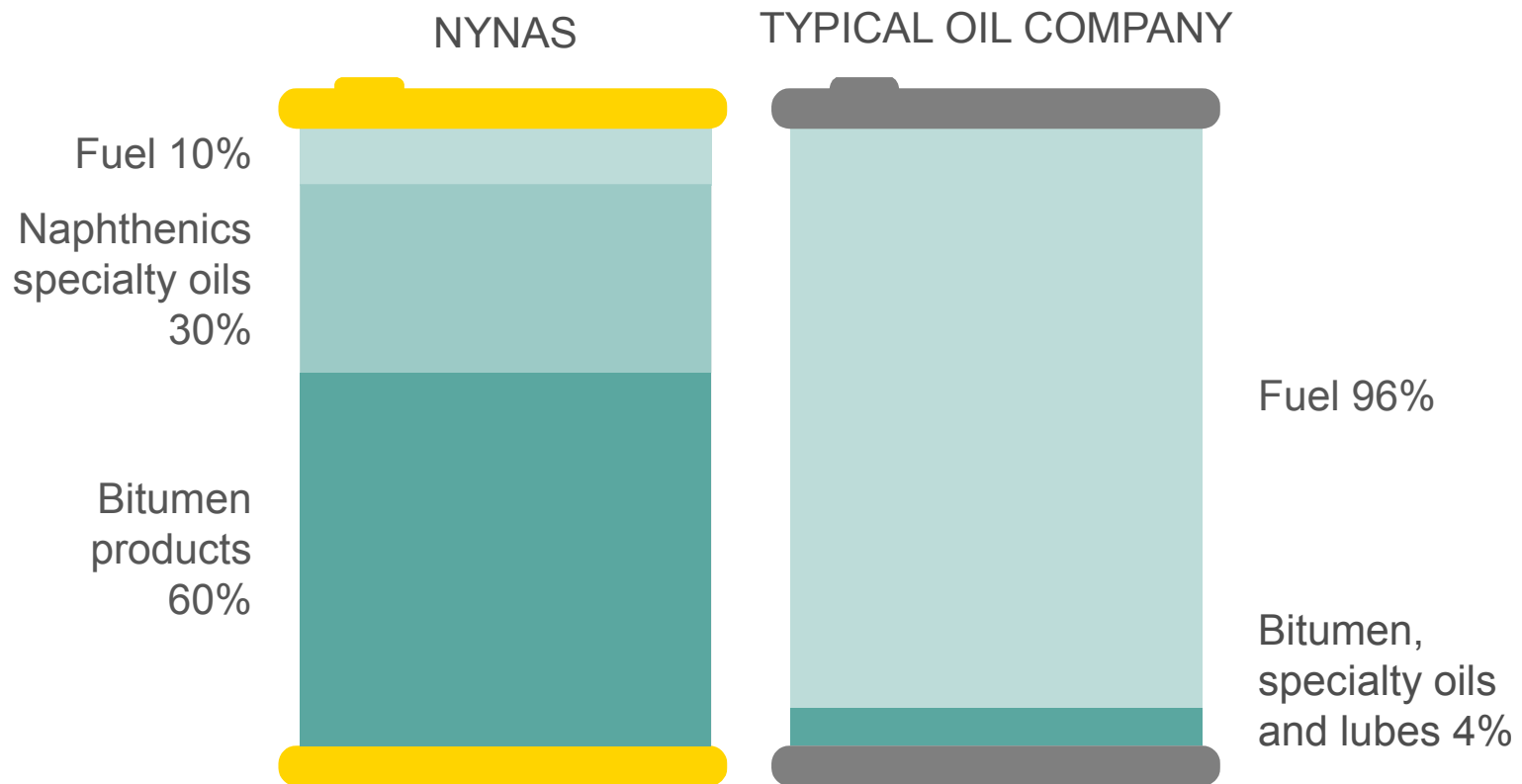


En vital 90-åring



We make the most of oil

– instead of burning it, we work together with our customers to transform oil into valuable products and applications.



Naphthenics: A world of possibilities





Nynas – Nynashamn Refinery

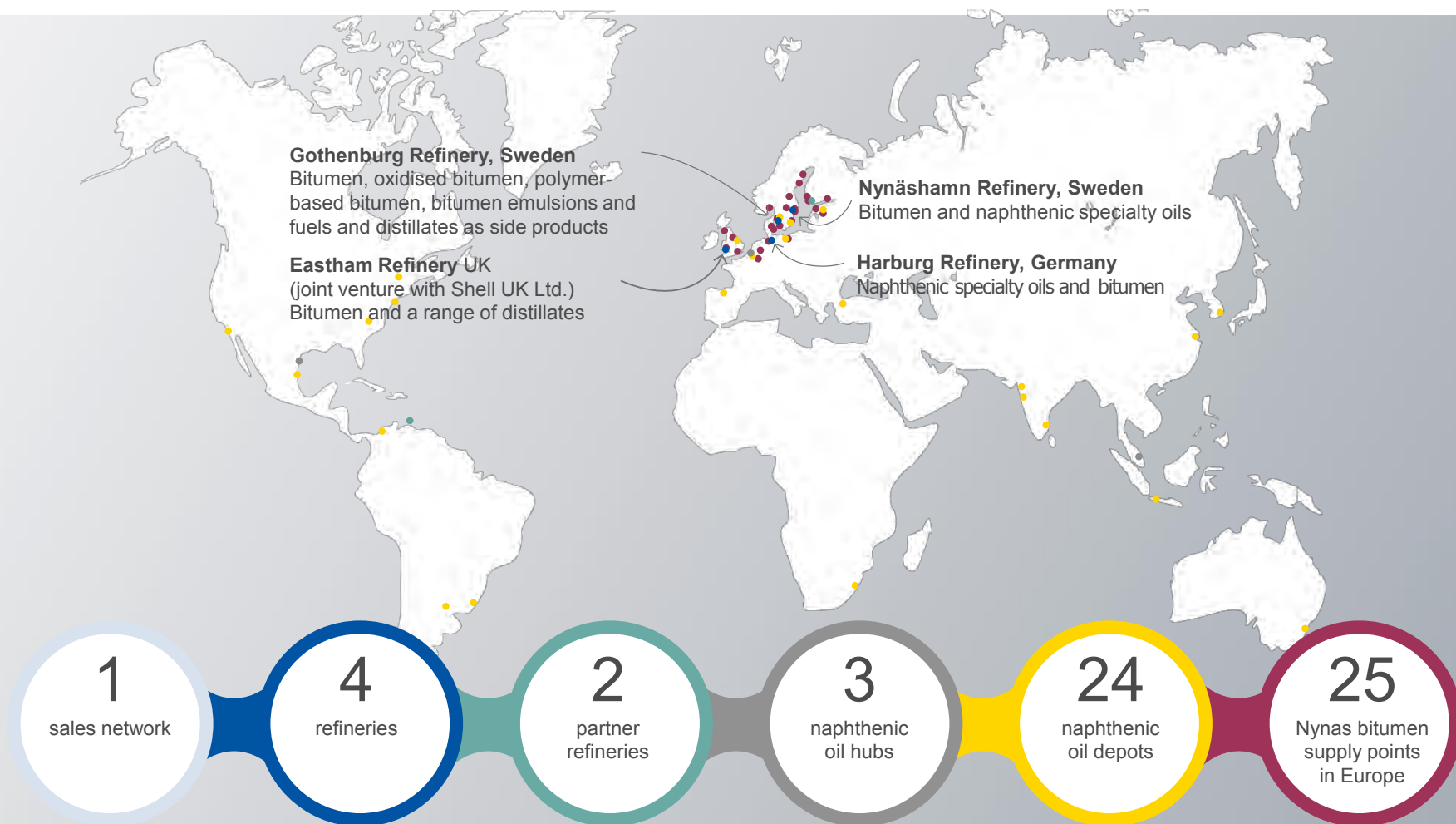




Nynas – Harburg Refinery South



Strategically placed to serve customers



A dedicated workforce of 1,000+

- ▶ Global company with a personal touch
- ▶ Diverse workforce from different countries and cultural backgrounds
- ▶ Specialised career paths, apprentice programme and leadership development
- ▶ Living the Core Values: Dedication, Cooperation and Proactivity



NYNAS in Tyre & Rubber Market

Meet Nynas TYR Team

- ▶ TYR = Tyre, Rubber & TPE
- ▶ Dedicated marketing and R&D team
 - 2 Sr Advisors, PhD level
 - Market manager, PhD
 - Highly recognized industry expert joining in 2015
 - 2 Dev Engineer, MSc



Dr Mika Lahtinen
Tech Manager



Dr Kamyar Alavi
Sr Tech Advisor



Patrik Salomonsson
Dev Eng



Emma Öberg
Dev Eng



Dr Herbert Fruhmenn
Market Manager

Nynas R&D for the industry

- ▶ Rubber lab 2017
 - All compounding studies before done at DIK in Germany

- ▶ R&D focused on tyre & rubber industries
 - EPDM
 - ESBR
 - Impact of vulcanising additive on process & properties
 - Oil-extended ESBR → ESBR 1753 vs competition
 - Impact on mixing time
 - *NR & conveyor belt applications*
 - SSBR
 - F-SSBR
 - Multivariate analysis approach to compound development
 - Real tyre tests
 - New product development
 - Chloroprene Rubber

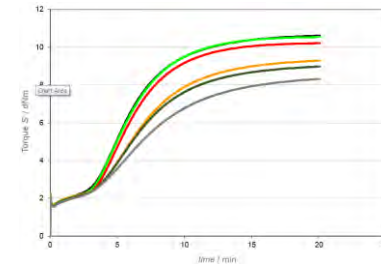


List of selected studies

Study	Application	Benchmark oils	Nynas Oils	Outcome / Benefits
ESBR/SSBR/BR	Tyres	DAE, RAE, TDAE	NYTEX® 4700; 840, 846, 832	Lower rolling resistance
ESBR/NR	Rubbers	DAE	NYTEX® 4700	Lower heat build-up
Impact mixing time	General	TDAE/RAE	NYTEX® 4700, 840	More efficient mixing process
Multivariate analysis	General / Tyre	DAE, RAE, TDAE	NYTEX 4700	Compound design & trouble-shooting
Real Tyre Tests	Tyre	RAE, TDAE	NYTEX® 4700, 840	Confirmation low rolling resistance & Good grip
Chloroprene	Rubbers	DAE, DOP	NYTEX® 810; 820	Higher performance than DAE
EPDM	Rubbers	SN600, Brightstock	NYTEX® 840, 846 & NYFLEX® Range	Faster process; Low OOH consumption

Nynas Rubber Lab capabilities

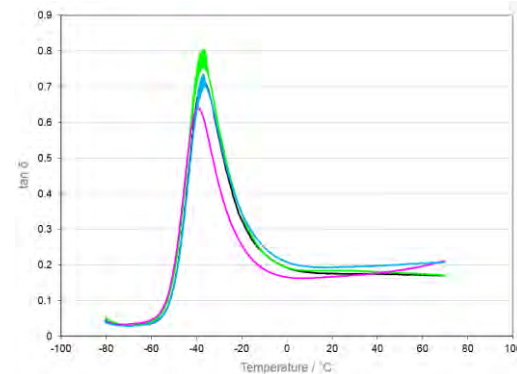
Processing properties



Mechanical properties and ageing performance



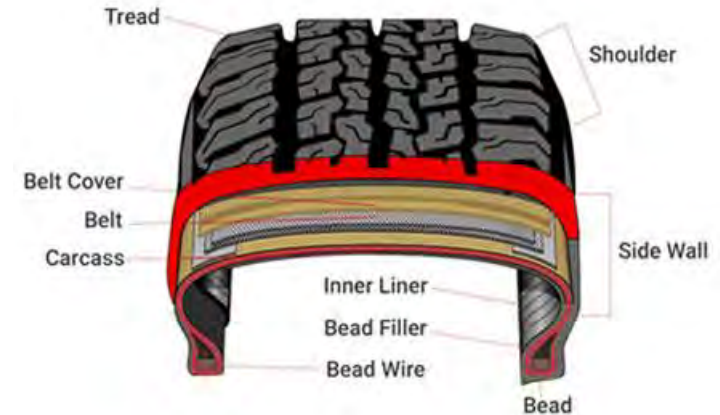
Dynamic properties and elastic recovery



Tyre: A complex construction

► Multiple part construction

- Rubber parts
 - Tread
 - Subtread
 - Sidewall
 - ...
- Non-rubber parts
 - Plies
 - Belts
 - Cords
 - Bead
 - All non-rubber parts also covered with rubber



Picture courtesy of MRF Tyres

► Rubber oil materials in a car (PC)

- Tyres
 - Ca 40 kg rubber
 - Ca 2,5 kg oil
- Non-tyre rubbers
 - Ca 30 kg oil
 - Ca 5 kg oil



Where does the oil come in

► Simplified rubber formulation

- Polymer
- Filler
- Plasticising oil
- Curing chemicals
- Additives

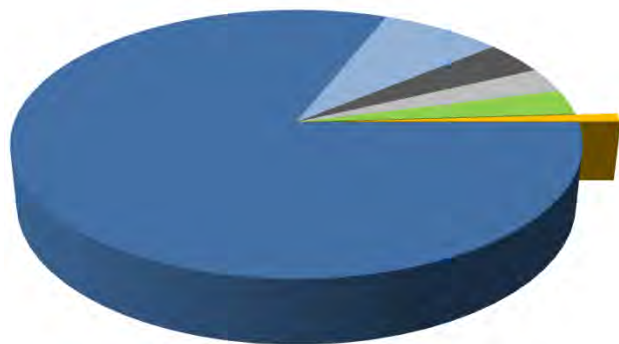
► Impacts of the oils

- Compound & Process design
 - Viscosity / Handling
 - Process speed
- Static material properties
 - Tensile
 - Hardness
- Dynamic material properties
 - Related to tyre performance
 - Grip & Fuel economy

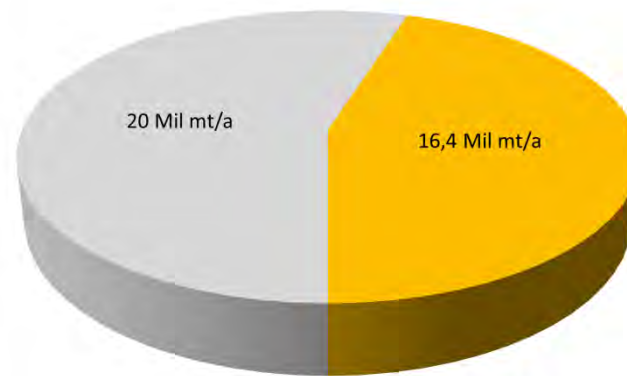
► Not a processing aid but a key component



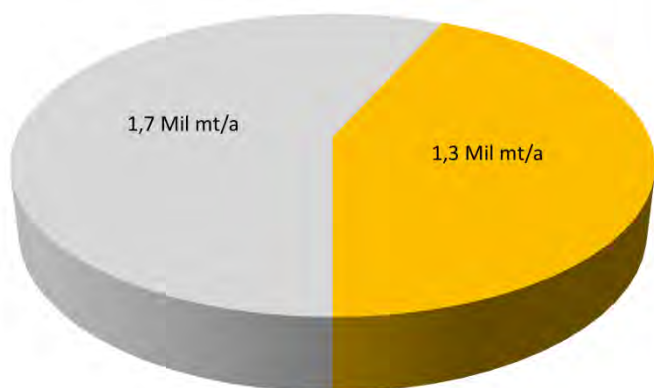
Global oil consumption



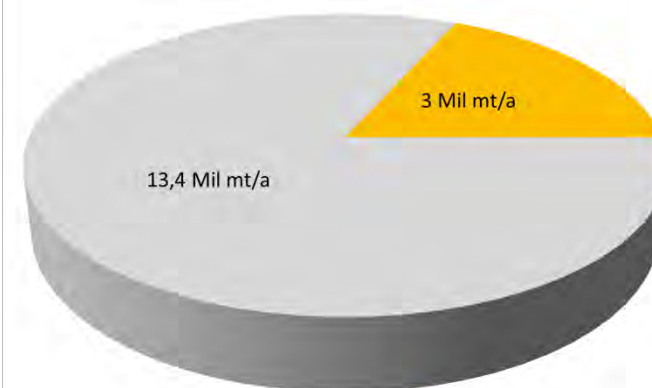
Fuels: 81%
 Gas: 8%
 Coke: 4%
 Bitumen: 3%
 Chemical feedstocks: 3%
 Lubricants: 1%



Automotive Industrial



Other Rubber Oils Tyre Rubber Oils

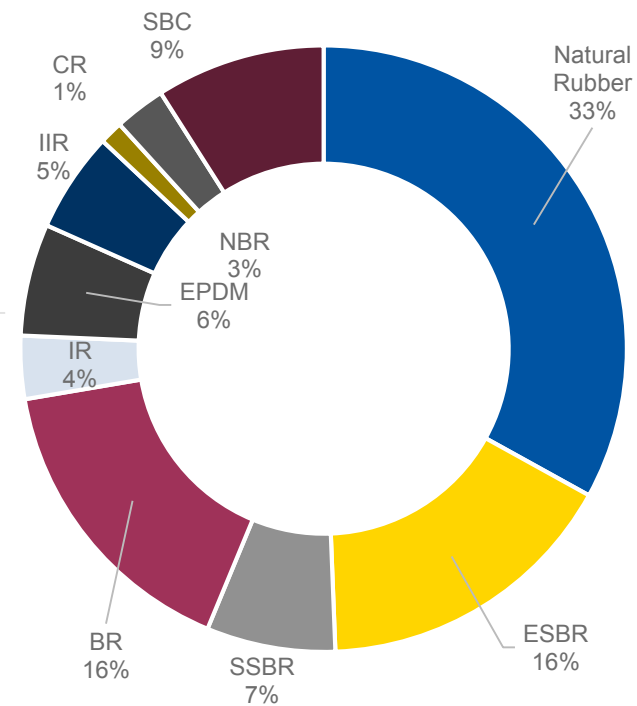
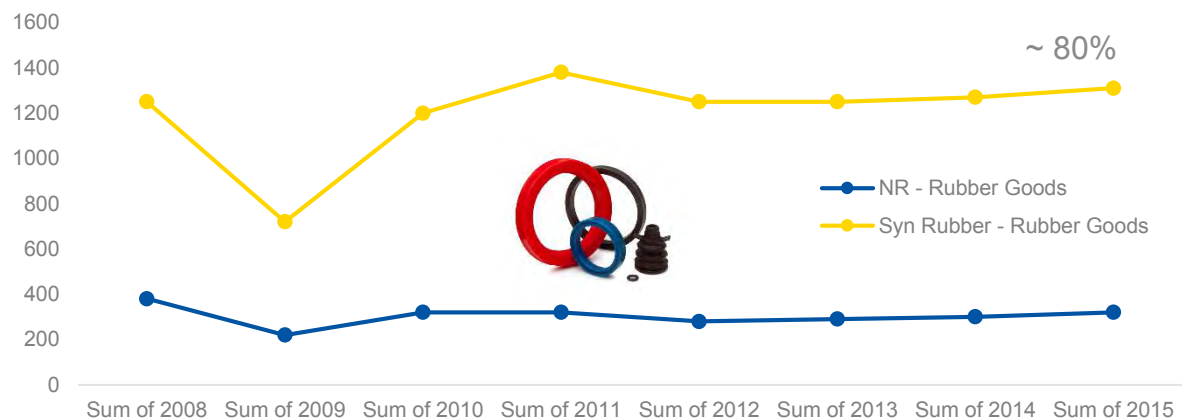
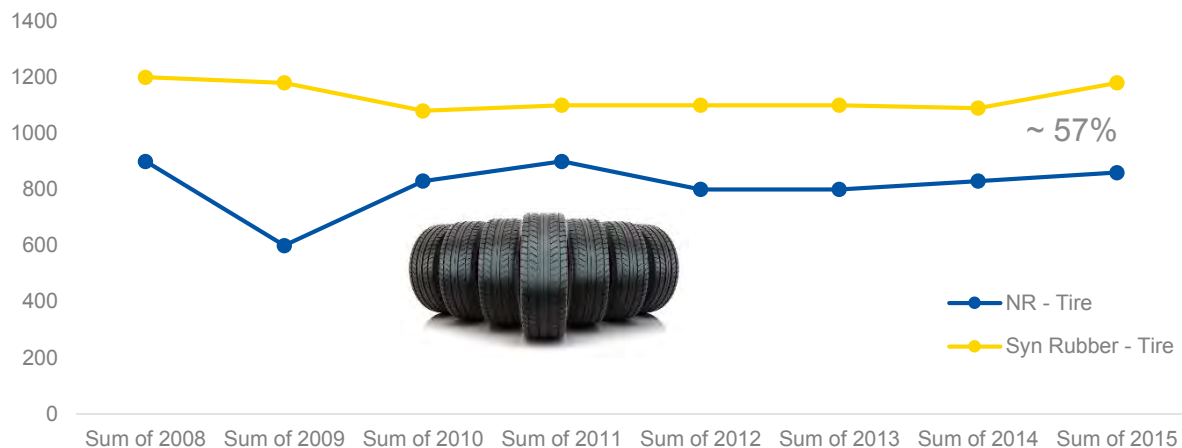


Other Industrial applications Rubber Process oils

Rubber process oils: ca 0.082% of total oil consumption
Tyre oils: ca 0.035% of total oil consumption

Sources:
 Nynas Internal research
 Kline

Type of Rubbers used: volumes in tyre and industrial rubber



Source:
ETRMA, IISRP

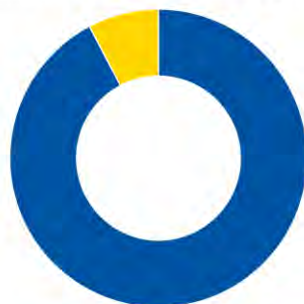
Rubber vs Oil in Compound

Typical Rubber Formulations

Component (phr)	SBR/NR/BR	EPDM
Polymer	100	
Filler black	5-100	50 - >100
Filler white	0-100	0 - >100
Oil (Estimated average)	5-40 (10)	50->>100 (100)
Other Rubber Chemicals (phr)	As needed	

Polymer Type

Calculated relative market share



■ SBR/NR/BR ■ EPDM

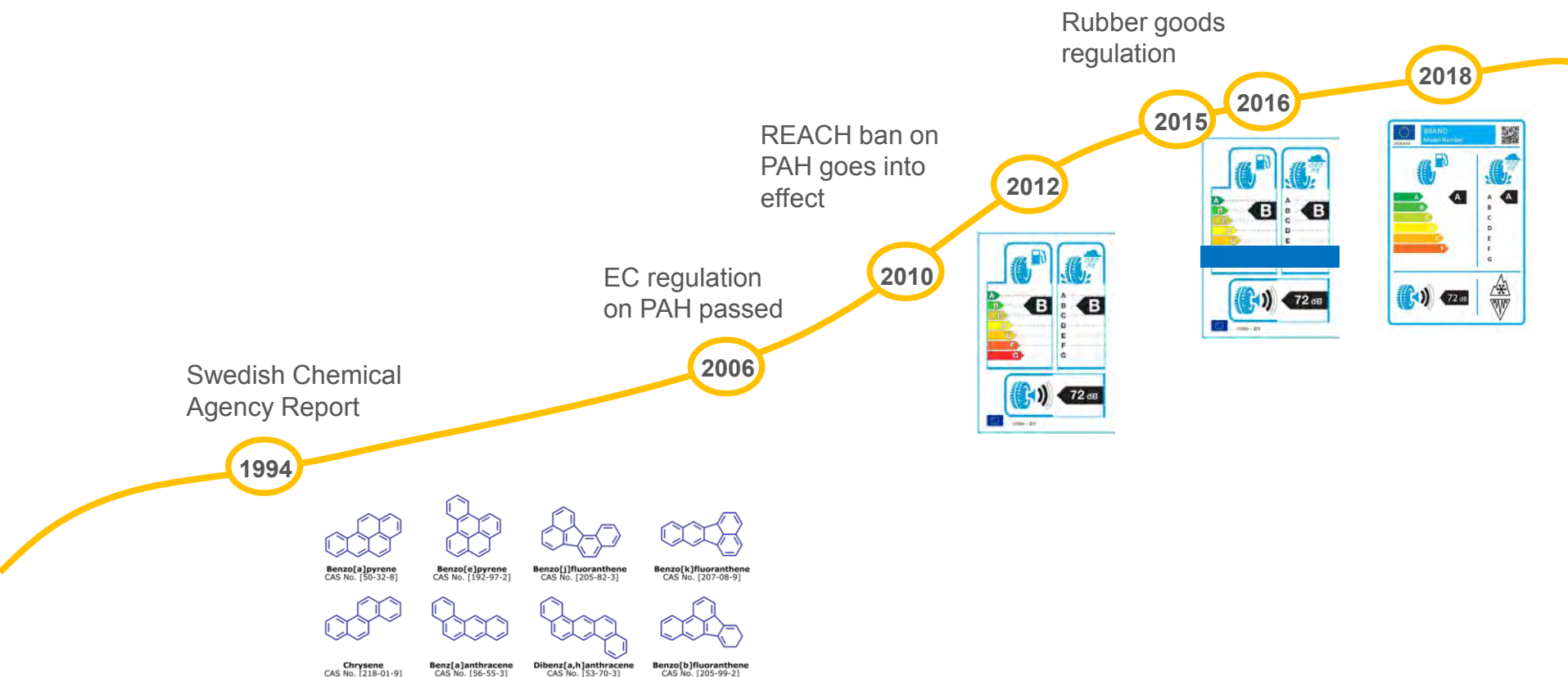
Plasticiser type

Estimated relative market share



■ SBR/NR/BR ■ EPDM

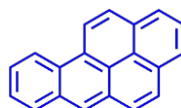
Paradigm shift: Low PAH Oils for Tyre & Rubber



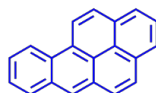
1907/2006/EC (REACH), Annex XVII, Entry 50



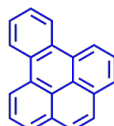
- ▶ Extender oils shall not be placed on the market, or used for production of tyres or parts of tyres if they contain:
- ▶ more than **1 ppm** of
- ▶ or, more than **10 ppm** of the sum of all listed PAHs



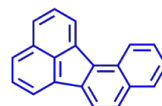
Benzo[a]pyrene
CAS No. [50-32-8]



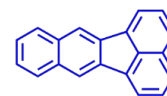
Benzo[a]pyrene
CAS No. [50-32-8]



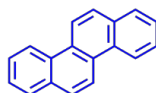
Benzo[e]pyrene
CAS No. [192-97-2]



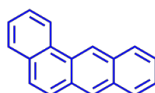
Benzo[j]fluoranthene
CAS No. [205-82-3]



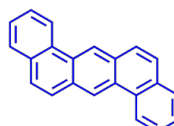
Benzo[k]fluoranthene
CAS No. [207-08-9]



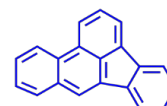
Chrysene
CAS No. [218-01-9]



Benz[a]anthracene
CAS No. [56-55-3]



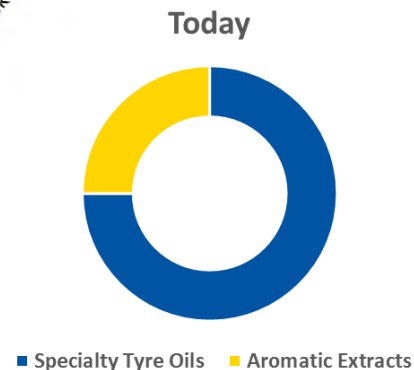
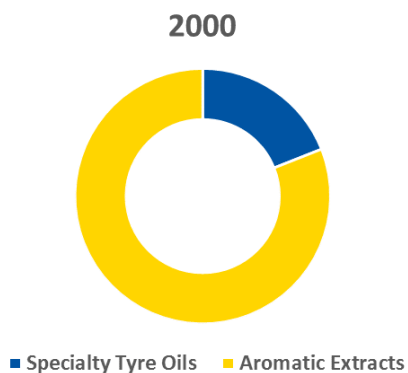
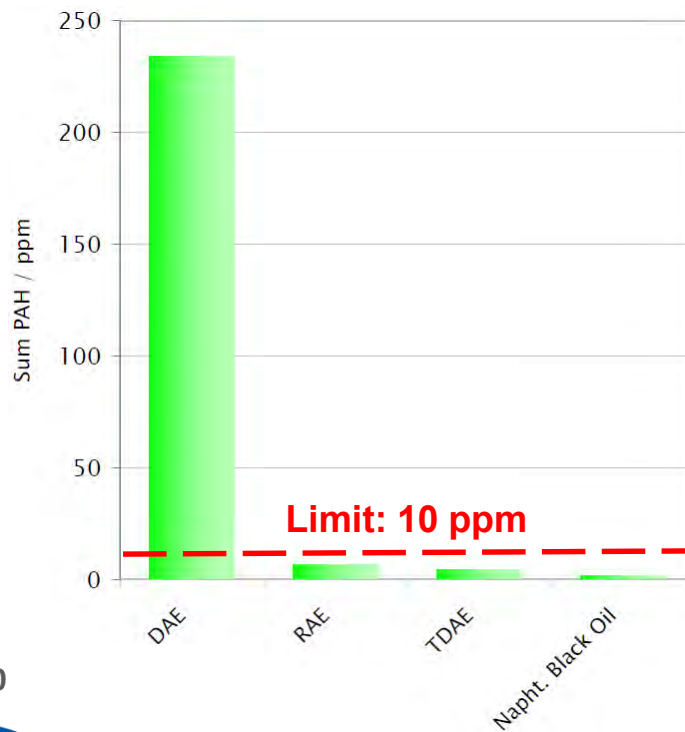
Dibenz[a,h]anthracene
CAS No. [53-70-3]



Benzo[b]fluoranthene
CAS No. [205-99-2]

“New” quantification Method:
EN 16143:2013

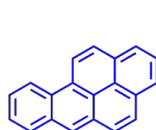
Why the ban on aromatic extracts?



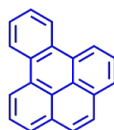
Amendment to REACH “tyre oil” regulation



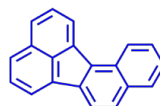
- Articles shall not be placed on the market for supply to the general public, if any of their **rubber or plastic components** that come into **direct as well as prolonged or short-term repetitive contact** with the human skin or the oral cavity, under normal or reasonably foreseeable conditions of use, contain more than **1 mg/kg (0.5 mg/kg for toys)** of any of the listed PAHs.



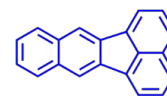
Benzo[a]pyrene
CAS No. [50-32-8]



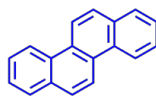
Benzo[e]pyrene
CAS No. [192-97-2]



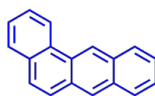
Benzo[j]fluoranthene
CAS No. [205-82-3]



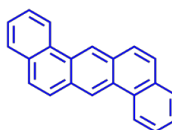
Benzo[k]fluoranthene
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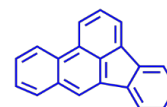
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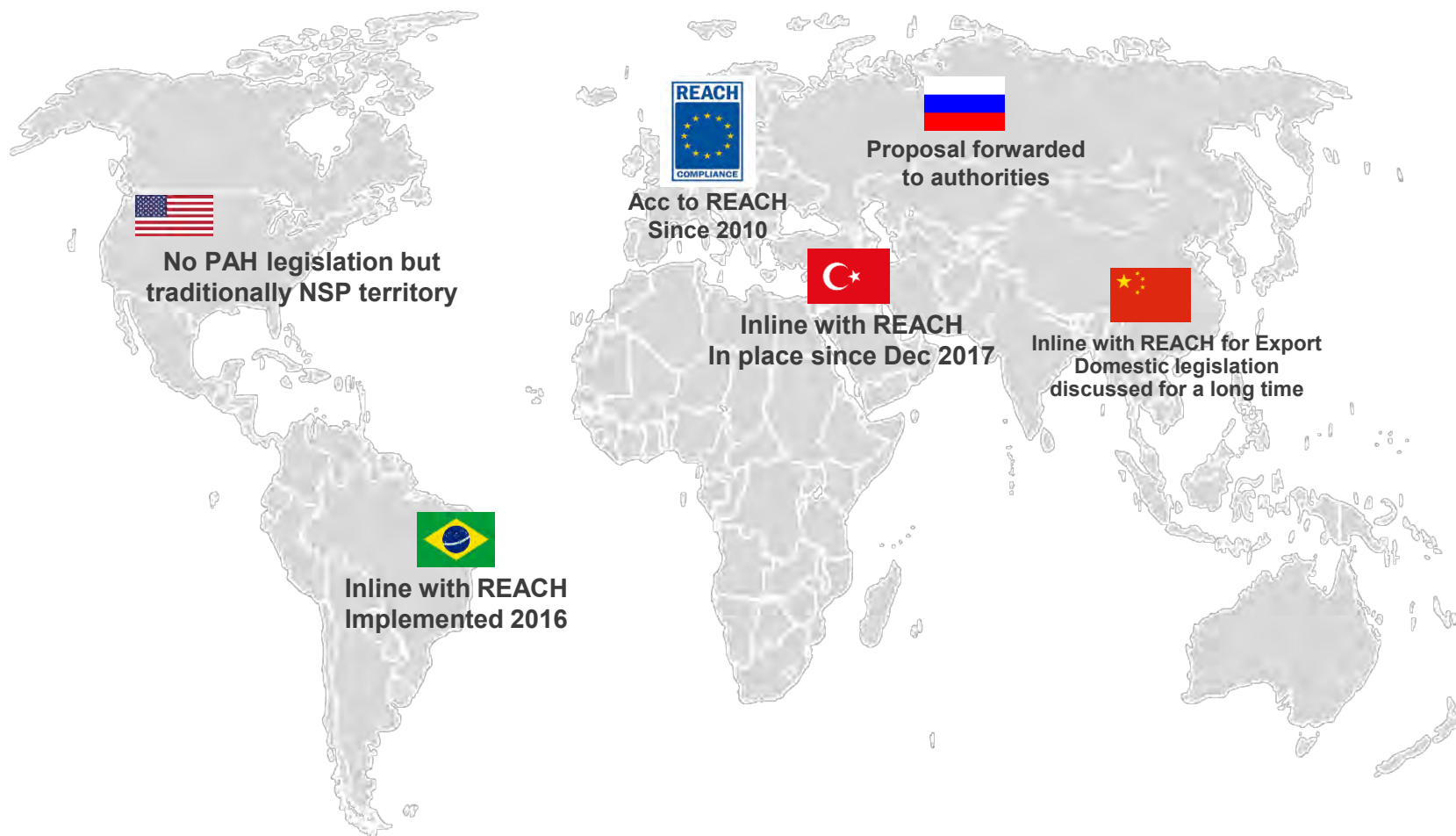
Dibenz[a,h]anthracene
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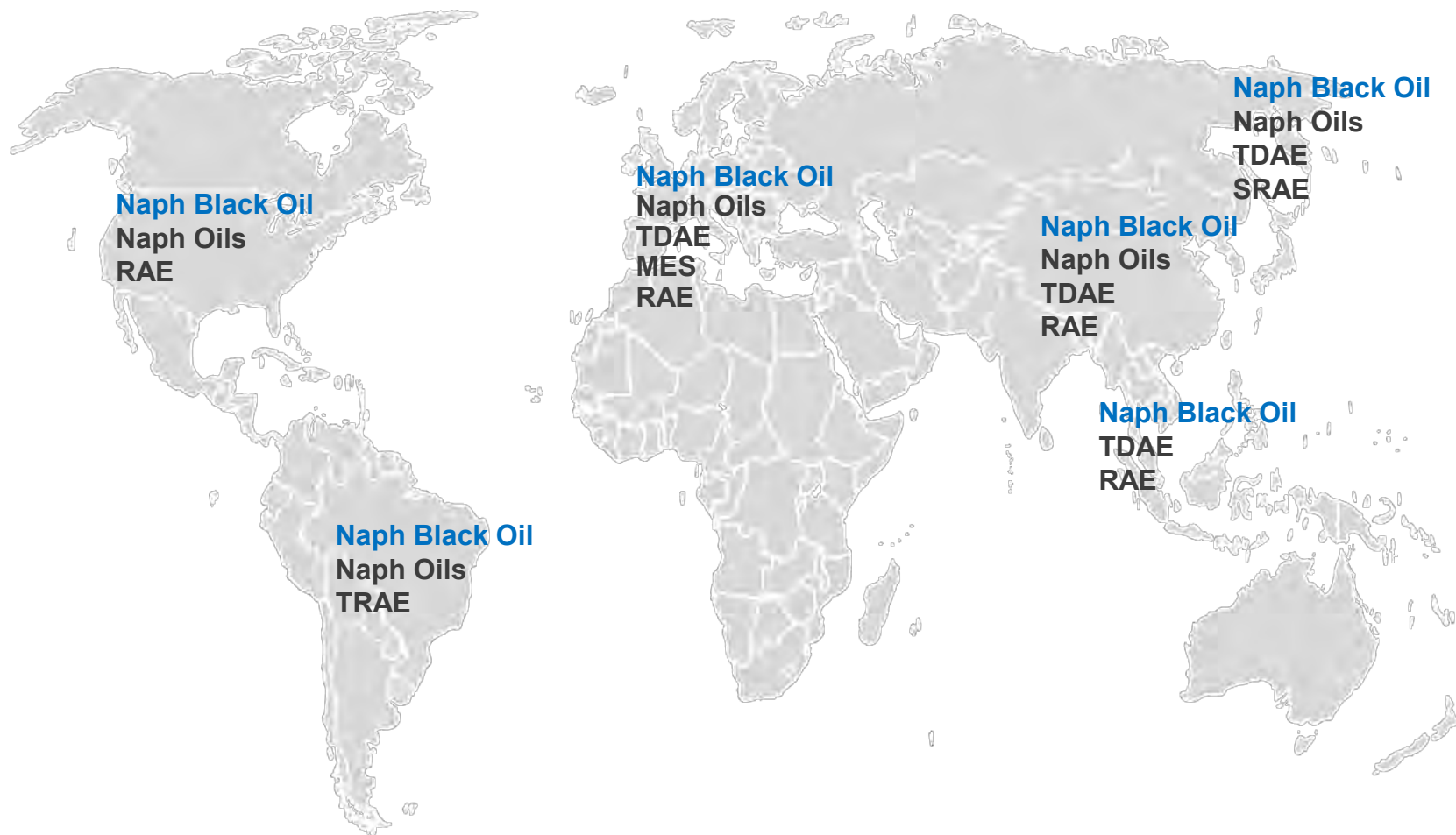
Benzo[b]fluoranthene
CAS No. [205-99-2]

From Dec 27,
2015

PAH regulation: A global overview



Map of DAE replacement



A true paradigm shift

- ▶ European legislation but global impact
 - Export markets adapting to the REACH legislation
 - National & regional regulations increasingly introduced

- ▶ Impact spreading to other industries
 - Technical rubber industry
 - Lubricant industry
 - Generally higher focus on PAH and their health effects

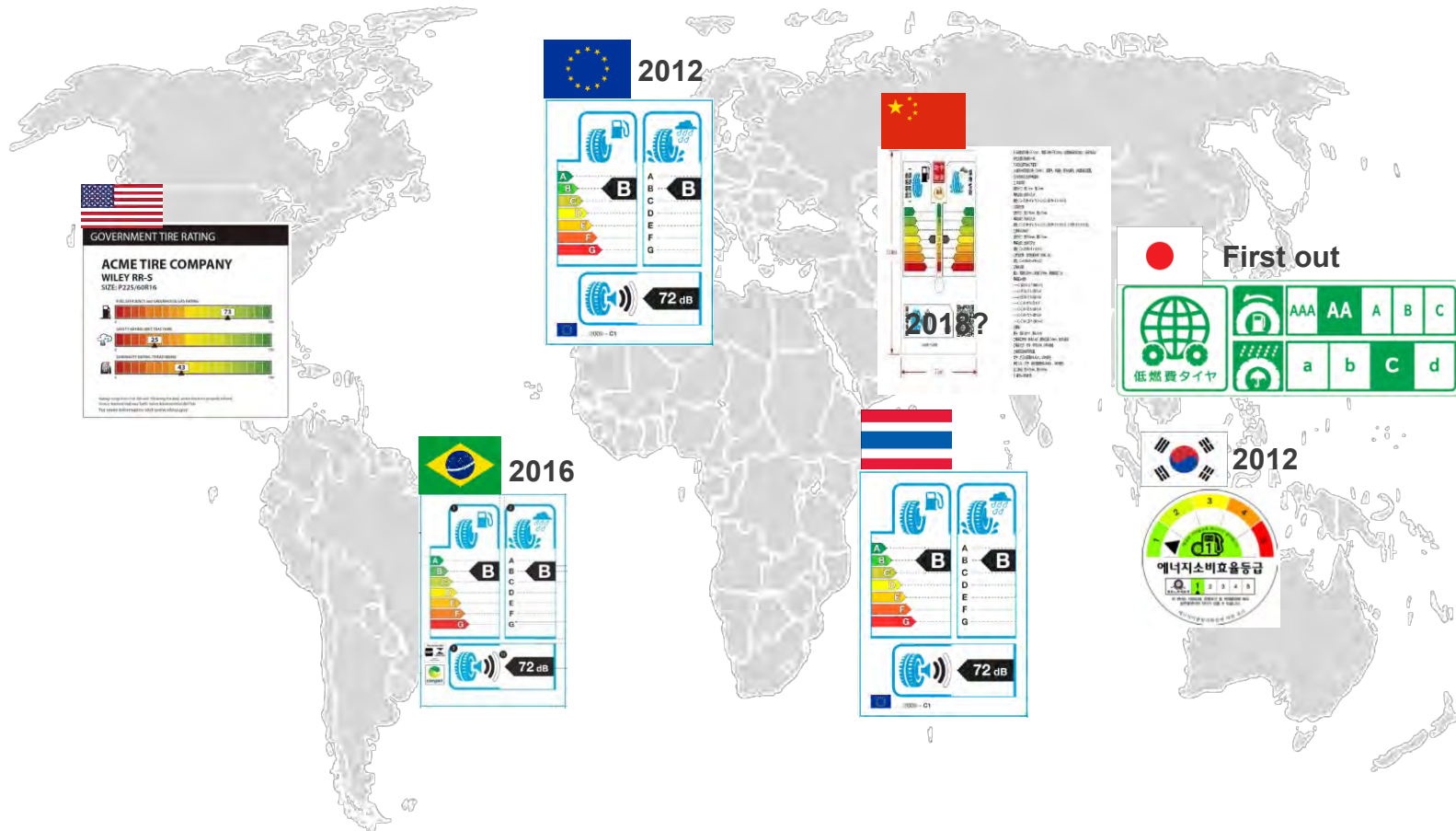
- ▶ Higher complexity in the industry
 - From single component to multiple choice
 - Conversion to different tyre oil regimes



Nynas in tyre oil market: A longterm partner



Consumer Tyre Labelling

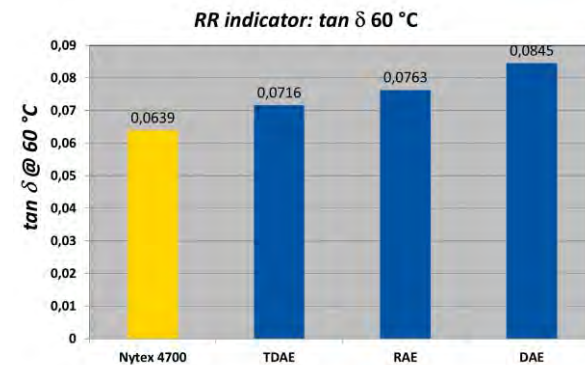
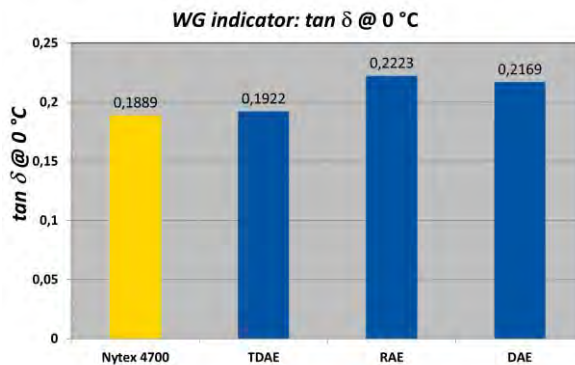
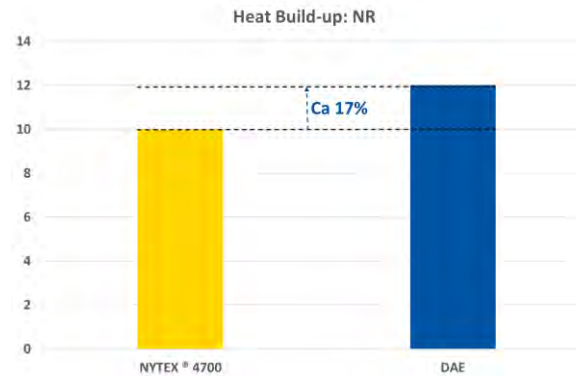


- ▶ Japan first out but EU influencing other regions
 - More and more countries are considering
- ▶ Traction and fuel economy common denominators
 - Wear additional in the US

How we contribute

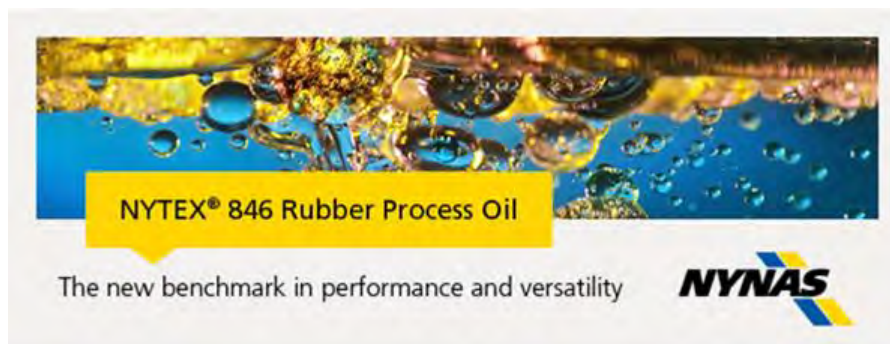


Application studies



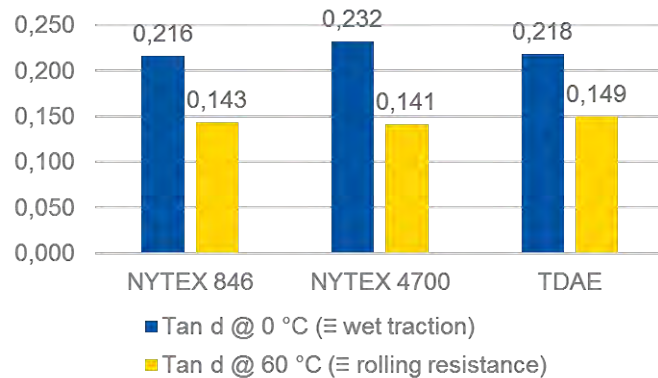
- Understanding our customers' applications and their needs
- Fact-based observations relevant for the industry

Product development



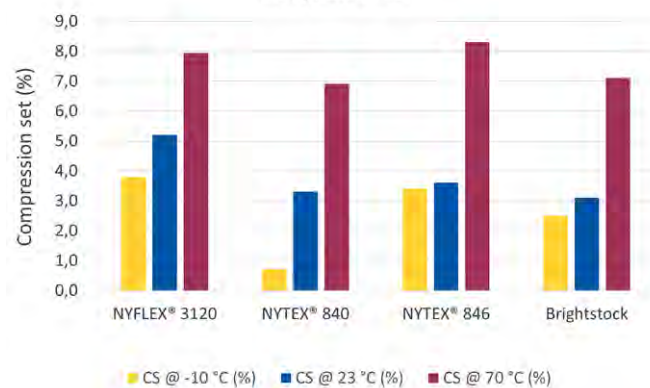
SSBR/BR: Tyre

Dynamic properties at 0°C and 60°C

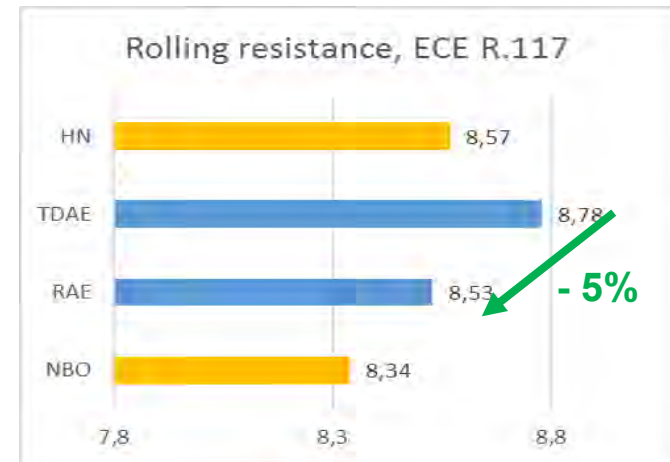
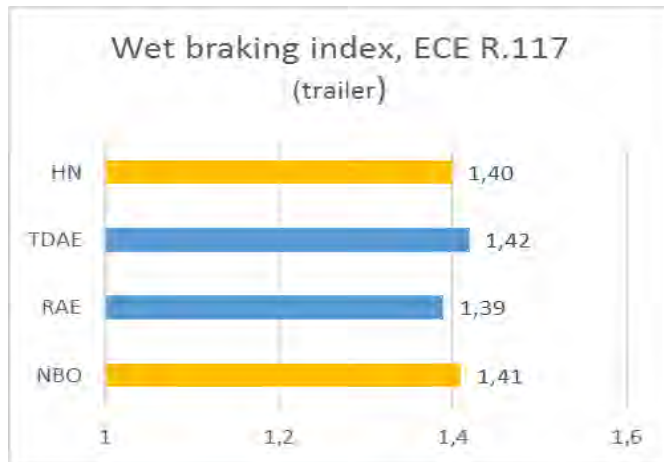


EPDM: Rubber

Compression Set



Real application tests: Summer tyres



- ▶ Real tyre testing program on wet braking and rolling resistance
 - Wet grip index → The higher the better
 - Rolling resistance → The lower the better
 - HN = NYTEX® 840
 - NBO = NYTEX® 4700
- ▶ Advantages observed in model compound studies confirmed in reality as well

Converting results into effect

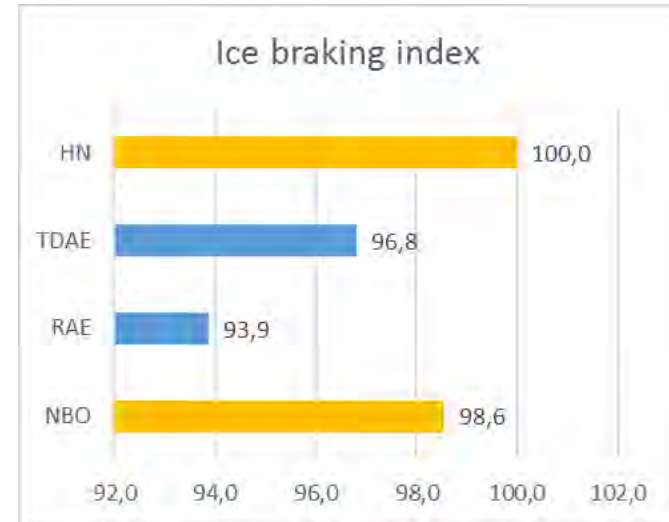
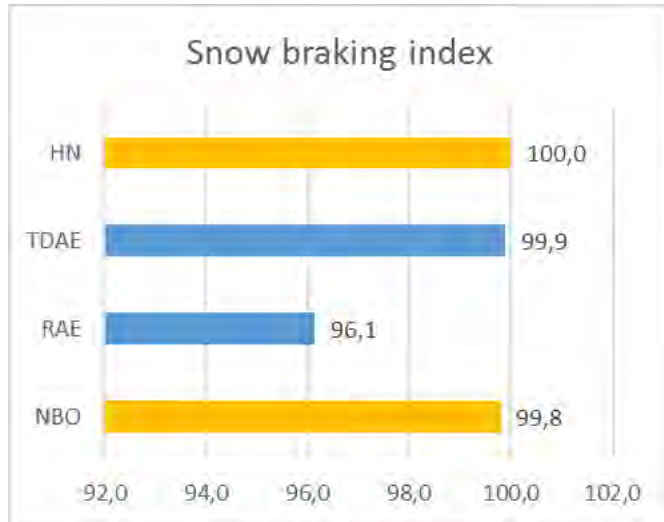
- ▶ 5 % lower RRC \approx 1 % higher fuel efficiency
- ▶ Estimated annual mileage \rightarrow 300 000 km
- ▶ Estimated fuel consumption \rightarrow 35 l / 100 km
- ▶ Fuel cost \rightarrow 1.5 € / l
- ▶ Average annual savings:
 - 1 truck \approx 1 600 €
 - Fleet of 50 trucks \approx 79 000 €
- ▶ Environmental savings \rightarrow Priceless



Picture courtesy of Scania



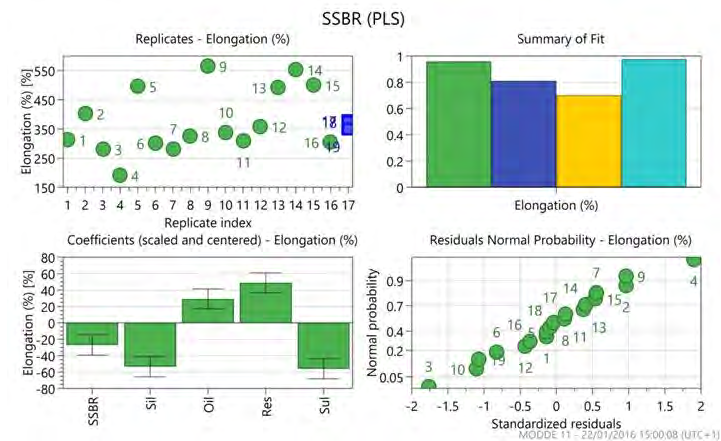
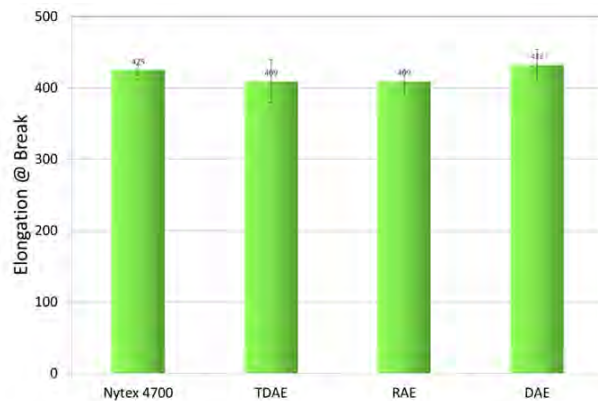
Real application tests: Winter tyres



- ▶ Snow & ice performance tests on real tyres
 - Higher value indicates higher performance
- ▶ Tests carried out at Mellanaava Proving Ground, Fi

A level deeper

Traditional vs Multivariate analysis



- ▶ Underlying fundamentals for observed behaviour in application
- ▶ How to convert that to added value for the application

Preparing for a sustainable future

- ▶ Commitment to sustainable tyre & rubber oil development
- ▶ Ongoing investigations on different routes
- ▶ Solutions for different parts of the industry under study
- ▶ Initial interesting results obtained



Nynas in Tyre & Rubber Industry at a Glance

▶ Tyre Industry

- ▶ Low PAH oils tyre oils in complete fulfilment with the REACH regulation
- ▶ High compatibility & performance in compounds used in the tyre industry
- ▶ Consistently lower rolling resistance combined with on-par wet grip behaviour
- ▶ Wide product range offering degree of freedom in compound design

▶ Rubber Industry

- ▶ Wide range of compatibility covering low to medium high polarity rubbers
 - ▶ EPDM, SBR/NR, CR
- ▶ Offering low PAH rubber oils for further replacement of highly aromatic oils
- ▶ Offering an alternative to fill the gap in the process oil market

▶ General

- ▶ Dedicated team with state of the art technical facilities
- ▶ R&D driven with a focus to address customers' needs



Nynas tyre oils compatibility guide

Applications	NYTEX® 810	NYTEX® 820	NYTEX® 8150	NYTEX® 832	NYTEX® 840	NYTEX® 846	NYTEX® 4700
Summer treads	●	●	●	●●	●●	●●	●●
Winter / All-Season Treads	●●	●●	●●	●●	●●	●●	●●
NR truck treads	●●	●●	●●	●●	●●	●●	●●
Carcass compounds	●●	●●	●●	●●	●●	●●	●●
Coloured sidewalls	●●	●●	●	●	●	●	○
Innerliners	●●	●●	●●	●●	●●	●●	●●
Butyl innertubes	●●	●●	●●	●●	●●	●●	●●
TBR/OTR tyres	●●	●●	●●	●●	●●	●●	●●
Solid tyres	●●	●●	●●	●●	●●	●●	●●
Banbury mixer dust-stop oil	○	●	●	●●	●●	●●	●●
Polymers							
Natural Rubber	●●	●●	●●	●●	●●	●●	●●
SBR, high styrene (>30% styrene)	●	●	●	●●	●●	●●	●●
SBR, medium and low styrene	●●	●●	●●	●●	●●	●●	●●
BR	●●	●●	●●	●●	●●	●●	●●
CIIR/BIIR	●●	●●	●●	●●	●●	●●	●●
IIR	●●	●●	●●	●●	●●	●●	●



Highly recommended for the application



Recommended for the application



Not recommended for the application

Nynas' recommendations are based on own investigations using industry standard formulations and results may vary in customer specific formulation. Nynas does not warrant the performance in any customer specific formulation. For further information, contact Nynas sales personnel.

Nynas rubber oils compatibility guide

	Nynas Product	SBR	NR	BR	CR	IIR	XIIR	EPDM (S)	EPDM (OOH)	Mixer Lubricant
Hydrotreated Naphthenic Process Oils High compatibility with polar rubber types	NYTEX® 810	●●	●●	●●	●●	●●	●●	○	○	○
	NYTEX® 820	●●	●●	●●	●●	●●	●●	●	○	○
	NYTEX® 8150	●●	●●	●●	●	●●	●	●	○	●●
	NYTEX® 832	●●	●●	●●	○	●●	●	●	○	●●
	NYTEX® 840	●●	●●	●●	○	●●	●	●●	●	●●
	NYTEX® 846	●●	●●	●●	○	●●	●	●●	●	●●
Naphthenic Black Process Oil (NBO) Low-PAH naphthenic black oil for various rubber applications	NYTEX® 4700	●●	●●	●●	●●	●●	●●	●	○	●●
3000 Series Process Oils Designed for EPDM	NYFLEX® 3120	○	○	○	○	○	○	●●	●●	○
	NYFLEX® 3185	○	○	○	○	○	○	●●	●	○
	NYTEX® 3250	●	●	●	○	●	●	●●	●	○

●●	Highly recommended for the application
●	Recommended for the application
○	Not recommended for the application

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TAKING OIL FURTHER

We take oil further to bring lasting value to customers and the world we live in.

