ETRTO
The European Tyre and Rim Technical Organisation

Tyre Abrasion

How to develop a Method for quantitative assessment

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In coordination with

ETRMA
EUROPEAN TYRE & RUBBER manufacturers' association

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Agenda

- INTRODUCTION
- WHAT TO MEASURE
- IMPACTING FACTORS
- TEST METHOD GLOBAL SCHEME
- REPRESENTATIVE EU USAGE CONDITIONS
- MITIGATING EXTERNAL CONDITIONS INFLUENCE
- PROTOTYPING REFERENCE CIRCUITS
- ETRTO WG SCHEDULE

Background and Motivation

- *Tyre and Road Wear Particles (TRWP) belong to "microplastics unintentionally generated through wear and tear of products"*
  - Mostly cigar shaped particles
  - Length ranges from 10 to 500 µm; Size distribution mode 70 to 100 µm
  - Mix 50/50 of rubber from tire tread and minerals from the road surface
    > Density ~ 1.8
- *TRWP are spread in several environmental compartments*
  - Fate assessment studies are showing that TRWPs end up mostly in soils and river sediments

It is estimated that in the EU there is an annual release of about 500.000 tons of tyre rubber

Way Forward Report European TRWP Platform Sept 2019

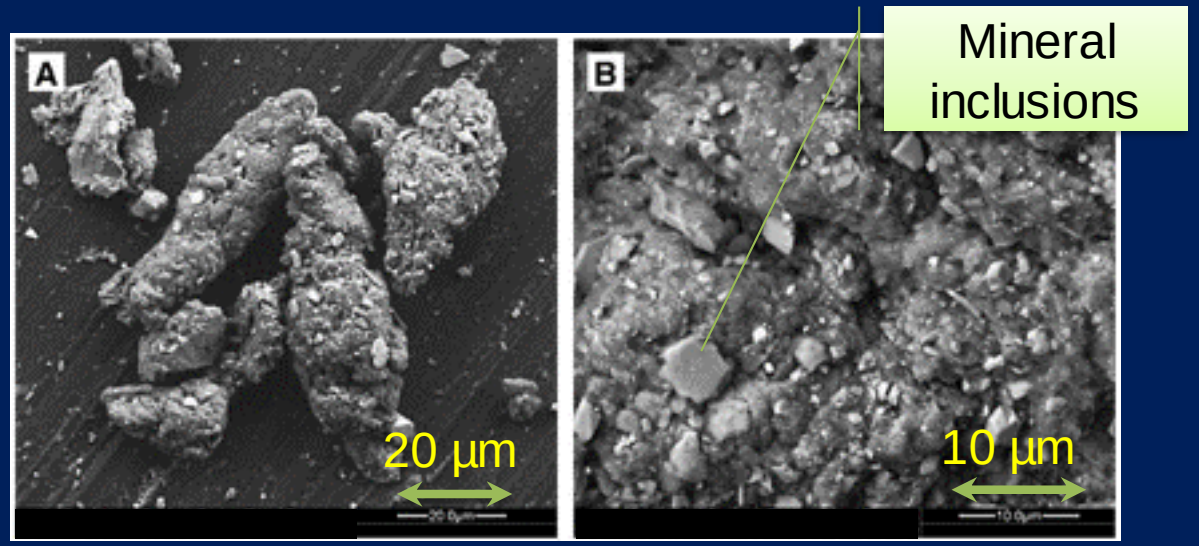
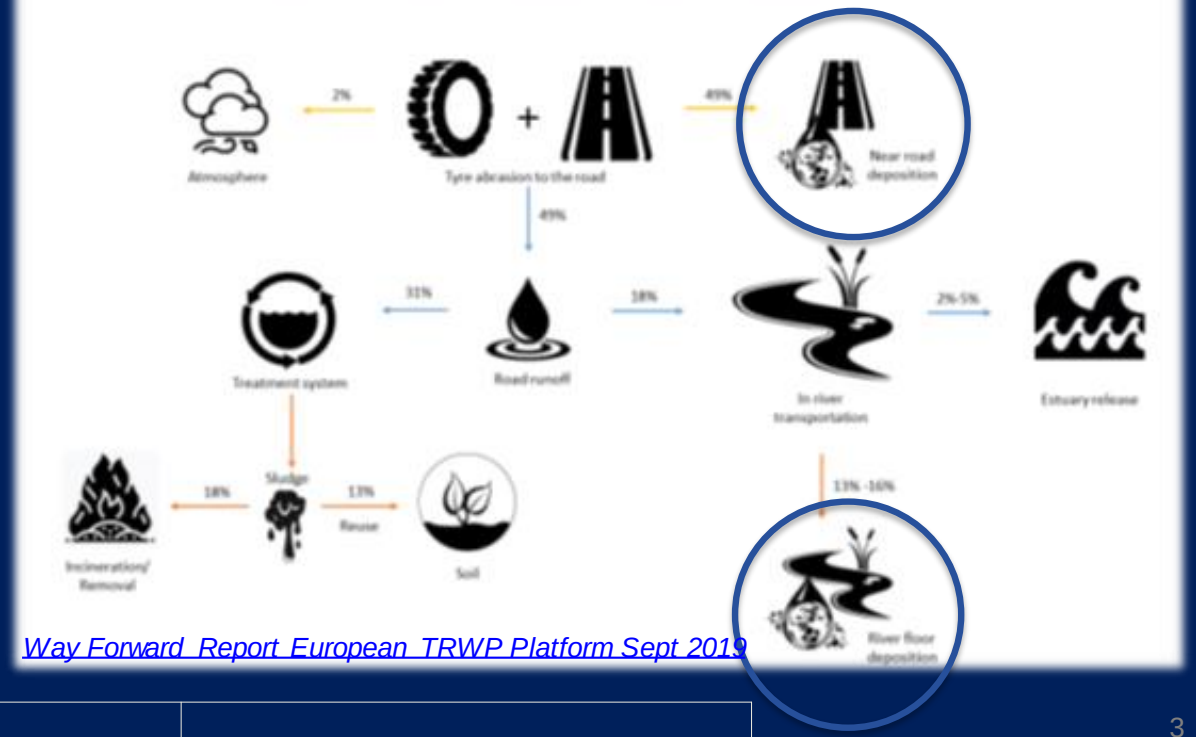


Fig. 1 – The fate of TRWP in the environment (adapted from Unice et al. (2019))



Way Forward Report European TRWP Platform Sept 2019

ETRTO WG Mandate and Objectives

- *ETRTO Working Group aims to:*
  - Identify the most suitable test method to measure abrasion rate for passenger tyres
  - Evaluate the feasibility of the test method and associated planning
  - Develop and implement the test method
  - Validate the final test method and parameters

- *The final goal is:*
  - to have a feasible tyre abrasion rate test method with the following characteristics:
    - > repeatable, reproducible, cost efficient and practicable
    - > representative of real driving environment in European market
    - > usable for regulation purpose (including market surveillance)
    - > open to all tyre manufacturers worldwide

Quantifying tyre emitted particles: *abrasion rate is the relevant indicator, not tyre mileage!*

- *Example: Same final mileage, different quantity of rubber to wear*

	A	B
Tread depth (mm)	6	9
Tyre mileage (km)	50 000	50 000
Abrasion rate (mg/km)	20	30

- *Relevant indicator*

The best tyre is the one releasing the lowest quantity of rubber for an identical mileage, means here the A tyre.

In this case, the tyre final mileage is not a relevant indicator, while the only relevant indicator is the abrasion rate

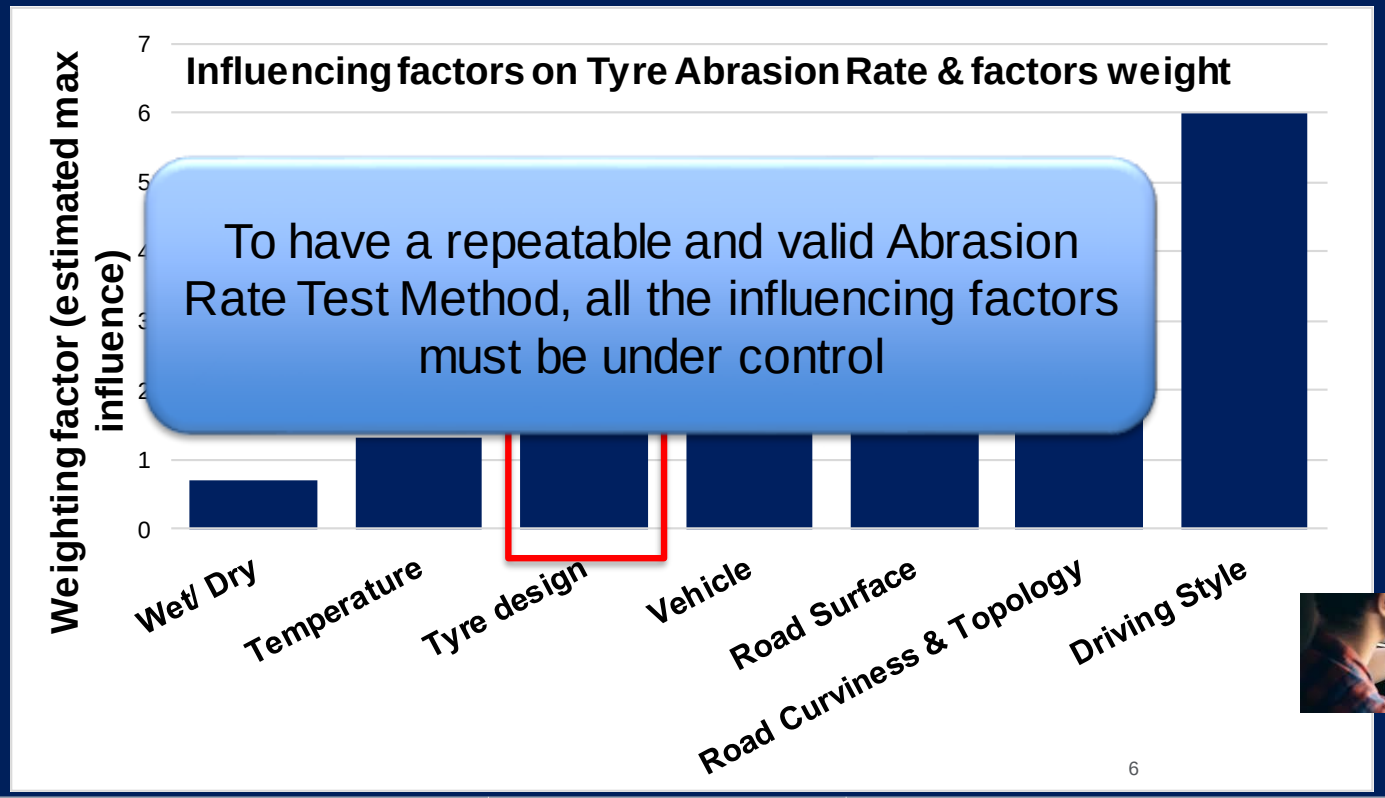
➔ *Relevant indicator for tyre particles emission:* ***abrasion rate****, in mg/km (reduced → better)*

Impacting factors on tyre abrasion rate

- ***Road & driving style*** *are the predominant factors influencing abrasion rate:*
  Road design as well as driver's training are ***major levers of progress*** *to decrease abrasion rate and related particle release.*

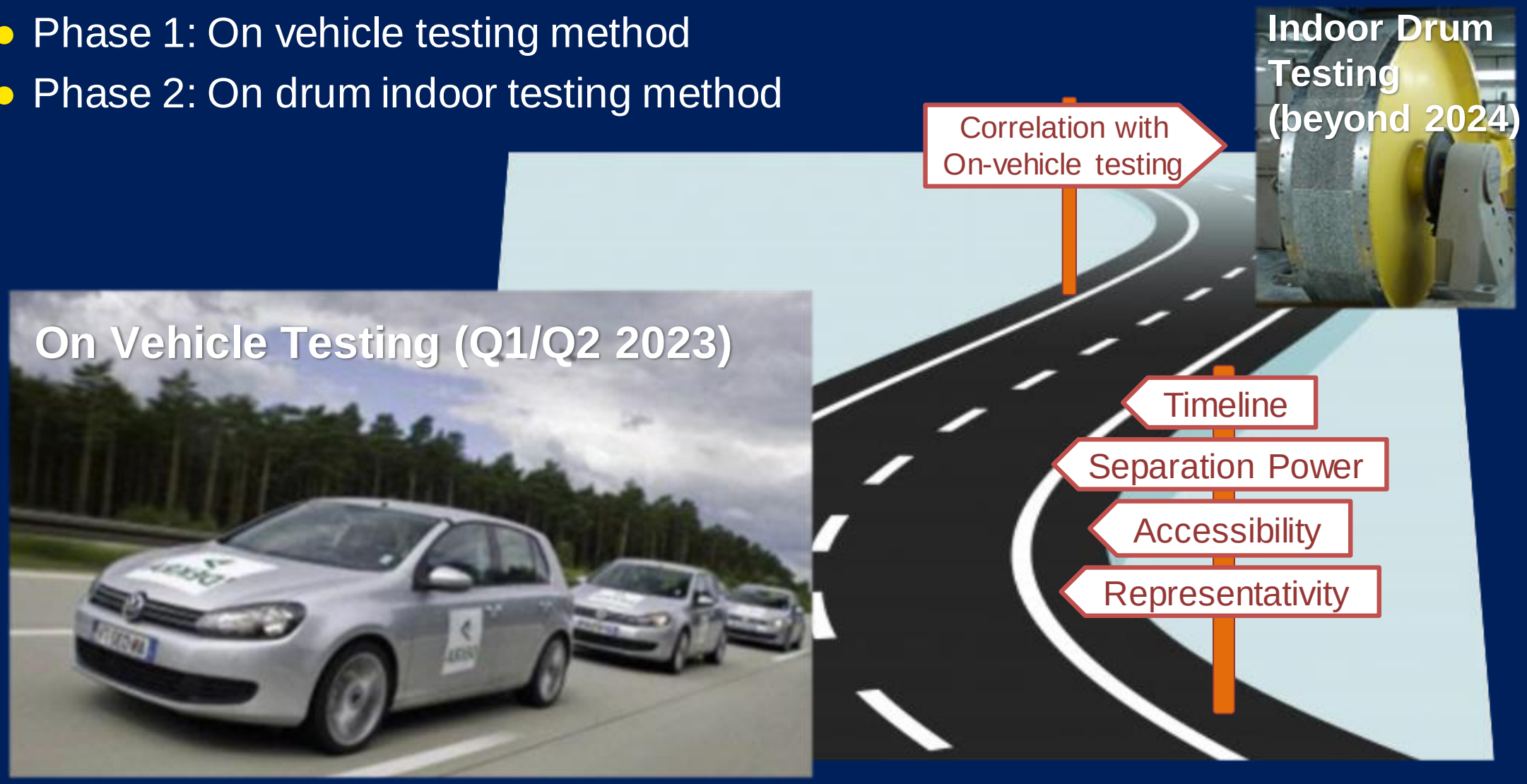
- ***Tyre design****, even if not the main one, is however a relevant factor to impact rubber wear emission that needs to be addressed.*

  - **An holistic approach is to be considered to achieve best improvements**



From feasability phase by ETRTO, 2 options remain

- *For accessibility reasons, we scheduled them as:*
  - Phase 1: On vehicle testing method
  - Phase 2: On drum indoor testing method



ETRTO On-Vehicle Test Method Proposal

- *ETRTO proposal is an <u>on-Vehicle test method</u> running convoy with several vehicles with same controlled conditions on a defined test route on public roads*
  - A reference tyre in each convoy is required
    - > to mitigate the impact of outside parameters on absolute abrasion rate

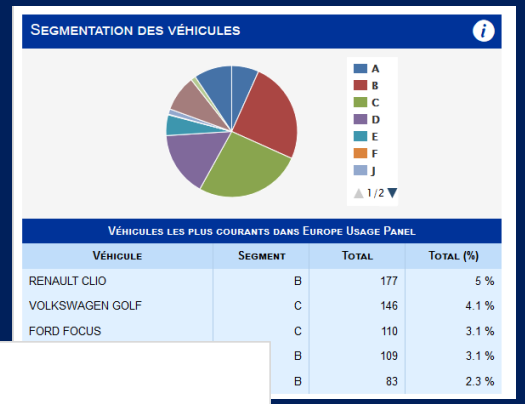
- *Main parameters to master*
  - Road & Driving Style
    - > Circuit on public roads, Road types, Pavement surfaces
    - > Speed & Acceleration Distributions
  - Vehicle type & Settings
    - > Targeted tyre load in % LI
  - Weather impact
    - > Temperature range for testing
    - > Rain: limited % of wet roads, no snow or ice



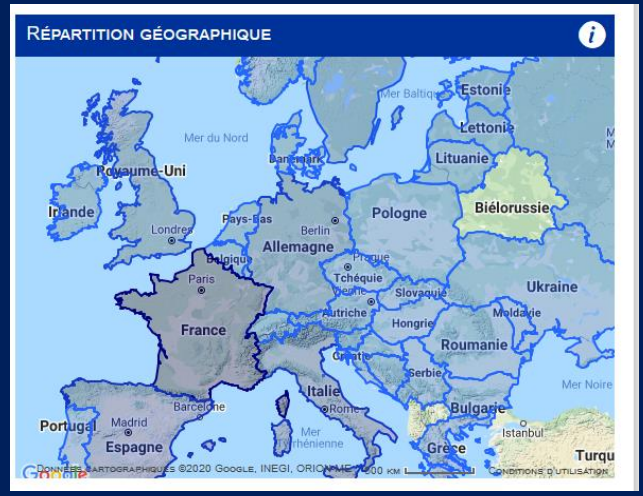


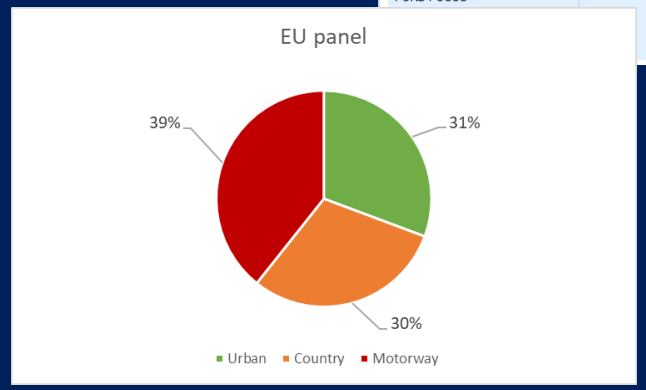
Which usage can be representative for Europe?

- *Collecting Europe usage tracking Data Base from Tire Manufacturers*
  - All over Europe
  - 3555 vehicles
    - > All Passenger Car Market segments
    - > Since 2015
  - 15 Millions of trips
  - 150 Millions of kilometers

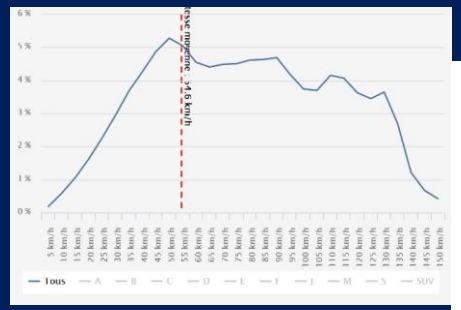


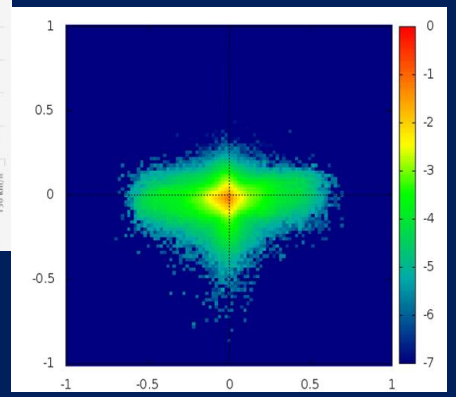
VÉHICULE	SEGMENT	TOTAL	TOTAL (%)
RENAULT CLIO	B	177	5 %
VOLKSWAGEN GOLF	C	146	4.1 %
FORD FOCUS	C	110	3.1 %
	B	109	3.1 %
	B	83	2.3 %



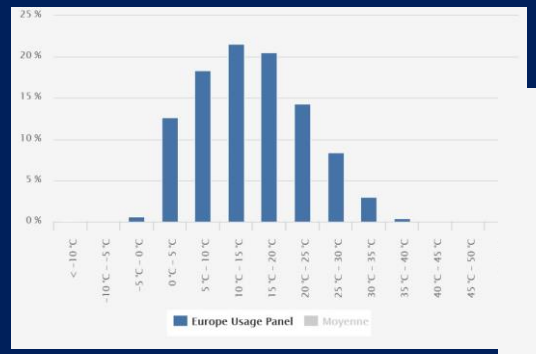


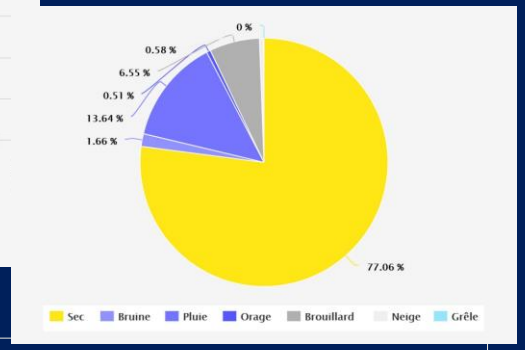
- *Roads are split in*
  - Urban, Rural, Highway
    - > using OpenStreetMap definitions





- *Driving Style Statistics*
  - Speed & Acceleration distributions





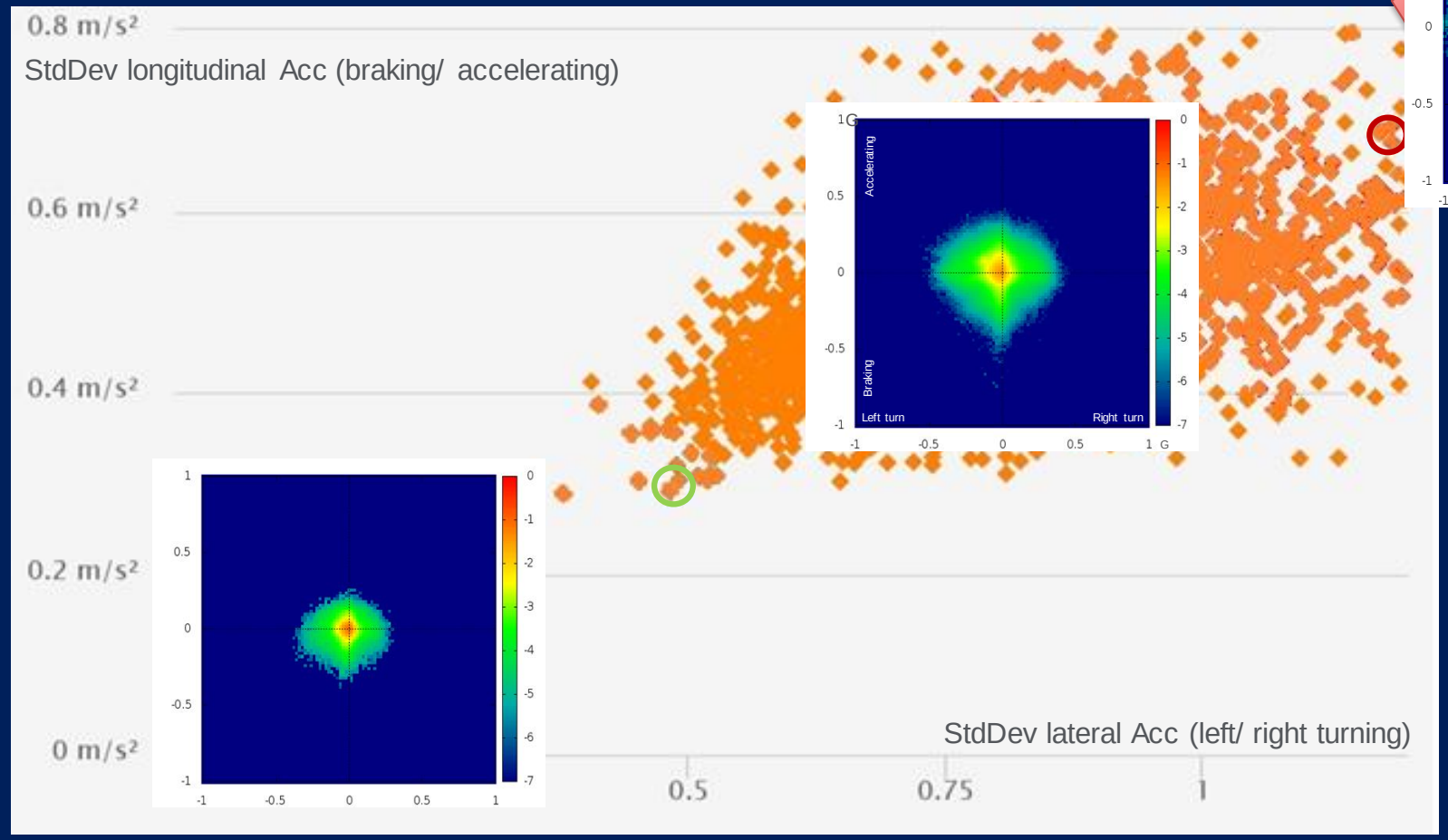
- *Weather Statistics*
  - Temperatures & Wetness

Distribution of European Driving Styles (X/Y Accelerations)

Targeted Usage for Abrasion Test

- *EU usage Data Base reveals the range and variety of severities*

  - Each point from graph beside represents the range (StdDev) of X & Y accelerations for one single vehicle over several ten thousands of km

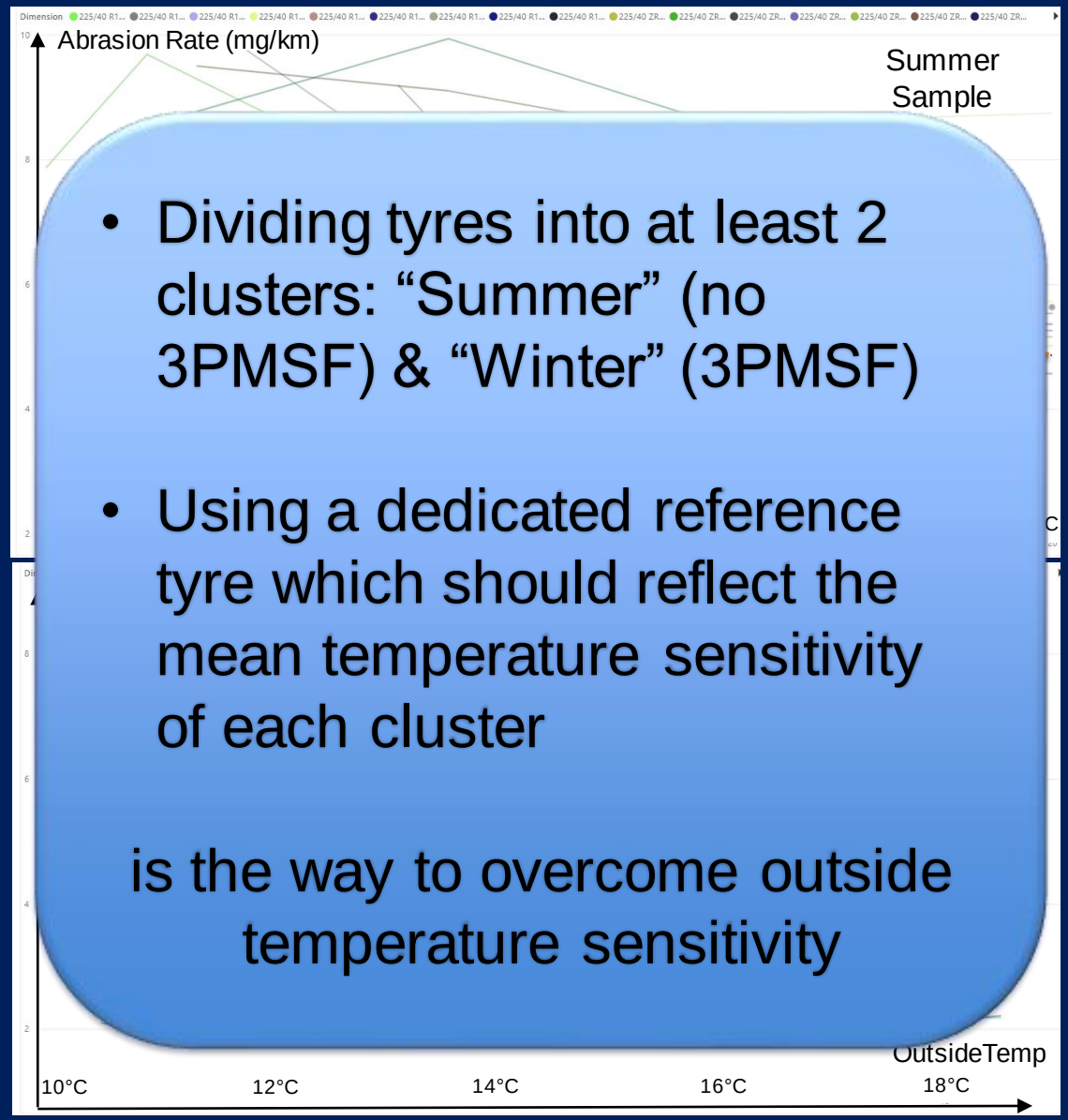


Tyre Sensitivity to Outside Temperature

- *Passenger Car Tyre Abrasion Rate changes when outside temperature varies…*
  - Therefore a reference tyre is required in each convoy

- *But not all tyres show the same sensitivity*
  - From non-standardized historical abrasion rate tests, 70 different tyres have been evaluated in the given example which show certain statistical tendencies. For instance, considering the following groups:
    - > Summer sample Abrasion Rate drops by~32%
      - through a [10 – 20°C] range
    - > Winter + All season sample Abrasion Rate drops by~16%
      - through a [10 – 20°C] range

Tyres from these two groups should not be mixed in a same convoy
Their relative Abrasion Rate will heavily depend on the outside temperature during the test



- Dividing tyres into at least 2 clusters: “Summer” (no 3PMSF) & “Winter” (3PMSF)
- Using a dedicated reference tyre which should reflect the mean temperature sensitivity of each cluster

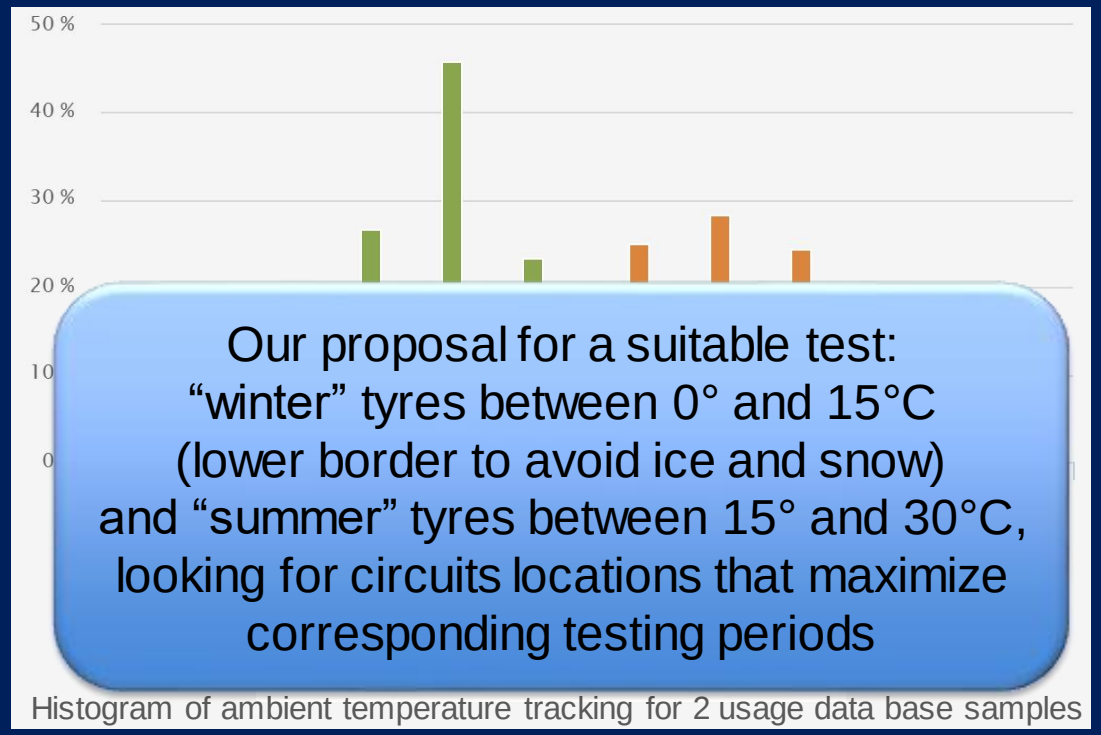
is the way to overcome outside temperature sensitivity

Clustering the Tyre Market for better reproducibility

- *Tyres should be separated in Clusters such as: « Summer » No 3PMSF & « Winter » 3PMSF*
  - One circuit + One Reference Tyre for each cluster
    - > *"circuit" = "test route on public roads"*

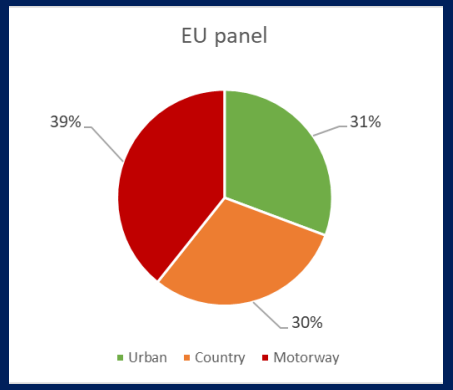
- *Each circuit should be located to match actual temperatures for tyre use in each cluster:*
  - EU usage tracking Data Base gives actual temperatures
    - > by Map-matching weather records with vehicle location through time-stamp
  - Winter (Northern Europe) Temperatures
    - > Range [0 ; 20°C] - Mean ~ 7,5°C
  - Summer (Europe) Temperatures
    - > Range [10 ; 35°C] - Mean ~ 23°C

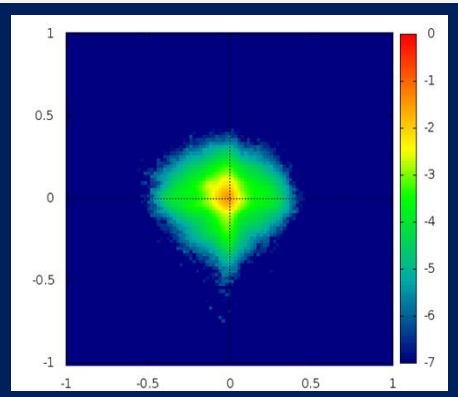
- *Other circuit specifications*
  - Road Mix: Urban, Rural, Highway
  - X/Y acceleration histograms
  - Speed range

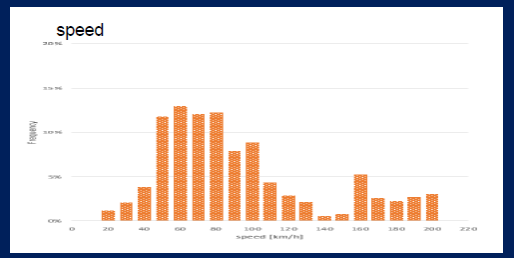


Our proposal for a suitable test:
"winter" tyres between 0° and 15°C
(lower border to avoid ice and snow)
and "summer" tyres between 15° and 30°C,
looking for circuits locations that maximize
corresponding testing periods

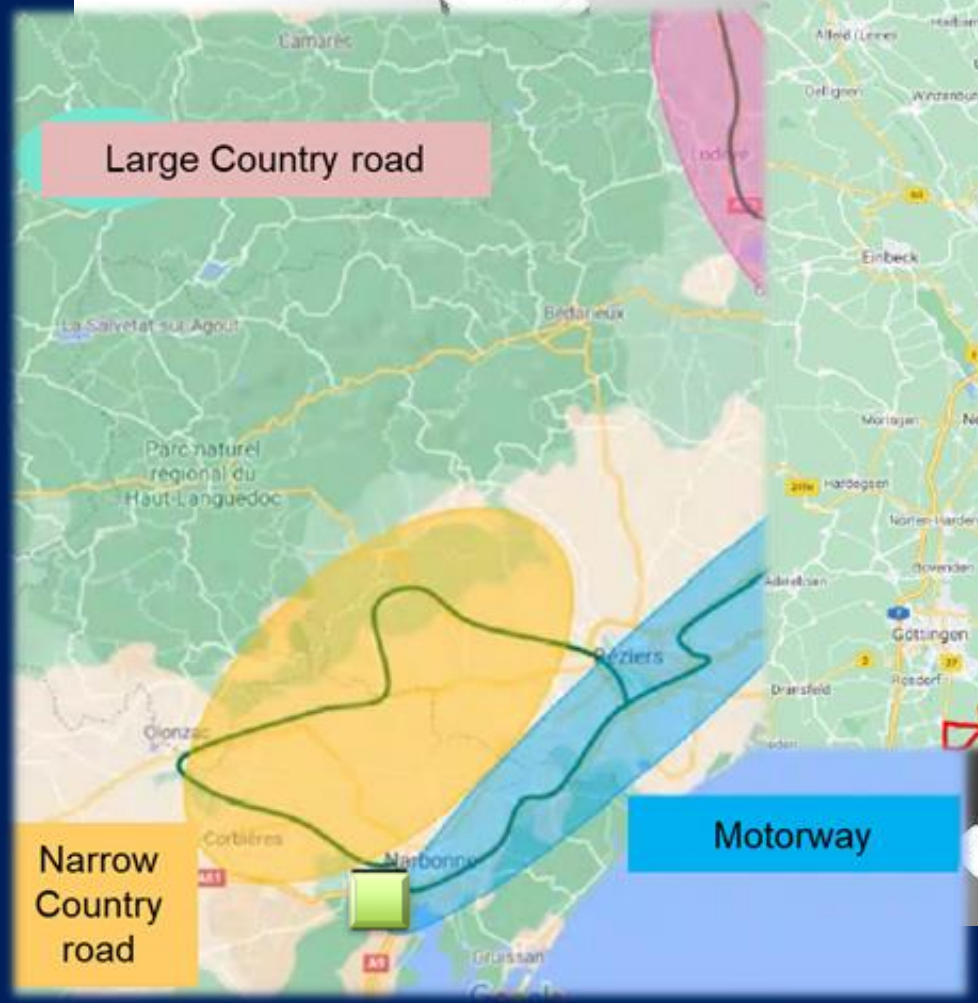
Histogram of ambient temperature tracking for 2 usage data base samples

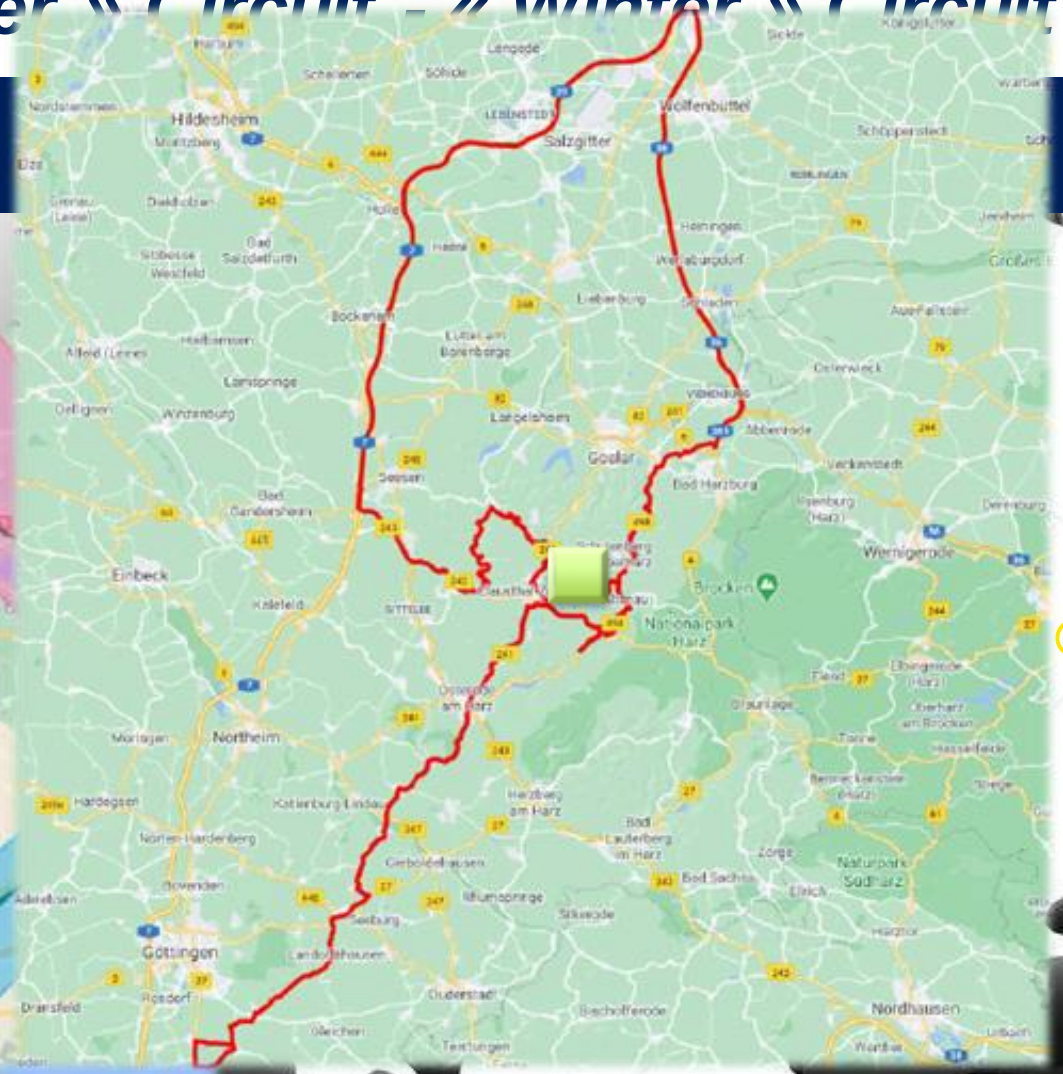






« Summer » Circuit - « Winter » Circuit





- *1 Loop ~ 500 km*
  - Using open roads
  - Not completely fixed
  - Compatible with Electric vehicle operations

ETRTO Workplan Phases & Projected Schedule

Standard Tyre Abrasion Test Method C1 (passenger car tyres)

a) On-Vehicle reference method

Q1/Q2 2023 ➔ **Standardization Q2 2025**

b) On-Vehicle multicircuit
Q3/Q4 2023 ➔ **Standardization Q4 2025**

c) Drum
Q4 2026 ➔ **Standardization Q4 2028**

Outcome:
Standardized test methods
Market assessment method starting (2023)

ETRTO WG
Feasibility checks, macro planning

Test method development start

Step A)
Definition of basis vehicle test and conditions

Step B)
Test methods development based on conditions of Step A

Step C)
Standardization

Q1 2020 **Q2 2021**

Conclusion

- *By 2023, Tyre Industry is committed to deliver a test method*
  - that will support regulatory action on TRWP mitigation,
  - with the inclusion of abrasion rate in the tyre regulatory framework

- *This Method will be On-vehicle based, measuring tyre Abrasion rate (mg/km)*
  - in a relative manner to a known Reference Tyre
  - representative of real driving conditions of European market
  - that will be open to all test suppliers

- *Develop a Method which will be fair, robust and reproducible, requires*
  - Fine tuning of many influencing test parameters
  - Expertise and market knowledge

Many thanks to all participants of ETRTO & ETRMA Working Groups representing major European Tyre Manufacturers

Many thanks for your attention