« AUTOMOTIVE IN SOUNDSCAPE »

FUTURE OF PASS BY NOISE REGULATION AND THEIR IMPACT ON CITY LIFE

PRESENTED BY THOMAS ANTOINE (RENAULT) TO : UNECE OCT 26TH & 27TH 2021

Worgroup purpose

« Our purpose is to better understand and analyze the noise emission regulation applied to the automotive OEM and suppliers as NVH experts, embracing a broad vision : from noise sources to the environmental acoustics and urban soundscape »

Workgroup members :

acoucité

faurecia

Trèves

PSA GROUPE

MICHELIN

BRUITPARIF

UTAC CERAM

Valeo

GROUPE RENAULT

Regulatory panorama

Context :
Objectives of the Pass-By Noise Regulation

Our understanding of Pass-by noise regulation purposes :

Environmental protection

Improve Quality of life

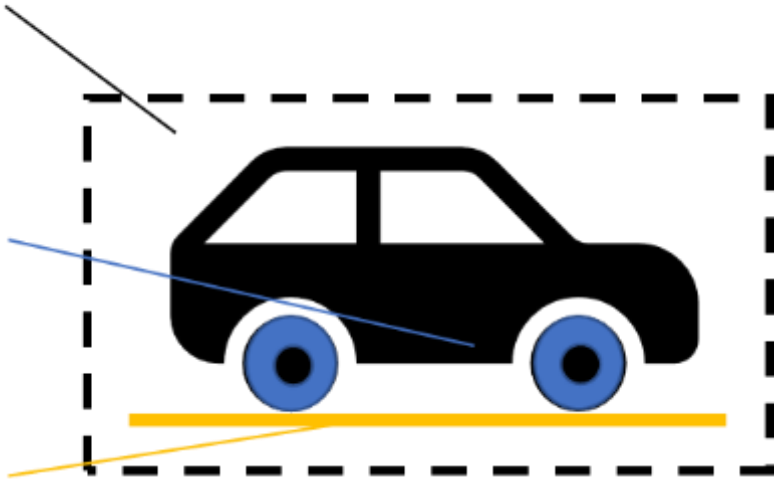
Public Health and Safety

In a word : progress – and progress has a meaning if it is shared by everyone

Regulation panorama : for Vehicles / Tires / Roads

Run up (acceleration)	Constant speed	limit dependent on	T°C correction	
Yes	50 kph	Nothing	No	Pass by noise for vehicle UN/ECE R51
No	80 kph	Tire widht	Yes	Tires EC 661 R117
No	40 kph	?		Road ISO 11819

50 KpH and run up mix
Level not dependent on Tire width

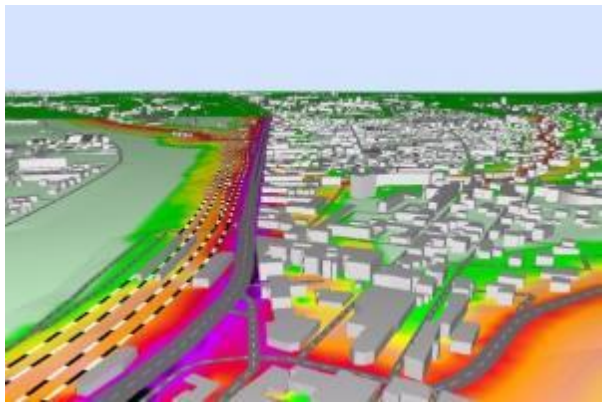


Inconsistencies between all these standards

Regulation panorama :
Noise in the Environment
Directive 2002/49/CE

Population survey

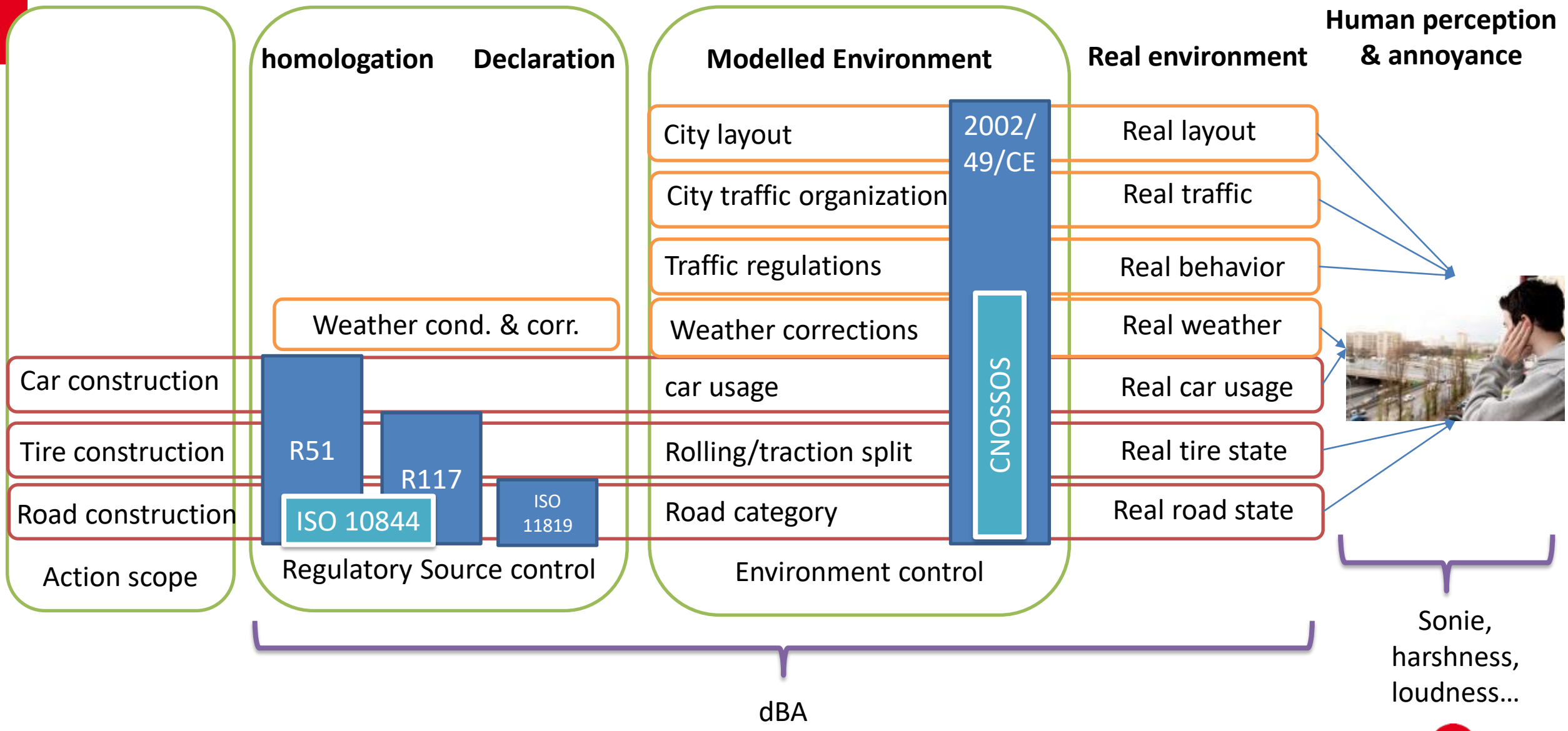
Short- or long-term measurements



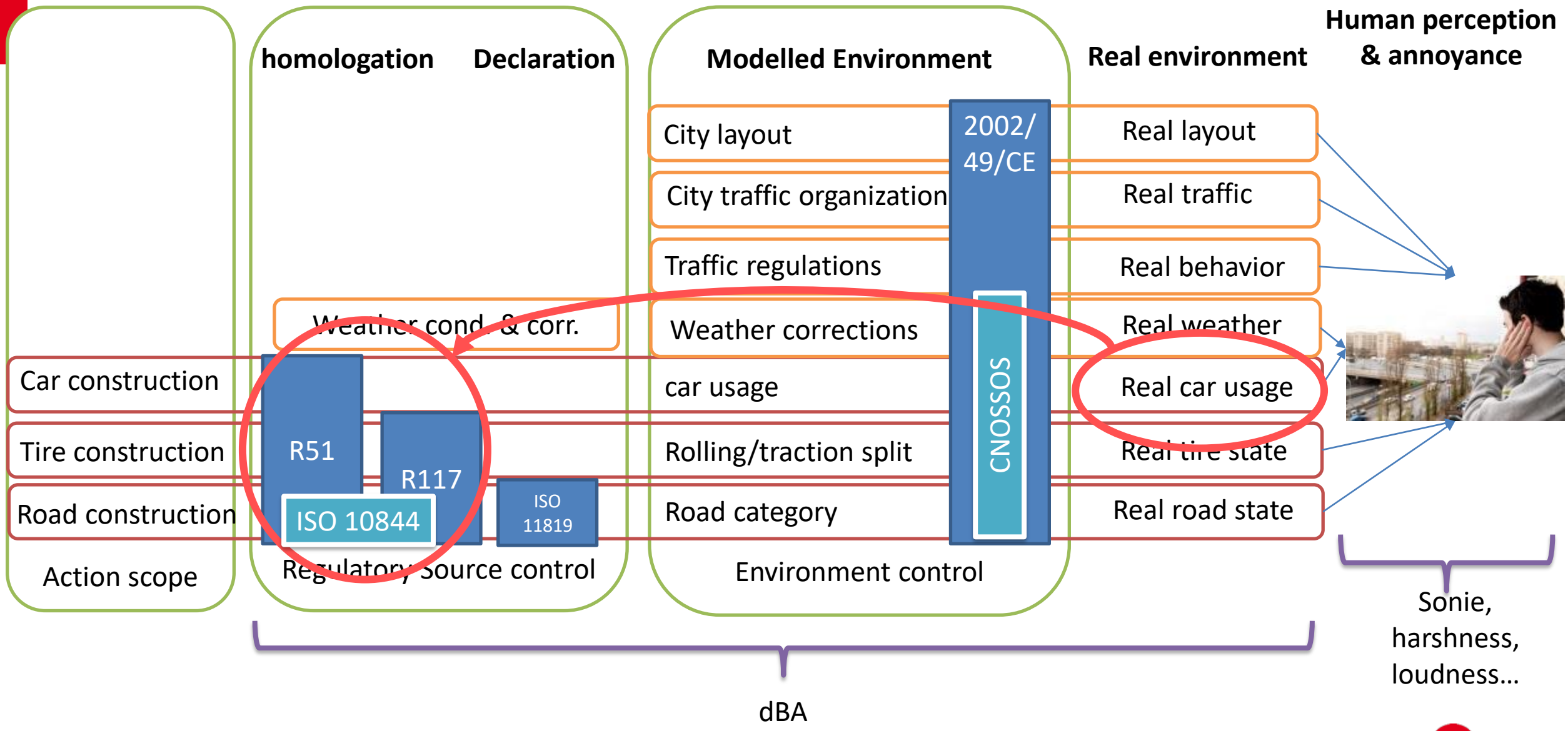
Modelling and mapping

Workgroup Roadmap and focus

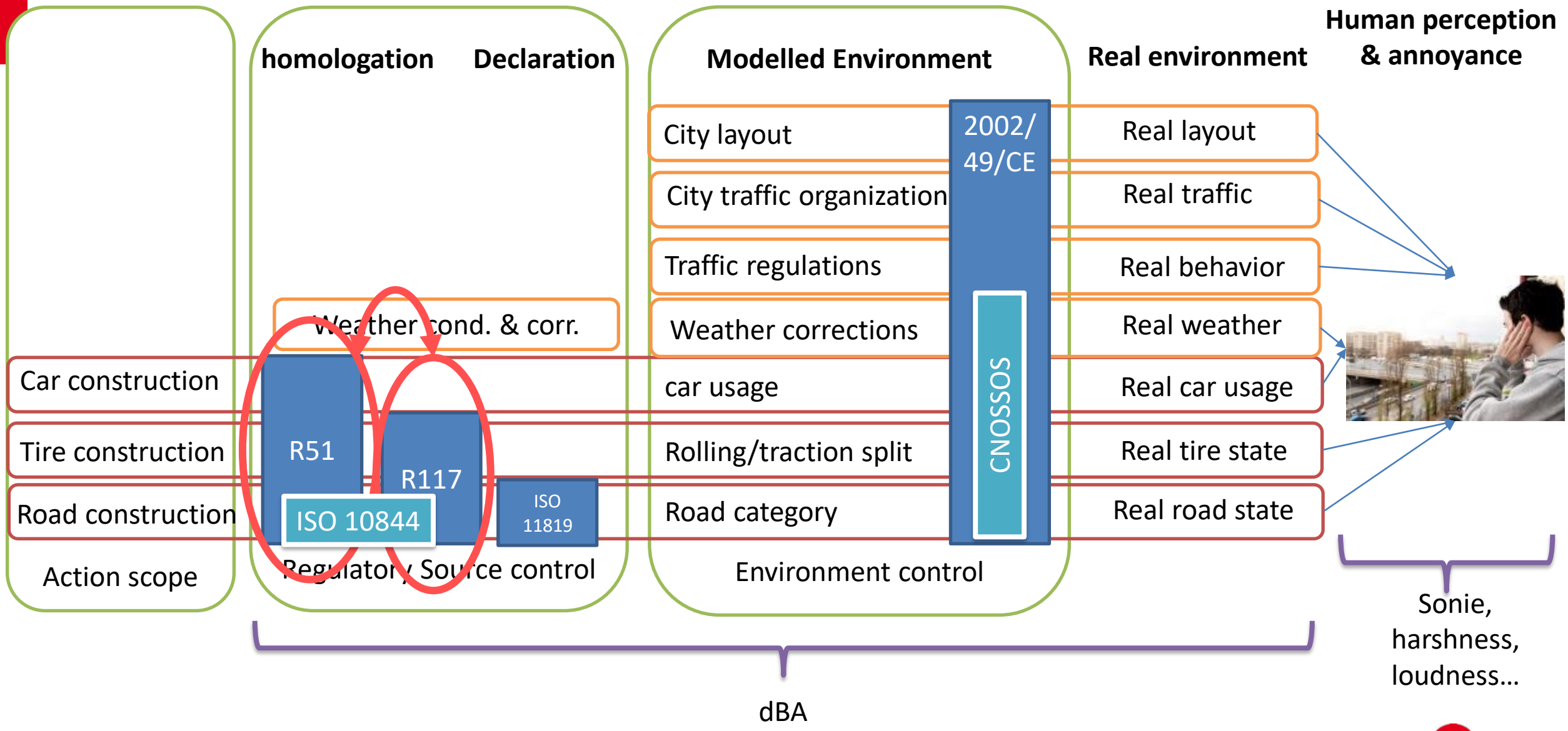
Global mindmap



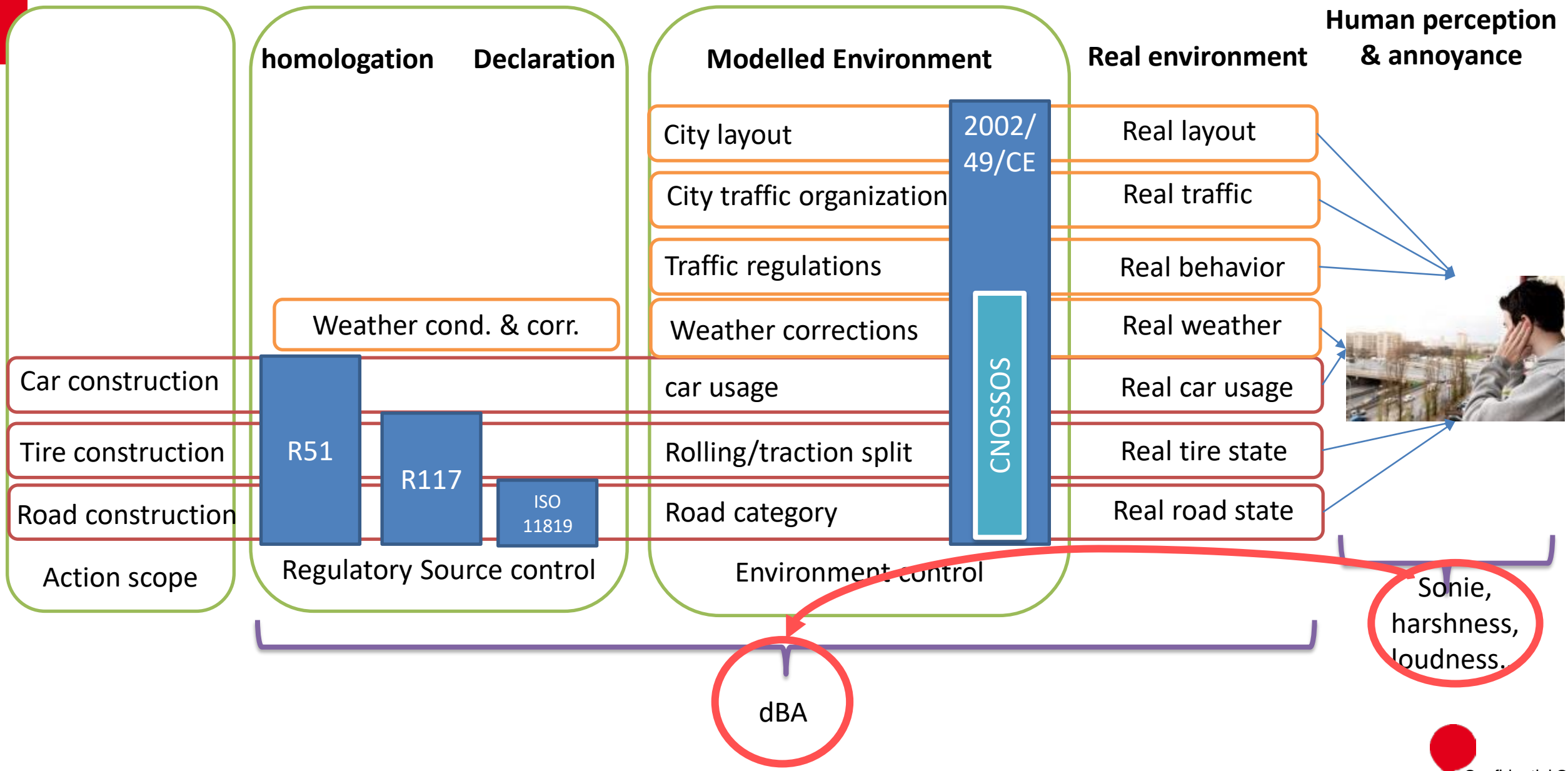
1st step Review real usage with R51 Homologation



2nd step : review consistency between UN-R51/R117



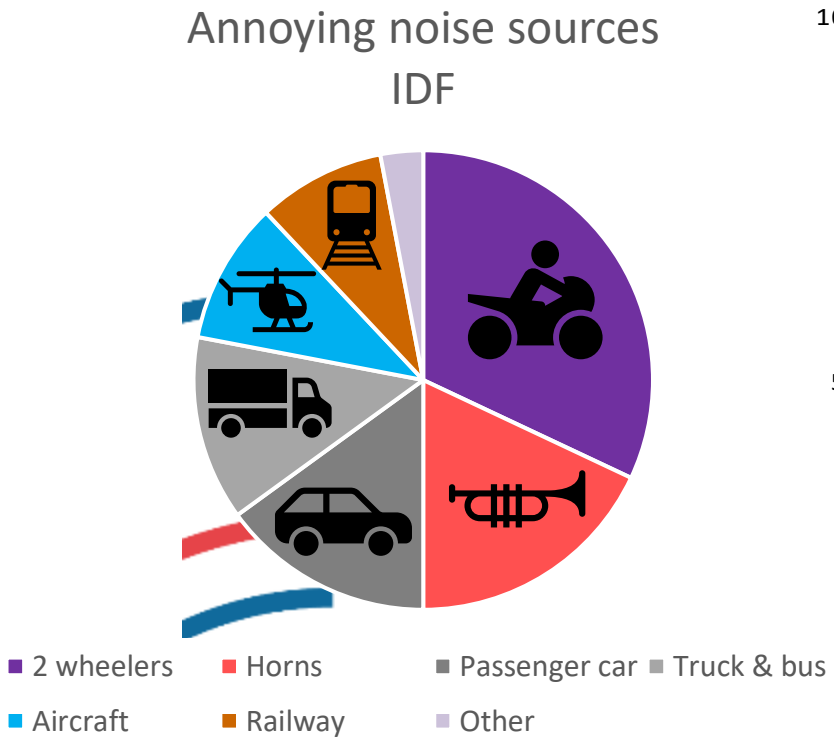
3rd step : review metrics

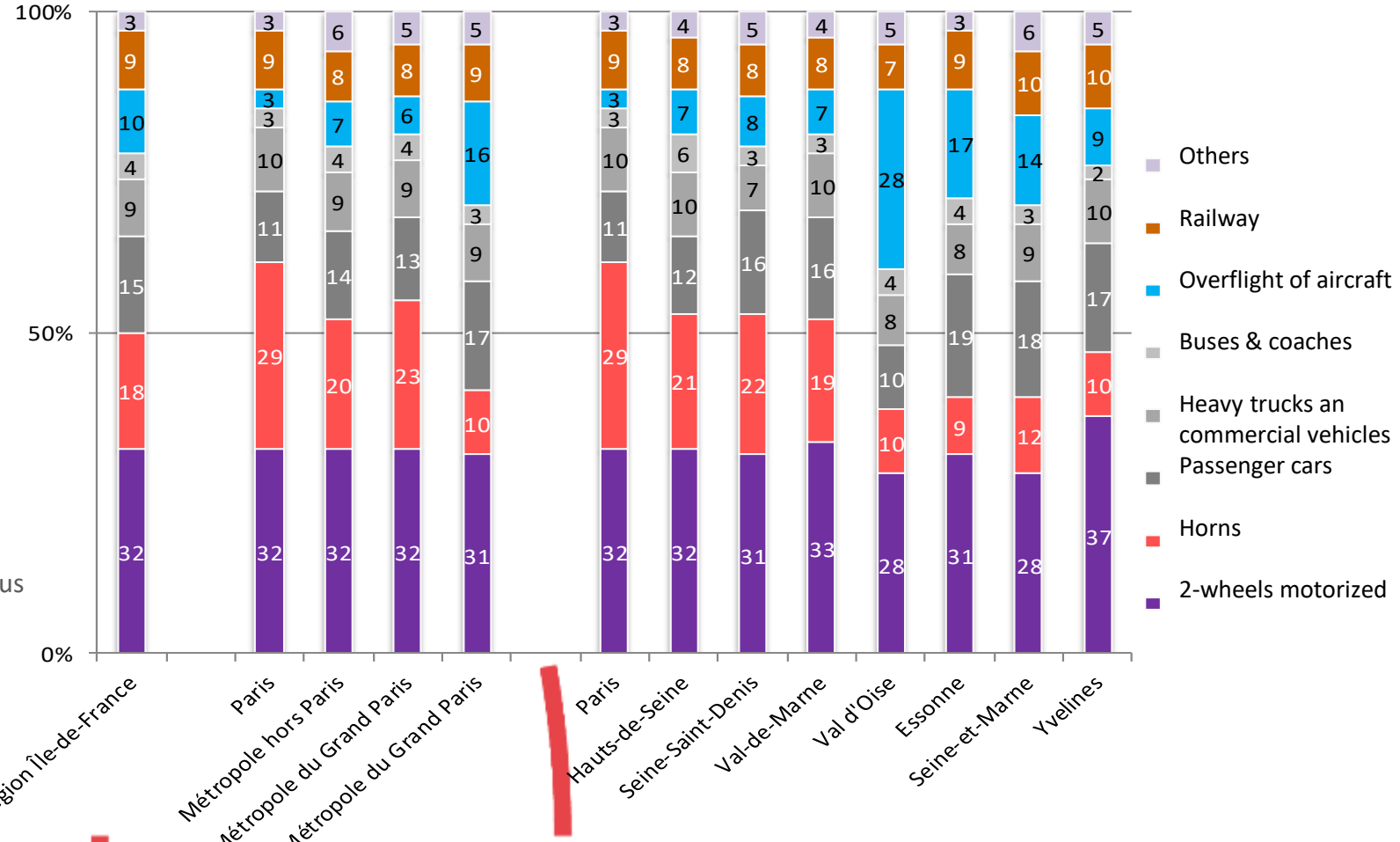


Noise perception in urban environment

Source : Bruiparif 2019

THE TYPES OF NOISE CONSIDERED AS THE MOST ANNOYING AMONG TRANSPORT NOISE

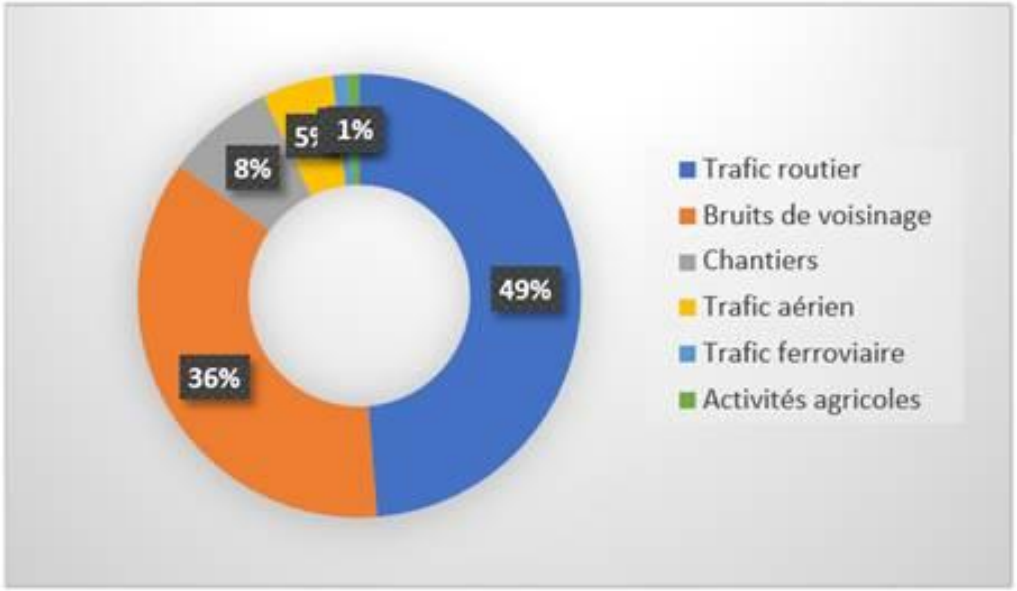




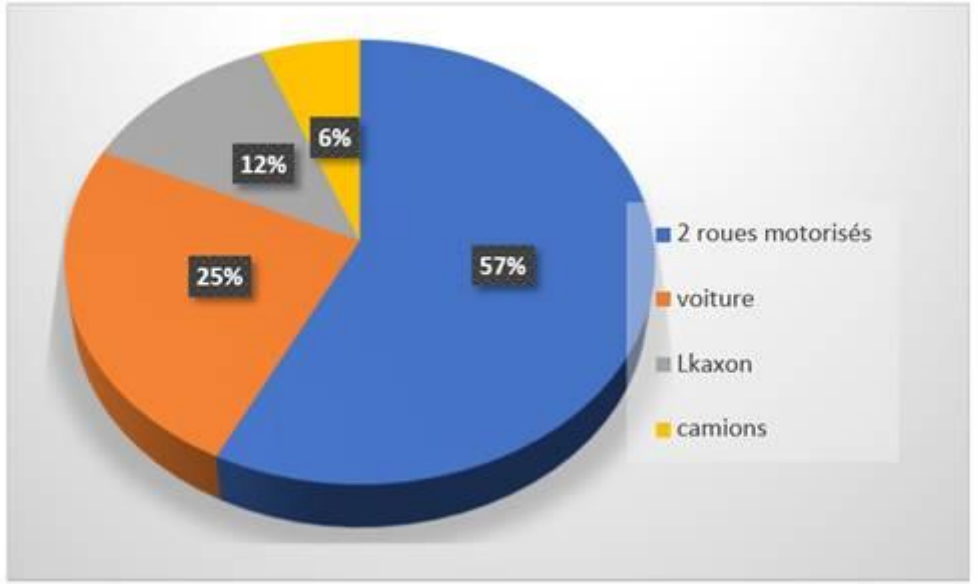
BRUITPARIF

Noise annoyance update : The after lockdown for COVID Impact

COVID did provide an unprecedented real life masking experiment / below are BRUIPARIF data for « Ile de France » on percieved annoyance, after lockdown upon economical restart, a survey was conducted :



Graphique 34 : Répartition de la gêne selon les sources de bruit après le confinement

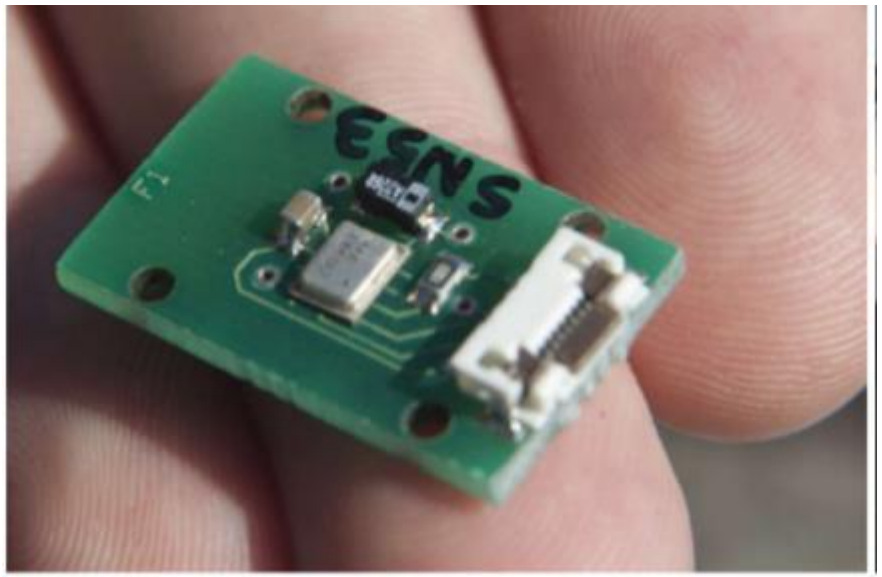


Graphique 35 : Répartition de la gêne due au trafic routier après le confinement

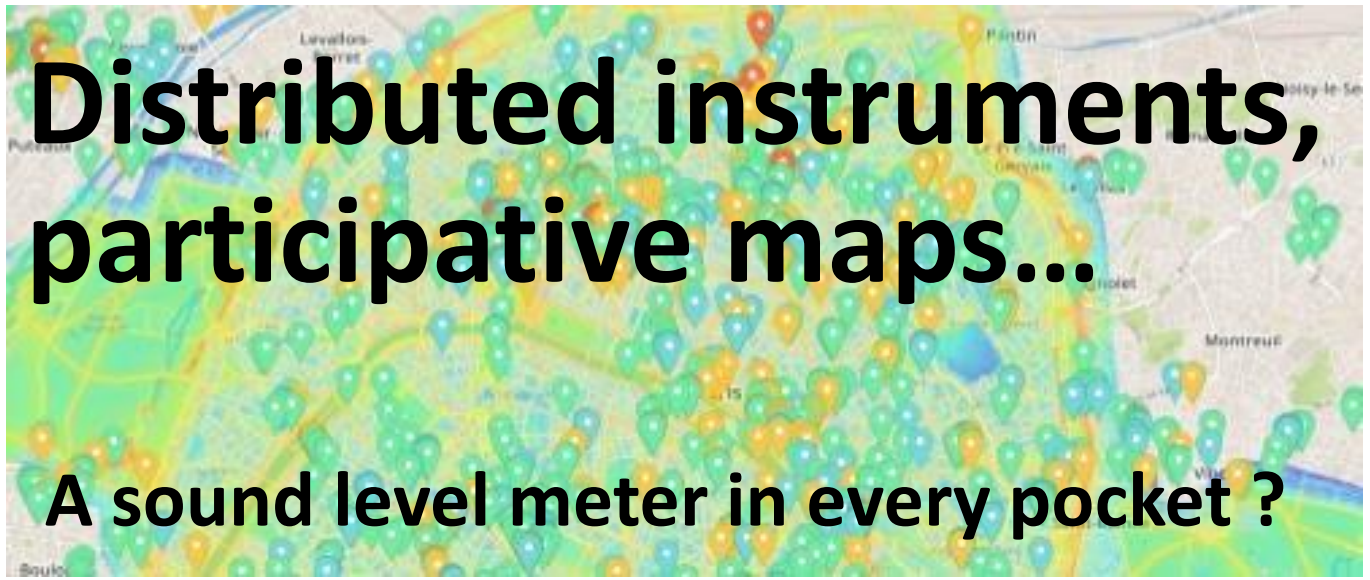
49% of the annoyance is linked to road traffic in which passenger cars represents 25% of the annoyance
=> 13% of total annoyance linked to car traffics

The world we are stepping into

- **Smart cities**: connectivity, collaborative systems, traffic management, big data…
- Health and safety , quality of life is priority
- Hazardous Pollution monitoring (noise, radio, air quality…)
- Cheap sensors



(c) Microphone MEMS



Distributed instruments, participative maps…

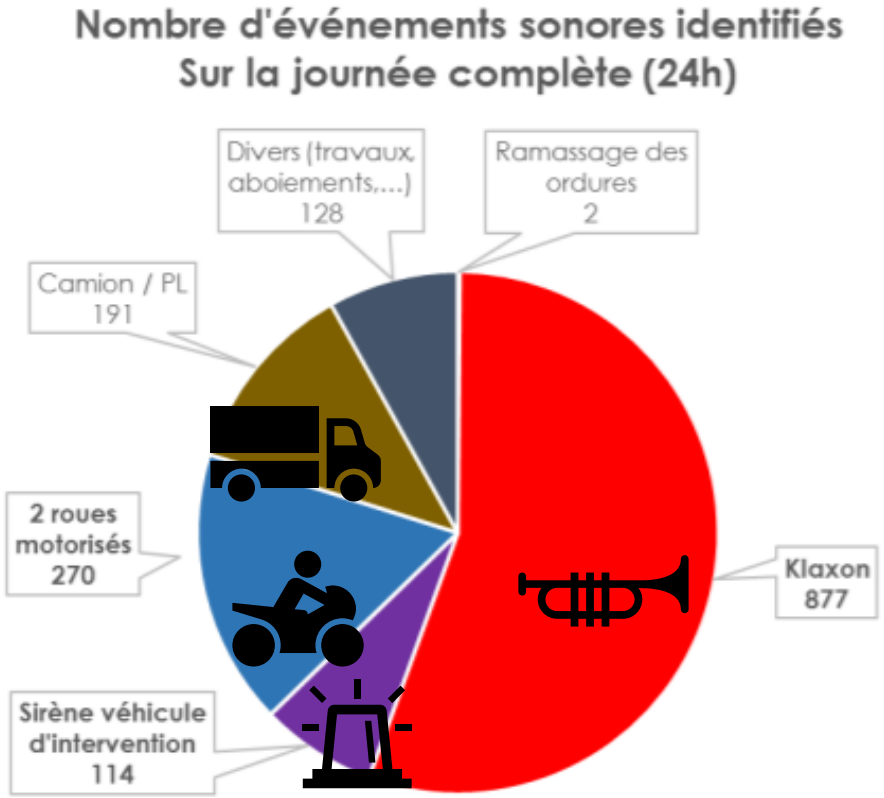
A sound level meter in every pocket ?

Noise measurement in urban environment

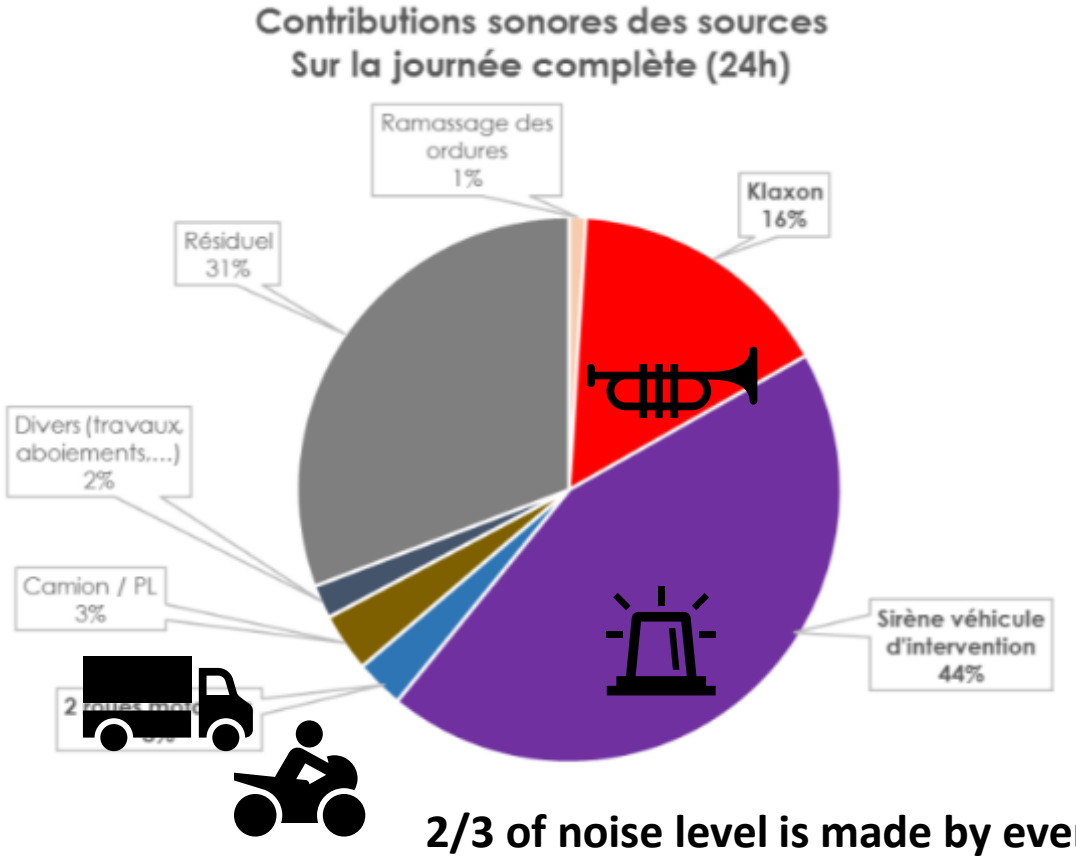
Source : Bruiparif 2019

Example of smart noise monitoring

Noise « peak events » in a Paris boulevard in 2016 (source : Bruiparif), and their contribution to LAeq



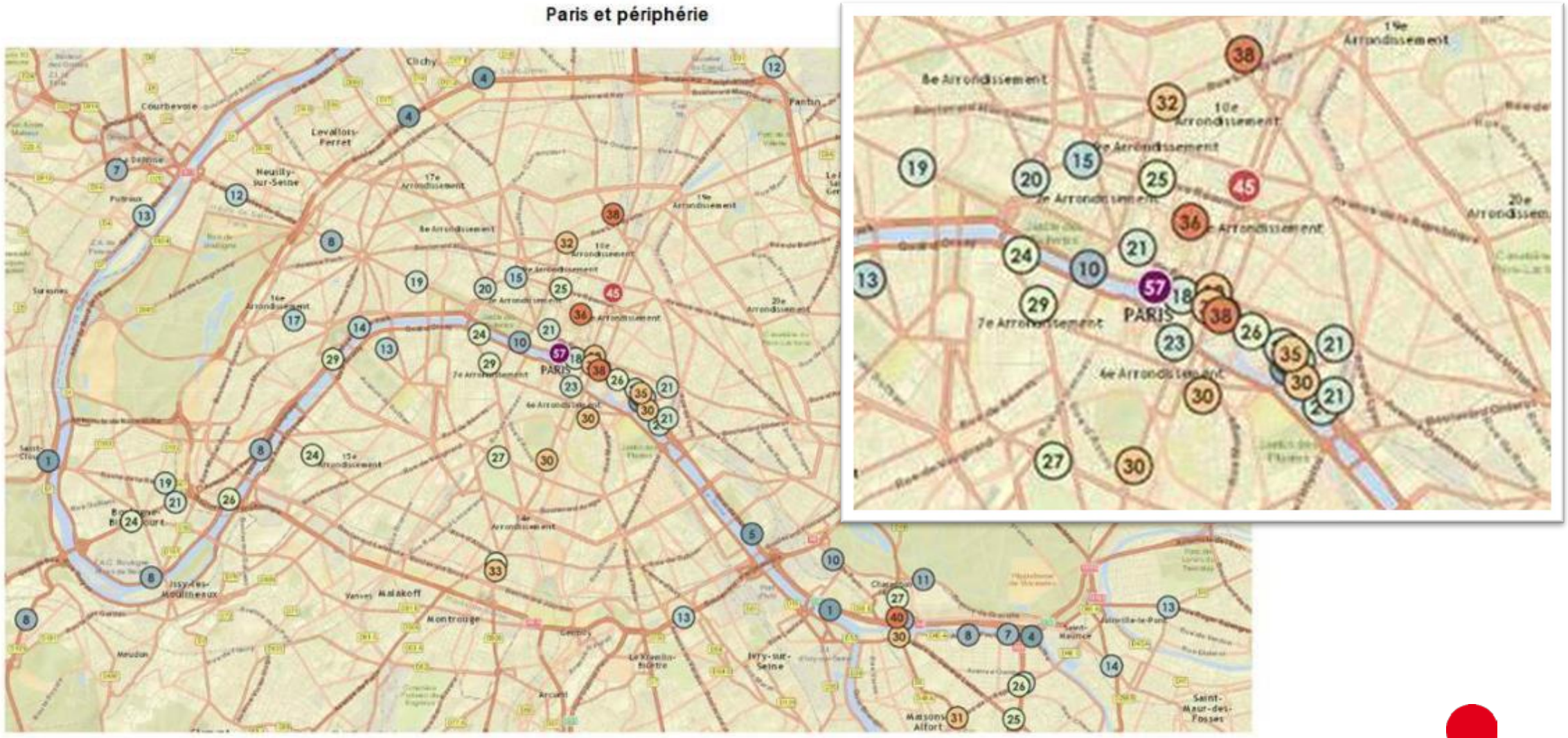
80% of events are Horns, Sirens, 2 wheelers and trucks



2/3 of noise level is made by events

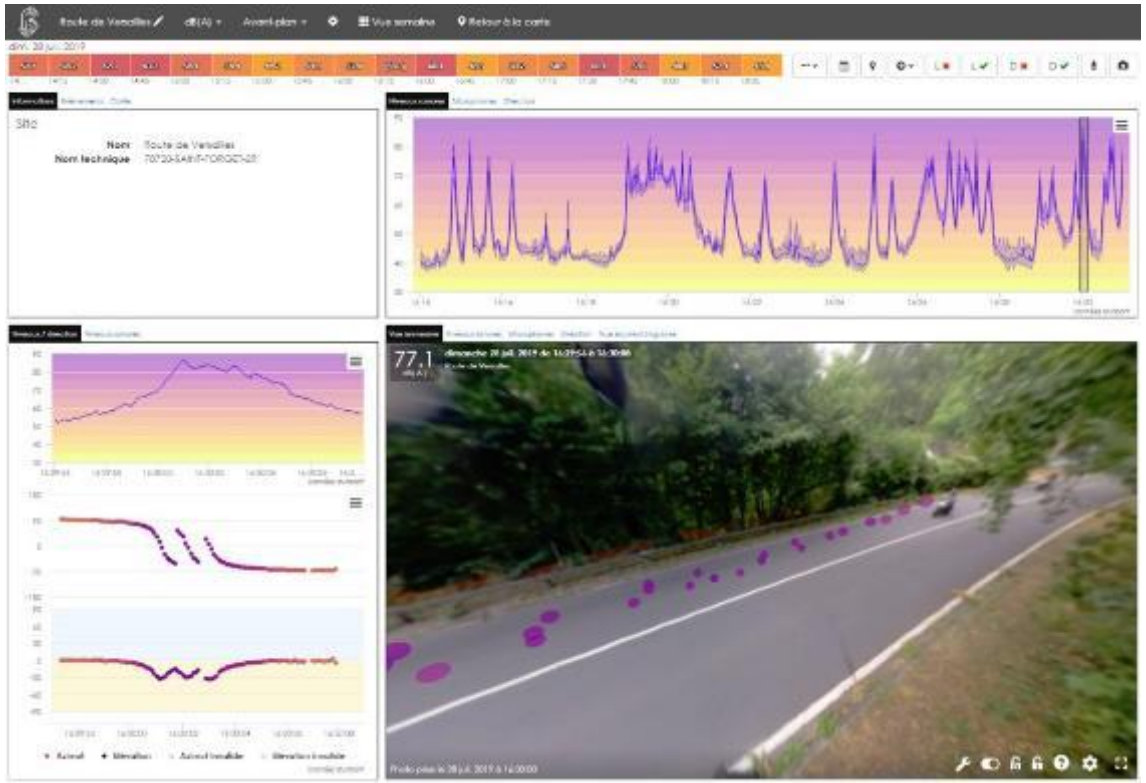
Contribution of noise peaks to LAEQ over 1 month in 90 measurement points in Paris.

Contribution diurne en énergie sonore des pics de bruit pour les jours ouvrables (en%)



The noise radar

We can foresee a large spread of such technologies financed by fines
Meaning also that detailed soundscape data are available, and generalized noise event participation precise measurement.



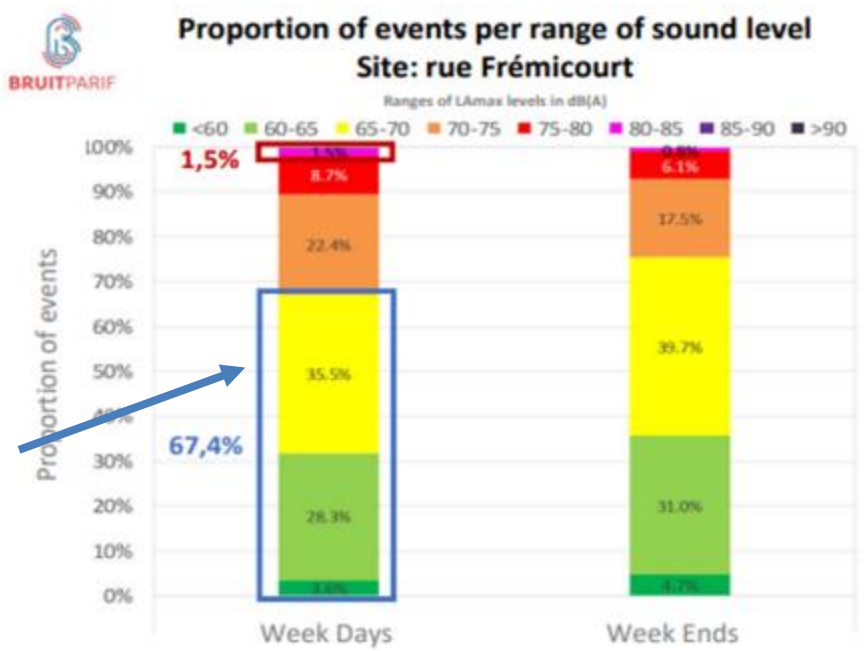
THE NOISE PEAKS' ISSUE

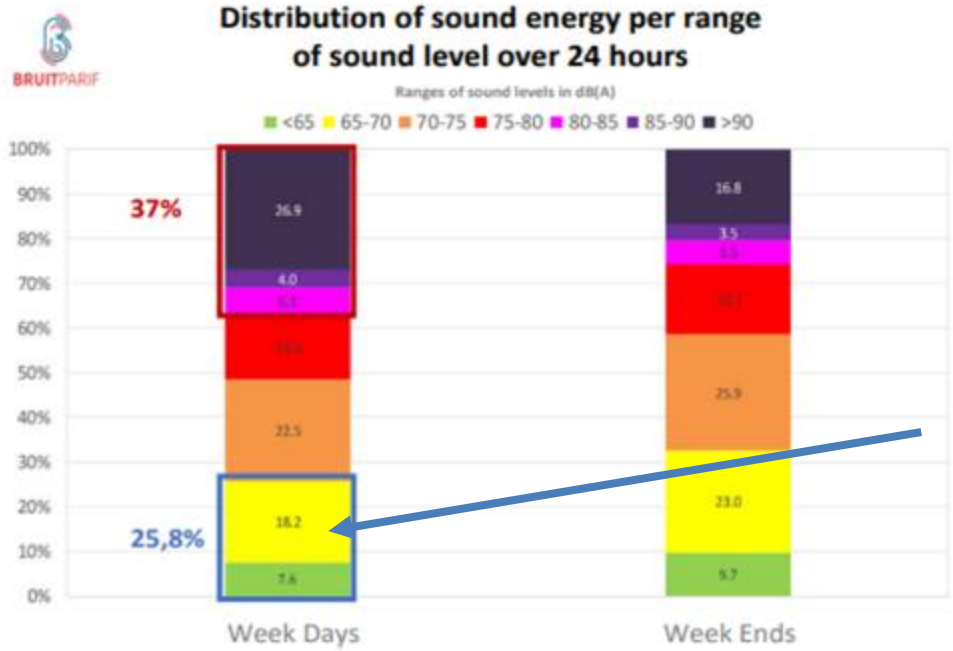
Results for rue Frémicourt, Paris 15

High noise peaks with LAmax >= 80 dB(A) (non-respect of homologation standards)
Represent less than 2% of the number of peaks due to vehicles
But are responsible for 37% (week days) of road noise

Low noise peaks with LAmax < 70 dB(A) (respect of ECE R51 regulation for Passengers cars)
Represent 2/3 of the number of peaks due to vehicles
But are responsible for only 1/4 of road noise

Range of Pass by level at constant speed of passenger cars



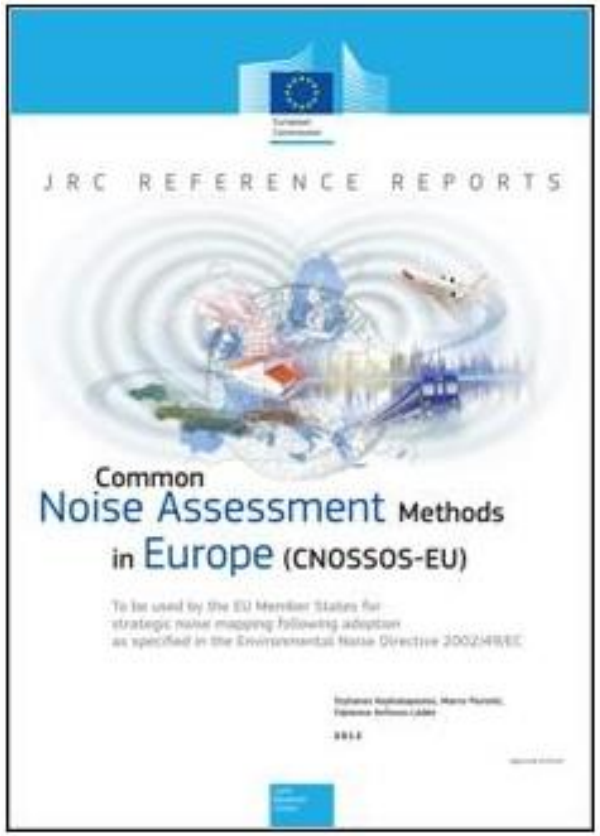


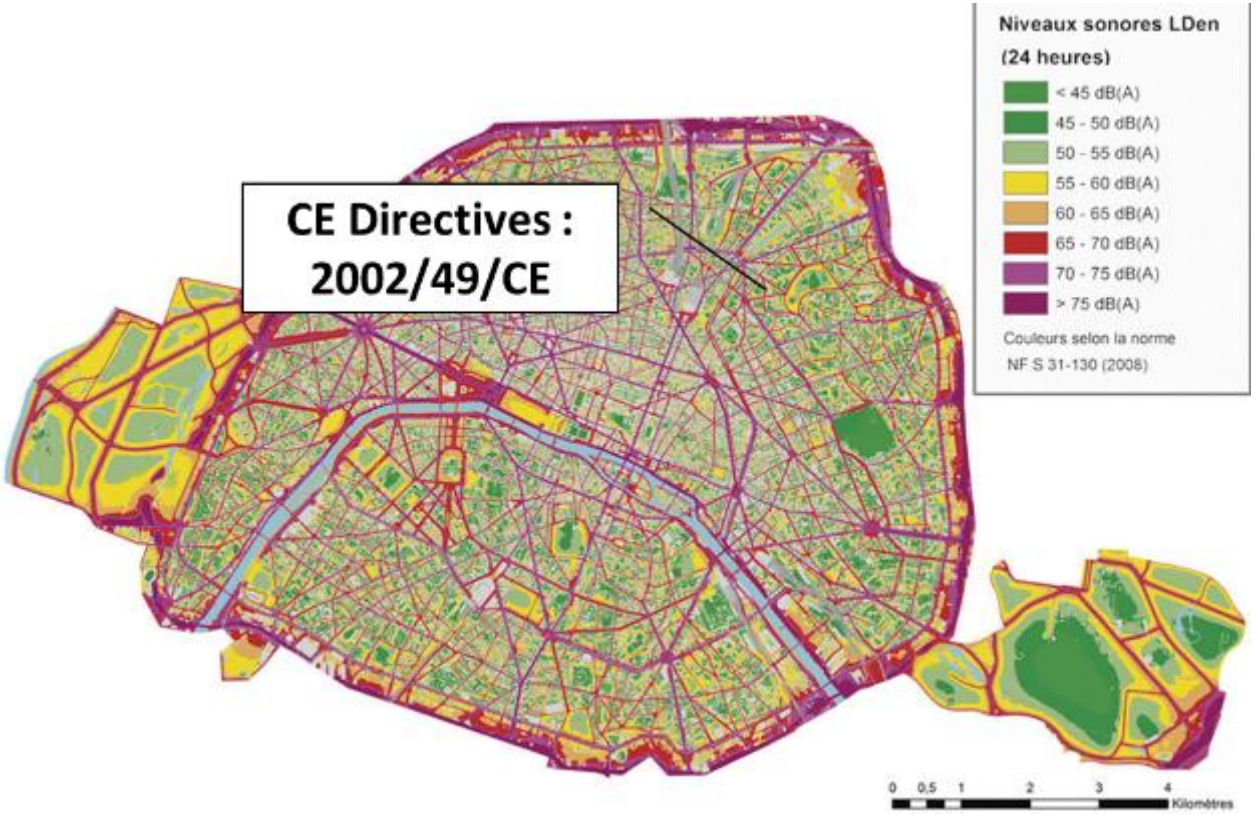
Contribution to global LAeq

We already know that R51 72 or 74 dBA Vehicles in pass by are not major sources today

BRUITPARIF

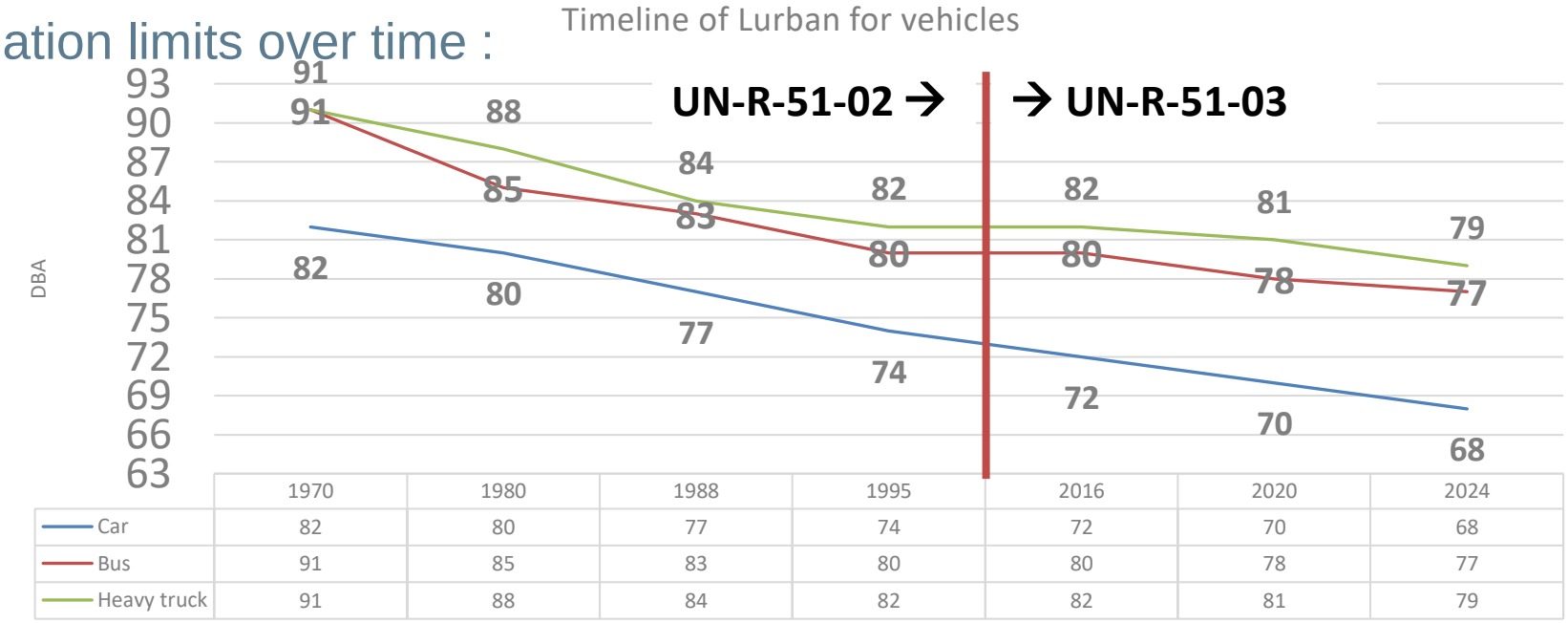
Car noise regulation & Environmental noise regulation





URBAN GROUND VEHICLE SOUNDSCAPE

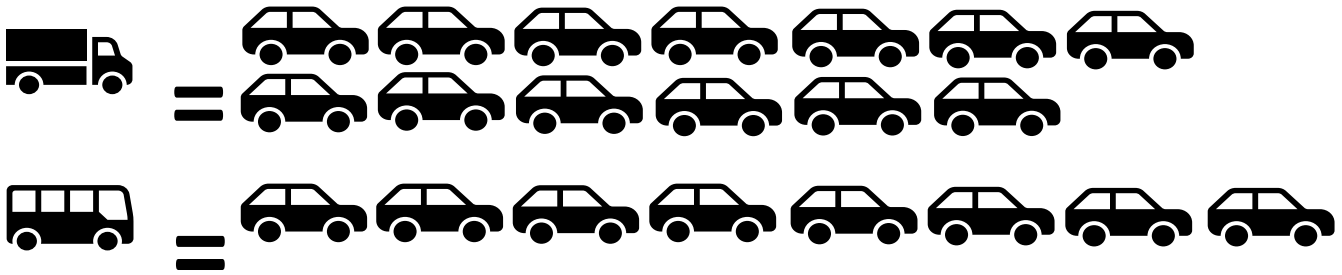
Analysis of regulation limits over time :



	1970	1980	1988	1995	2016	2020	2024
Car	82	80	77	74	72	70	68
Bus	91	85	83	80	80	78	77
Heavy truck	91	88	84	82	82	81	79

In 2024 in France :

Number of trucks x L_{urban} trucks > Number of cars x L_{urban} of cars



Trying to link R 51 Homologation with CNOSSOS for M1 vehicles is Homologation representative of real usage ? Of real modeling ?

	R51	CNOSSOS	CNOSSOS real use	Link ?
Tires	Standard (no stud)			
Vehicle operation	Accelerated (f(PMR))	All accelerations	Not used systematically	
	Constant speed (50 kPH)	All Constant speed	All Constant speed	50 Kph point
External condition	Iso Track	R1/R2/R3	R1/R2/R3	Avg Iso = R1 ??
	Flat	Flat or Slope	Flat or Slope	Flat
		Temperature correction	Temperature correction	Strong influence on tire noise !

Very weak or no connection between vehicle homologation and source description

Yet good correlation between computed maps and measurements

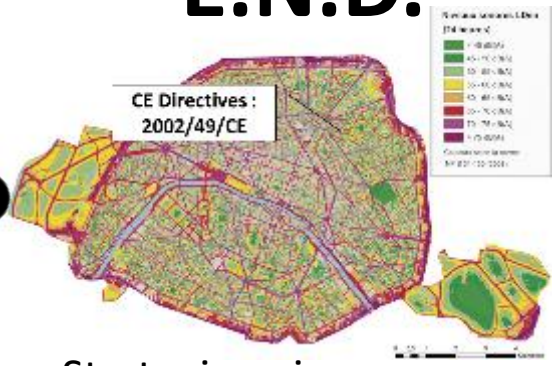
Possible consequences of the global misalignment

Everyone (Car makers and public policies) worked to comply, but citizen complains
And regulations on source becomes tougher for no real effect

R51

Pass by noise regulation

E.N.D.



Strategic noise maps

WORLD

Real soundscape

Public authorities

World Health Organization

Public policies, speed, barriers…

Complaints

Cost, safety tradeoffs

Compliance to R051

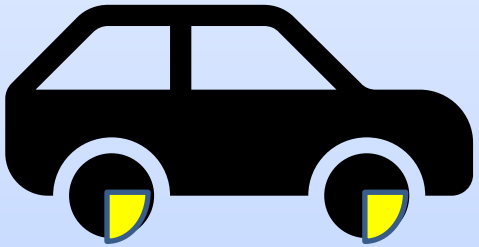
More stringent limits

Deep dive : Technical aspects at car source levels

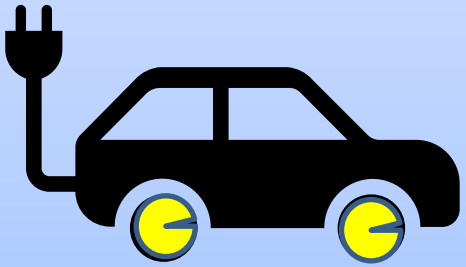
Main impacts of future PBN

Technical insight for future Pass-By Noise Regulation (R051) : Tire/road interaction contribution (for the full PBN test)

→ 2020 :72 dB (Phase 1)

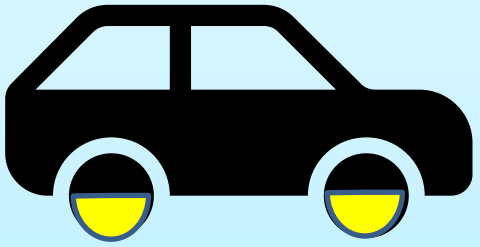


≈25% from Tire/Road contact

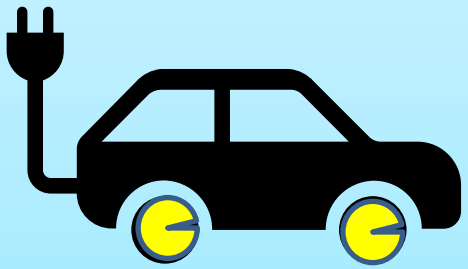


≈90% from Tire/Road contact

→ 2024 :70 dB (Phase 2)

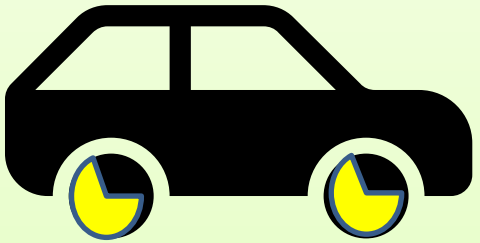


≈50% from Tire/Road contact

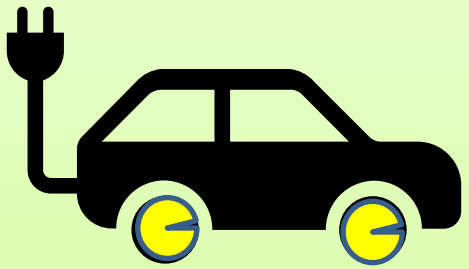


≈90% from Tire/Road contact

2024 → :68 dB (Phase 3)



≈70% from Tire/Road contact

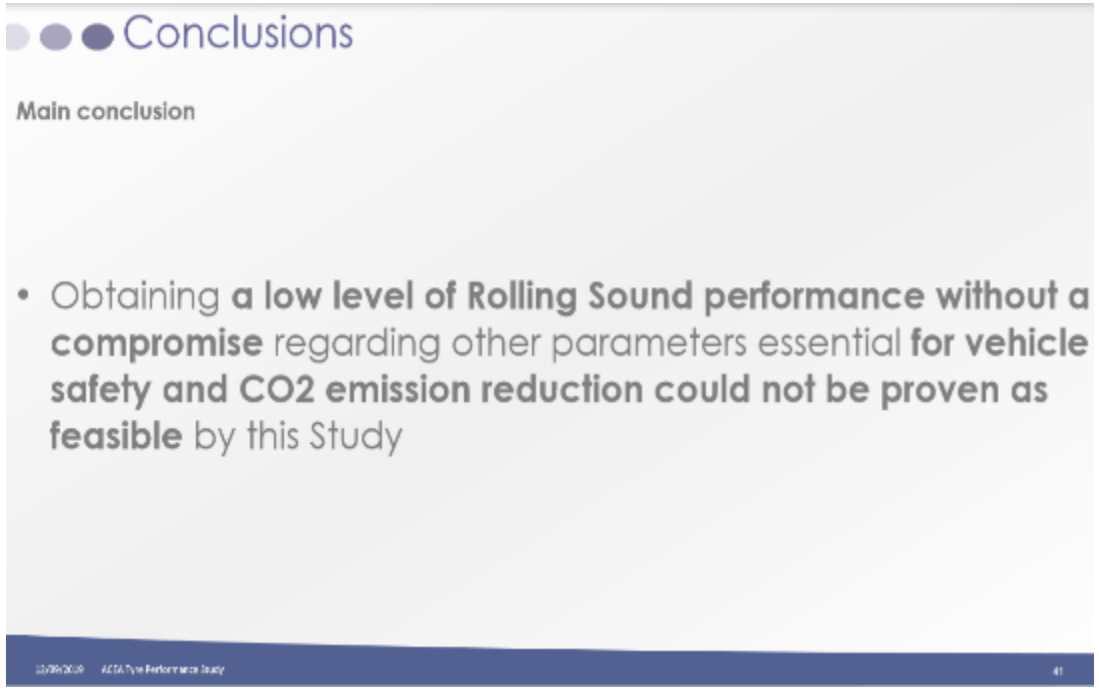


≈90% from Tire/Road contact

(on ISO Tracks in homologation conditions for mean vehicle & mean tire)

Source : Renault, 2020

Tire trade-offs : ACEA/OICA sudy



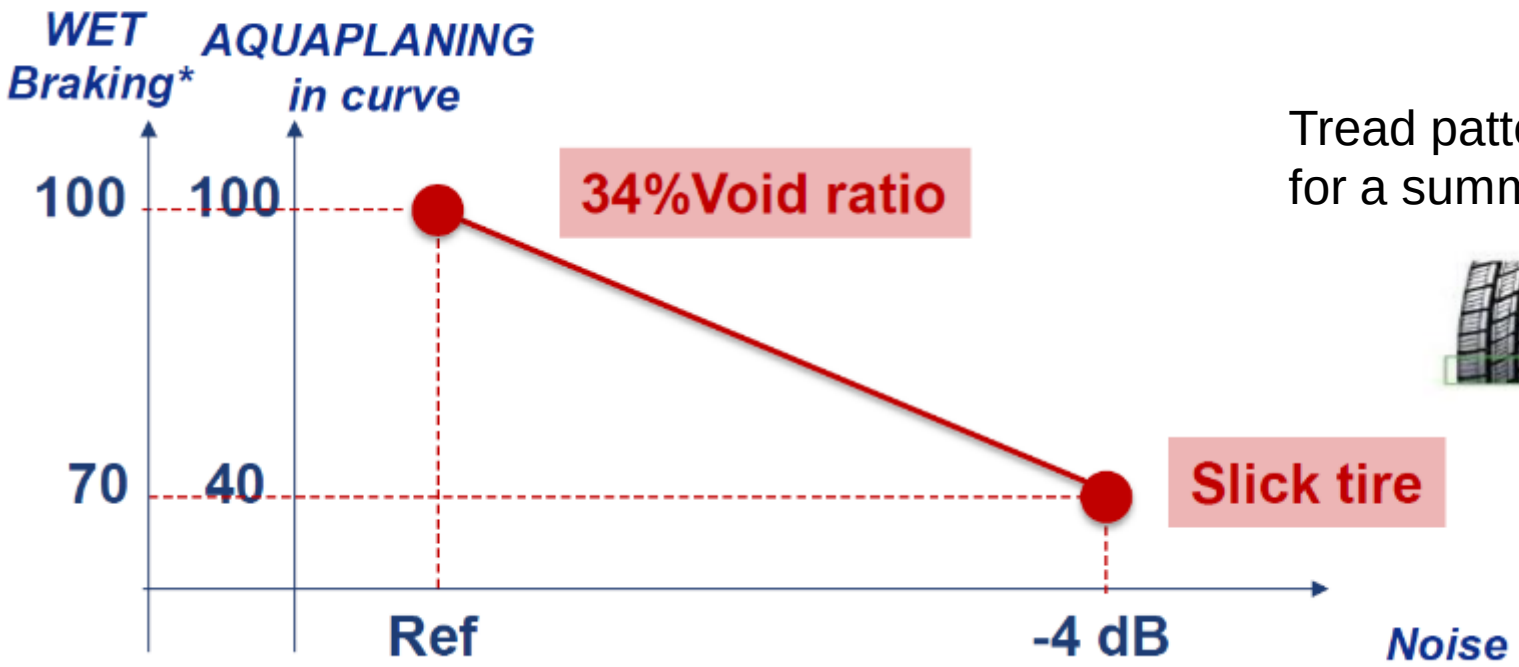
There is a hard limit to tire/road interaction noise

➔ Tradeoff with safety (wet grip, braking…) and emission (C02, Particles)

Tire main tradeoff for noise is Safety

Slick tire is the asymptote for the noise coming from tire sculpture

Void ratio is essential for safety (wet braking and aquaplaning)

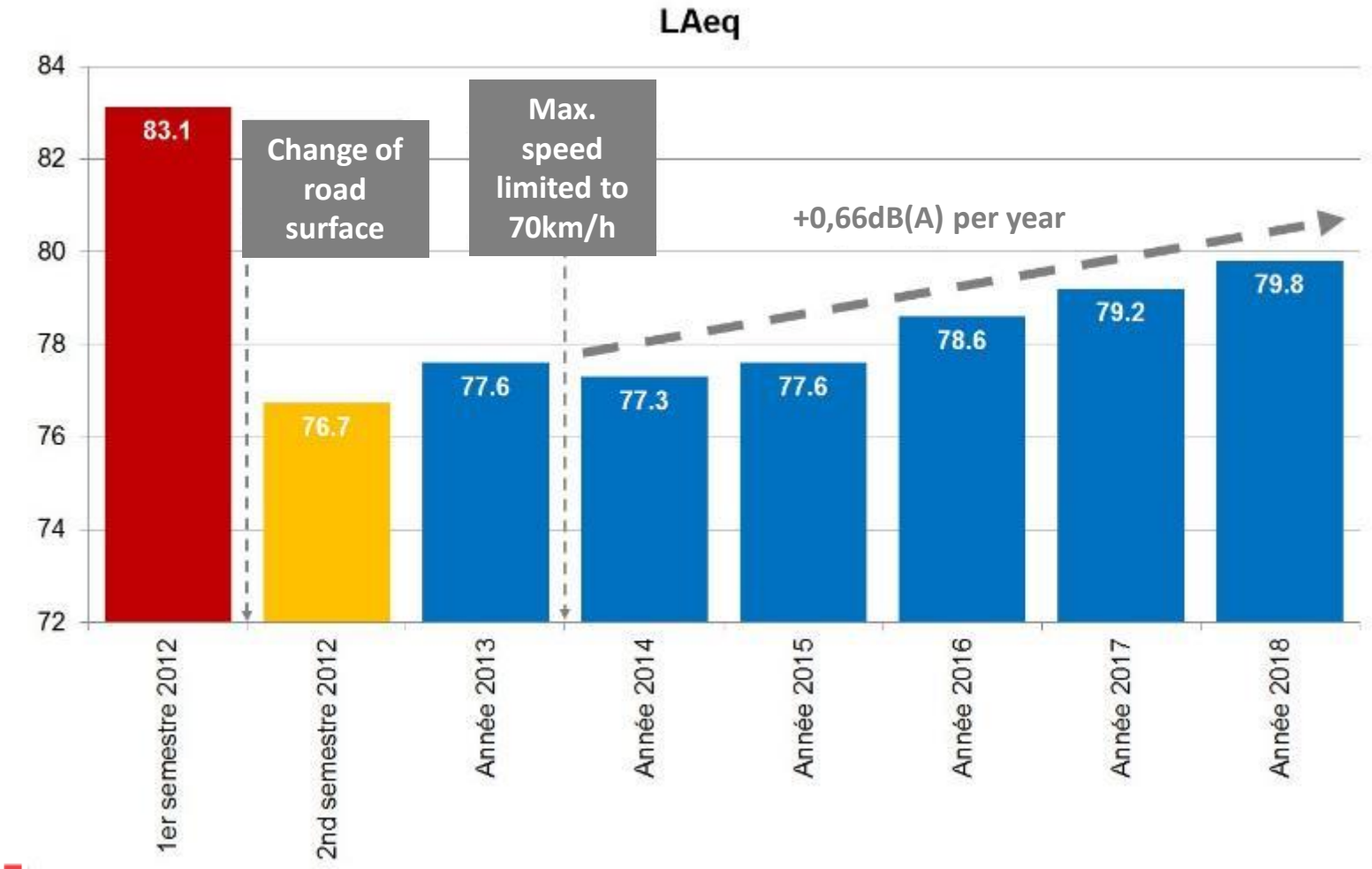


Tread pattern design for a summer tire

Car noise on real world roads

EXAMPLES OF ROAD IMPROVEMENTS FOLLOWED BY BRUITPARIF

Installation of anti-noise road surfaces
Parisian ring road Pte de Vincennes

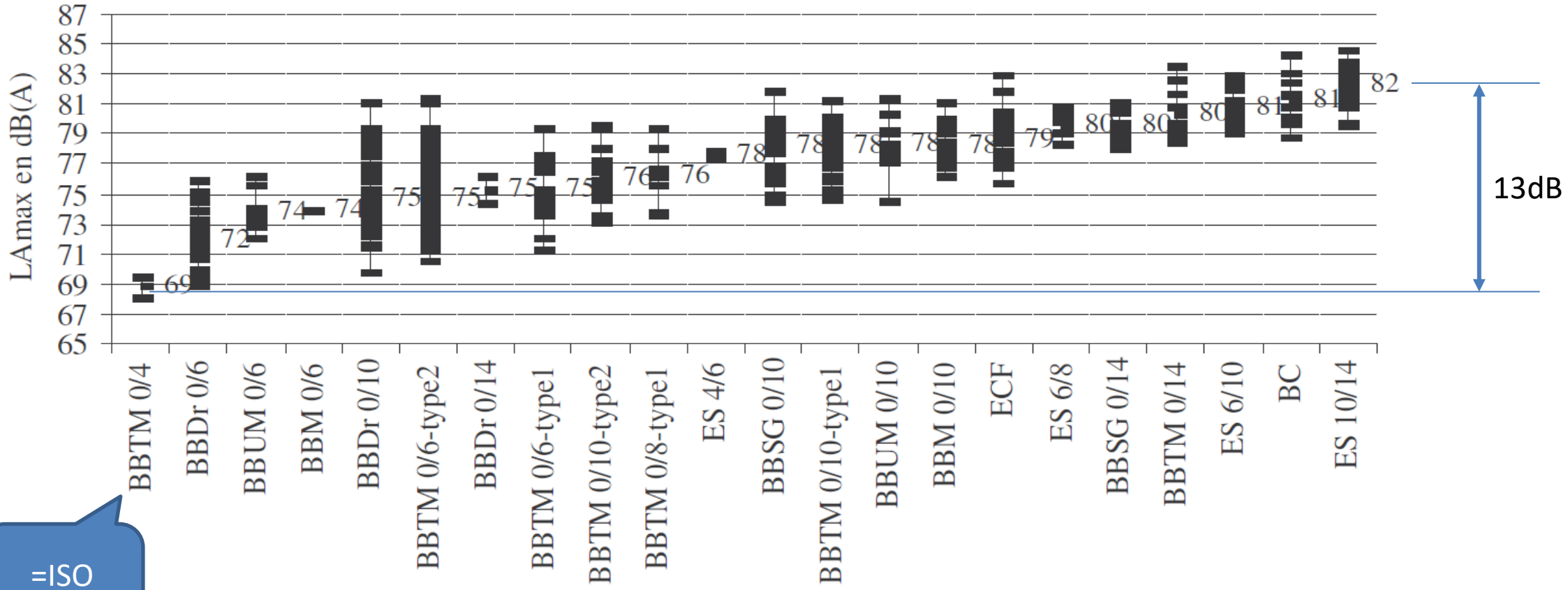


BRUITPARIF

Road noise assessment from vehicles compliant to future PBN requirements on real roads

Road surface & wear impact

Source : CEREMA / DEUFRABASE data



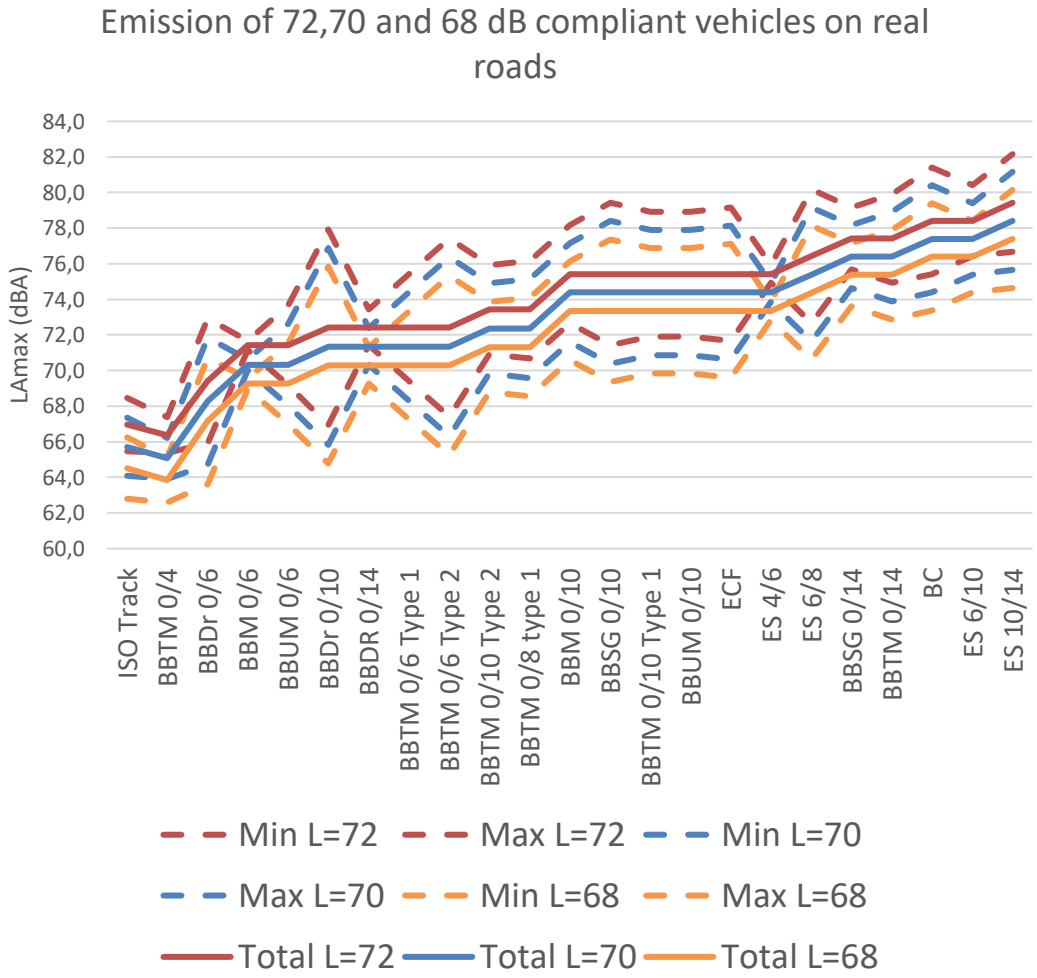
=ISO Track

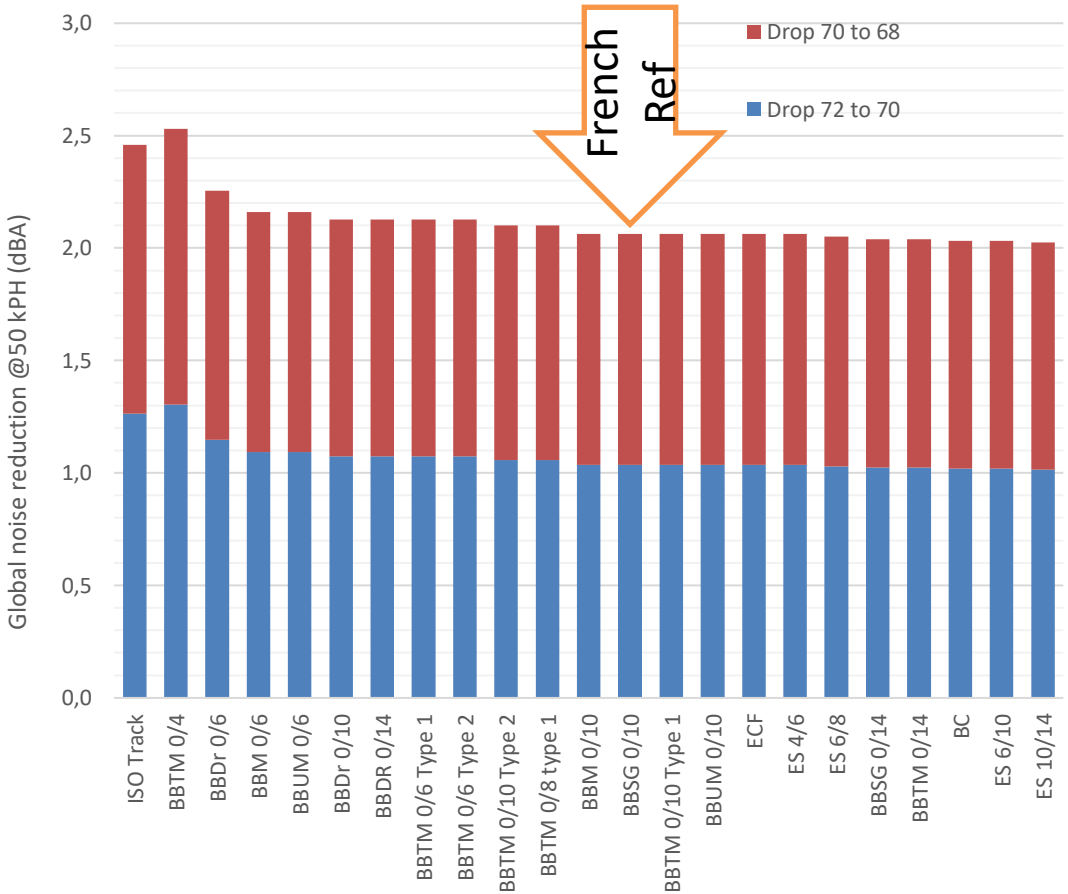
Sigma (road type + state) = 4,2 dB

ISO track = best road then 50% chance that real world = +8dB

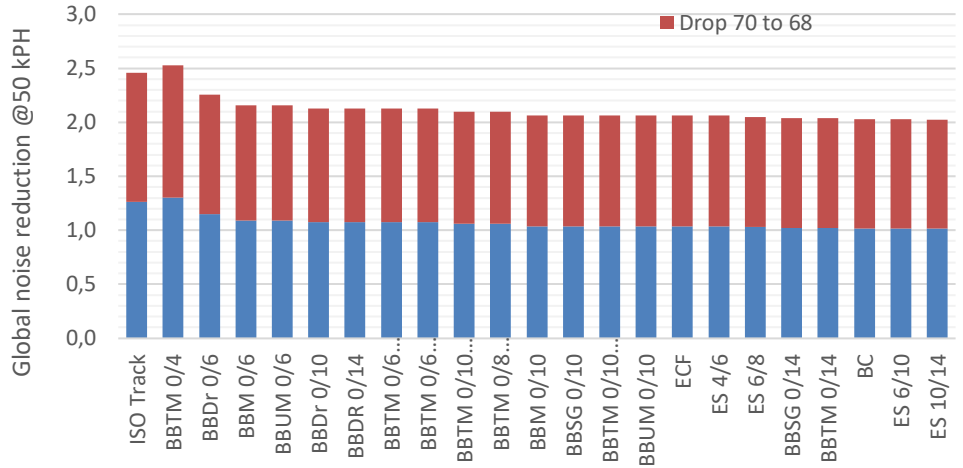
Results : projected levels for nominal vehicle @ Constant Rolling Speed

Levels are dropping of 1,25 dB on ISO track for each regulation step, And about 1 dB for all kind of roads (at 50 kph steady speed) / Source : WG SIA 2020





Assesment of impact of compliant vehicles on real roads @ constant rolling speed

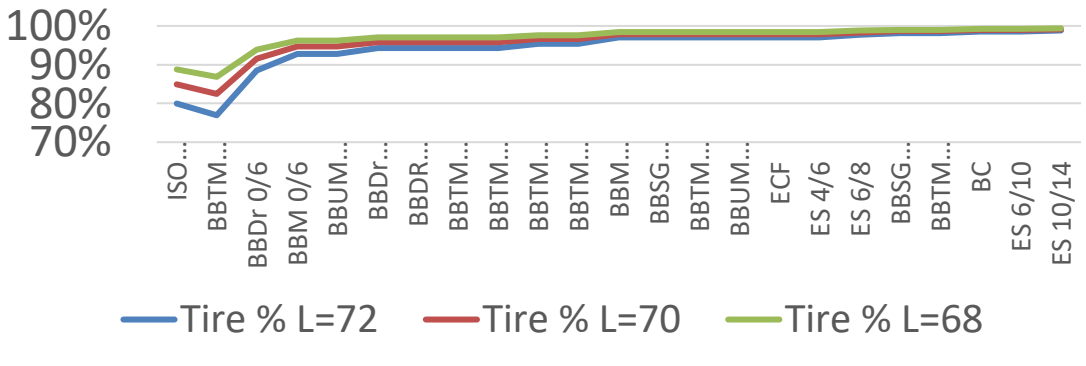


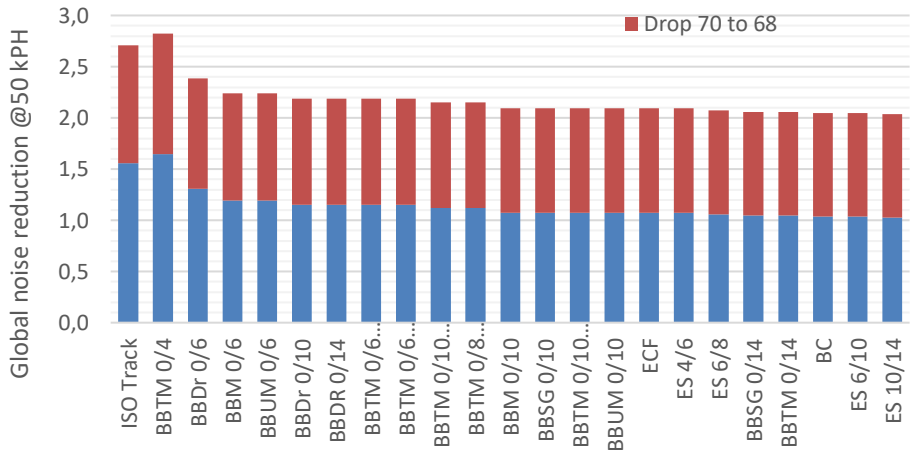
Best tire, nominal vehicle (-2,5 ; -5 dB)

Gain on ISO track : 1,2 dB/ step

Gain on all roads ≈ 1dB / step

dependancy to tire/road interaction noise



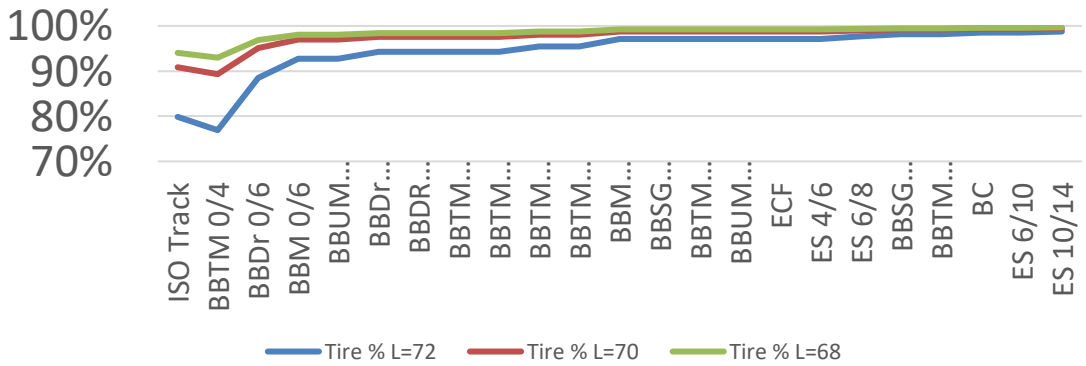


Best tire, **improved vehicle** (-5 ; -8dB)

Gain on ISO track : 1,5 dB – 1,2dB / step

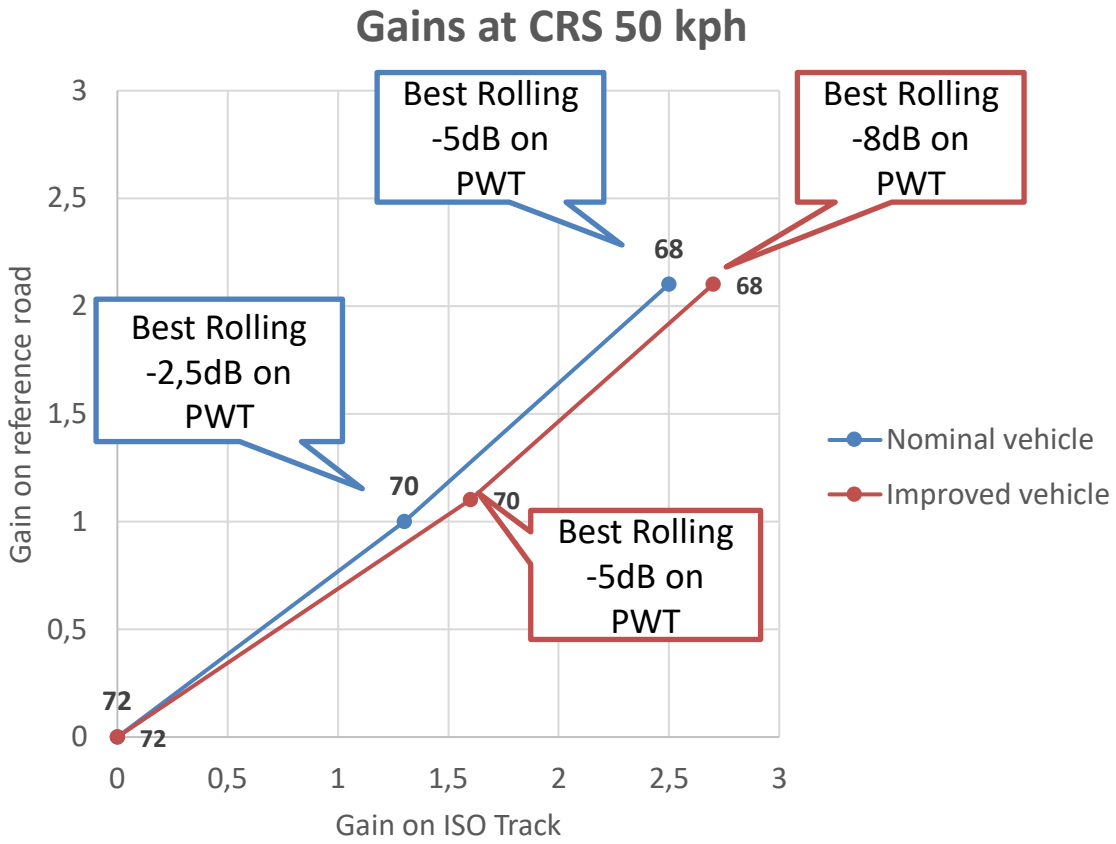
Gain on all roads ≈ 1dB / step

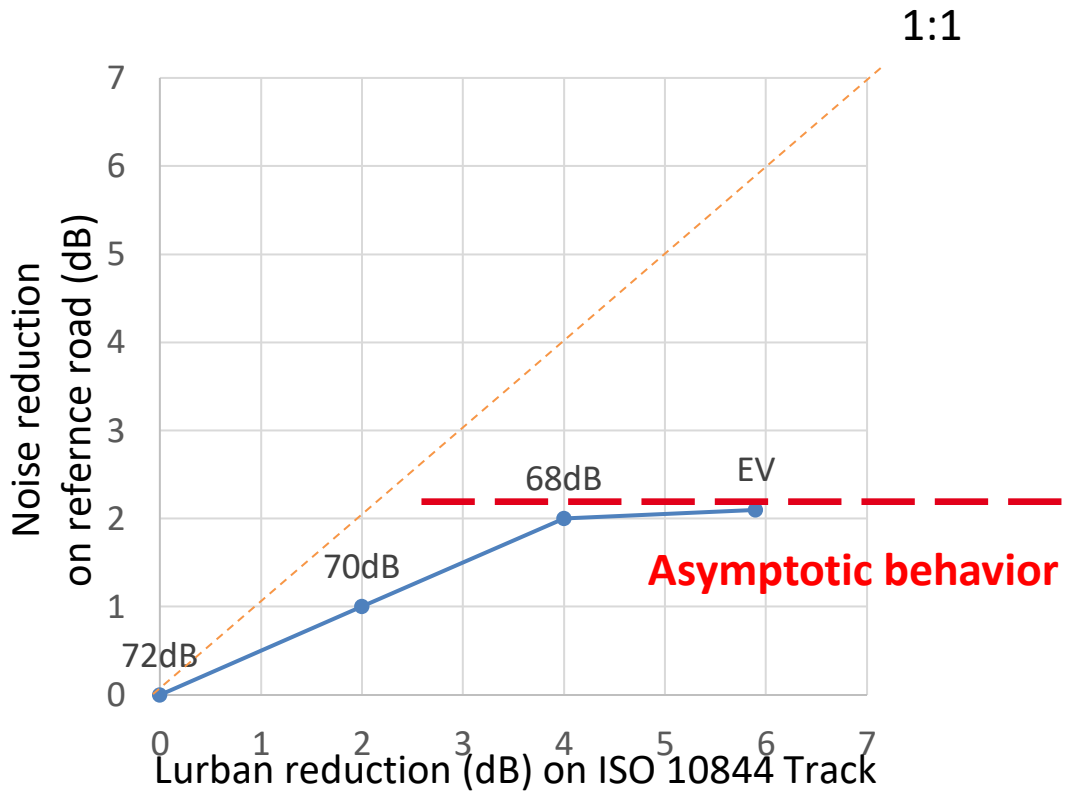
dependancy to tire/road interaction noise



Rolling noise dependancy becomes so high that even huge efforts on vehicle build have no impact on real roads

Global efficiency & asymptotic behavior :
Going below 68 dB is useless





5dB on PWT, 2dB on tire → 4dB on Lurban → 2,5 dB on track → 2 dB on road

8dB on PWT, 2dB on tire → 4dB on Lurban → 2,6 dB on track → 2 dB on road

Conclusions : real road assessments

Rolling noise is so dominant that

1) improving other sources has no effect when tire/road is at its best => 4 dB improvement of Lurban would lead to 2dB reduction on reference roads (-37%) way below road variability (13dB)
2) tire and vehicle already reduced and are now cin the asymptote
3) Working on road surface has a much better efficiency (-6dB) (-75%) (see report of Bruiparif on Periphérique)