INTERNATIONAL UNION
OF RAILWAYS

UIC Railway Noise Days

2025

Agenda

09:00 – 09:30	**Welcome addresses & introduction** • **Jakob Oertli (SBB) Chair of UIC Noise and Vibration Sector**
09:30 – 10:00	Seating Arrangement & Division in Groups
10:00 – 10:30	Interactive debates - Session 1 Debaters: Bart Van Damme (EMPA) Jenny Böhm (DZSF) • Which has a higher potential for noise mitigation: the vehicle or the track?
10:30 – 11:00	Coffee break
11:00 – 11:30	Interactive debates - Session 2 Debaters: Ard Kuijpers (M+P) Rüdiger Garburg (DB) • Have the railways undertaken enough to reduce noise?
11:30 – 12:00	Interactive debates - Session 3 Debaters: Lorenzo Franzoni (UIC) Franck Poisson (SNCF) • Should railways promote higher or lower noise limit values along railway lines?
12:00 – 12:30	Interactive debates - Session 4 Debaters: Pınar Yılmazer (UIC) Alf Ekblad (TRV) • Should railways promote or attempt to prevent construction next to railway lines?
12:00 – 12:30	General discussion and debates recap
12:30 – 14:00	Lunch Break & Sponsors Booths

SUSTAINABILITY
Action Week

Agenda

14:00 – 15:00	**Global Framework | Railway noise management and maintenance** • Vytaute Bacianskaite, Directorate-General for Environment (DG ENV) of the European Commission • Sandy Zaehringer, Directorate-General for Mobility and Transport (DG MOVE) of the European Commission • Ethem Pekin, Community of European Railway and Infrastructure Companies (CER) • Bertrand Goalou and Carlito (Bing) Mendoza Rufo Jr. Asian Development Bank
15:00 – 15:20	Coffee break | ERJU QuieterRail

15:20 – 16:45	**ERJU-QuieterRail | On-board roughness measurements and rail grinding**
	• Acoustic rail roughness as a noise control measure - Baldrik Faure (SNCF)
	• Points of view in terms of on-board measurements
	  ○ Supplier perspective - Ard Kuijpers (M+P)
	  ○ Research perspective - Luis Baeza (UPV)
	• Rail grinding & annoyance: UIC ACORD - Juliette Florentin (Infrabel)
	• The EU-QuieterRail WP3 approach: How you can participate - Pınar Yılmazer (UIC)

16:45 – 17:15	Summary and closing session “Reflections on more than 30 years in the railway noise business: Personal observations and lessons learned” Jakob Oertli (SBB) Chair of UIC Noise Vibration Sector
18.00 – 20.00	Networking drinks and reception (Atrium)

This project has received funding from the European Union’s Horizon Europe research and innovation programme under Grant Agreement No 101176865.

1

WHICH HAS A HIGHER POTENTIAL FOR NOISE MITIGATION:

VEHICLE OR TRACK?

3

Bart Van Damme

Scientist at Laboratory for

Acoustics/Noise Control

Swiss Federal Laboratories for Materials

Science and Technology (EMPA)

Jenny Böhm

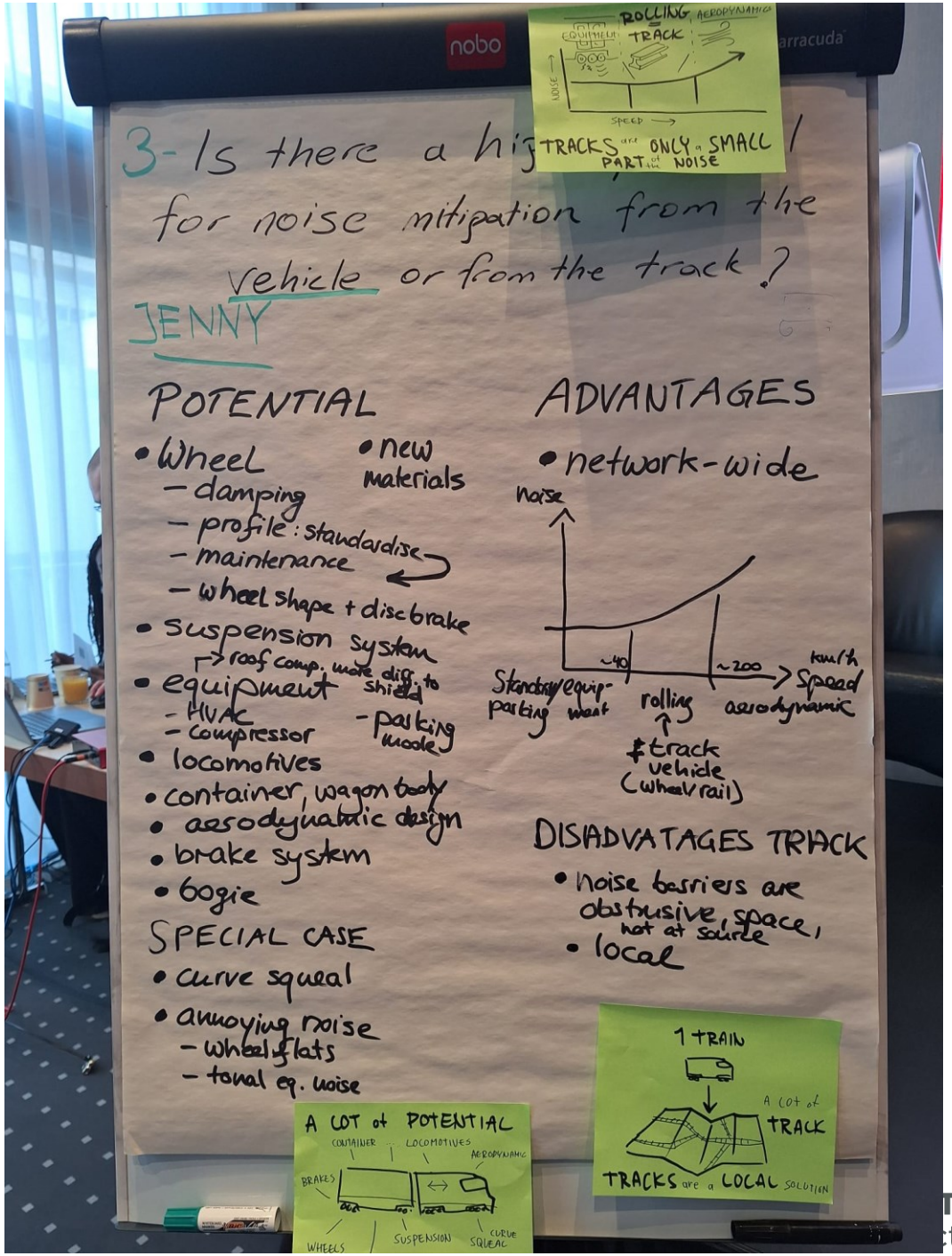
Scientific Consultant for

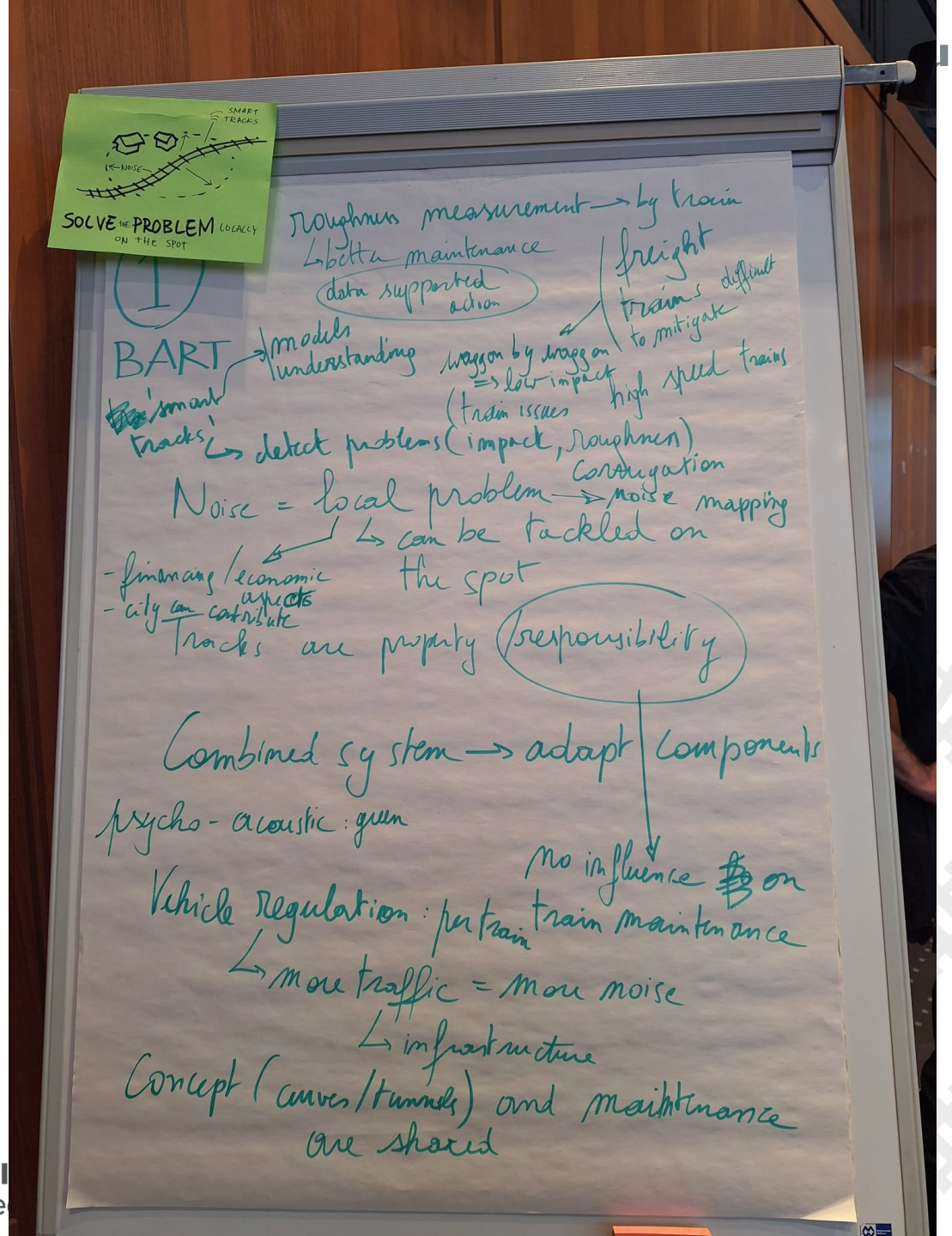
Railway Noise and Vibration

German Centre for Rail Traffic Research at

the Federal Railway Authority (DZSF)

SUSTAINABILITY
Action Week


nobo
3- Is there a hig
for noise mitigation from the
vehicle or from the track?
JENNY
POTENTIAL
• Wheel
– damping
– profile: standardise
– maintenance
– wheel shape + disc brake
• suspension system
↳ roof comp. more diff. to shield
• equipment
– HVAC
– compressor
– parking mode
• locomotives
• container, wagon body
• aerodynamic design
• brake system
• bogie
• new materials
SPECIAL CASE
• curve squeal
• annoying noise
– wheel flats
– tonal eq. noise
ADVANTAGES
• network-wide
noise
~40
~200
km/h
Speed
Standby/equip-parking
equip-ment
rolling
aerodynamic
track vehicle (wheel/rail)
DISADVATAGES TRACK
• noise barriers are obstrusive, space, not at source
• local
ROLLING TRACK
AERODYNAMIC
EQUIPMENT
NOISE
SPEED
TRACKS are ONLY a SMALL PART of the NOISE
A LOT of POTENTIAL
CONTAINER
LOCOMOTIVES
AERODYNAMIC
BRAKES
WHEELS
SUSPENSION
CURVE SQUEAL
1 TRAIN
A LOT of TRACK
TRACKS are a LOCAL SOLUTION


SMART TRACKS
NOISE
SOLVE the PROBLEM LOCALLY ON the SPOT
1
Roughness measurement → by train
↳ better maintenance
data supported action
BART → models understanding
'smart tracks'
↳ detect problems (impact, roughness)
wagon by wagon ⇒ low impact
freight trains difficult to mitigate
high speed trains
(train issues
corrugation
Noise = local problem → noise mapping
↳ can be tackled on the spot
- financing / economic aspects
- city can contribute
Tracks are property
responsibility
Combined system → adapt components
psycho-acoustic: green
Vehicle Regulation: per train
no influence on train maintenance
↳ more traffic = more noise
↳ infrastructure
Concept (curves/tunnels) and maintenance are shared

2

Ard Kuijpers

CEO and Senior Consultant

M+P

HAVE THE RAILWAYS UNDERTAKEN ENOUGH TO REDUCE NOISE?

4

Rüdiger Garburg

Senior Consultant

Noise and Vibrations

Deutsche Bahn AG

Center of Competence Rail Technology

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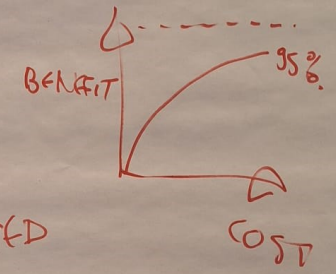
nobo Barracuda

YES!

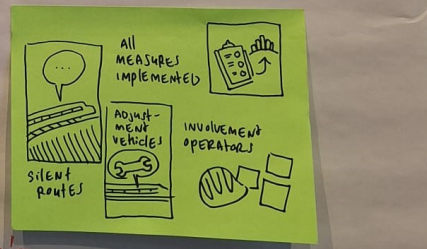
2- Have the Railways Undertake Enough to Reduce Noise?

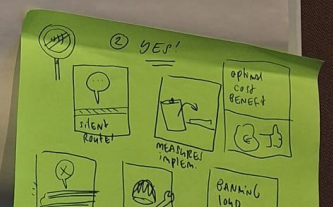
ARD

- BANNING CAST IRON BRAKES
- QUIETER ~~SILENT~~ ROUTES
- TRACK ACCES CHARGES.



- ALL MEASURES IMPLEMENTED
  - BARRIERS
  - PREVENTIVE GRINDING / MAINTENANCE
- VEHICLES
  - BRAKES.
  - TSI - rolling
    - equipment
- involvement of im's and operators.
- friction modifier
- cost benefit is optimal now
  - +1dB = €€€



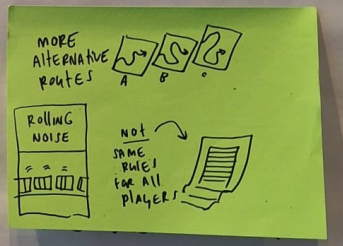


nobo Piranha

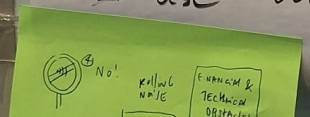
- noise > WHO recom.
- there are a lot of complaints

RÜDIGER

- build alternatives / detour routes & tunnels
- introduce / improve "acoustic" maintenance
- reduce speed / night bans.
- focus / speed up work on existing tracts / trains
- reduction needed from track maintenance operation & yellow machines
- shunting yards
- rolling noise ✓ ⇒ focus
- technical solutions ✓ → legal, financial, organisational → obstacles



- fair / same rules for all market players "RENFE" vs. "IRYO" vs. "..."
- use "bonus system" in technical spec. for trains → track charges



5

Lorenzo Franzoni

Sustainability Advisor

UIC

SHOULD RAILWAYS PROMOTE HIGHER OR LOWER NOISE LIMIT VALUES ALONG RAILWAY LINES?

7

Franck Poisson

Manager at the Rolling Stock Engineering Center

SNCF Voyageurs

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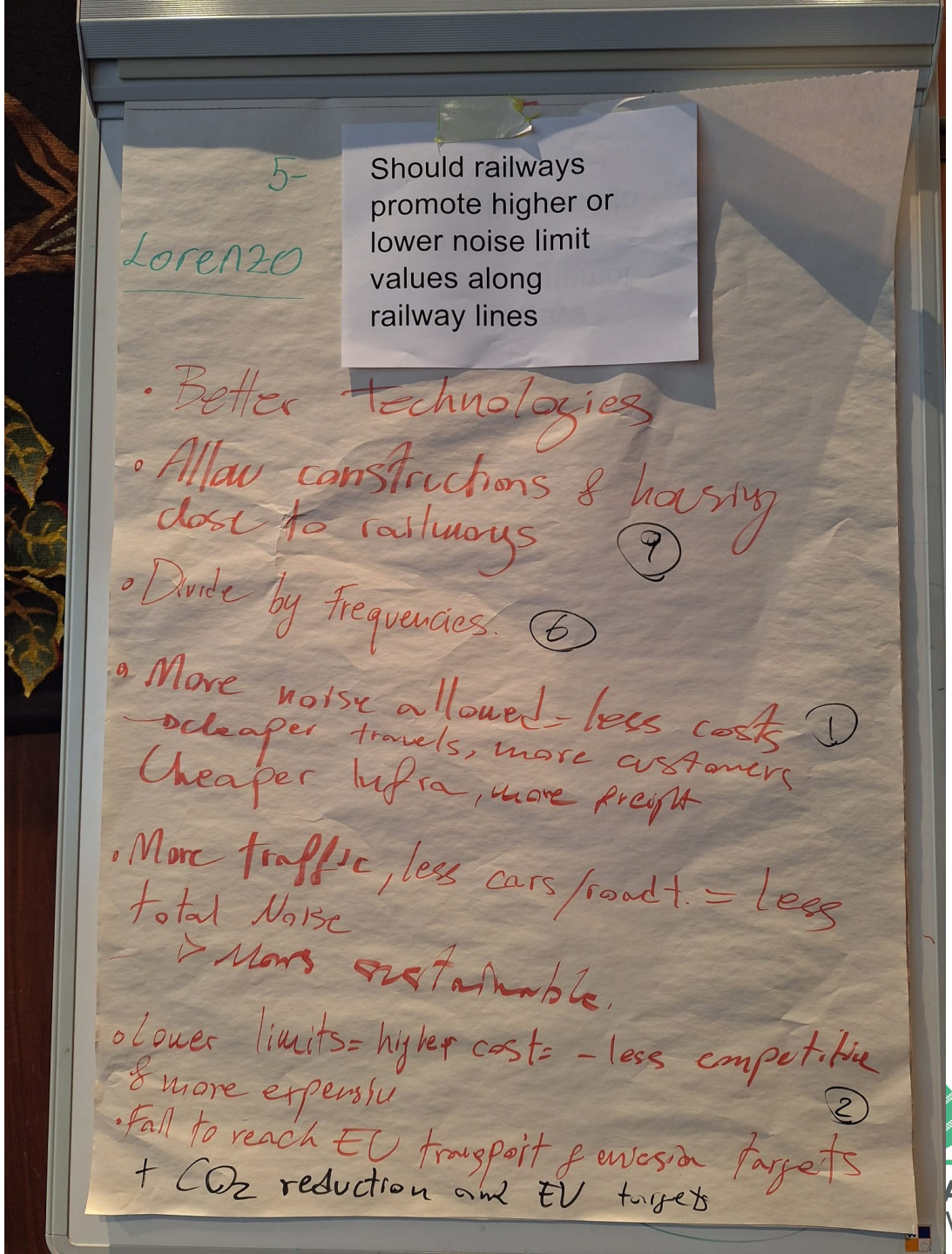
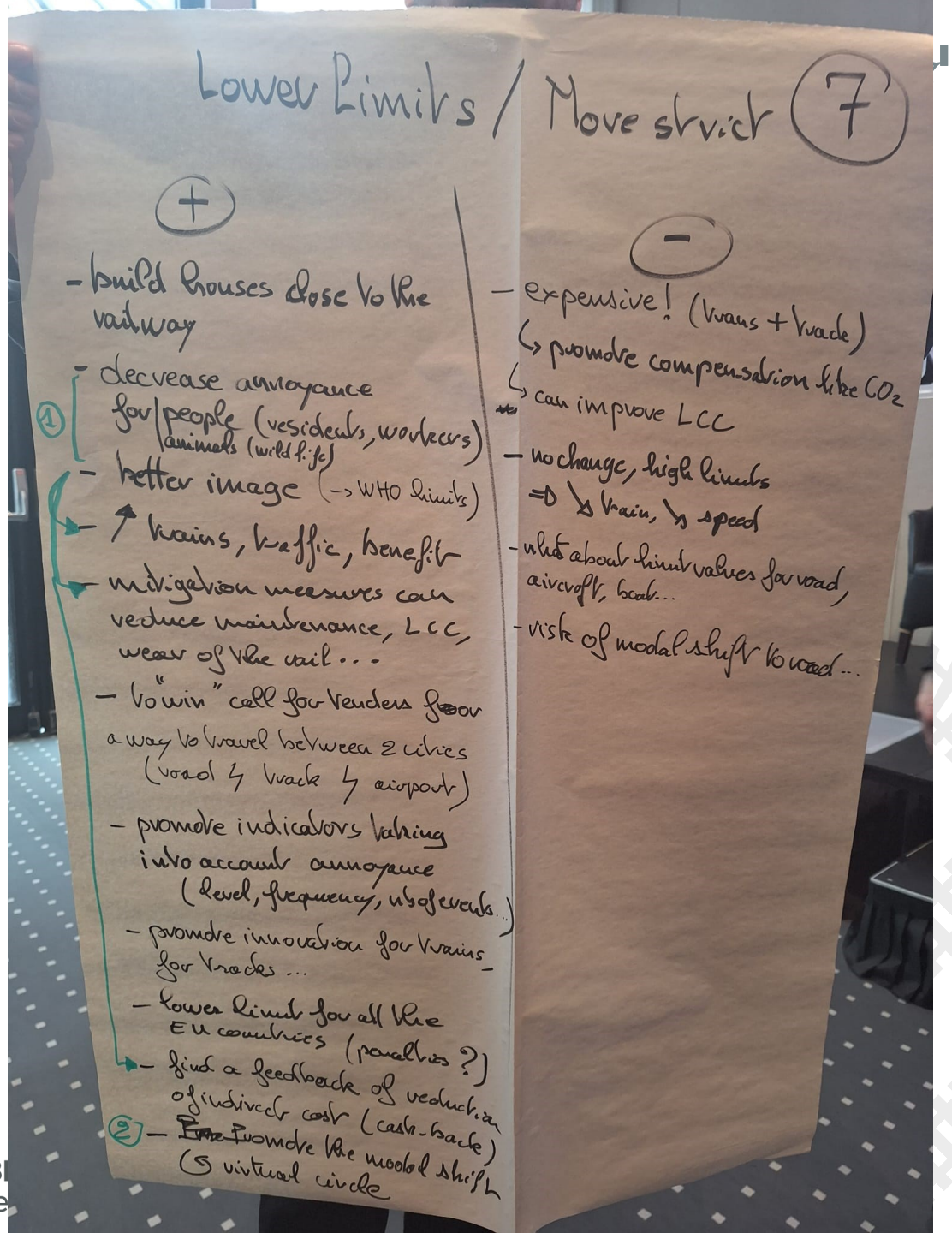

5-
Should railways promote higher or lower noise limit values along railway lines
Lorenzo
• Better technologies
• Allow constructions & housing close to railways (9)
• Divide by frequencies. (6)
• More noise allowed = less costs (1)
→ cheaper travels, more customers
Cheaper infra, more freight
• More traffic, less cars/road. = less total Noise
→ More sustainable.
• Lower limits = higher cost = - less competitive & more expensive (2)
• Fail to reach EU transport & emission targets + CO2 reduction and EV targets


Lower Limits / Move strict (7)
+
- build houses close to the railway
- decrease annoyance for people (residents, workers) animals (wild life) (1)
- better image (-> WHO limits)
↗ trains, traffic, benefit
- mitigation measures can reduce maintenance, LCC, wear of the rail...
- to "win" call for tenders favor a way to travel between 2 cities (road ↯ track ↯ airport)
- promote indicators taking into account annoyance (level, frequency, use of events...)
- promote innovation for trains for tracks...
- lower limit for all the EU countries (penalties?)
- find a feedback of reduction of indirect cost (cash-back) (2)
- promote the modal shift
(5 virtual circle
-
- expensive! (trains + track)
↳ promote compensation like CO2
↳ can improve LCC
- no change, high limits
⇒ ↘ train, ↘ speed
- what about limit values for road, aircraft, boat...
- risk of modal shift to road...

6

Pınar Yılmazer

Head of Sustainability Programme

UIC

SHOULD RAILWAYS PROMOTE OR ATTEMPT TO PREVENT CONSTRUCTION NEXT TO RAILWAY LINES?

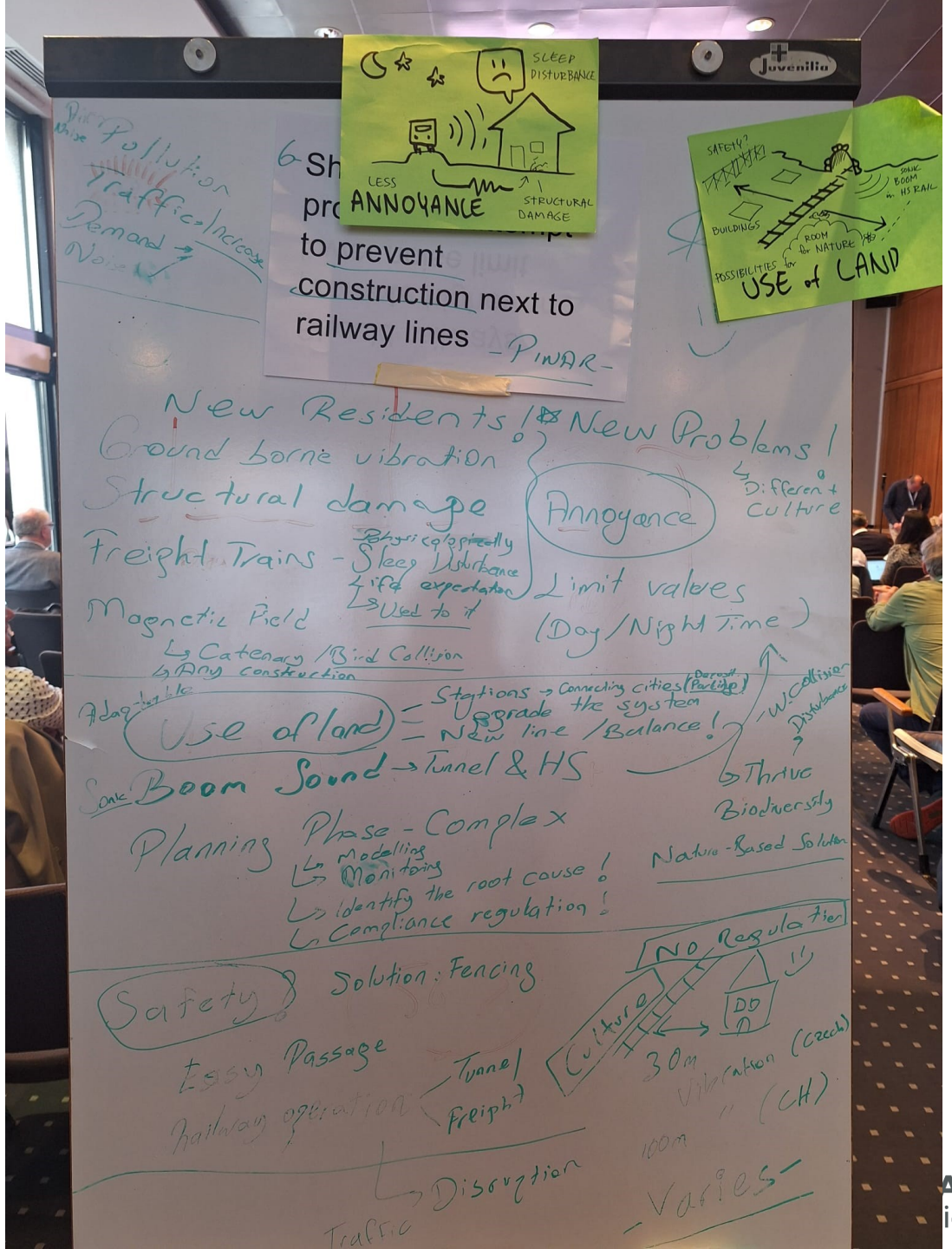
8

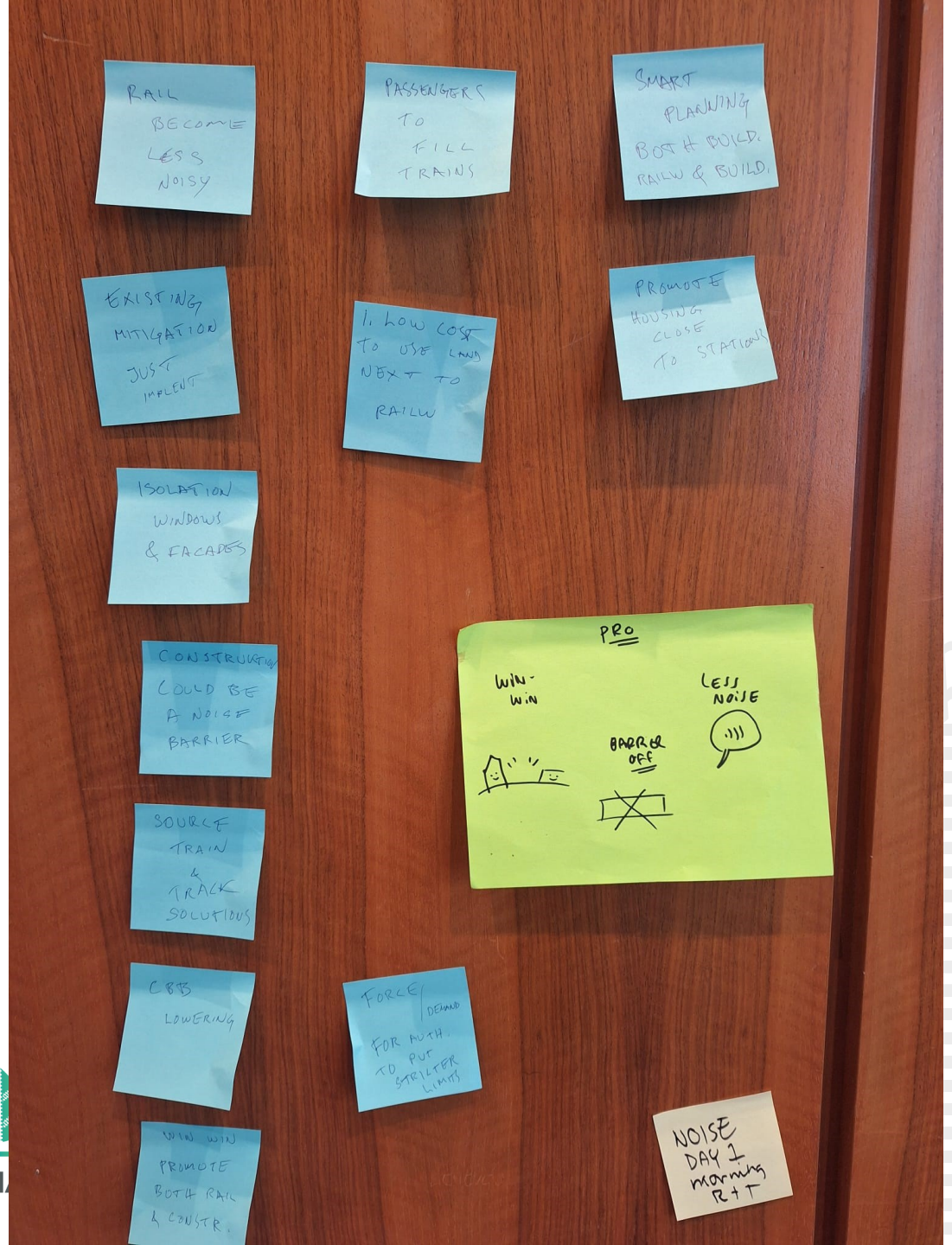
Alf Ekblad

Senior Specialist Vibration
UIC Noise Vibration Chair

Swedish Transport Administration (Trafikverket)

SUSTAINABILITY
Action Week


SLEEP DISTURBANCE
LESS ANNOYANCE
STRUCTURAL DAMAGE
SAFETY?
BUILDINGS
ROOM OF NATURE
POSSIBILITIES for USE of LAND
to prevent construction next to railway lines
-PINAR-
New Residents! New Problems!
Ground borne vibration
Structural damage
Annoyance
Different culture
Freight Trains - Sleep Disturbance
Limit values (Day/Night Time)
Magnetic Field
Catenary / Bird Collision
Any construction
Use of land
Stations → Connecting cities
Upgrade the system
New line / Balance!
Boom Sound → Tunnel & HS
Thrive Biodiversity
Planning Phase - Complex
Modelling
Monitoring
Identify the root cause!
Compliance regulation!
Nature-Based Solution
Safety
Solution: Fencing
Easy Passage
Railway operation
Tunnel / Freight
Disruption
Traffic
No Regulation
Culture
30m
Vibration (Czech)
(CH)
100m
-Varies-


RAIL BECOME LESS NOISY
PASSENGERS TO FILL TRAINS
SMART PLANNING BOTH BUILD. RAILW & BUILD.
EXISTING MITIGATION JUST IMPLEMT
1. LOW COST TO USE LAND NEXT TO RAILW
PROMOTE HOUSING CLOSE TO STATION
ISOLATION WINDOWS & FACADES
PRO
WIN-WIN
LESS NOISE
BARRIER OFF
CONSTRUCTION COULD BE A NOISE BARRIER
SOURCE TRAIN & TRACK SOLUTIONS
CBB LOWERING
FORCE DEMAND FOR AUTH. TO PUT STRICTER LIMITS
WIN WIN PROMOTE BOTH RAIL & CONSTR.
NOISE DAY 1 morning R+T

GENERAL DISCUSSION AND RECAP

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MÜLLER-BBM RAIL TECHNOLOGIES

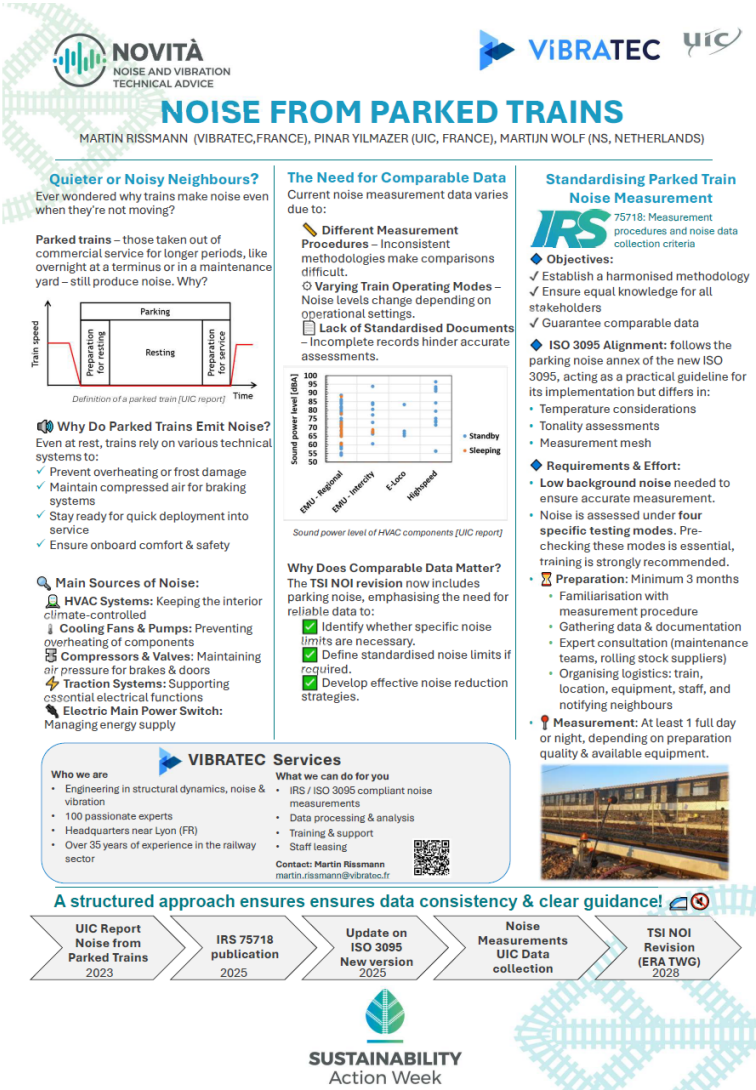
Schrey & Veit
Solutions for silence

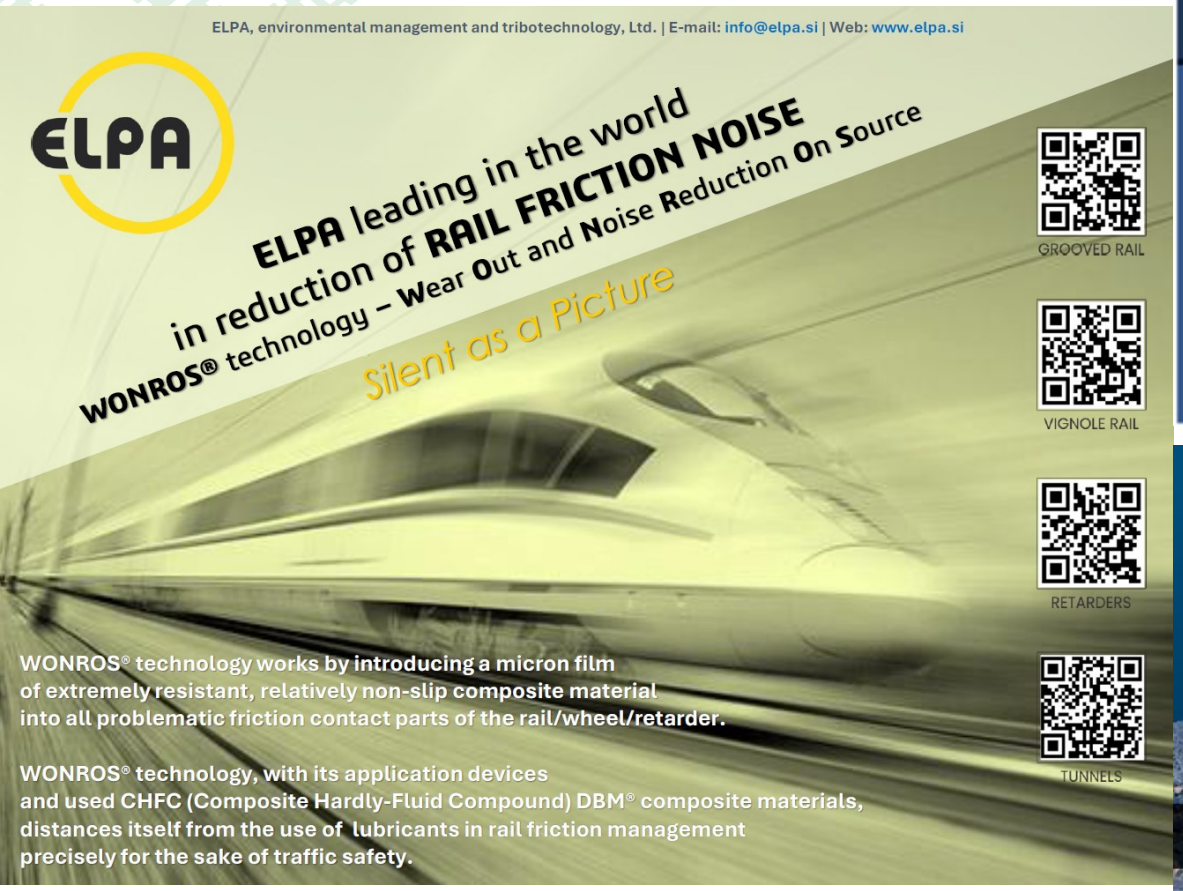
ELPA

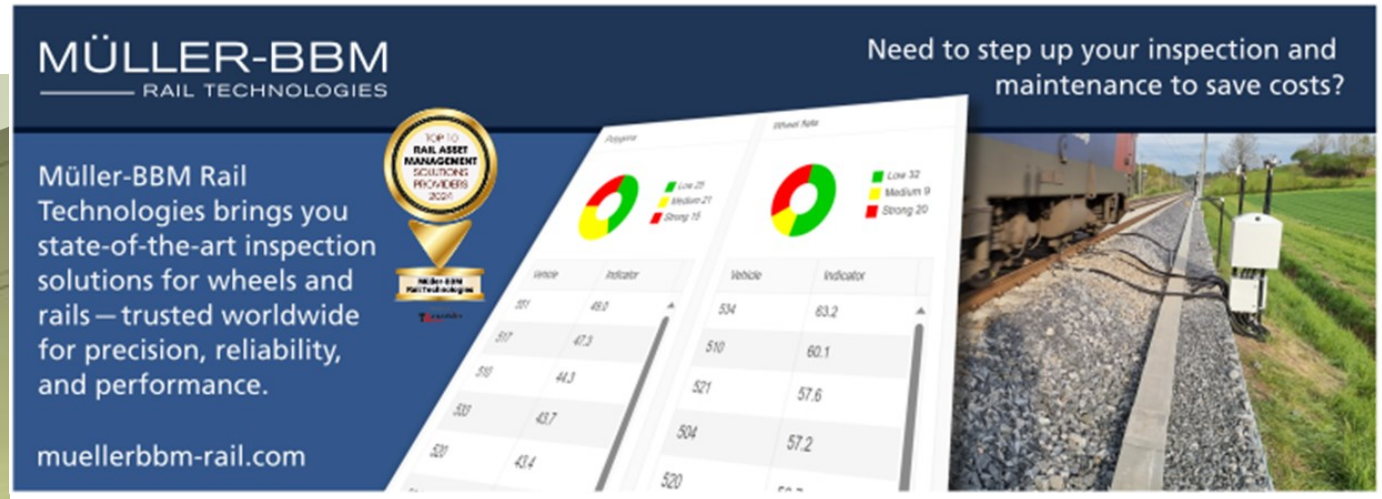
AtkinsRéalis

NEEL®

renfe







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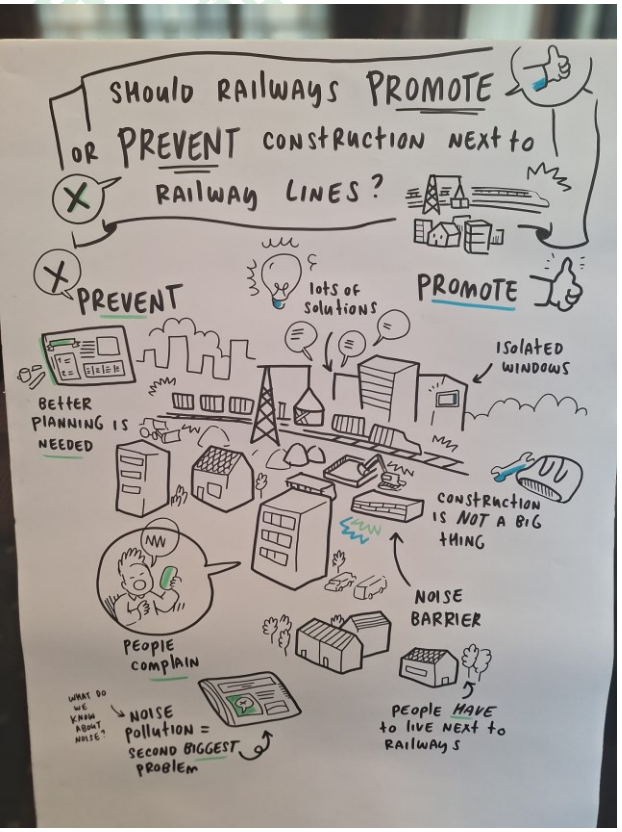
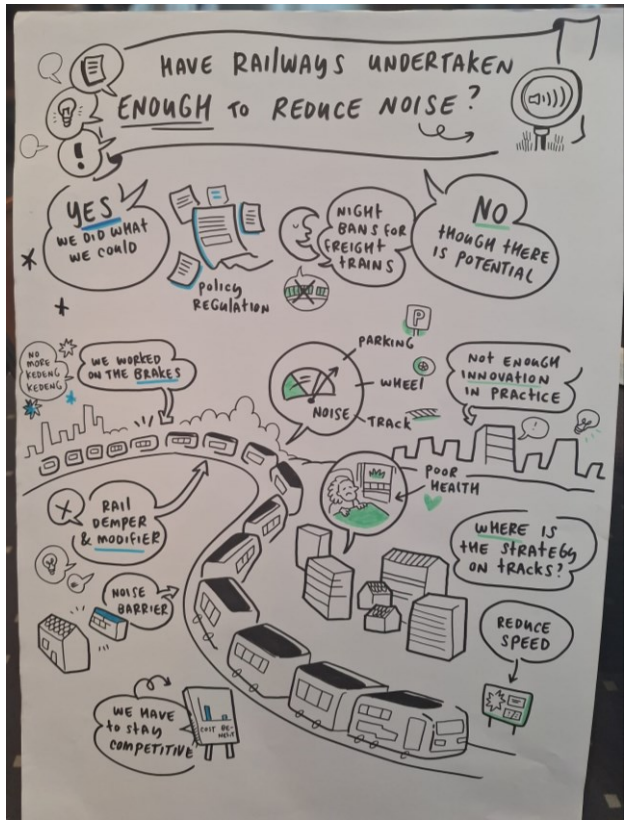
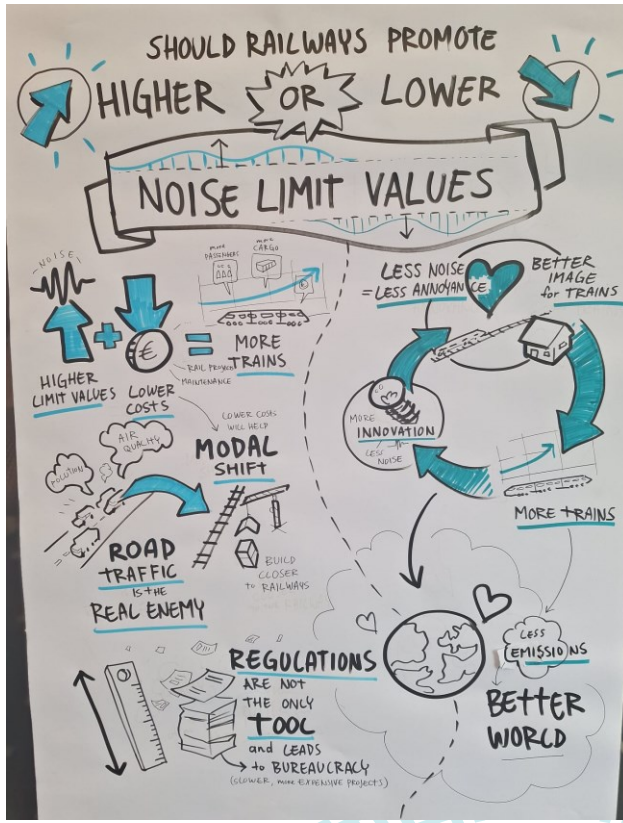

SHOULD RAILWAYS PROMOTE
OR PREVENT CONSTRUCTION NEXT TO
RAILWAY LINES?
PREVENT
PROMOTE
lots of solutions
ISOLATED WINDOWS
BETTER PLANNING IS NEEDED
CONSTRUCTION IS NOT A BIG THING
NOISE BARRIER
PEOPLE COMPLAIN
PEOPLE HAVE to live NEXT to RAILWAYS
WHAT DO WE KNOW ABOUT NOISE?
NOISE Pollution = SECOND BIGGEST PROBLEM


WHICH HAS A HIGHER POTENTIAL for
NOISE MITIGATION
VEHICLE
OR
TRACK
LOCOMOTIVE EQUIPMENT
comfort
LOADS+WAGONS
WHEELS
DAMPING
SUSPENSION
SHAPE
MAINTENANCE
the VEHICLE has A LOT of POTENTIAL
INFRA MANAGERS are RESPONSIBLE and THEY KNOW HOW
NEW
OLD
VEHICLE UPDATES are UNRELIABLE
COMPLAINTS
NOISE MAPPING
TRACK ONLY CAUSE PART of NOISE
AERODYNAMICS
EQUIPMENT
TRACK
NOISE
SPEED
NOISE is A LOCAL PROBLEM
PREDICTIVE MODELS
MEASURE
ROUGHNESS + MAINTENANCE
SMART TRACKS
NOISE BARRIERS are PRETTY
TRACKS are MADE to LAST
WILD LIFE
JOINT SOLUTIONS!


HAVE RAILWAYS UNDERTAKEN ENOUGH TO REDUCE NOISE?
YES
WE DID WHAT WE COULD
Policy REGULATION
NIGHT BANS for FREIGHT TRAINS
NO
THOUGH THERE IS POTENTIAL
WE WORKED ON THE BRAKES
PARKING
WHEEL
NOISE
TRACK
Not ENOUGH INNOVATION IN PRACTICE
POOR HEALTH
RAIL DAMPER & MODIFIER
WHERE IS the STRATEGY on TRACKS?
NOISE BARRIER
REDUCE SPEED
WE HAVE to stay COMPETITIVE


SHOULD RAILWAYS PROMOTE
HIGHER OR LOWER
NOISE LIMIT VALUES
HIGHER LIMIT VALUES
LOWER COSTS
MORE TRAINS
LESS NOISE = LESS ANNOYANCE
BETTER IMAGE for TRAINS
MORE INNOVATION
MORE TRAINS
MODAL SHIFT
ROAD TRAFFIC is the REAL ENEMY
BUILD CLOSER to RAILWAYS
REGULATIONS ARE NOT THE ONLY TOOL and LEADS to BUREAUCRACY
LESS EMISSIONS
BETTER WORLD

Agenda

14:00 – 15:00	**Global Framework | Railway noise management and maintenance** • Vytaute Bacianskaite Directorate-General for Mobility and Transport (DG MOVE) of the European Commission • Sandy Zaehringer Directorate-General for Environment (DG ENV) of the European Commission • Ethem Pekin Community of European Railway and Infrastructure Companies (CER) • Bertrand Goalou and Carlito (Bing) Mendoza Rufo Jr. Asian Development Bank
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SUSTAINABILITY Action Week

Global Framework – Railway Noise

Vytaute Bacianskaite

Policy Officer

Directorate-General for Environment (DG ENV) of the European Commission

Sandy Zaehringer

Policy Officer

Directorate-General for Mobility and Transport (DG MOVE) of the European Commission

Ethem Pekin

Head of Economic Policy and Sustainability

Community of European Railway and Infrastructure Companies (CER)

Bertrand Goalou

Principal Transport Specialist

Asian Development Bank

Carlito (Bing) Mendoza Rufo Jr.

Senior Safeguards Specialist

Asian Development Bank

Key developments of the EU noise policy and legislation

UIC Rail Noise Days March 2025

Vytaute Bacianskaite, DG ENV

Context

Political context:

- Zero Pollution Action Plan
- Smart and Sustainable Mobility Strategy

Legal framework

- Environmental Noise Directive
- EU “source specific” legislation on tyres, cars, buildings, aircrafts, trains
- National legislation

Implementation of the EU law

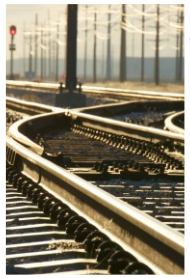
2nd Zero Pollution Monitoring and Outlook Report

Special report 02/2025: Urban pollution in the EU – Cities have cleaner air but are still too noisy

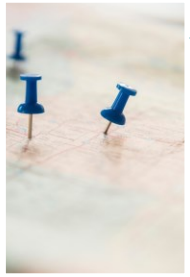
New!

Strategic noise maps and action plans on railways

Mapping scope:



1) **major railways** (> 30 000 trains a year)



2) In strategic noise maps for agglomerations (> 100 000 inhabitants) a special focus on the noise emitted by: <…> **rail traffic**

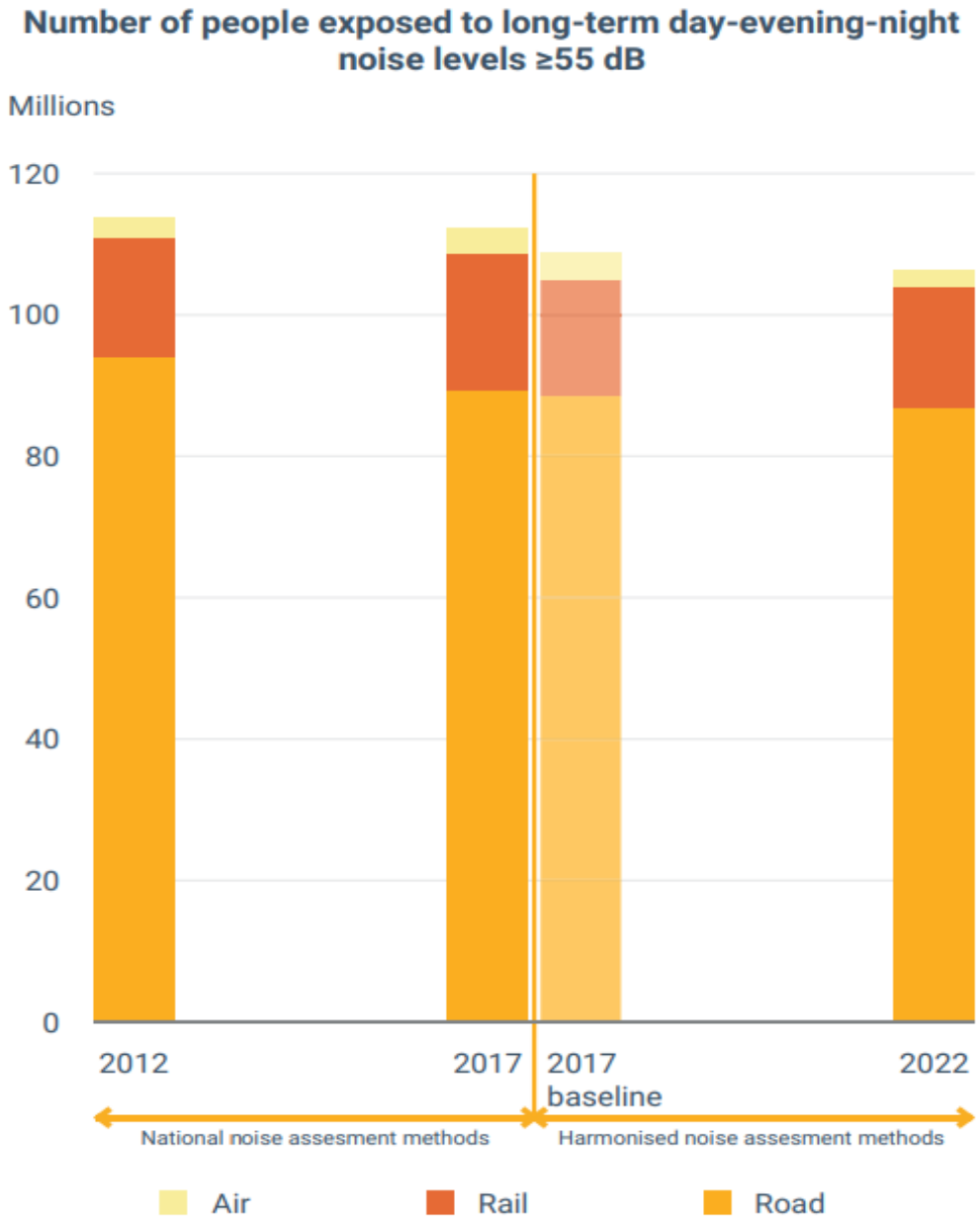
Annex V – requirements for actions plans

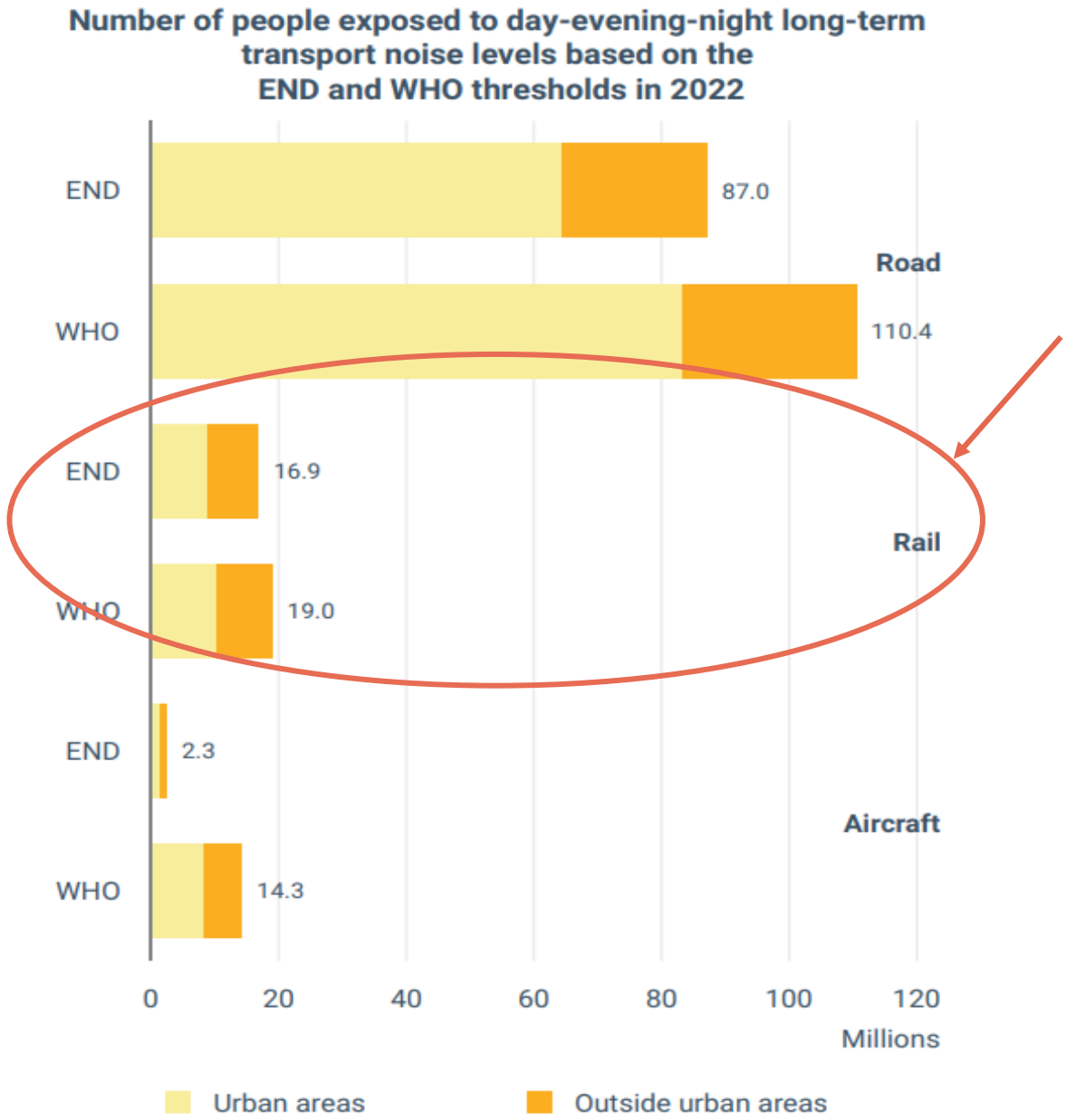
Noise reduction measures in force, long-term strategy, cost benefit assessment

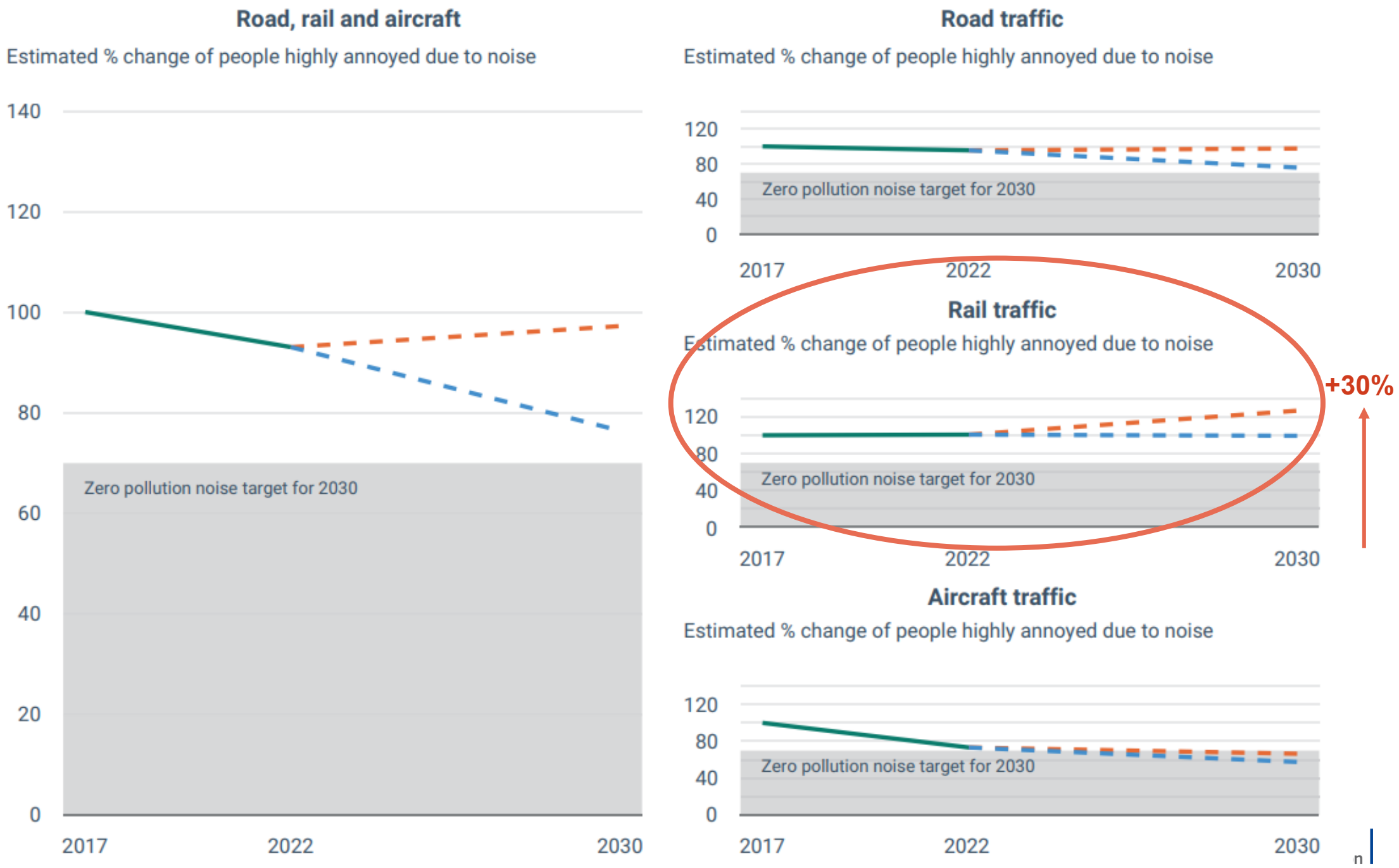
Actions to be considered

land-use planning	technical measures at noise sources,	selection of quieter sources,	reduction of sound transmission	regulatory or economic measures or incentives

New trends - 2nd Zero Pollution Monitoring and Outlook Report






Road, rail and aircraft
Estimated % change of people highly annoyed due to noise
140
120
100
80
60
40
20
0
Zero pollution noise target for 2030
2017
2022
2030
Road traffic
Estimated % change of people highly annoyed due to noise
120
80
40
0
Zero pollution noise target for 2030
2017
2022
2030
Rail traffic
Estimated % change of people highly annoyed due to noise
120
80
40
0
Zero pollution noise target for 2030
2017
2022
2030
+30%
Aircraft traffic
Estimated % change of people highly annoyed due to noise
120
80
40
0
Zero pollution noise target for 2030
2017
2022
2030
Annoyance
Conservative scenario
Optimistic scenario

ECA special report on urban pollution

Main findings

- ✓ Implementation gaps;
- ✓ Reporting thresholds only cover part of the EU population that may be exposed to harmful levels of noise;
- ✓ Lack of effective measures chosen;
- ✓ Gaps in mapping and reporting
- ✓ noise, unknown progress;
- ✓ No EU limit values or reduction
- ✓ targets related to noise.

Recommendation – Prioritising actions against noise pollution by 2029

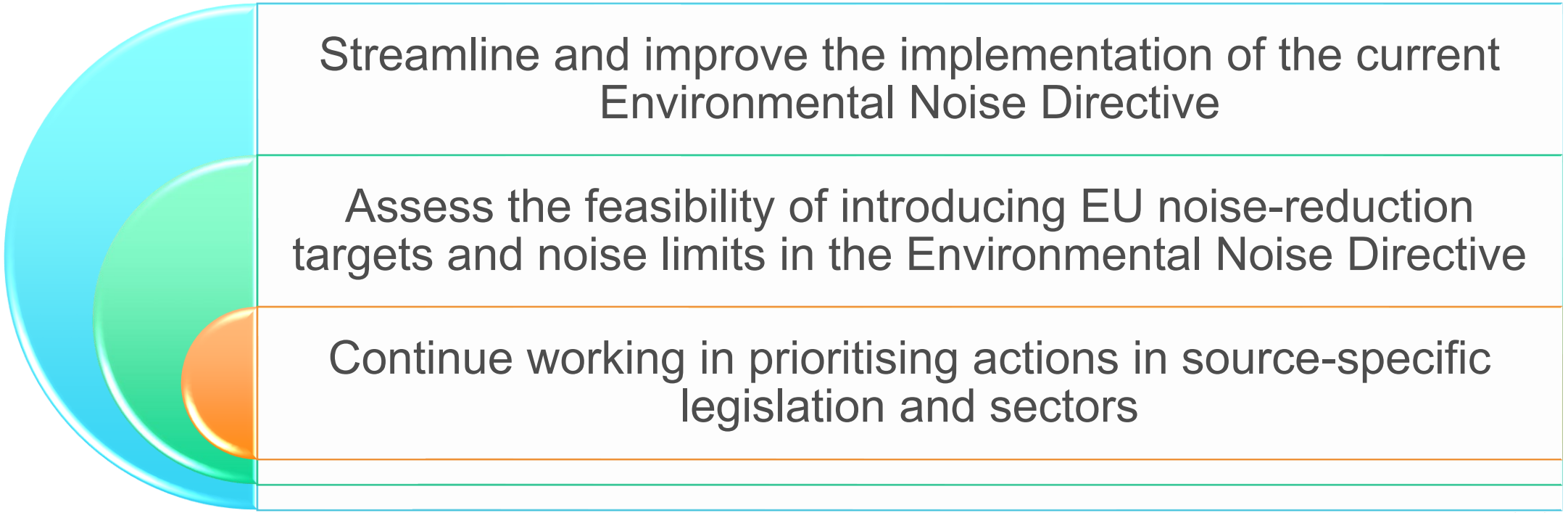
The Commission should assess the feasibility of:

- introducing EU noise-reduction targets and noise limits in the Environmental Noise Directive;
- aligning the noise exposure reporting thresholds as closely as possible with those recommended by the WHO.

N.B! Report covers 3 selected cities: Athens, Barcelona, Kraków

Next steps

→ Follow up on the Implementation Report of the Environmental Noise Directive (2023)



Commission’s request to ERA on the revision of the TSIs TSI NOISE

UIC Rail Noise Days March 2025

Dr. Sandy Zaehringer DG MOVE

Requirements in TSI Noise

- 2019 introduction of „quieter routes“ in TSI Noise
  - Minimum length: 20 km
  - Average of 12 freight trains per night
  - From 8/12/2024 vehicles need to meet certain noise limits (if operating on quieter routes)
  - List of quieter routes on ERA Homepage
- Limit values in chapter 4.2. TSI Noise for:
  - Stationary noise
  - Starting noise
  - Pass-by noise
  - Driver‘s cab interior noise
  - Not yet defined for „parked trains“

Future TSI revision

Clarity and transparency

Complete the Single European Railway area

Reduce complexity

Reduce future rail system cost

Increase accessibility

Rapid uptake of innovation

Topics for the new request to ERA

- Optimised Regulation (OR) – 16 topics
- Innovation uptake (IU) – 22 topics
- Completing SERA (CS) – 36 topics

→ To be specified in revised TSI

- Additional studies (AS) – 7 topics

→ To analyse certain topics

Multianual approach

- Topics with assigned to short-, mid-, and long-term delivery timelines
  → **predictability** regarding the change of legal framework
- Request planning to be revised yearly:
  - Reporting by ERA on progress made on June RISC of each year
  - Adjustment to the request presented in November RISC of each year

  → **Flexibility** to take constraints and dependencies (e.g. STIP, EN standards, results from studies) into account

Topics for TSI NOI

TSI NOI specific actions for revision 2028/2029 (mid-term):

CS-30	Completing SERA (Single European Railway Area)	Definition of parked train and respective noise limits, assessment methodology
CS-09	Composite brake blocks (CBBs) in Nordic winter conditions	Review existing specific cases to harmonise requirements on CBB in nordic winter conditions
CS-10	Provide deadline for historic CBB in TSI	Replace the reference to UIC 541-4 with a concrete deadline in the TSI

Topics for TSI NOI

TSI NOI specific actions for revision after 2030 (long-term):

IU-10	**Vibrations**	- Assessment of legal framework (environmental legislation included) on exposure to vibrations neighbouring areas of railways (limit values, measurement/calculation methods) - Requirements on measurement methodology and infrastructure-related and/or vehicle related limit values for the vibrations/structure borne noise induced by the railway system to the neighbouring areas

Noise limits for parked trains

- **Deliverable for ERA recommendation 2028**
  - **Definition of parked train**
  - **Noise limit(s)**
  - **Assessment methodology**
- **TWG Noise created**
  - **Kick-off meeting 23.10.2024**
  - **2nd meeting 29.01.2025**
  - **Next meeting 25.04.2024**

Thank you

European Commission

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European Commission

CER Economics
CER Environment
Working Groups

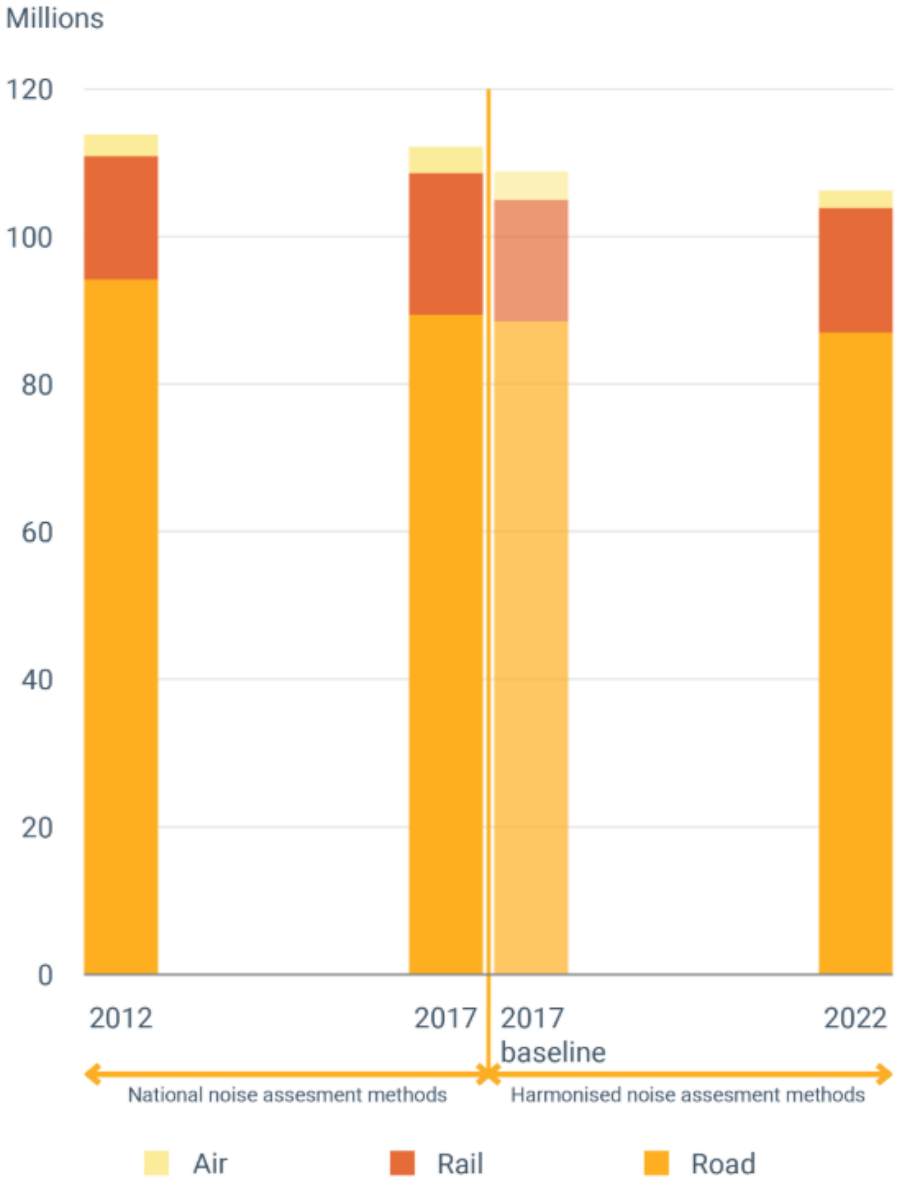
UIC Sustainability Action Week

UIC Railway Noise Days

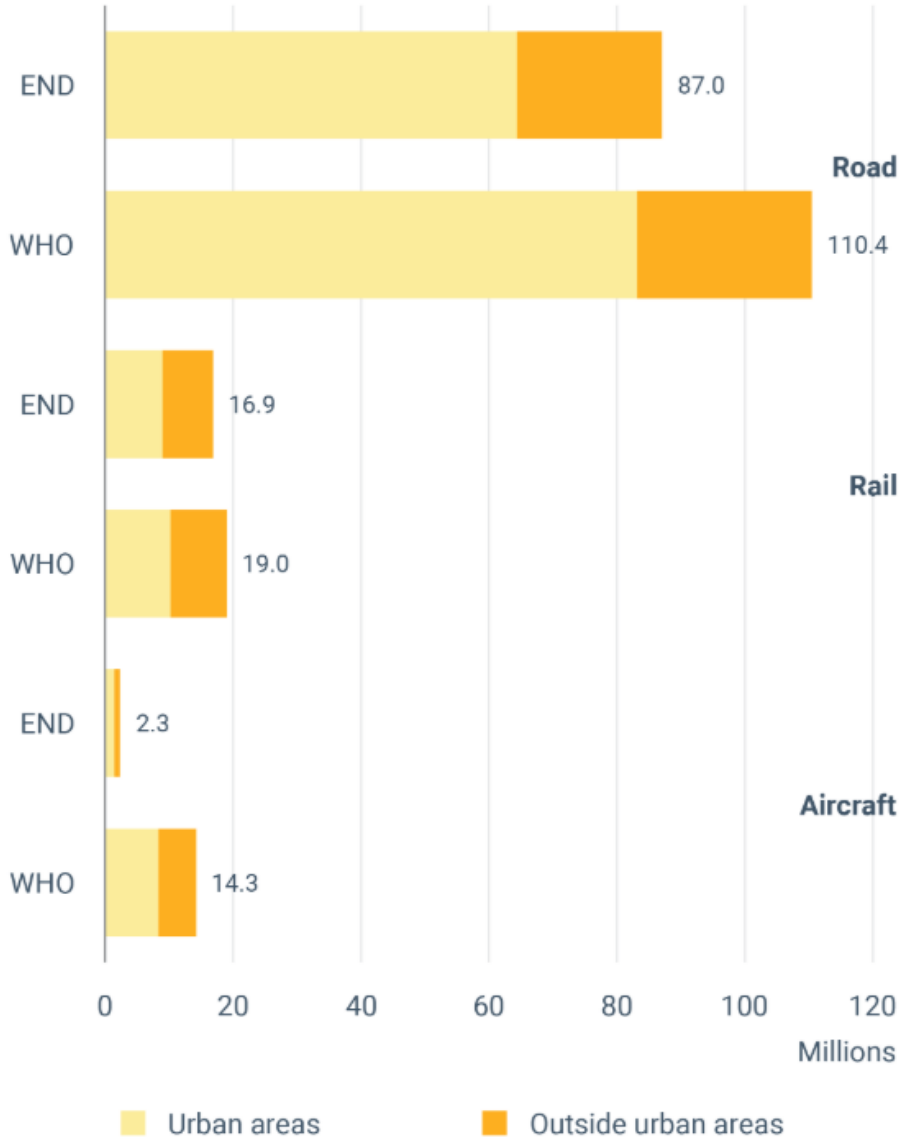
11 March 2025

Estimated number of people exposed to long-term harmful levels of road, rail and aircraft noise, EU-27

Number of people exposed to long-term day-evening-night noise levels ≥55 dB



Number of people exposed to day-evening-night long-term transport noise levels based on the END and WHO thresholds in 2022



Notes: Lden,day-evening-night noise level. Based on data submitted under END, where Member States are required to produce strategic noise maps for roads with more than 3 million vehicles per year,

EU citizens have a “noise” problem

- Road traffic remains the primary contributor to noise pollution; rail and aircraft noise impact fewer citizens
- Between 2017-2022 only a marginal decline in the population affected by noise levels
- Conclusions regarding this trend are difficult to make due to changes in the calculation methodologies used during these years
- The Court of Auditors highlight the gaps and delays in assessing and reporting the scale of noise by most EU member states
- EU fails to achieve its 2030 target of reducing the number of people chronically disturbed by transport noise levels of at least 30%

Outlook on the EU noise policy and railway noise mitigation strategy

- Additional measures including regulatory or legislative changes expected
- The Court of Auditors recommend the Commission by 2029 implementation date to assess the feasibility of:
  - Introducing EU noise-reduction targets and noise limits in the END
  - Aligning the noise exposure reporting with the WHO recommended values
- Railway activity is projected to grow:
  - EU level noise impact assessment needed to see modal shift from road to rail
  - Measures both on hot-spots and areas with moderate noise levels
  - Focus on cities, which struggle to address noise pollution effectively
  - Interventions to reduce the impact of rail noise on children's health (schools)

Final comments

- Quieter routes are now in force - noise from rail freight to reduce?
- Focus is on parked trains – address measurement procedure and harmonized data
- EN ISO 3095 is a perfect framework for measurement specification of noise from parked trains
- Need to collect data to support the definition of relevant and achievable limits
- Coordinated EU measurement campaign under the UIC umbrella is needed
- Such campaign requires a suitable EU funding to commence in 2025

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For regular updates on CER activities,
visit our website: **www.cer.be**
or follow **@CER_railways** | CER

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The Voice of European Railways

Managing Noise Impact in the Philippines

Case of North-South Commuter Project

Selected Flagship and innovative Projects

PHILIPPINES: North-South Commuter Railway

PHILIPPINES: North-South Commuter Railway

Project description and ADB support - financing

Malolos–Clark Railway Project (53 km)

- Approved in 2019
- ADB financing: $2.75 billion

South Commuter Railway Project (55 km)

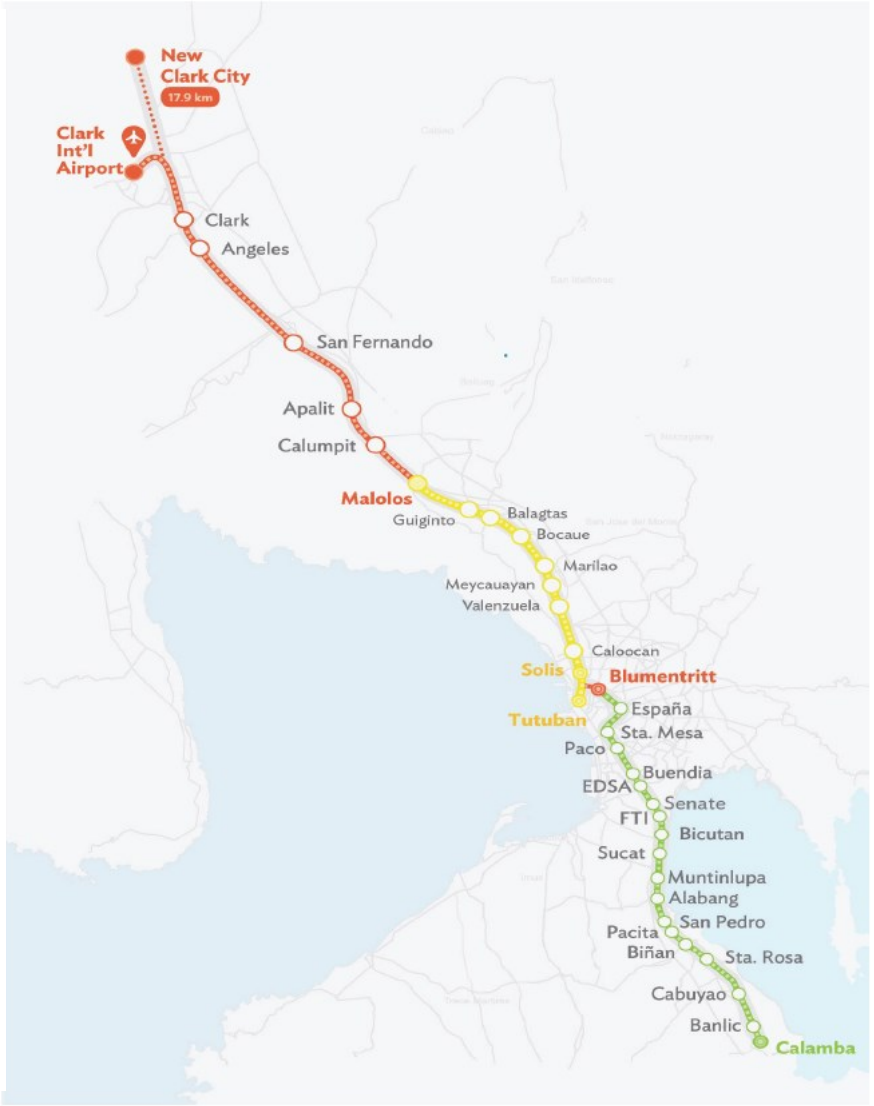
- Approved in 2022
- ADB financing: $4.3 billion

Clark–New Clark City Railway (18 km)

- ADB Peer Review of Feasibility Study ongoing

Technical Assistance

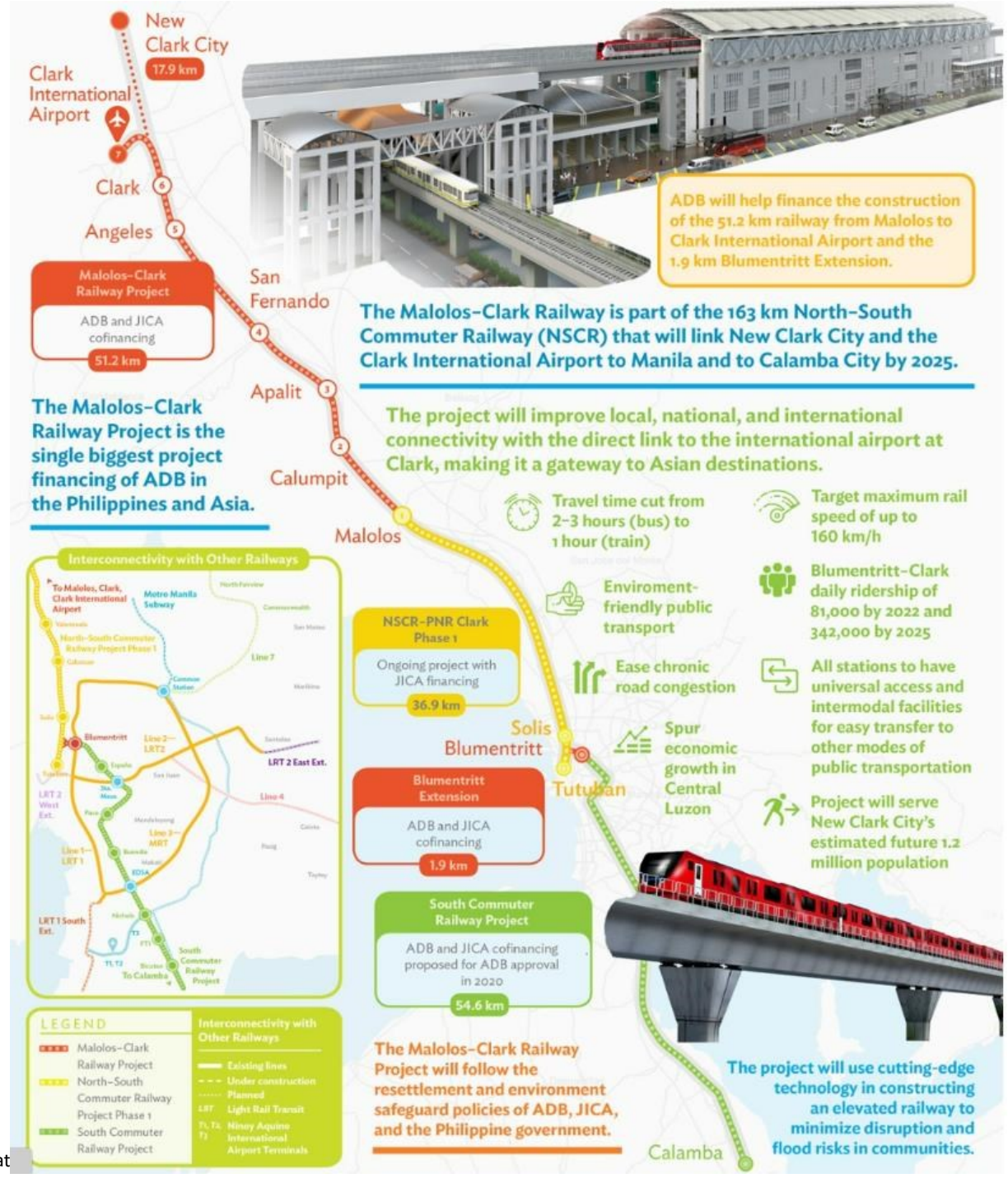
- TA-9570-PHI: Railway Project Implementation Support and Institutional Strengthening ($3.9 million grant)
- TA-9913- PHI: Strengthening the Transition of Vulnerable Communities Affected by the Malolos-Clark Railway Project ($2 million grant)
- TA-6922-PHI: Strengthening the Transition of Vulnerable Communities Affected by the South Commuter Railway Project ($2 million grant)



Malolos–Clark Railway Project

North–South Commuter Railway, PNR Clark - Phase 2

In May 2019, ADB approved a $2.75 billion facility for this flagship project of the Philippine government under its "Build, Build, Build" infrastructure development program.



South Commuter Railway Project

North–South Commuter Railway (NSCR), PNR Calamba

The NSCR will improve local, national, and international connectivity with the direct link to the international airport at Clark, making it a gateway to Asian destinations.

The South Commuter Railway Project (SCRP) is part of the 163 km North–South Commuter Railway network that will link Clark, Pampanga to Calamba, Laguna by 2028.

New Clark City
Clark International Airport
Clark
Angeles
San Fernando
Apalit
Calumpit
Malolos
Guiguinto
Balagtas
Bocaue
Marilao
Meycauayan
Valenzuela
Caloocan
Solis
Blumentritt
España
Tutuban
Santa Mesa
Paco
Buendia
EDSA
Senate - DepEd
FTI
Bicutan
Sucat
Alabang
Muntinlupa
San Pedro
Pacita
Biñan
Santa Rosa
Cabuyao
Banlic
Calamba

Malolos–Clark Railway Project
Ongoing project with ADB and JICA cofinancing
51.2 km

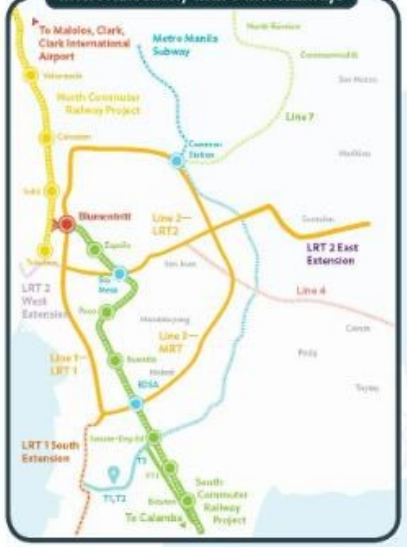
NSCR–PNR Clark Phase 1
Ongoing project with JICA financing
36.9 km

Blumentritt Extension
Ongoing project with ADB and JICA cofinancing
1.9 km

South Commuter Railway Project
ADB and JICA cofinancing
54.6 km

SCRP will offer direct trains connecting with the Metro Manila Subway

Interconnectivity with Other Railways



LEGEND

- Malolos–Clark Railway Project
- North–South Commuter Railway Phase 1
- South Commuter Railway Project

Interconnectivity with Other Railways

- Existing lines
- Under construction
- Planned
- LRT Light Rail Transit
- T1, T2, T3 Ninoy Aquino International Airport Terminals

The railway project will follow the resettlement and environment safeguard policies of ADB, JICA, and the Philippine government

ADB has approved the financing for the construction of the 54.6 km railway line from Blumentritt to Calamba

- Travel time cut from 1 to 2 hours by bus to 45 mins to 1 hour by train
- Target maximum rail speed of up to 120 km/h
- Spur economic growth in South Luzon
- Estimated daily ridership of 600,000 passengers during full operations*
- Reduce net greenhouse emissions by over 344,000 tons of CO_2 annually by 2040*
- Over 59,000 direct jobs for NSCR during construction and over 4,600 jobs upon operation*
- Ease chronic road congestion*
- All stations to have intermodal facilities for easy transfer to other modes of public transportation*
- Designed to provide safe access for all, including people with disabilities*

*NSCR project benefits

Issues in the Philippines

- Following standards, the noise measurement equipment measures instantaneous noise and not exposure
- Lack of measurement procedure – we recommend the US standards but the community finds it hard to follow
- The ADB uses the WB-EHS + 3 dB limit but almost impossible to meet during construction, what to do?
- Noise environment

Philippine North-South Commuter Railway Project

- What we want to do ....

Philippine Railway Project in the Philippines

- Where we are starting from ……

Baseline Noise Levels – Before the Project

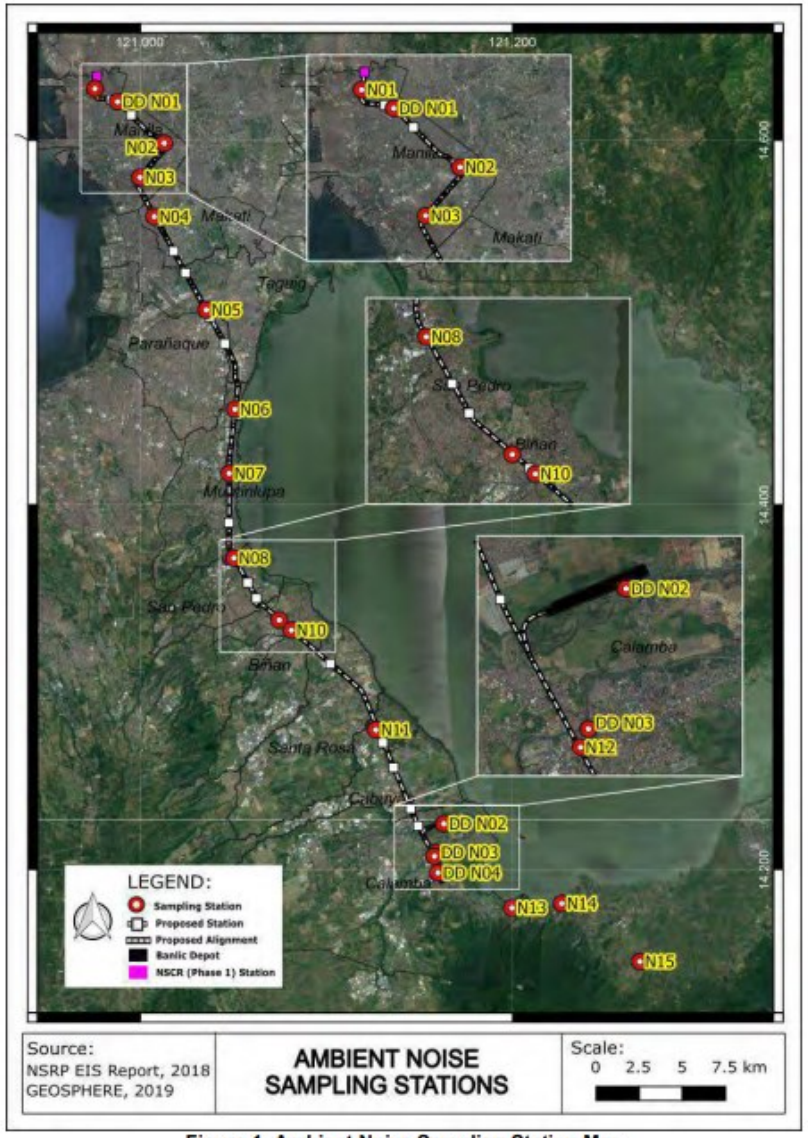


Figure 1: Ambient Noise Sampling Station Map

Sta, No.	Dry Season			Wet Season			NPCC Standard			Exceed Standard ?
	Date	Time	Noise Levels	Date	Time	Noise Levels	Area Class	Period	Noise Level	Y/N
N09	Mar 24, 2018	0755H	69.3	July 16, 2018	0752H	70.4	AA	Morning	45 dBA	Y
	Mar 8, 2018	1512H	61.9	July 13, 2018	1515H	65.3		Daytime	50 dBA	Y
	Mar 8, 2018	2007H	73.1	July 13, 2018	2140H	61.2		Evening	45 dBA	Y
	Mar 24, 2018	0353H	69.9	July 13, 2018	2245H	57.6		Nighttime	40 dBA	Y
N10	Jan 24, 2018	0738H	66.4	July 13, 2018	0612H	69.0	AA	Morning	45 dBA	Y
	Jan 23, 2018	1259H	61.7	July 13, 2018	1008H	59.3		Daytime	50 dBA	Y
	Jan 23, 2018	1858H	62.0	July 12, 2018	1920H	69.1		Evening	45 dBA	Y
	Jan 23, 2018	2308H	64.5	July 12, 2018	2255H	56.1		Nighttime	40 dBA	Y
N11	Mar 24, 2018	0630H	69.5	July 06, 2018	0754H	69.2	AA	Morning	45 dBA	Y
	Mar 8, 2018	1035H	78.5	July 06, 2018	0926H	79.3		Daytime	50 dBA	Y
	Mar 23, 2018	1800H	63.0	July 06, 2018	2003H	62.1		Evening	45 dBA	Y
	Mar 23, 2018	2315H	77.3	July 06, 2018	2355H	64.0		Nighttime	40 dBA	Y
N12	Jan 25, 2018	0657H	70.7	June 27, 2018	0600H	79.8	A	Morning	50 dBA	Y
	Jan 25, 2018	1248H	66.4	June 27, 2018	1430H	81.1		Daytime	55 dBA	Y
	Jan 24, 2018	1908H	73.8	June 26, 2018	1910H	75.9		Evening	50 dBA	Y
	Jan 25, 2018	2247H	64.3	June 27, 2018	0115H	59.3		Nighttime	45 dBA	Y
N13	Mar 8, 2018	0750H	72.5	July 06, 2018	0535H	72.6	AA	Morning	45 dBA	Y
	Feb 22, 2018	1614H	71.8	June 28, 2018	1015H	70.8		Daytime	50 dBA	Y
	Feb 22, 2018	1954H	73.4	July 06, 2018	1810H	80.2		Evening	45 dBA	Y
	Mar 8, 2018	2208H	74.2	June 26, 2018	2322H	62.0		Nighttime	40 dBA	Y
N14	Mar 8, 2018	0520H	81.2	June 26, 2018	0504H	77.3	AA**	Morning	50 dBA	Y
	Feb 22, 2018	1054H	61.7	June 27, 2018	1150H	73.2		Daytime	55 dBA	Y
	Feb 22, 2018	1825H	74.8	June 26, 2018	2040H	78.0		Evening	50 dBA	Y
	Mar 8, 2018	0349H	74.5	June 26, 2018	1004H	72.3		Nighttime	45 dBA	Y
N15	Jan 26, 2018	0655H	63.8	June 26, 2018	0740H	74.2	AA	Morning	45 dBA	Y
	Jan 26, 2018	1254H	67.8	June 25, 2018	1430H	66.1		Daytime	50 dBA	Y
	Jan 25, 2018	1834H	74.6	June 25, 2018	1900H	63.5		Evening	45 dBA	Y
	Jan 25, 2018	2255H	65.0	June 26, 2018	0130H	65.3		Nighttime	40 dBA	Y

ormation is accessible to ADB M

Additional baseline (41 locations)

Table 8: Additional Noise Measurement Results

No.	Location	Coordinates		Average Noise		Dominant Source of Noise	Remarks
		Latitude	Longitude	Day	Night		
1	Ilang-Ilang St., Calamba Laguna	N 14° 11' 47"	E 121° 09' 40"	65.6	50.0	Motorcycle, Cars, Dog, Tricycle	
2	Near Villa Carpio Subdivision, Calamba, Laguna	N 14° 12' 53.74"	E 121° 09' 10.56"	54.7	No Data	Construction Site, Dog, People	Slum Area, unsafe during nighttime
3	San Cristobal Garden Homes, Sta. Rosa, Laguna	N 14° 13' 32"	E 121° 08' 46"	52.1	56.4	Motocycle, Cars	Videoke playing, Playing Basketball during nighttime
4	Villa Palao Subd., Calamba Laguna	N 14° 13' 45"	E 121° 08' 52"	61.3	63.8	Motorcycle, Cars, People, Jeepney, People	playing basketball

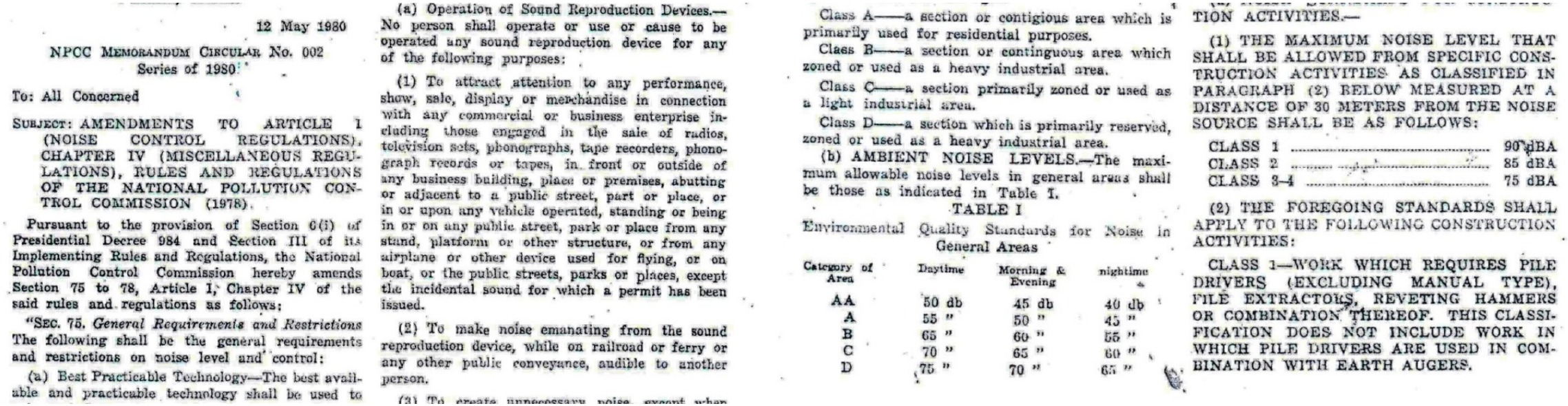
No.	Location	Coordinates		Average Noise		Dominant Source of Noise	Remarks
		Latitude	Longitude	Day	Night		
38	Visayan cor. Domingo Santiago St, Sampaloc, Manila	N 14° 36' 19"	E 121° 00' 16"	64.4	62.3	Cars, Motorcycle, People	motorcycle revolution
39	Sobriedad cor. V. Cruz, Sampaloc, Manila	N 14° 36' 30"	E 121° 59' 54"	69.8	60.8	Trucks, Cars, Motorcycle, Tricycle, Jeepney	
40	R. Cristobl St., Sampaloc, Manila	N 14° 37' 2"	E 121° 59' 26"	55.3	57.9	Cars, Motorcycle, People	
41	Vertex Road (Near SM San Lazaro), Manila	N 14° 37' 13"	E 121° 59' 08"	64.7	55.3	Cars, Motorcycle, Tricycle	engine running

No.	Location	Coordinates		Average Noise		Dominant Source of Noise	Remarks
		Latitude	Longitude	Day	Night		
5	San Isidro Homes, Cabuyao, Laguna	N 14° 41' 30"	E 121° 08' 36"	52.0	54.8	Motorcycle, People	
6	Birmingham Village, Sta. Rosa, Laguna	N 14° 14' 36"	E 121° 08' 17"	59.9	55.6	Motorcycle, Cars, People	
7	Katapatan Homes, Cabuyao, Laguna (Beside Pamanatasan ng Cabuyao)	N 14° 15' 36"	E 121° 07' 59"	53.8	58.3	Motorcycle, Cars, People	ongoing house construction; playing basketball
8	Marysville Academy, Santa Rosa, Laguna	N 14° 17' 26"	E 121° 07' 14"	55.3	49.1	Cars, Motorcycle, Dog, Train	
9	Don Jose Zavalla Subd., Santa Rosa, Laguna	N 14° 18' 13"	E 121° 06' 41"	54.6	54.6	Dog, Motorcycle	
10	Howard Village, Tagapo, Santa Rosa, Laguna	N 14° 18' 59.7"	E 121° 05' 57.71"	56.4	58.2		
11	Near Platero - G. Sigue Road, Biñan, Laguna	N 14° 19' 18"	E 121° 05' 29"	51.7	44.3	Motorcycle, Dog	
12	Parking Area, Pacita Complex, San pedro, Laguna	N 14° 20' 48"	E 121° 03' 43"	60.3	56.1	Cars, Tricycle, Motorcycle	
13	jasmin cor. Crismore ave., San Pedro Laguna	N 14° 21' 23"	E 121° 21' 23"	64.4	55.5	Cars, Tricycle, Motorcycle	
14	Ricarte St., San Pedro Laguna	N 14° 21' 54"	E 121° 03' 15"	55.0	51.4	Motorcycle, Jeepney, Cars	
15	E. Rodriguez Jr. Ave., Brgy. Tunasan, Muntinlupa City (infront of Brgy. Hall)	N 14° 22' 37"	E 121° 02' 54"	69.0	59.4	Cars, Tricycle, Motorcycle, Jeepney, Truck	
16	St. John St., JPA Subd., Tunasan, Muntinlupa City	N 14° 23' 07"	E 121° 02' 46"	56.3	47.9	Cars, Motorcycle, Dog	
17	San Francisco St., Brgy. Putatan, Muntinlupa City	N 14° 23' 31"	E 121° 02' 48"	58.3	No Data	Motorcycle, People	Videoke playing; unsafe
18	The Church of Jesus Christ the Latter of Saint, Muntinlupa City	N 14° 24' 18.1"	E 121° 02' 49.72"	68.4	65.2	Cars, Tricycle, Motorcycle, Jeepney, Truck	
19	near Arevalo St.,Parañaque City	N 14° 25' 45"	E 121° 02' 56"	54.7	58.0	Train, Motorcycle, People	
20	Espeleta St., Muntinlupa City	N 14° 26' 31"	E 121° 03' 06"	65.	No Data	Train, Motorcycle, People, fun fair	unsafe and too noisy due to fun fair
21	Lakefront Drive, Sucat, Parañaque City	N 14° 27' 54"	E 121° 03' 00"	58.5	61.1	Cars, Tricycle, Motorcycle	

No.	Location	Coordinates		Average Noise		Dominant Source of Noise	Remarks
		Latitude	Longitude	Day	Night		
22	Arthuro Drive, Mañalac Industrial Estate, Brgy. Bagumbayan, Taguig City	N 14° 28' 16.58"	E 121° 03' 9.28"	61.9	61.5	Cars, Motorcyle, Tricycle, Truck, Train	
23	1st Ave., Mañalac Industrial Estate, Brgy. Bagumbayan, Taguig City	N 14° 28' 38"	E 121° 03' 05"	66.0	72.	Truck, Cars, Tricycle, Motorcycle	
24	Eric Oil Gas Station, East Service Road, Taguig City	N 14° 28' 58"	E 121° 02' 43"	74.8	73.1	Trucks, Cars, Motorcycle, Tricycle, Jeepney	Siren
25	7th Day Adventist Marian Road, Bicutan, Taguig City	N 14° 29' 45"	E 121° 2' 36"	59.6	62.1	Tricycle, Motorcycle, Cars, Truck	
26	Caltex Gas Station (Near C5 Extension), Parañaque City	N 14° 30' 33"	E 121° 01' 57"	67.8	65.6	Trucks, Cars, Motorcycle, Tricycle, Jeepney	
27	Rosal St., East Service Road, Taguig City	N 14° 30' 59.39"	E 121° 01' 54.76"	64.5	58.2	Airplane, Motorcycle, people, Dog	Ambulance
28	AFPOVI Phase III Subd., East Service Road, Taguig City	N 14° 31' 22.16"	E 121° 01' 38.22"	73.3	69.4	Cars, Truck, Jeepney, Train	Helicopter, Train passing
29	Magallanes Village, Lapu-Lapu St., Makati City	N 14° 32' 0.81"	E 121° 1' 8.16"	59.0	56.9	Cars, Motorcycle	
30	Don Bosco, Chino Roces Ave., Makati City	N 14° 32' 54.23"	E 121° 00' 55.57"	63.9	55.2	Cars, Motorcycle	
31	Sagrada Familya cor Amatista, Manila	N 14° 34' 09"	E 121° 00' 13"	58.4	54.9	Cars, Motorcycle, Tricycle, Truck	
32	4th St., Sta. Ana, Manila	N 14° 34' 35"	E 121° 0' 1"	61.4	58.8	Cars, Motorcycle, People, Dog	
33	Kahilom St., Manila	N 14° 34' 58"	E 121° 00' 19"	59.5	55.	Cars, jeepney, motorcycle, people	
34	St. Luis Compound, Pandacan Manila	N 14° 35' 18"	E 121° 00' 16"	64.9	61.8	Cars, Motorcycle, Trucks	
35	Beata, Pandacan, Manila	N 14° 35' 27"	E 121° 0' 31"	67.0	64.6	Jeepney, Cars, Truck, Motorcycle, Train	
36	Oasis Condominium, Sta. Mesa Manila	N 14° 35' 46"	E 121° 00' 43"	60.6	59.9	Cars, Tricycle, Motorcycle, Train	Train Passing
37	Hippodromo St., Sta. Mesa, Manila	N 14° 36' 2"	E 121° 00' 31"	64.4	58.1	Cars, Tricycle, Motorcycle	

- The additional 41 short-term, 30-minute noise measurements
- Microphone height was set at 1.5m above the ground, least 7.5 meters from a reflecting surface as required in the ANSI/ASA S12.9-2013 Part 3.
- The noise descriptor is the one-hour A-weighted equivalent sound level [Leq(h)]. The 30-minute measurement duration was assumed to be “able to represent the one-hour Leq with a shorter-term measurement to reduce time and cost for the measurement study, but without sacrificing accuracy” as provided the FHWA guidelines.
- 2 integrating sound level meters including microphone and preamplifier capable of 1-minute sampling intervals were used.
- Each measurement is comprised of 30 records of 1-minute Leq at repeating intervals to allow the identification and removal of unrepresentative events
- sound meters were calibrated before and after the measurements using a Reed Instruments R8090 (SC-05) Sound Level Calibrator.
- additional noise measurements and day and nighttime results being located 1-3 blocks away from the project alignment yielded noise levels that are, on the average, **17.6 dB(A) and 12.7 dB(A) lower than the previous daytime and nighttime measurements along the alignment**.

Issue No. 1 Philippine Noise Standards are antiquated



12 May 1980

NPCC MEMORANDUM CIRCULAR No. 002
Series of 1980

To: All Concerned

SUBJECT: AMENDMENTS TO ARTICLE 1 (NOISE CONTROL REGULATIONS), CHAPTER IV (MISCELLANEOUS REGULATIONS), RULES AND REGULATIONS OF THE NATIONAL POLLUTION CONTROL COMMISSION (1978).

Pursuant to the provision of Section 6(i) of Presidential Decree 984 and Section III of its Implementing Rules and Regulations, the National Pollution Control Commission hereby amends Section 75 to 78, Article I, Chapter IV of the said rules and regulations as follows:

"SEC. 75. *General Requirements and Restrictions* The following shall be the general requirements and restrictions on noise level and control:

(a) Best Practicable Technology—The best available and practicable technology shall be used to

(a) Operation of Sound Reproduction Devices.—No person shall operate or use or cause to be operated any sound reproduction device for any of the following purposes:

(1) To attract attention to any performance, show, sale, display or merchandise in connection with any commercial or business enterprise including those engaged in the sale of radios, television sets, phonographs, tape recorders, phonograph records or tapes, in front or outside of any business building, place or premises, abutting or adjacent to a public street, part or place, or in or upon any vehicle operated, standing or being in or on any public street, park or place from any stand, platform or other structure, or from any airplane or other device used for flying, or on boat, or the public streets, parks or places, except the incidental sound for which a permit has been issued.

(2) To make noise emanating from the sound reproduction device, while on railroad or ferry or any other public conveyance, audible to another person.

(3) To create unnecessary noise, except when

Class A——a section or contigious area which is primarily used for residential purposes.

Class B——a section or continguous area which zoned or used as a heavy industrial area.

Class C——a section primarily zoned or used as a light industrial area.

Class D——a section which is primarily reserved, zoned or used as a heavy industrial area.

(b) AMBIENT NOISE LEVELS.—The maximum allowable noise levels in general areas shall be those as indicated in Table I.

TABLE I

Environmental Quality Standards for Noise in General Areas

Category of Area	Daytime	Morning & Evening	nightime
AA	50 db	45 db	40 db
A	55 "	50 "	45 "
B	65 "	60 "	55 "
C	70 "	65 "	60 "
D	75 "	70 "	65 "

TION ACTIVITIES.—

(1) THE MAXIMUM NOISE LEVEL THAT SHALL BE ALLOWED FROM SPECIFIC CONSTRUCTION ACTIVITIES AS CLASSIFIED IN PARAGRAPH (2) BELOW MEASURED AT A DISTANCE OF 30 METERS FROM THE NOISE SOURCE SHALL BE AS FOLLOWS:

CLASS 1	90 dBA
CLASS 2	85 dBA
CLASS 3-4	75 dBA

(2) THE FOREGOING STANDARDS SHALL APPLY TO THE FOLLOWING CONSTRUCTION ACTIVITIES:

CLASS 1—WORK WHICH REQUIRES PILE DRIVERS (EXCLUDING MANUAL TYPE), FILE EXTRACTORS, REVETING HAMMERS OR COMBINATION THEREOF. THIS CLASSIFICATION DOES NOT INCLUDE WORK IN WHICH PILE DRIVERS ARE USED IN COMBINATION WITH EARTH AUGERS.

- No guidance if the baseline without the project already exceeds standards
- No clear definition of the noise metric
- No method of measurements

ADB adopts the International Finance Organization-World Bank Environment Health and Safety

Noise Level Guidelines

Noise impacts should not exceed the levels presented in Table 1.7.1, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

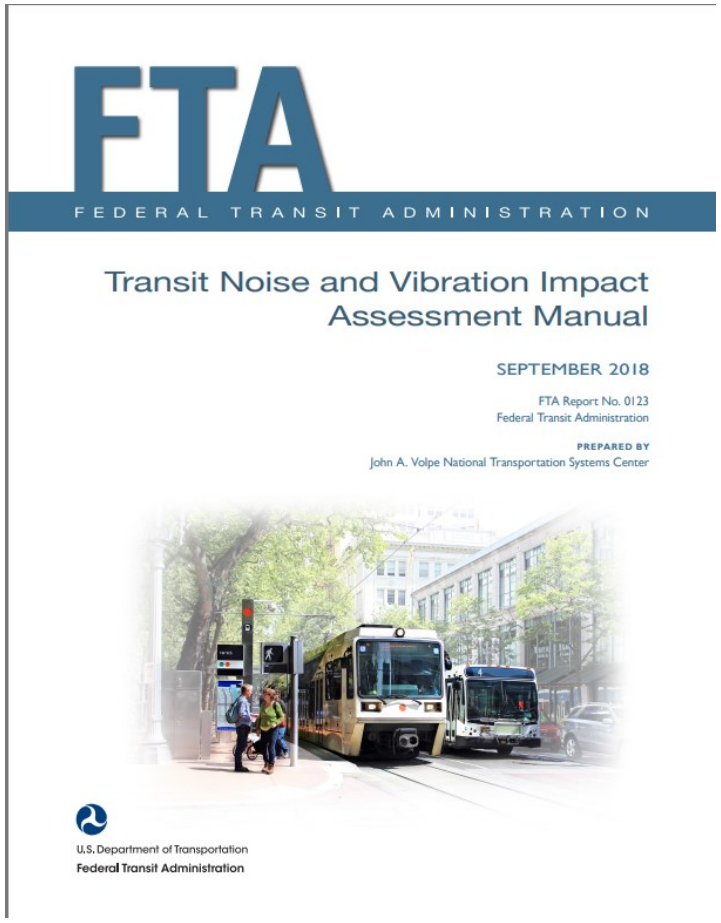
Table 1.7.1- Noise Level Guidelines[54]

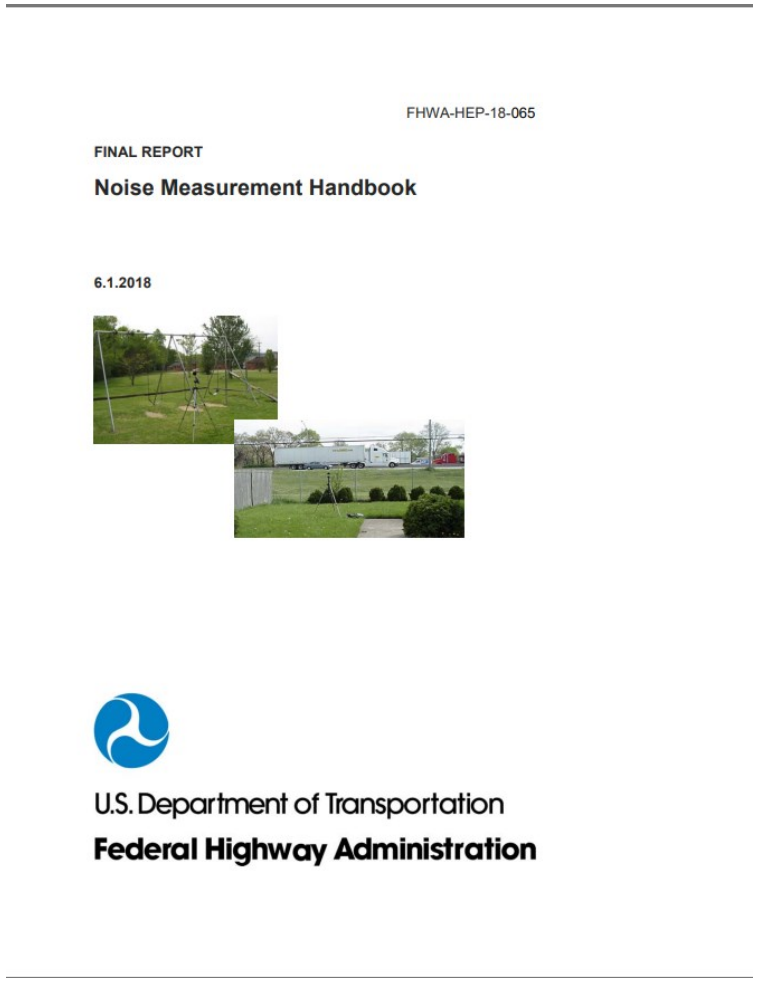
Receptor	One Hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

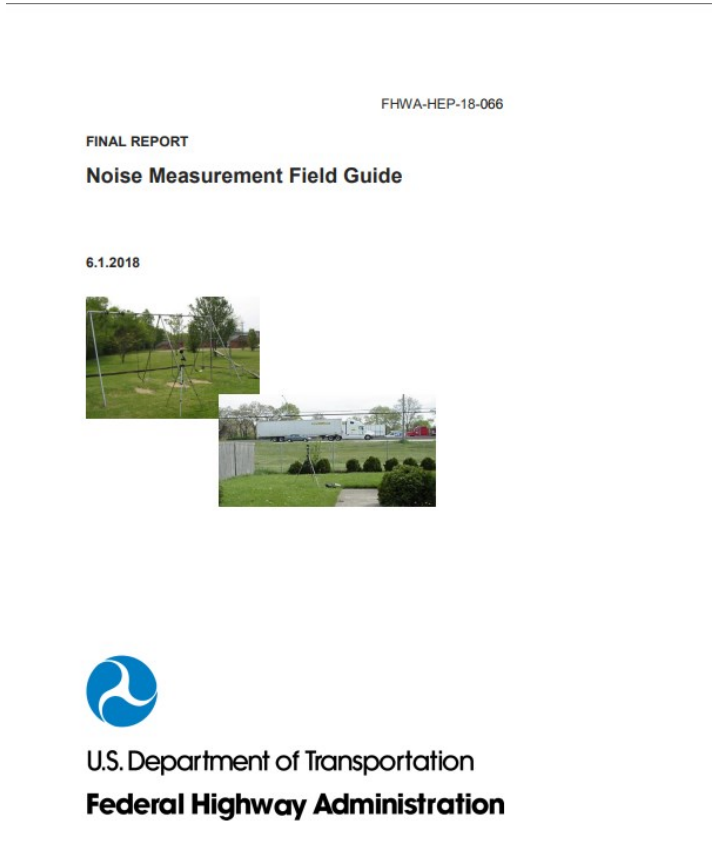
Rudimentary guides for field measurements:

- Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours
- noise monitors capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate
- acoustic indices recorded depends on the type of noise being monitored, as established by a noise expert.
- Monitors should be located approximately 1.5 m above the ground and no closer than 3m to any reflecting surface (e.g., wall).
- Use Type 1 or 2 sound level meter meeting all appropriate IEC standards

FTA Standards and Measurements







Noise and Vibration Related Grievances received 2025

- 18 complaints received for the south section only
- Noise and vibration
- 02/05/25 Cabuyao Central School principal noise and vibration disrupts the examination of the students and agreed to shift construction from daytime to night-time (4PM to 7AM)
- Relocation of generator sets away from residential structures
- Night-time noise
- Board piling cause a lot of complaints
- Houses within 10 meters from pier construction

Issue No 2. No Standard Measurement Procedure and Equipment

IDOM

Station NV-06: CCF Center Pasig

PERIOD	L10	L50	L90	Leq	NPCC (CLASS AA)
MORNING (050045H-090045H)	78.1	73.2	69.6	75.8	55
DAYTIME (090045H-180045H)	78.0	73.7	70.1	81.9	60
EVENING (180045H-220045H)	77.1	73.0	70.2	75.5	55
NIGHTTIME (220045H-050045H)	77.3	71.2	66.5	74.5	50

PERIOD	L10	L50	L90	Leq	IFC (R/I/E)
DAYTIME (070045H-220045H)	78	73.5	70	80.3	55
NIGHTTIME (220045H-070045H)	77.4	71.8	67	74.9	45

ADB

DETAILED ARCHITECTURAL AND ENGINEERING DESIGN CONSULTANT ("DEDC") (50288-001)
Loan-3886 Phi

14

N8 - Steel Authority of India, Outer Ring Road

Extech SL10 Sound Level Meters - Minimum Sound Level: 40 dB, Maximum Sound L Level Meter): Analog

0 reviews | UPC: 793950470107 | Model: Extech SL10

Personal Sound Level Meter

- Measures sound level from 40 to 130dB with a Frequency Weighting for human hearing and fast response time of 125ms
- Pocket-sized housing with easy one-button operation
- Large, backlit LCD display
- Double-molded side grip
- Tripod mount (tripod not included)
- Complete with 9V battery
- CE Certified
- One year warranty

View Product Details

Issue No. 3 Structures within the Right-of-Way

Let us collaborate. We need your expertise

Future Projects in ADB I am working on:

- L4 Ortigas to Taytay Metro Project
- Jakarta Metro Project
- Extensions of the Manila Railway Project

ERJU-QuieterRail
On-board roughness measurements and rail grinding

Baldrik Faure

Project Manager in acoustics and vibration

SNCF Holding

Ard Kuijpers

CEO and Senior Consultant

M+P

Luis Baeza

University Professor

Universitat Politècnica de València

Juliette Florentin

Noise and Vibration Engineer

Infrabel

Pinar Yilmazer

Head of Sustainability Programme

UIC

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101176865.

Acoustic rail roughness as a noise control measure

Baldrik Faure

Project Manager in acoustics and vibration

SNCF Holding

SUSTAINABILITY
Action Week

Acoustic rail roughness as a noise control measure

Baldrik Faure – SNCF

UIC Railway Noise Days
11th and 12th March 2025

GROUPE SNCF

How to be a responsible neighbour?

Reduce noise emissions!

The most substantial mitigation measures have been already developed and used

➔ Noise reduction up to around 10 dB(A)

Braking system

Noise barrier

Other technological mitigation measures are less effective and less convenient

➔ Noise reduction of some dB(A)

➔ Maintenance issues

Dampers, low noise pads, low-height noise barriers…

How to be a responsible neighbour?

Predict, disseminate information…

Railway noise can be predicted with appropriated accuracy levels depending on the application :

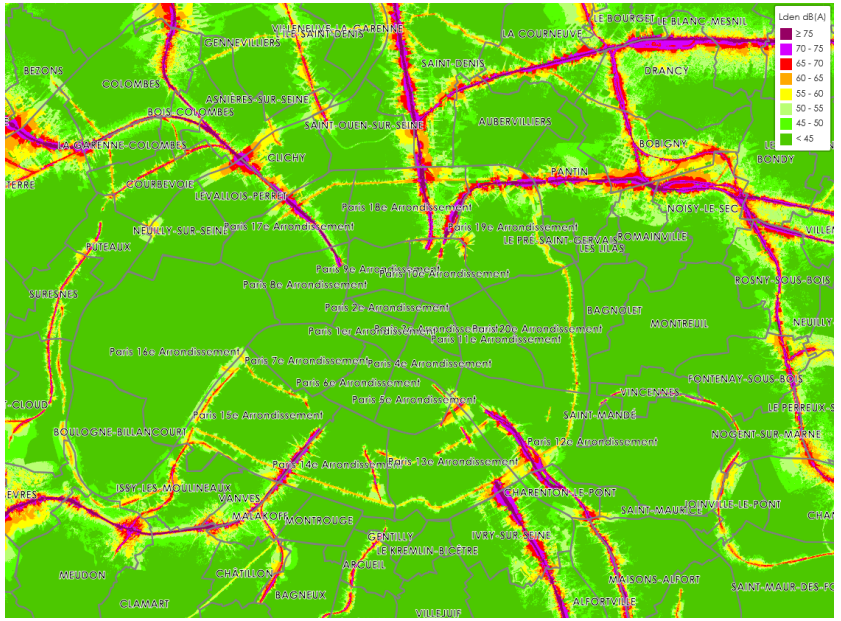
- Strategic noise mapping
- Impact studies
- Research activities

➔ The accuracy of the prediction highly depends on the precision of the input parameters

- Noise sources on the rolling stock
- Mechanical properties of the rolling stock components
- Mechanical properties of the track components
- Wheel/Rail combined roughness

Table IV.2: Classification of the track types

Digit	1	2	3	4	5	6
Descriptor	**Track base**	**Railhead Roughness**	**Rail pad type**	**Additional measures**	**Rail joints**	**Curvature**
Explanation of the descriptor	Type of track base	Indicator for roughness	Represents an indication of the 'acoustic' stiffness	A letter describing acoustic device	Presence of joints and spacing	Indicate the radius of curvature in m
Codes allowed	**B** Ballast	**E** Well maintained and very smooth	**S** Soft (150-250 MN/m)	**N** None	**N** None	**N** Straight track
	S Slab track	**M** Normally maintained	**M** Medium (250 to 800 MN/m)	**D** Rail damper	**S** Single joint or switch	**L** Low (1000-500 m)

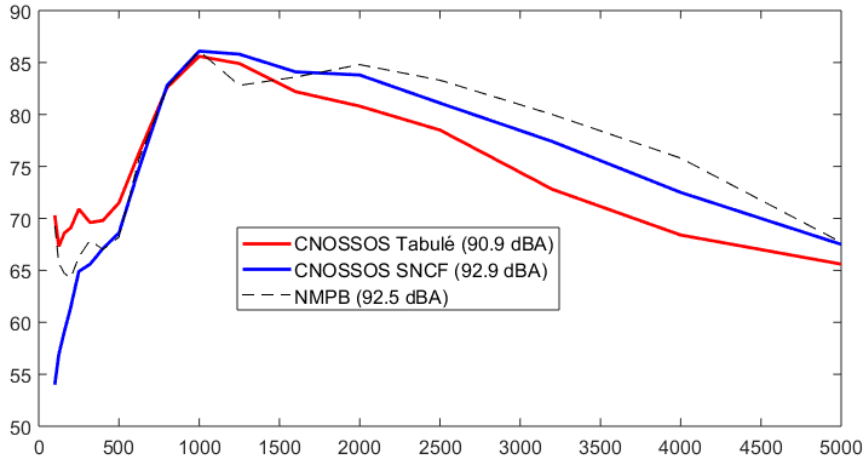


Rail roughness and railway noise

One of the sources of the problem… And a potential solution!

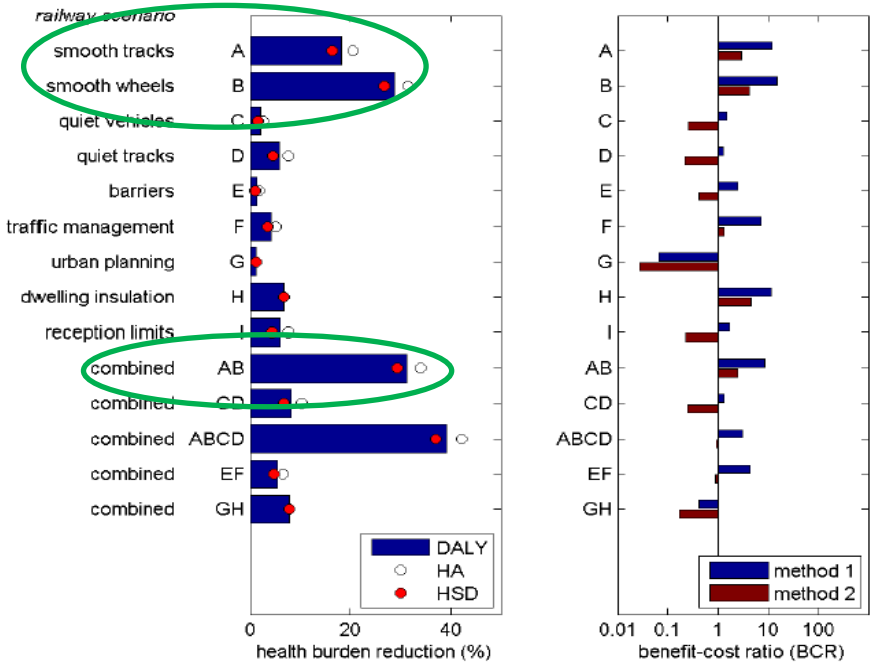
- Wheel/rail combined roughness is the excitation mechanism of rolling noise
- Rolling noise is the main source contributing to railway noise for conventionnal speeds

Pass-by noise with different roughness levels



➔ Rail roughness can influence pass-by noise up to some dB

CBA for different mitigation measures (Phenomena-EU)



➔ Rail roughness control provides opportunities for railway noise mitigation!

Rail roughness and railway noise

Still some challenges for the sector

Rail acoustic roughness is a key parameter that significantly influences railway noise

- We know how to take it into account within noise models (source of rolling noise)
- We know how to measure it (EN 15610)
- We know/suspect that it should be controlled for noise issues
- We don’t know exactly how
- We don’t know exactly what are the costs and the benefits

How to increase the knowledge and support the evolution of maintenance process?

➔ Rail Roughness Monitoring!
➔ Optimised maintenance process!

ACORD
Acoustics of Reprofiling and Onboard Monitoring of Rail Roughness

QuieterRail

SNCF

Rail roughness monitoring

Needs, opportunities

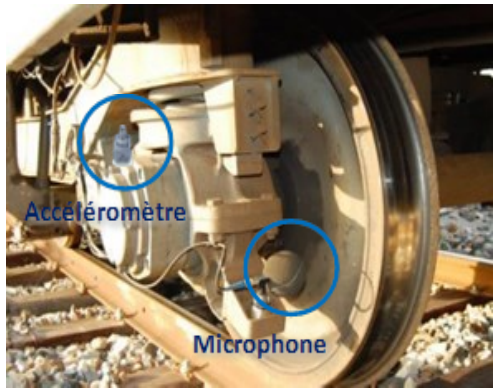
Direct measurements meet the basic needs

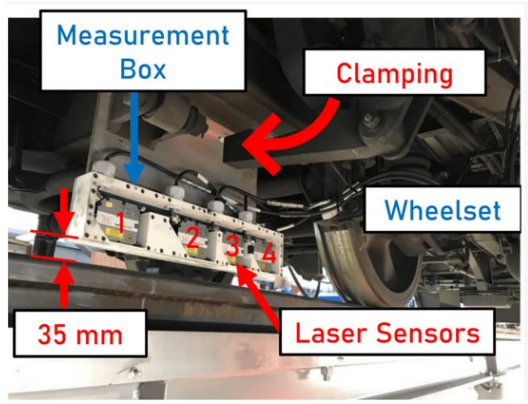
- Find TSI compliant tracks for homologation
- Research projects, noise prediction

They are:

- Standardised (EN 15610)
- Accurate
- Widely used
- Time consuming
- Representative of a site and a date

Onboard monitoring systems provide opportunities





www.mdpi.com

They are:

- Not standardised, probably less accurate
- Convenient and coupled with other track measurements

They could provide:

- Roughness growth depending on track components and operational conditions ➔ Adapt grinding strategies
- Representative rail roughness data for strategic noise mapping ➔ Cost effective noise mitigation strategies
- Acoustic grinding reception/validation
- Detection of corrugation, rail defects…

Rail roughness monitoring

A solution to many questions and concerns…

“More investments will not lead to less noise”
Ard

“Does it help in terms of complaints if we reduce noise more?”
Martijn

“I don’t see the innovations on track!”
Rüdiger

“We still need some money for the research”
Rüdiger

“It is clear that… LCC… Track…”
All debaters

“Roughness is one of the most crucial aspects”
Bart

➔ All you need is rail roughness monitoring and control!

Thank you

Baldrik Faure
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Assessment of track quality with on-board measurements

Supplier perspective

Ard Kuijpers

CEO and Senior Consultant

QuieterRail

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ACOUSTIC RAIL ROUGHNESS

Roughness

Longitudinal variation of height

- amplitude (0.01 µm – 100 µm)
- wavelength (1 mm – 60 cm)

Acoustic

Wavelength range that causes vibation/sound in audible range

- speed

Rail

Sound is caused by combination of wheel ⊕ rail roughness

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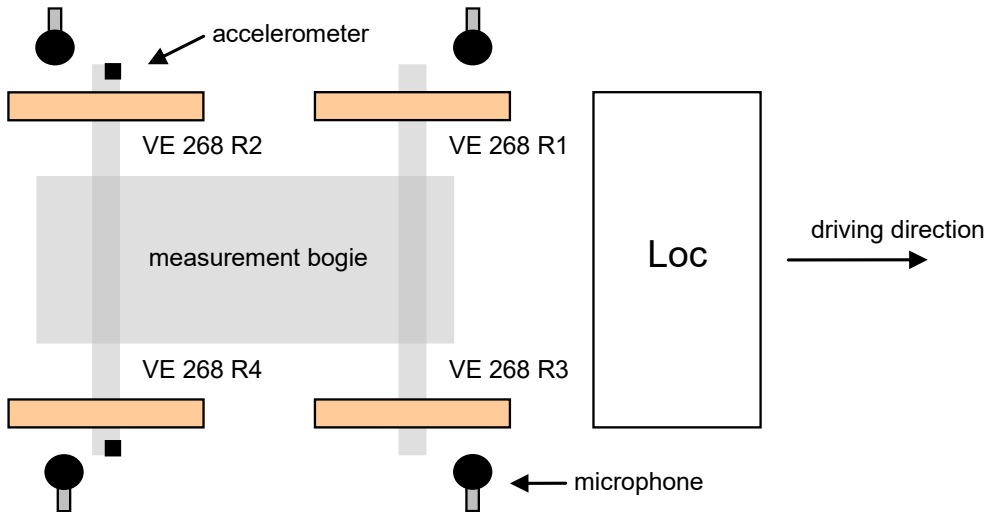
CURRENT PRACTICE

measurement system

- 4 microphones
- 2 accerelometers
- GPS: position and speed
- Mounting on (test) train bogie



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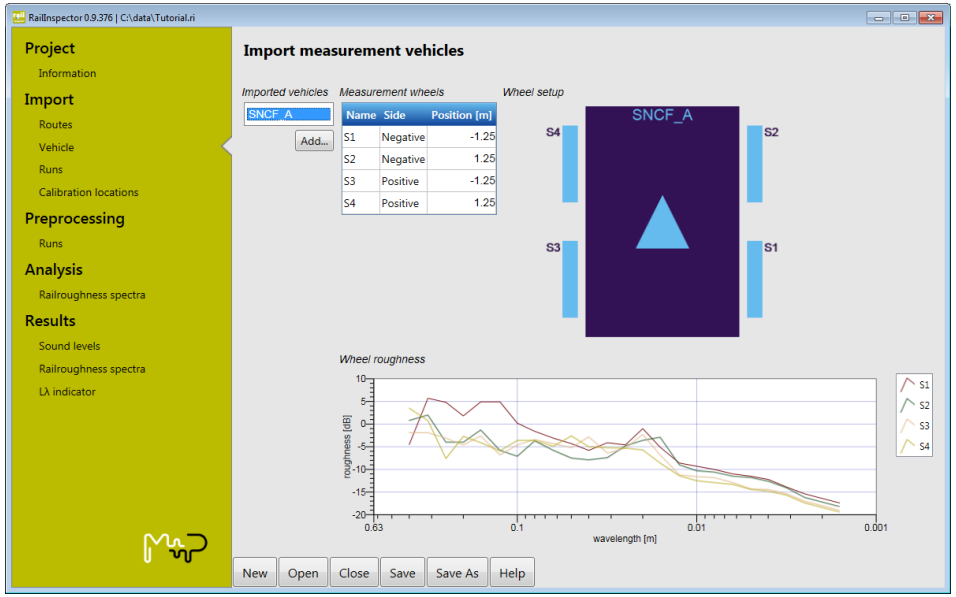
ARRoW

CURRENT PRACTICE

+ analysis system

- automated (offline) processing
- result quantities:
  - Acoustics
    - emission correction
    - emission maps
    - 3rd octave rail roughness
  - Asset management
    - noise events (joints)
    - rail defects



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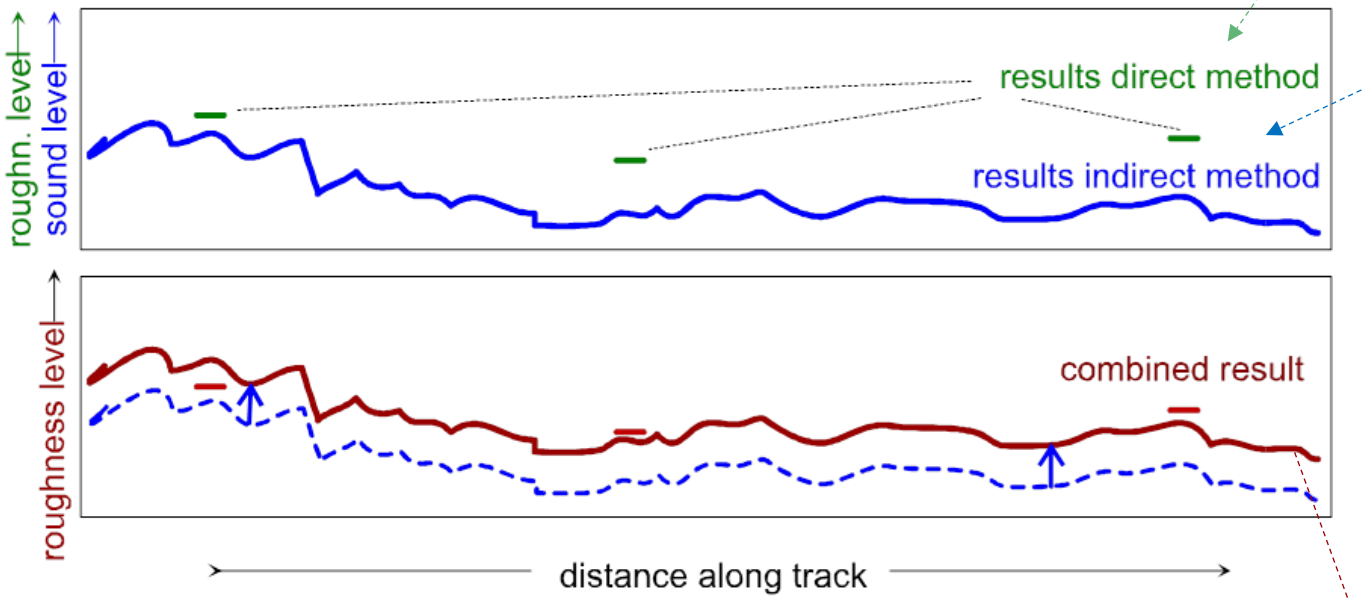
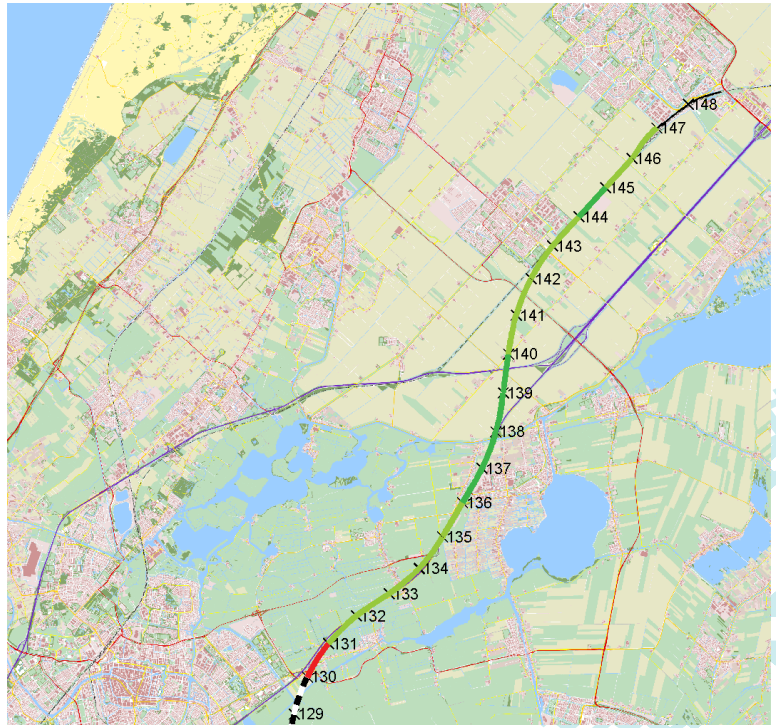
ARRoW

PRINCIPLE OF INDIRECT ON-BOARD MEASUREMENTS





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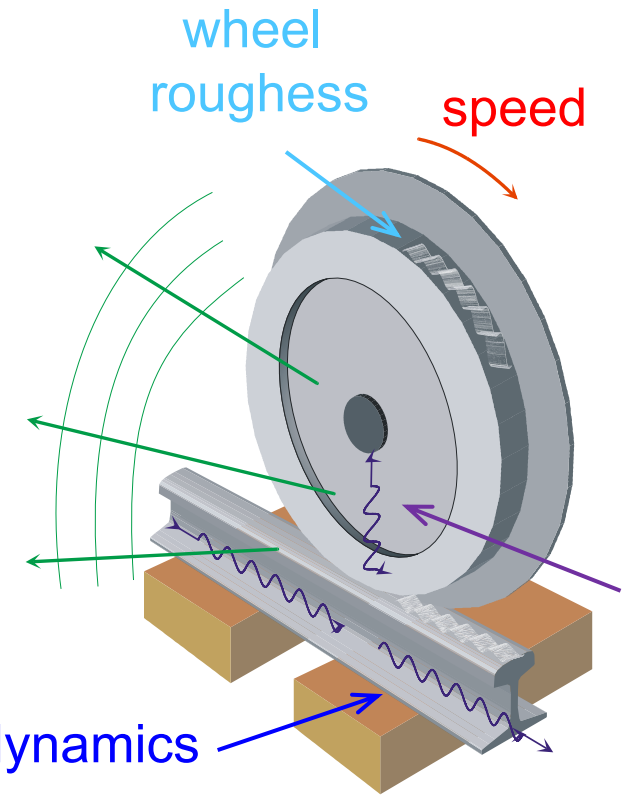
IMPORTANT PARAMETERS FOR ON-BOARD MEASUREMENTS



Vehicle speed
- correction on sound spectrum

Track dynamics
- Influence on sound (and vibration)
- calibration for each track type

Wheel & axle-box dynamics
- Filtering on roughness wavelengths
- Non-linearities in bearings

Wheel roughness
- different for each wheel
- low enough
- (not) constant during measurement

Surroundings

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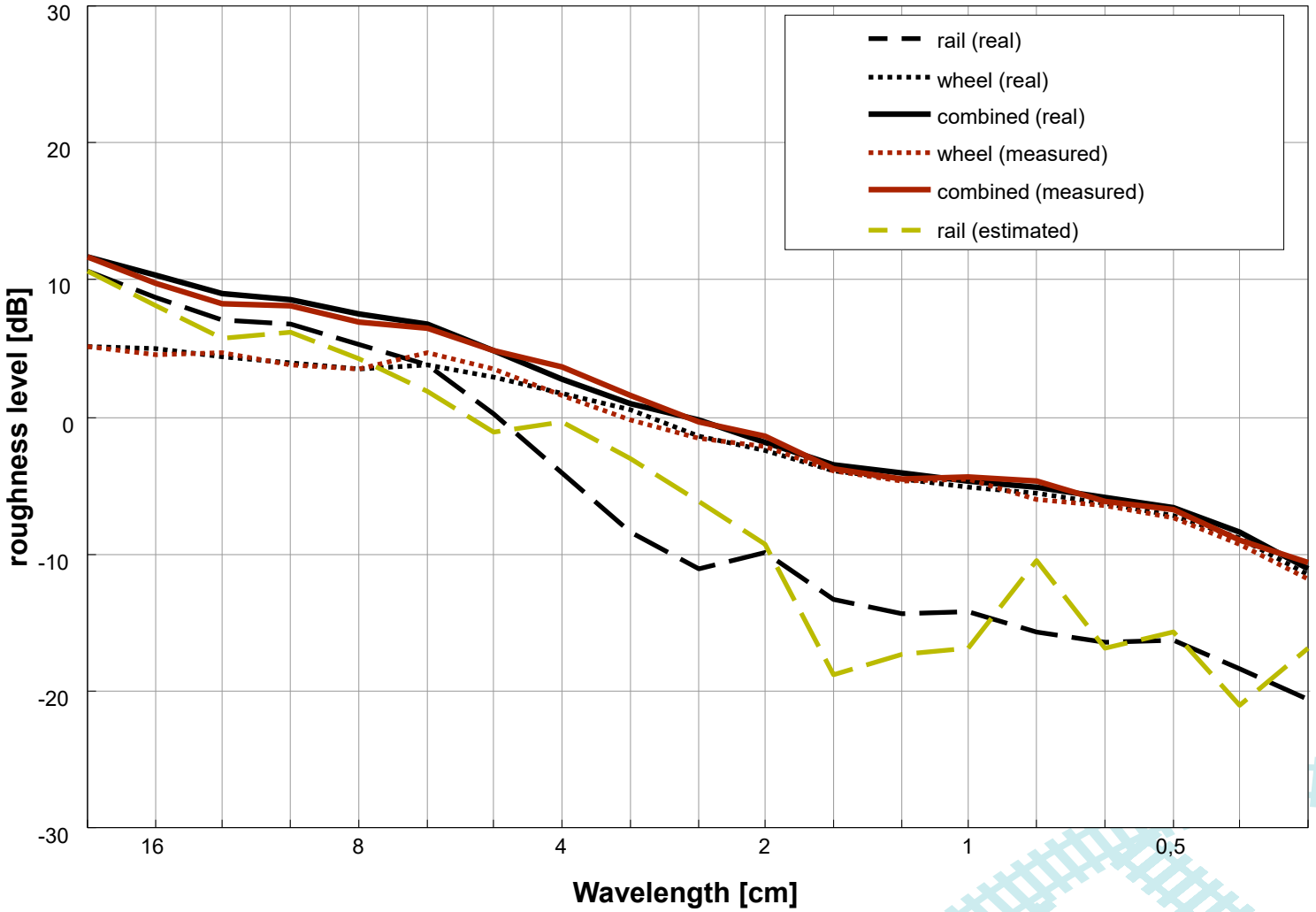
QuieterRail

COMBINED ROUGHNESS AND DEALING WITH UNCERTAINTY



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QuieterRail

CHOICE OF RESULT QUANTITY IS IMPORTANT

Rail roughness

- can be directly compared to direct measurement
- very sensitive to wheel roughness on measurement bogie

Effect on rolling noise emission (ΔL)

- directly expressed into a quantity that the public understands
- can be directly compared to pass-by noise measurements
- not so sensitive to wheel roughness

QUIETERRAIL EXPECTED RESULTS

- **State-of-the-art survey**
  - suppliers
  - users
- **Guidelines**
  - common understanding and terminology
  - generalized technical procedures
  - realistic requirements
  - objective comparison
- **Analysis Toolbox**

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Points of view in terms of on-board measurements

Research perspective

Luis Baeza

University Professor

Technical University of Valencia

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RAIL ROUGHNESS & ONBOARD MEASUREMENT SYSTEMS – WHY MODELS ARE NEEDED

📌 **Research Focus:**

- Evaluating **rail acoustic-roughness measurement** using **axlebox vibration** data.
- Advanced modelling of the **system**, considering:
  - **Rotational effects**
  - **Infinite track assumptions**
  - **Non-steady-state wheel-rail contact theory**

🔑 **Key Contribution:**

- Identification of the **transfer function** linking:
  - Axlebox displacement ↔ Roughness-induced displacement
  - Function of **roughness wavelength**, vehicle speed, and track properties

⚙️ **Modelling Significance:**

- Accounts for **vibration propagation & dynamic interactions**
- Enables **real-time, onboard roughness estimation**
- Supports **noise control, maintenance planning & grinding optimisation**

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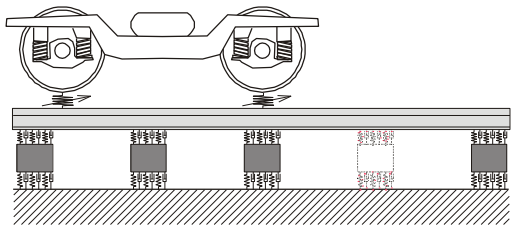
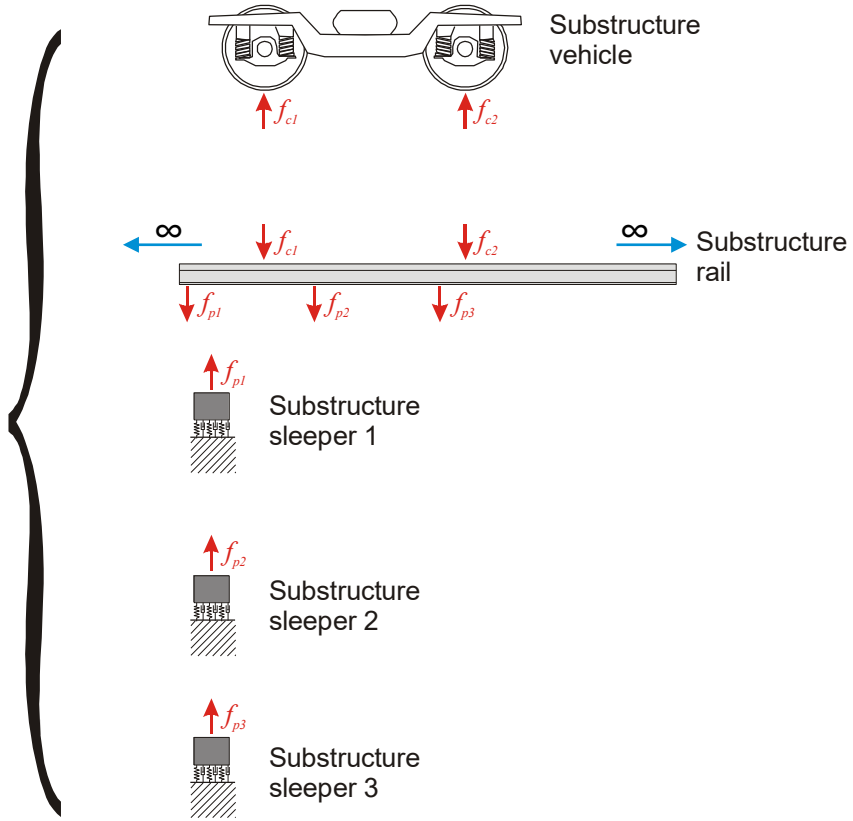
General Methodology

Receptance-Based Substructuring (RBS)

In RBS the dynamic behavior of substructures is expressed in terms of receptance matrices (frequency response functions) and the coupling between the substructures is achieved by enforcing compatibility and equilibrium conditions through forces and displacements. Constitutive relations are used to define how these forces and displacements interact at the coupling interfaces.

The complete system

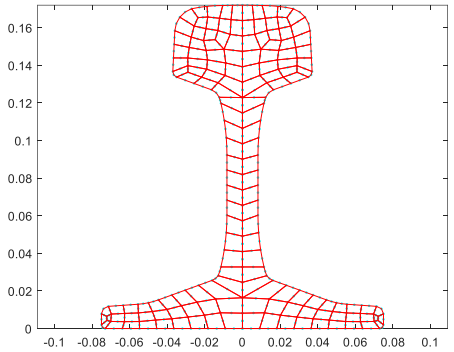




Dynamic model of the track

Rail model

The Finite Element Waveguide Method (2.5D FEM) is a numerical technique used to analyze wave propagation in structures with one dimension that is infinite or periodic such as rails. It combines the Finite Element Method (FEM) in the cross-sectional dimensions with a wave decomposition approach in the propagation direction.



Free response (wave) equation

$$[(-\mathrm{i}\kappa)^2\mathbf{K}_2 + (-\mathrm{i}\kappa)\mathbf{K}_1 + \mathbf{K}_0 - \omega^2\mathbf{M}]\widetilde{\mathbf{U}}(\kappa) = 0$$

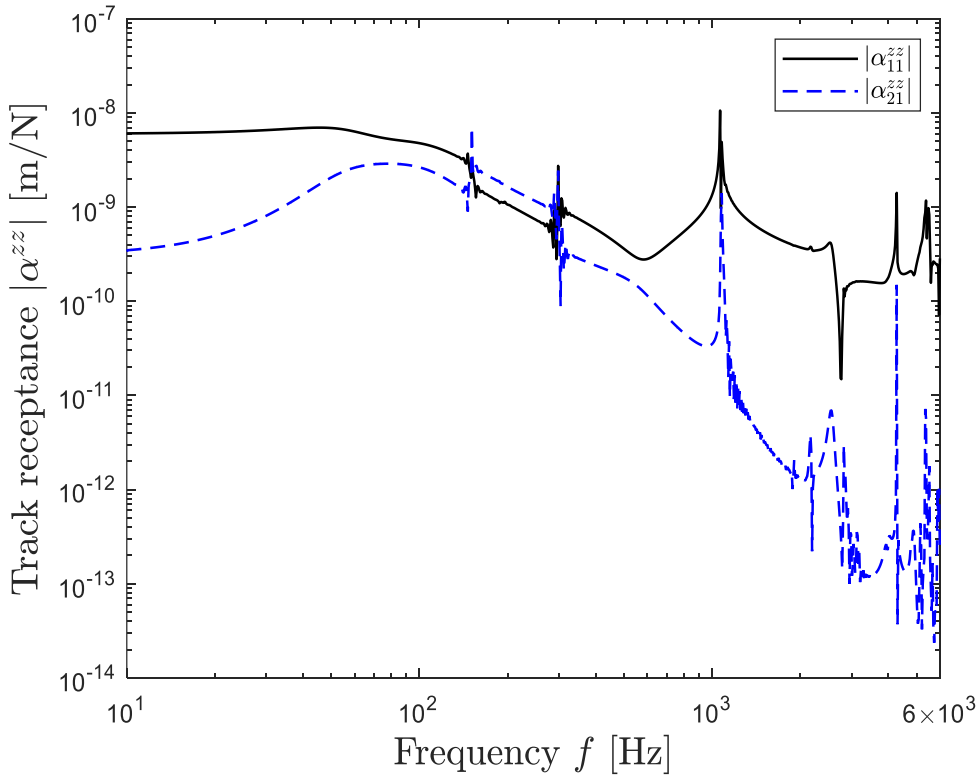
Karasalo's receptance formula

$$H_{\ell j}(x) = -\mathrm{sign}(x)\sum_n \frac{\mathrm{i}\,\widetilde{U}^L_{jn}\widetilde{U}^R_{\ell n}\,\mathrm{e}^{-\mathrm{i}\kappa_n x}}{\left(\widetilde{\mathbf{U}}^L_n\right)^{\mathrm{T}}[-2\,\kappa_n\mathbf{K}_2 - \mathrm{i}\,\mathbf{K}_1]\,\widetilde{\mathbf{U}}^R_n}$$

Dynamic model of the track

Whole track model

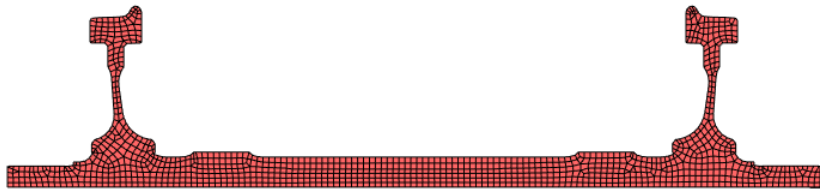
The receptances of the three-dimensional complete track are obtained through Receptance-Based Substructuring. The substructures comprising this model include two infinite rails (modeled using the Waveguide-Karasalo method) and 200-300 sleepers (implemented through receptances).

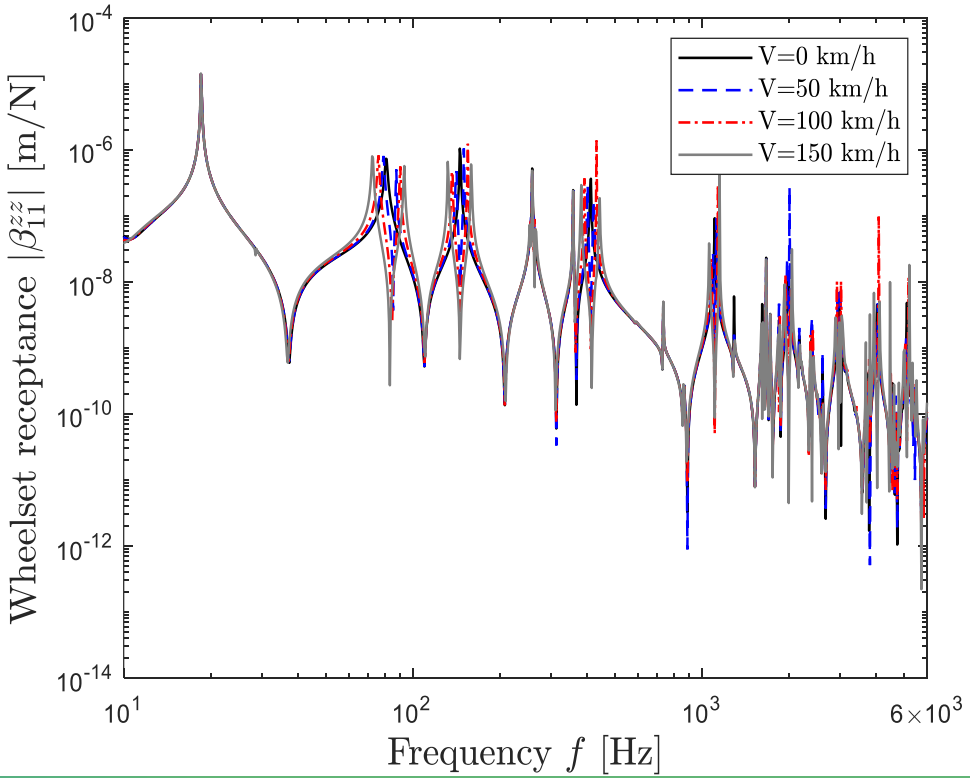


Dynamic model of the wheelset

Wheelset receptances

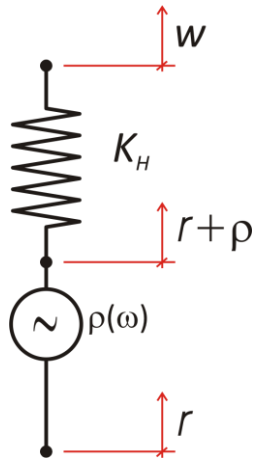
The model developed by UPV is based on a mesh of the cross-section of the wheelset (two wheels + axle). This model accounts for flexibility and the inertial effects associated with rotation. Two axleboxes are added to this solid as non-rotating point masses along with the primary suspension. The primary suspension is assumed to be connected to a stationary bogie frame. The resulting model produces receptances with resonances that depend on the angular velocity of the wheelset.





Model development

Constitutive relationship



The constitutive relationships define the connection between forces and displacements based on the normal contact stiffness and a non-Hertzian and non-stationary contact theory developed by UPV. This involves the displacements of the wheel the rail the roughness and their derivatives.

$$\mathbf{f}_c = \mathbf{K}_H[\mathbf{R}_c\mathbf{T}\,\mathbf{w}_c - \mathbf{r}_c - \boldsymbol{\rho}_c] + \mathbf{C}_K\left[\mathbf{R}_c\mathbf{T}\,\dot{\mathbf{w}}_c - \dot{\mathbf{r}}_c - V\frac{\partial \boldsymbol{\rho}_c}{\partial x}\right] \quad c = 12$$

wheel rail roughness — wheel rail roughness

Receptance-Based Substructuring

Wheel displacement; Rail displacement; Roughness

$$\begin{aligned}\mathbf{f}_c = &\\ = \mathbf{K}_H&\left[-\mathbf{R}_c\mathbf{T}\left(\boldsymbol{\beta}_{c1}\mathbf{T}^{\mathrm{T}}\mathbf{R}_c^{\mathrm{T}}\,\mathbf{f}_1 + \boldsymbol{\beta}_{c2}\mathbf{T}^{\mathrm{T}}\mathbf{R}_c^{\mathrm{T}}\,\mathbf{f}_2\right) - \left(\boldsymbol{\alpha}_{c1}\,\mathbf{f}_1 + \boldsymbol{\alpha}_{c2}\,\mathbf{f}_2\right) - \boldsymbol{\rho}_c\right]\\ + \mathbf{C}_K&\left[-\mathrm{i}\omega\mathbf{R}_c\mathbf{T}\left(\boldsymbol{\beta}_{c1}\mathbf{T}^{\mathrm{T}}\mathbf{R}_c^{\mathrm{T}}\,\mathbf{f}_1 + \boldsymbol{\beta}_{c2}\mathbf{T}^{\mathrm{T}}\mathbf{R}_c^{\mathrm{T}}\,\mathbf{f}_2\right) - \mathrm{i}\omega\left(\boldsymbol{\alpha}_{c1}\,\mathbf{f}_1 + \boldsymbol{\alpha}_{c2}\,\mathbf{f}_2\right) - V\left(\frac{\partial \boldsymbol{\alpha}_{c1}}{\partial \mathrm{x}_1}\mathbf{f}_1 + \frac{\partial \boldsymbol{\alpha}_{c2}}{\partial \mathrm{x}_1}\mathbf{f}_2\right) - \mathrm{i}\omega\boldsymbol{\rho}_c\right]\end{aligned}$$

Wheel velocity; Rail velocity ∂/∂t; Rail convective velocity V ∂/∂x; Roughness

Model development

Force equation

$$\begin{pmatrix} \mathbf{I} + (\mathbf{K}_H + \mathrm{i}\omega\mathbf{C}_K)\left(\mathbf{R}_1\mathbf{T}\,\boldsymbol{\beta}_{11}\mathbf{T}^{\mathrm{T}}\mathbf{R}_1^{\mathrm{T}} + \boldsymbol{\alpha}_{11}\right) + V\mathbf{C}_K\dfrac{\partial\boldsymbol{\alpha}_{11}}{\partial \mathrm{x}_1} & (\mathbf{K}_H + \mathrm{i}\omega\mathbf{C}_K)\left(\mathbf{R}_1\mathbf{T}\,\boldsymbol{\beta}_{12}\mathbf{T}^{\mathrm{T}}\mathbf{R}_1^{\mathrm{T}} + \boldsymbol{\alpha}_{12}\right) + V\mathbf{C}_K\dfrac{\partial\boldsymbol{\alpha}_{12}}{\partial \mathrm{x}_1} \\ (\mathbf{K}_H + \mathrm{i}\omega\mathbf{C}_K)\left(\mathbf{R}_2\mathbf{T}\,\boldsymbol{\beta}_{21}\mathbf{T}^{\mathrm{T}}\mathbf{R}_2^{\mathrm{T}} + \boldsymbol{\alpha}_{21}\right) + V\mathbf{C}_K\dfrac{\partial\boldsymbol{\alpha}_{21}}{\partial \mathrm{x}_1} & \mathbf{I} + (\mathbf{K}_H + \mathrm{i}\omega\mathbf{C}_K)\left(\mathbf{R}_2\mathbf{T}\,\boldsymbol{\beta}_{22}\mathbf{T}^{\mathrm{T}}\mathbf{R}_2^{\mathrm{T}} + \boldsymbol{\alpha}_{22}\right) + V\mathbf{C}_K\dfrac{\partial\boldsymbol{\alpha}_{22}}{\partial \mathrm{x}_1} \end{pmatrix} \begin{Bmatrix} \mathbf{f}_1 \\ \mathbf{f}_2 \end{Bmatrix} = -\begin{Bmatrix} (\mathbf{K}_H + \mathrm{i}\omega\mathbf{C}_K)\boldsymbol{\rho}_1 \\ (\mathbf{K}_H + \mathrm{i}\omega\mathbf{C}_K)\boldsymbol{\rho}_2 \end{Bmatrix}$$

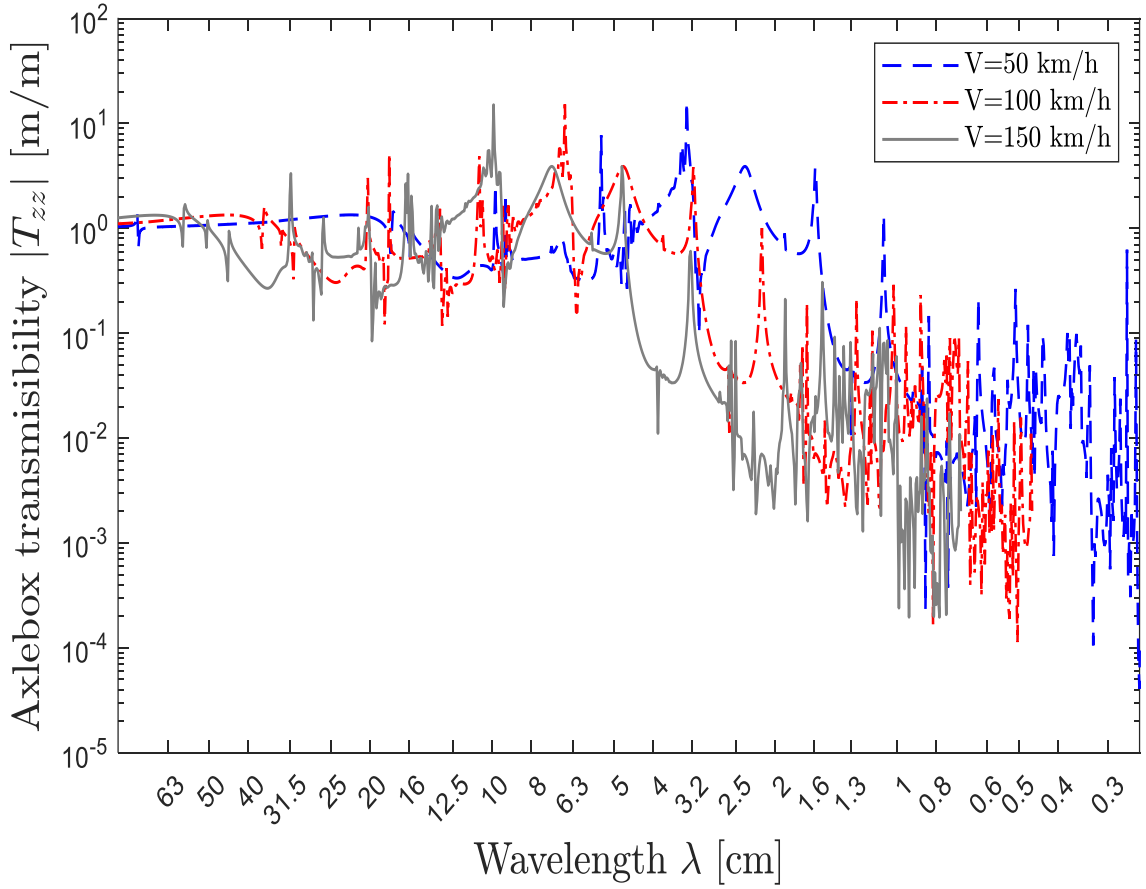
Axlebox displacements

$$\begin{Bmatrix} \mathbf{w}_3 \\ \mathbf{w}_4 \end{Bmatrix} = -\begin{pmatrix} \mathbf{R}_1\mathbf{T}\,\boldsymbol{\beta}_{31}\mathbf{T}^{\mathrm{T}}\mathbf{R}_1^{\mathrm{T}} & \mathbf{R}_1\mathbf{T}\,\boldsymbol{\beta}_{32}\mathbf{T}^{\mathrm{T}}\mathbf{R}_1^{\mathrm{T}} \\ \mathbf{R}_2\mathbf{T}\,\boldsymbol{\beta}_{41}\mathbf{T}^{\mathrm{T}}\mathbf{R}_2^{\mathrm{T}} & \mathbf{R}_2\mathbf{T}\,\boldsymbol{\beta}_{42}\mathbf{T}^{\mathrm{T}}\mathbf{R}_2^{\mathrm{T}} \end{pmatrix} \begin{Bmatrix} \mathbf{f}_1 \\ \mathbf{f}_2 \end{Bmatrix}$$

Preliminary Results

Axlebox vertical transmissibility due to the excitation of both rails narrow band analysis

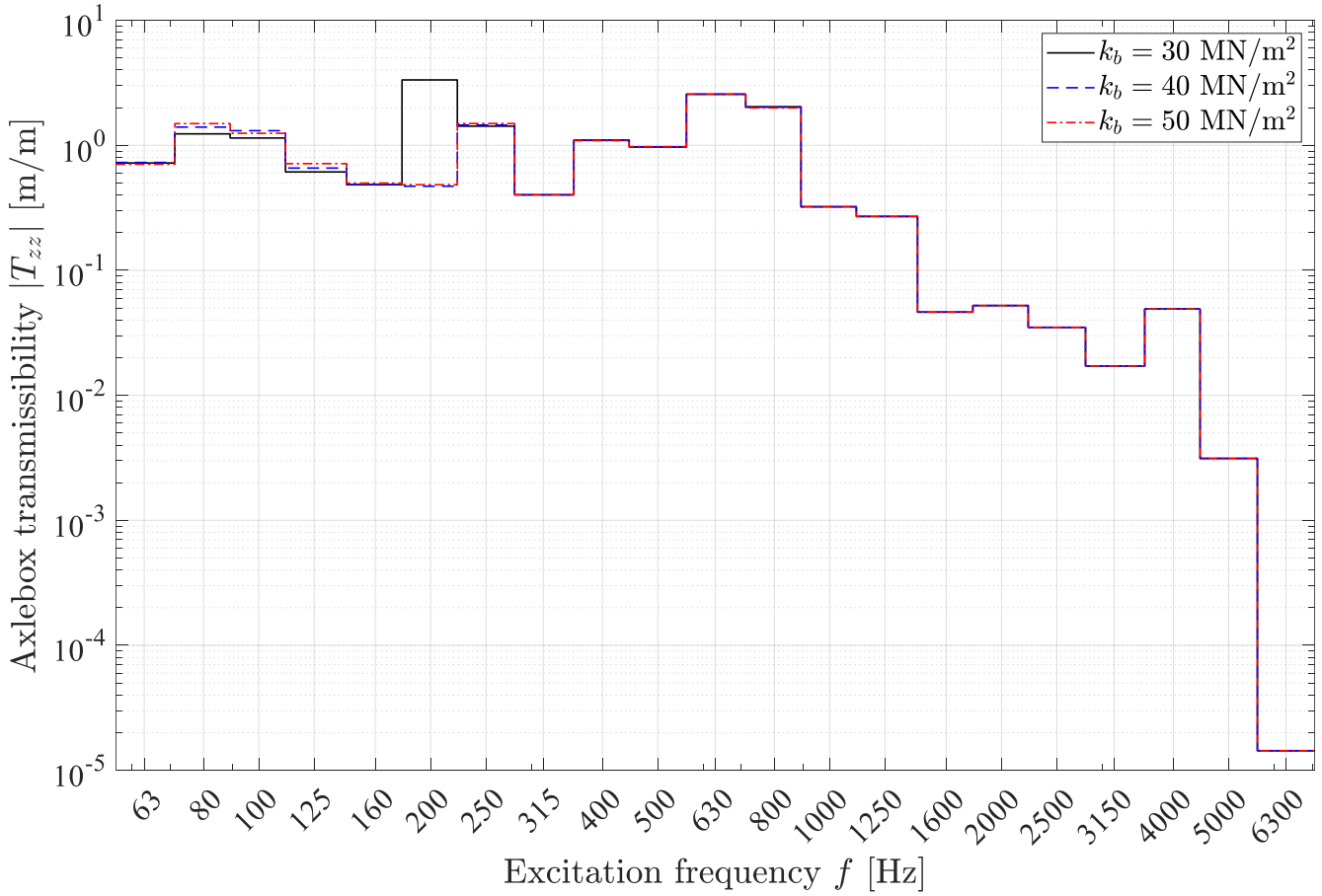
Vehicle speed influence.



Preliminary Results

Axlebox vertical transmissibility due to the excitation of both rails broad band analysis

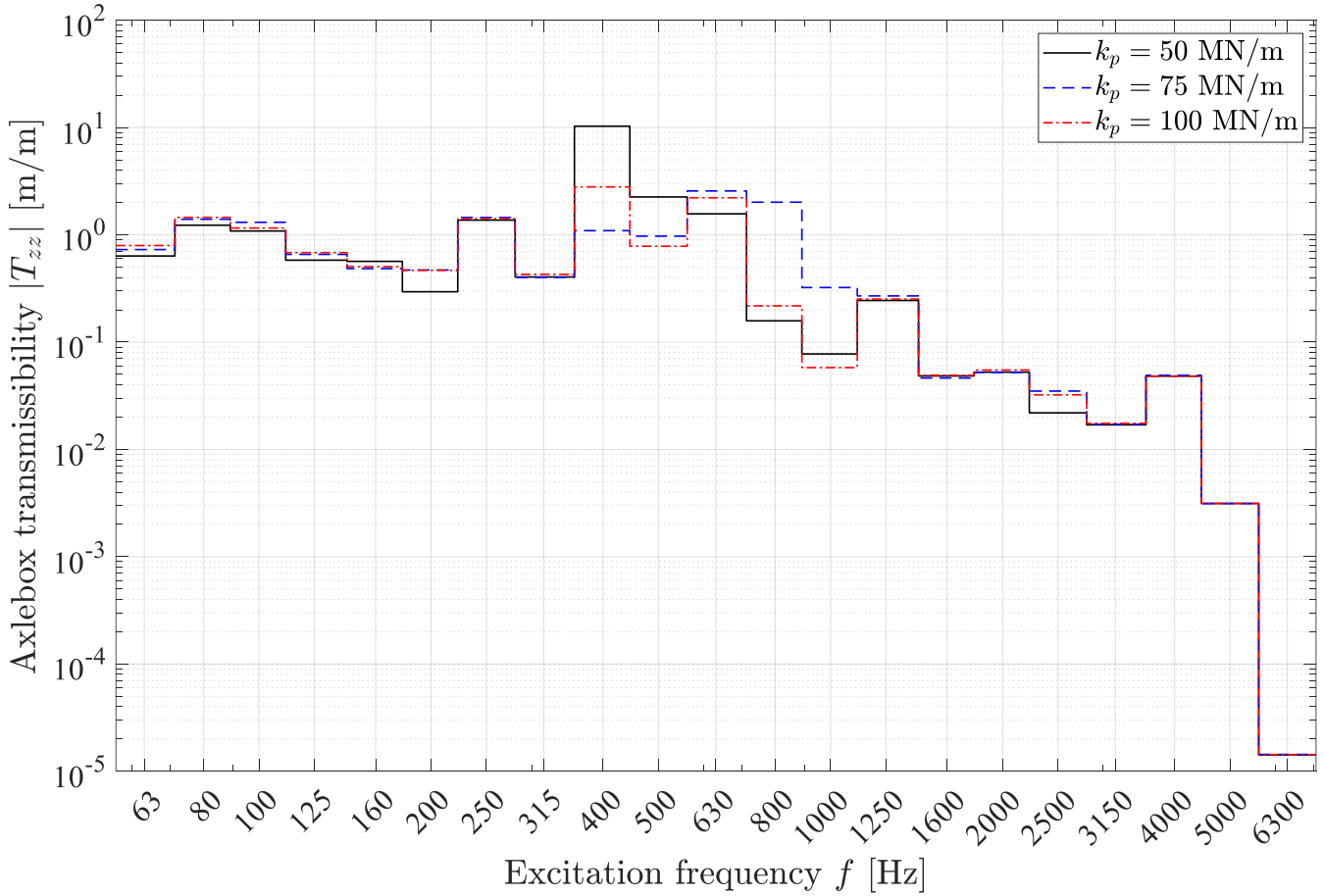
Ballast stiffness influence.



Preliminary Results

Axlebox vertical transmissibility due to the excitation of both rails broad band analysis

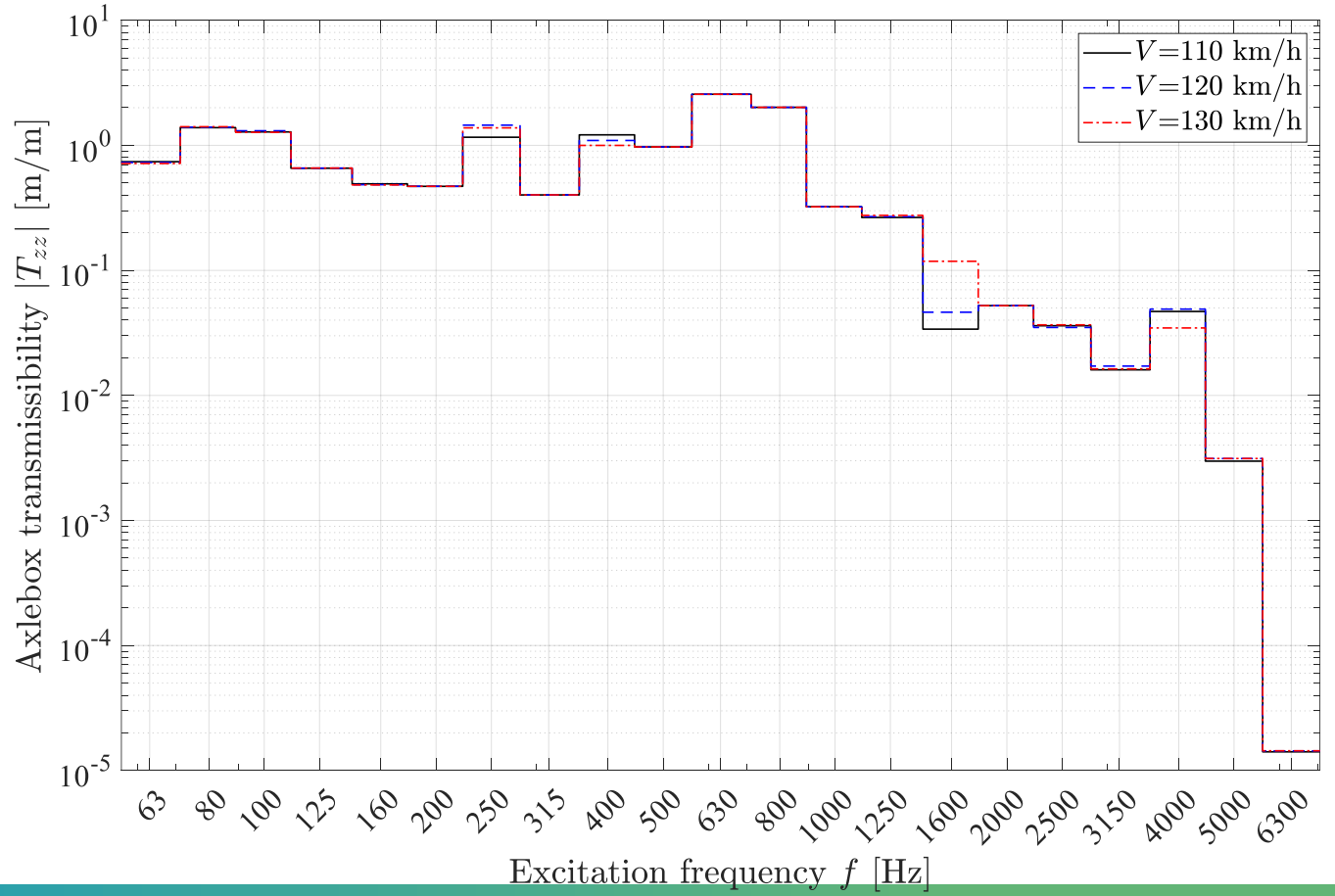
Rail pad stiffness influence.



Preliminary Results

Axlebox vertical transmissibility due to the excitation of both rails broad band analysis

Vehicle speed influence.



QuieterRail

Thank you!

UPV| Luis Baeza

baeza@mcm.upv.es

Rail grinding & Annoyance

Juliette Florentin

Noise and Vibration Engineer

Infrabel

SUSTAINABILITY Action Week

Rail grinding & annoyance

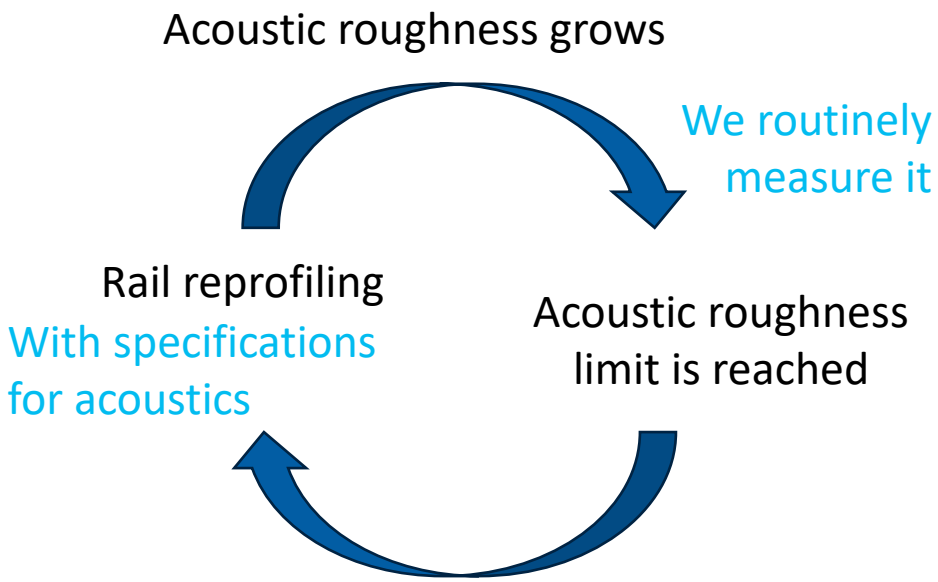
UIC ACORD project: a new indicator for the acoustic quality of reprofiling

J. Florentin INFRABEL I-O.233

UIC Noise Days 11.03.2025

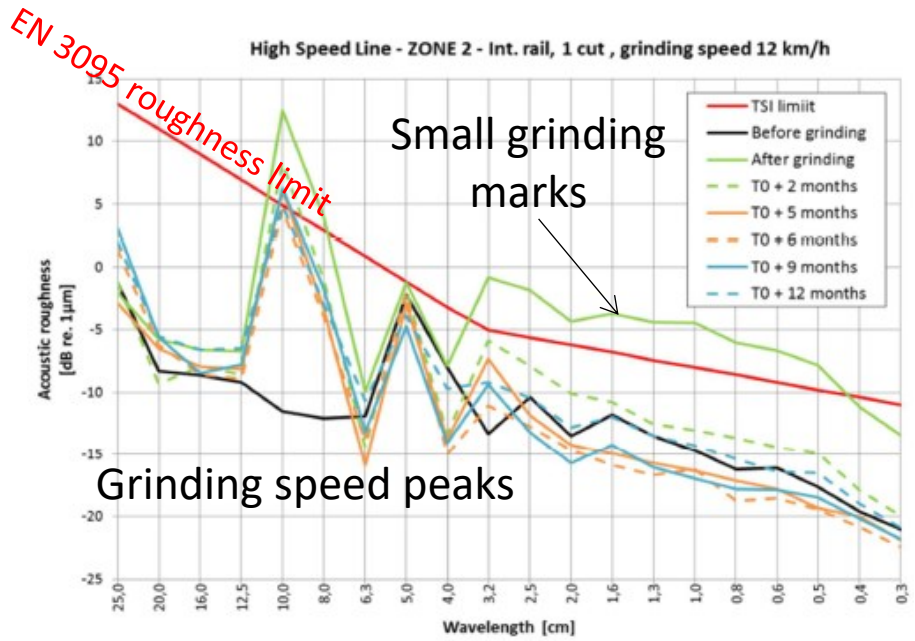
Rail reprofiling is how to shape rail roughness to maintain a low noise

Then the end predictive maintenance scenario is…



Grinding has acoustical side effects…

- High frequency tonal noise from small grinding marks
  (temporary, polished away by the passage of trains)
- Some longer grinding marks can remain for long periods
- Link marks / noise annoyance depends on size, match with track dynamics, speed, roughness growth…
- Acoustic specifications for grinders must foresee these issues



Optimisation of rail grinding parameters to improve the acoustic track performance and its durability: towards an acoustic maintenance of the rail on the French network

P. Fodiman[1], B. Trollé[2], F. Létourneaux[3], M. Ribourg[4].

Reprofiling quality control: what should the target roughness be?

Dependent on the line speed?

Dependent on track dynamics?

Dependent on train type?

What quantity do we control
when we control “roughness” ?

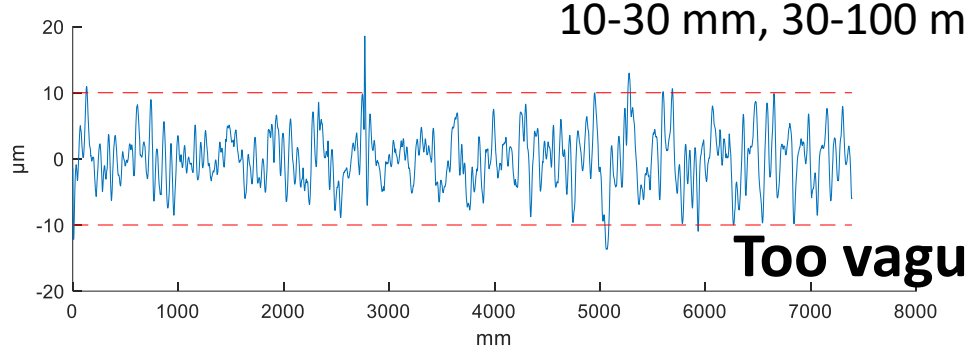
WP1 – Indicator for acoustic quality of reprofiling

The objective is to define a generally accepted indicator applicable to rail roughness and suitable for assessing the nuisance due to reprofiling.

Is roughness just a number?

EN 13231-2

Grinding quality control
10-30 mm, 30-100 mm



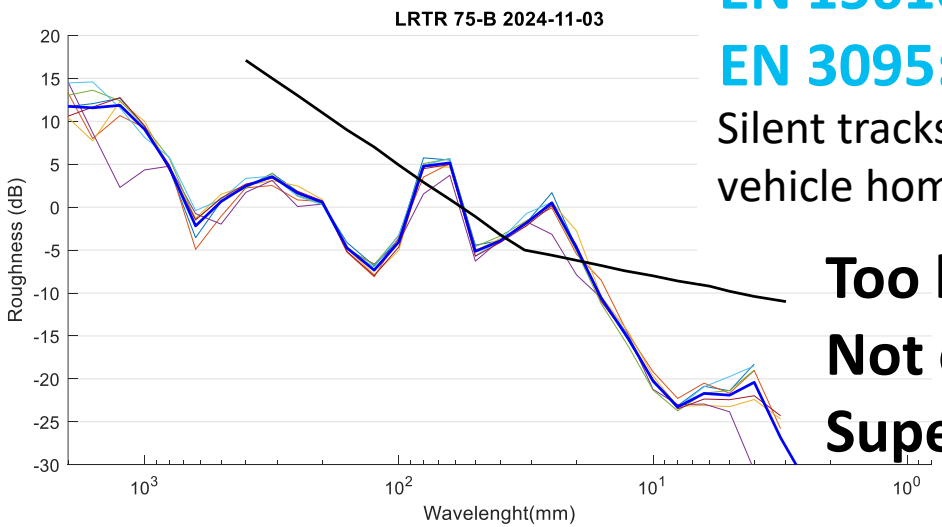
Too vague!

Swiss law

Unique roughness < 10

EN 15610
EN 3095:2013

Silent tracks for
vehicle homologation



Too harsh!

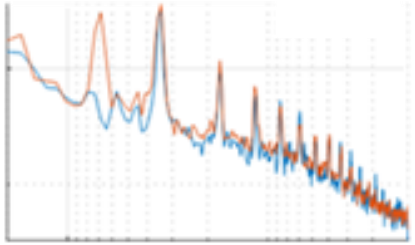
Not cost-effective!

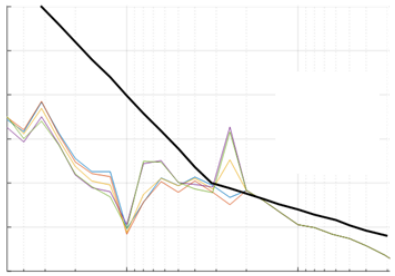
Super complicated!

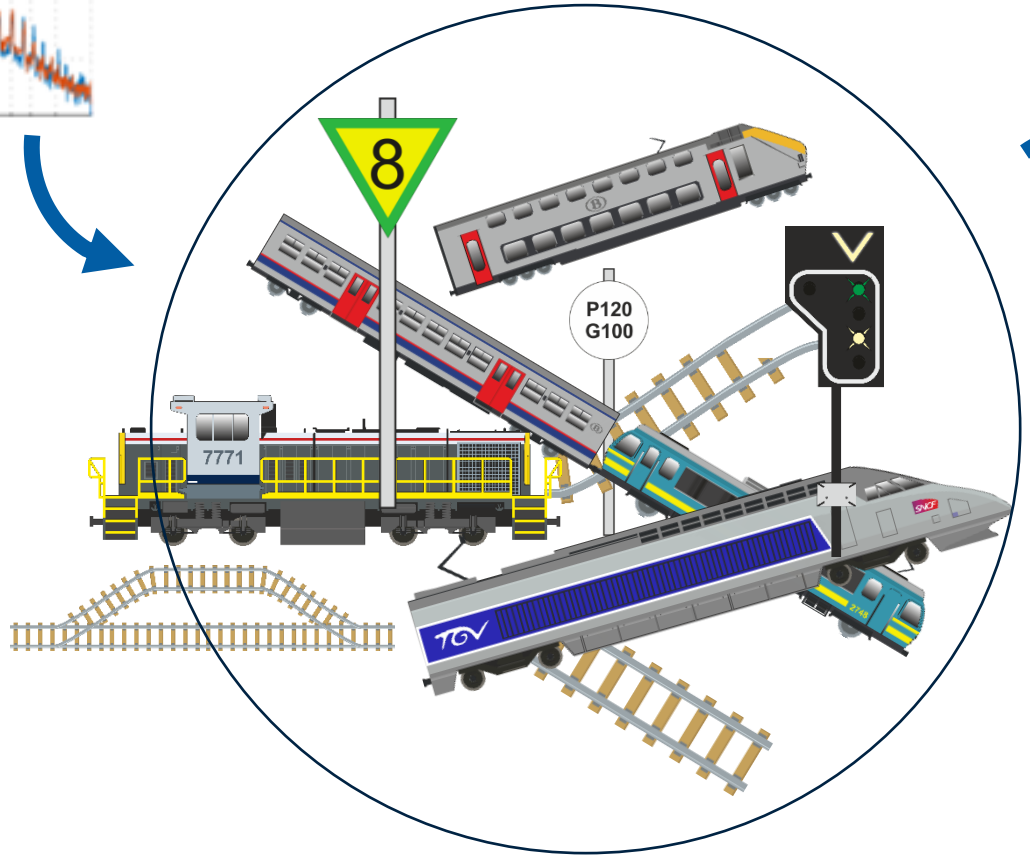
Is it really correlated to noise annoyance?

Applicable to reprofiling control?

Different roughnesses







Model

Different noises

New roughness indicator correlated to annoyance

ACORD
Acoustics of Reprofiling and Onboard Monitoring of Rail Roughness

VIBRATEC

CSTB
le futur en construction

What comes out of this?

Common reprofiling acoustic indicator

We can set meaningful targets

We can develop the practical procedures to measure it

IRS

We can set specifications for grinding works

EN 13231-2:**2028**

We give grinding companies a goal to chase

CFL

We are working towards the same goal

- ACORD steering group joins QuieterRail advisory board, bringing the user perspective to the development of on-board measurement systems
- Upcoming survey of (potential) users outside ACORD

ACORD
Acoustics of Reprofiling and Onboard Monitoring of Rail Roughness

QuieterRail

WP2 – Technical guidelines for the on-board measurement of the rail acoustic roughness

Facilitate the development and implementation of on-board measurement systems, by providing user specifications

Thank you!


AUTORAIL DE
31.942.001
R. min = 90 m
66 000 kg
31.0 t
23.80 m
17.00 m
G-75 P-85t

ERJU QuieterRail Project

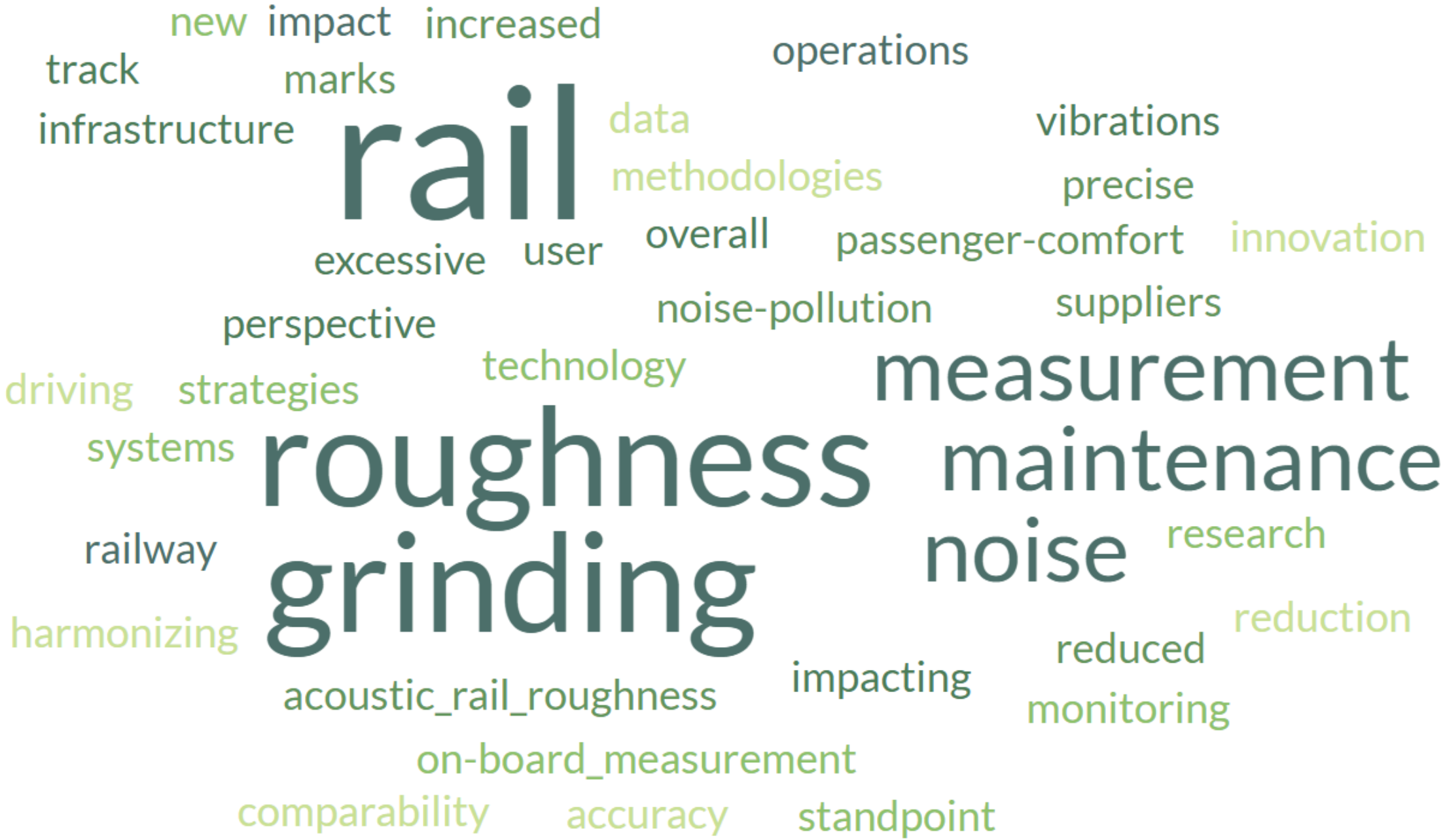
Pinar Yilmazer

Head of Sustainability Programme

ERJU QuieterRail WP3 Leader

UIC

SUSTAINABILITY
Action Week


new
impact
increased
track
marks
operations
rail
infrastructure
data
vibrations
methodologies
precise
overall
passenger-comfort
innovation
excessive
user
noise-pollution
suppliers
perspective
technology
measurement
driving
strategies
roughness
maintenance
systems
railway
grinding
noise
research
harmonizing
reduction
reduced
impacting
acoustic_rail_roughness
monitoring
on-board_measurement
comparability
accuracy
standpoint

QuieterRail

ON-BOARD ROUGHNESS MEASUREMENT and RAIL GRINDING

EU-QuieterRail | UIC M+P UPV

Pınar Yılmazer

UIC

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101101973.

QuieterRail in a Nutshell

Start Date: October 2024 / End Date: September 2027

36
Months
DURATION

4,1 M €
(3,28 M€ funded)
TOTAL PROJECT VALUE

16
PARTNERS

Project Members

Coordinator

unife
THE EUROPEAN RAIL INDUSTRY

Technical leader

VIBRATEC

Partners

CSTB
le futur en construction

Empa
Materials Science and Technology

Hes·so

KU LEUVEN

RINA

SYTRAL MOBILITÉS

TNO innovation for life

UIC
INTERNATIONAL UNION OF RAILWAYS

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

UNIVERSITY OF CAMBRIDGE

University of Southampton

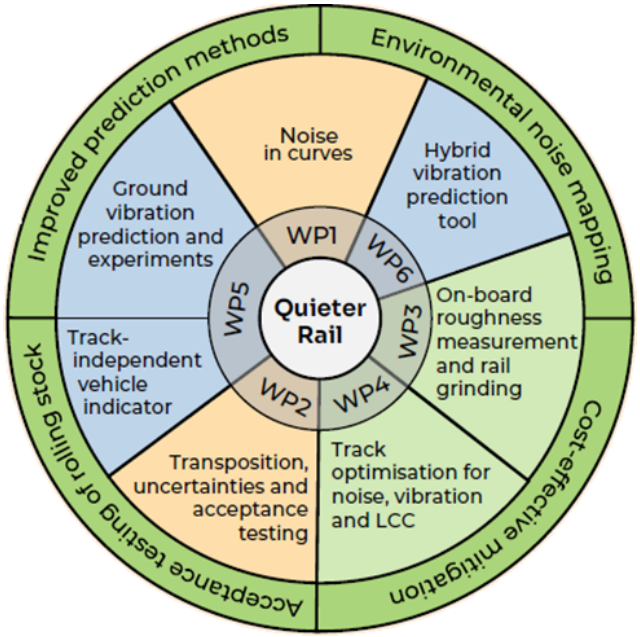
Wölfel
Developing people. Engineering the future.

A step change in prediction, mapping, acceptance testing and cost-effective mitigation for railway noise and vibration

🎯 Project's Impact:

Four Main Pillars:

1. Cost-effective mitigation of N&V
2. Improved prediction methods for railway N&V
3. Developments of acceptance testing of rolling stock
4. Improved environmental noise mapping, extended to include vibration



Noise analysis and evaluation methods

WP1 Noise in curves

WP2 Transposition, uncertainties and acceptance testing

Cost-effective noise mitigation

WP3 On-board roughness monitoring and rail grinding

WP4 Track optimisation for noise, vibration and LCC

Ground-borne vibration prediction

WP5 Ground vibration prediction and experiments.

WP6 Hybrid vibration prediction tool

In situ testing to support validation

Noise and vibration measurements to support the WP1, WP2 and WP5 on urban and mainline railway networks

WP3 Objectives

- Gather info/data on **existing on-board measurement systems –** IMs & Suppliers**.**
- Assess their performance in reprofiling to mitigate noise.

Data Collection & Stakeholder Input

- Describe based on principles, **key metrics, practicality, and costs**.

System Classification

- Define a unified method for determining rail roughness levels.
- Align the method with **EN 15610 (2019)**.

Harmonised Procedure Development

- Validate results across different systems.
- Use the harmonised procedure for consistency.

System Comparison & Validation

- Identify challenges via **dynamic simulation** and propose measures for achieving acceptable results.

Technical Challenges & Solutions

- **Evaluate system reliability and sensitivity** to track and service-specific conditions.

Performance Assessment

- Support **END noise mapping** by creating harmonised European guidelines for rail acoustic roughness measurement

Contributions to Noise Mapping

Work Programme (Oct 2024 - Sept2027)

- **Task 3.1 – Documentation of Existing Systems & Applications**
  - 📄**Public Report**: *State of the Art on On-Board Rail Roughness Measurement Systems* (March 2026)
  - **Preliminary Report**: *Investigation of On-Board Rail Roughness Measurement Systems* (July 2025)
  - 💡 **Get Involved → Join Online Surveys** !
- **Task 3.2 – Definition of a generalised procedure for comparison and validation**
  - Draft a **comparison and validation framework** for onboard measurement systems (December 2025)
- **Task 3.3 – Identifying Technical Issues & Solutions**
  - **Benchmarking** onboard rail roughness measurement systems to identify challenges and potential improvements → Workshops
- **Task 3.4 – Drafting a Technical Guideline**
  - 📄 **Public Report**: *Guideline for On-Board Measurement Systems of Acoustic Rail Roughness* (March 2027)
  - 🛠️ **Open-Source Tool**: *Acoustic Rail Roughness Toolbox* (September 2027)

Learn from Experts | Suppliers & Users

🔍 Supplier Survey - Coverage

- System Overview: Readiness levels, documentation
- Sensors & Data: Types, placement, key measurements
- Measurement & Positioning: Accuracy, speed, GPS reliability
- Data Processing & Analysis: Transfer functions, correction factors, noise handling
- Results & Future Outlook: Accuracy, limitations, improvement areas

https://forms.office.com/e/9wauRWrwe3

📢 User Survey – Coming Soon!

Working with ACORD Steering members to clarify key focus area

- Motivations for roughness measurements
- Needs for onboard system
- Applications & opportunities
- Expected performance

QuieterRail

Thank you!

UIC | Pınar Yılmazer

M+P | Ard Kuijpers and Bert Peeters

UPV| Luis Baeza and Javier Carballeira Morado

REFLECTIONS ON MORE THAN 30 YEARS IN THE RAILWAY NOISE BUSINESS:

PERSONAL OBSERVATIONS and LESSONS LEARNED

Jakob Oertli

Chair of
the UIC Noise and Vibration Sector

SBB

INTERNATIONAL UNION
OF RAILWAYS

Thank you
for your attention

Event Feedback & Satisfaction Survey | UIC Railway Noise Days 11-12/03

Stay in touch with UIC: #UICrail