



THE PHENOMENA PROJECT

Assessment of Potential Health Benefits
of Noise Abatement Measures in the EU

A Study for EU DG Environment
VVA, TNO, Tecnalía, Anotec, UAB



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Presentation for GRBP Task Force Noise Limits
12th July 2021



› OVERVIEW

- Consortium
 - Study objectives and scope
 - EU context
 - Tasks in the EU Call
 - EU and national legislation on transportation noise
 - Noise action plans
 - Noise abatement solutions
 - Health burden and scenario analysis
 - Scenario conclusions, observations, FAQ
 - Policy recommendations
 - Conclusions
-
- Main focus is on road traffic noise in this presentation

› THE CONSORTIUM

Duration: December 2019 – March 2021



Roles:

- VVA: Project coordination, EU policy, legislation, consultation, action plan analysis



- TNO: Noise modelling and mapping, noise abatement, scenario analysis, CBA and noise legislation and policy



- Anotec: Aircraft noise



- Tecnalia: Noise mapping/test sites



- UAB: EU Exposure and action plans

PHENOMENA STUDY OBJECTIVES AND SCOPE

› Recommend measures to **reduce the health impacts** of transportation noise by 20-50% in 2030 – technical solutions and legislation

› Major roads with $L_{den} > 53$ dB

› Major railways with $L_{den} > 54$ dB

› Major airports with $L_{den} > 45$ dB

› Major agglomerations with $L_{den} > 53$ dB

As required by Environmental Noise Directive (END) 2002/49

Noise mapping and action plans

› Existing mitigation measures, not new ones

› A key question is: What does the EU need to do in terms of policy and legislation to achieve this? How can the uptake of noise mitigation be increased?

› SCOPE: WHAT ARE THE HEALTH IMPACTS?

- › Cardiovascular disease
- › Sleep disturbance
- › Stress
- › Reduced cognitive performance
- › Psychological effects



› **SCOPE: WHY BY 2030?**

- › 2030 is short and medium term, during which policy can be put in place
- › Without changes, current situation would worsen
- › Action is required to counter increasing health impacts due to growing traffic and noise exposure near transport infrastructure
- › Any changes to legislation should have a significant reduction potential on the health burden

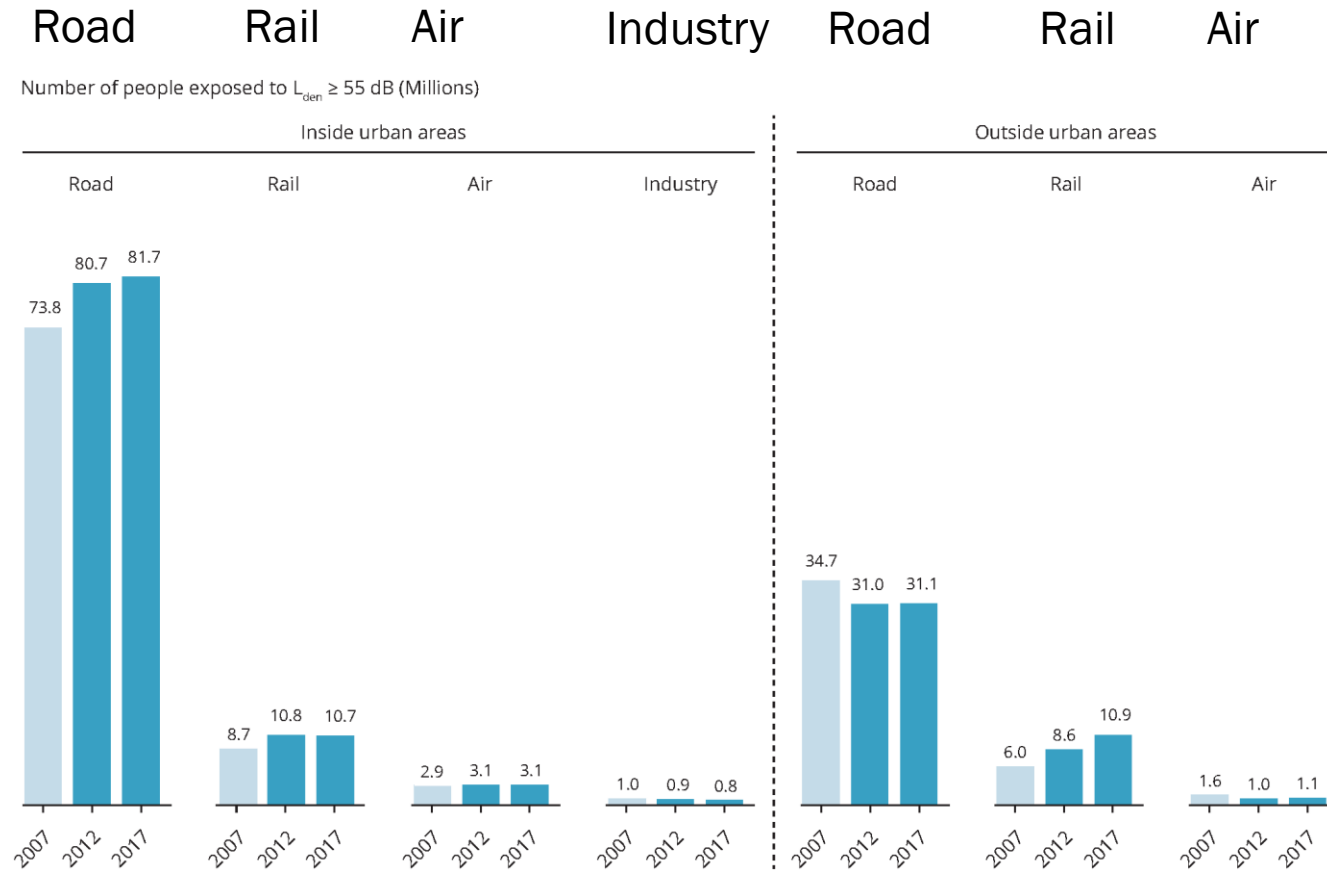
› **OUTSIDE THE SCOPE**

- › Peak noise
- › Short term noise exposure
- › Industrial noise
- › Wind turbines
- › Recreational noise

- › Innovations that will take longer for broad implementation or not yet widely available

EU CONTEXT

- › WHO Environmental Noise Guidelines 2018 potential health effects for 1 in 5 people
- › Increasing noise exposure due to traffic growth and urbanisation
- › Revision of EU noise policy
- › New Green Deal (Zero emissions in 2050)
- › Upcoming revision of vehicle noise limits, railway and aircraft noise regulations
- › Public pressure to reduce traffic noise
- › EU Noise Expert Group focused on the Environmental Noise Directive
- › EU conference Noise in Europe (2017)
- › And during the study: CORONA – the audible effect of noise reduction



Millions of people exposed to $L_{den} \geq 55$ dB (EEA data)

EU NOISE ABATEMENT APPROACHES



10 ways to combat NOISE POLLUTION

In the EU, more than 100 million citizens are affected by noise levels harmful to their health.



Road traffic is the major source of noise pollution, followed by railway and aircraft noise.



Noise pollution is associated with health effects, such as cardiovascular disease, sleep disturbance, stress, reduced cognitive performance, and psychological effects.



Implementation: Over 3,000 km of noise barriers have been installed alongside European rail networks. They are even more widely used alongside roads, including in Austria, Denmark, France, Germany, Italy, Poland, Spain & the Netherlands.

Implementation: Traffic management strategies are widely used across Europe. In Paris & Valencia there is restricted access for heavy goods vehicles, while Anney & Parma have implemented shuttle bus services to reduce private car use.

Implementation: Electric cars have the potential to reduce noise.

Implementation: Computer models can predict noise exposure & identify areas unsuitable for development. No houses should be allowed under landing and take-off, for instance.

Implementation: Several have been developed & are on sale on the European market.

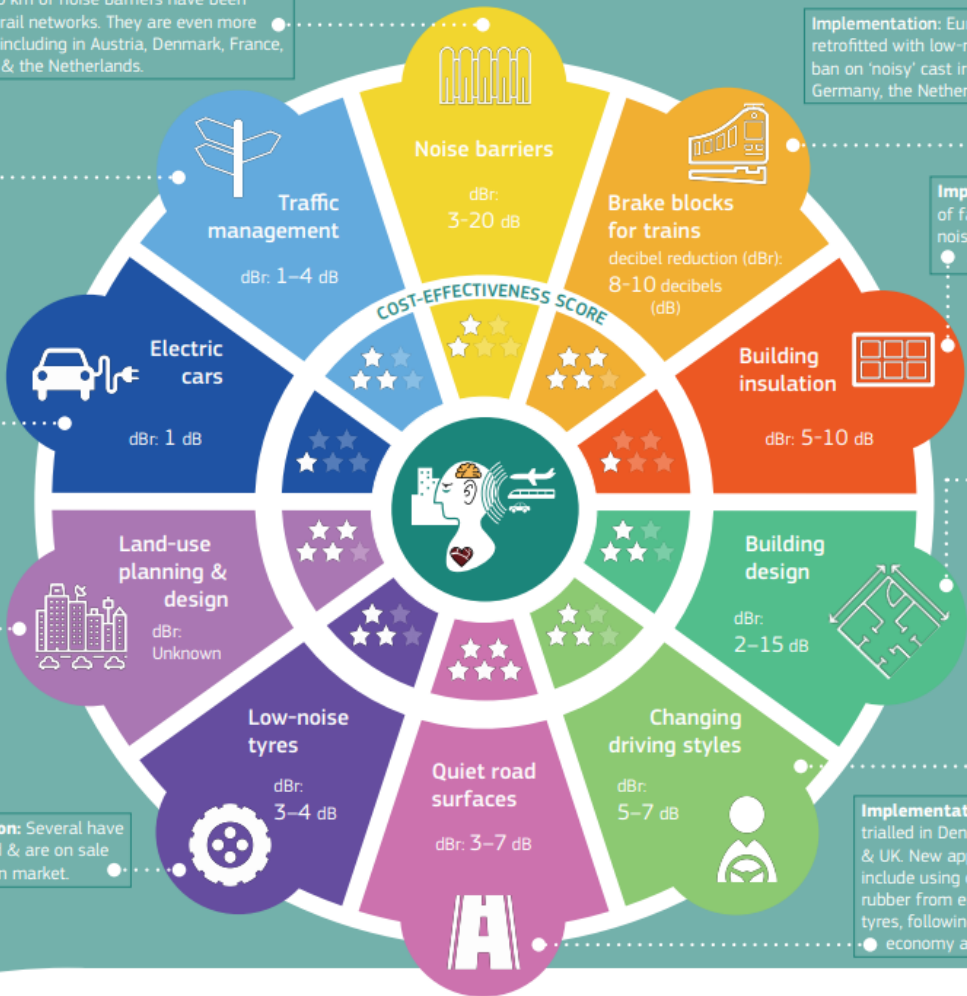
Implementation: European freight trains are being retrofitted with low-noise brake blocks. A complete ban on 'noisy' cast iron blocks is due to take place in Germany, the Netherlands & Switzerland in 2020.

Implementation: A Norwegian study of façade insulation found an average noise reduction of 7 dB inside buildings & a 30% reduction in annoyance.

Implementation: It is unclear how widely acoustical architectural planning is used. Administrative action is needed for large-scale use.

Implementation: Quieter driving could be incorporated into existing campaigns promoting 'eco-driving' to save fuel & reduce air pollution (e.g. <http://www.ecodriver.org>).

Implementation: Low-noise surfaces have been trialled in Denmark, France, Italy, the Netherlands & UK. New applications include using crumb rubber from end-of-life tyres, following a circular-economy approach.



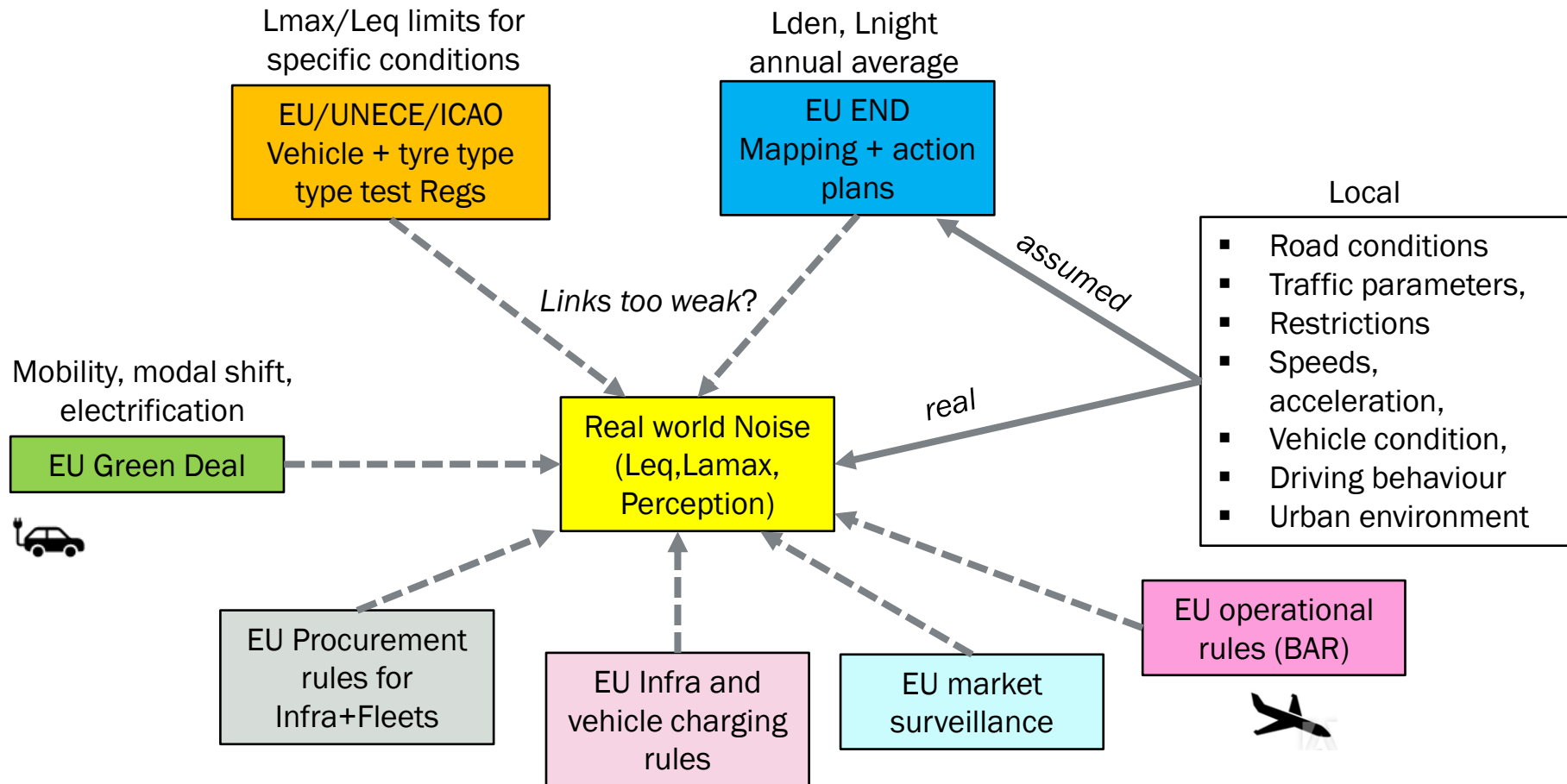
For more information, see the SfEP Future Brief, 'Noise abatement approaches'.



› **SPECIFIC TASKS IN THE CALL**

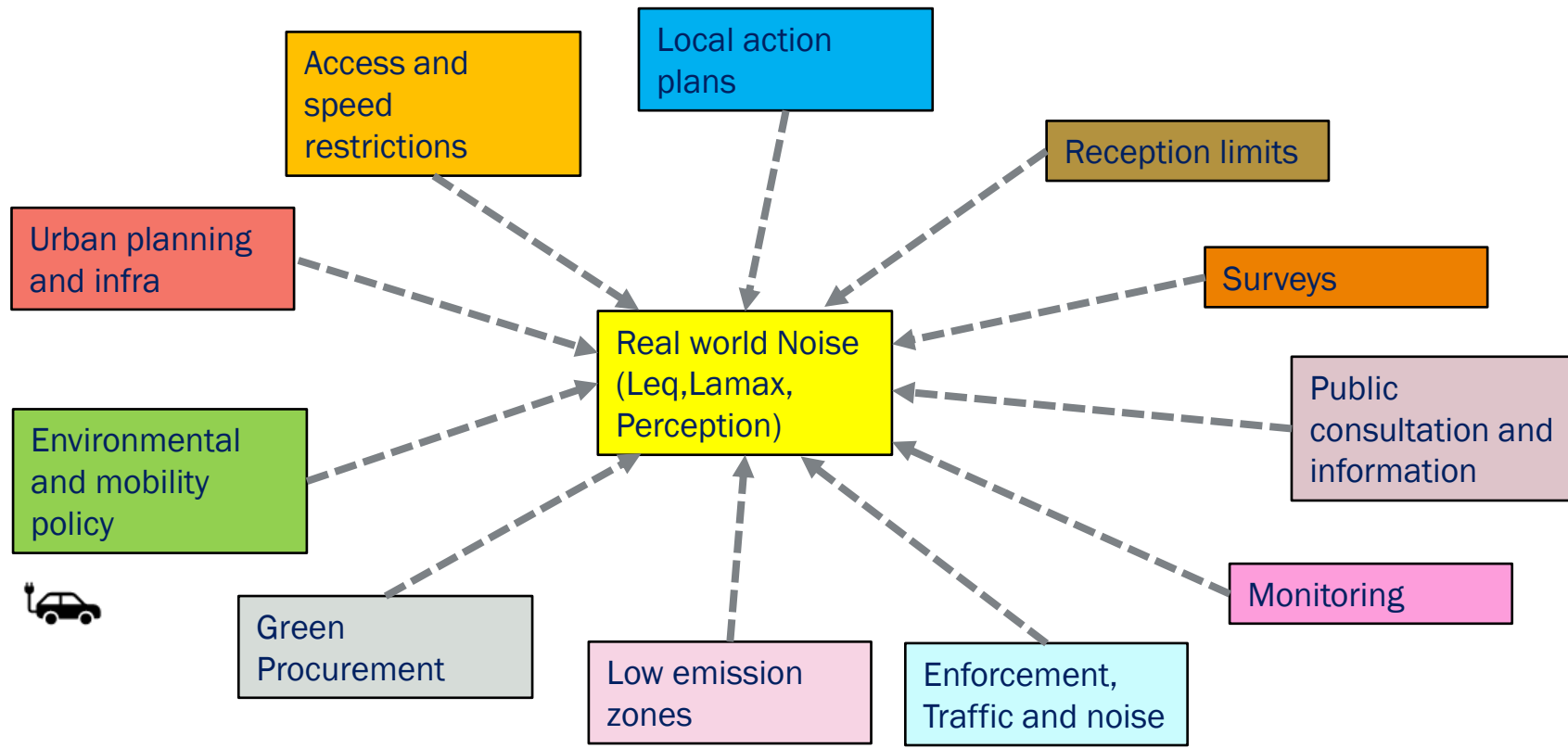
- › Review of EU and national noise legislation
- › Analysis of noise action plans
- › Intervention logic
- › Consultation and workshops
- › Selection of broadly applicable noise abatement solutions, drivers and obstacles
- › Test site analysis (sections of noise maps)
- › Scenario analysis for health burden reduction and CBA
- › Proposals for improved legislation:
general and specific for road, rail and aircraft

EU LEGISLATION ON TRANSPORTATION NOISE



› NATIONAL LEGISLATION ON TRANSPORTATION NOISE

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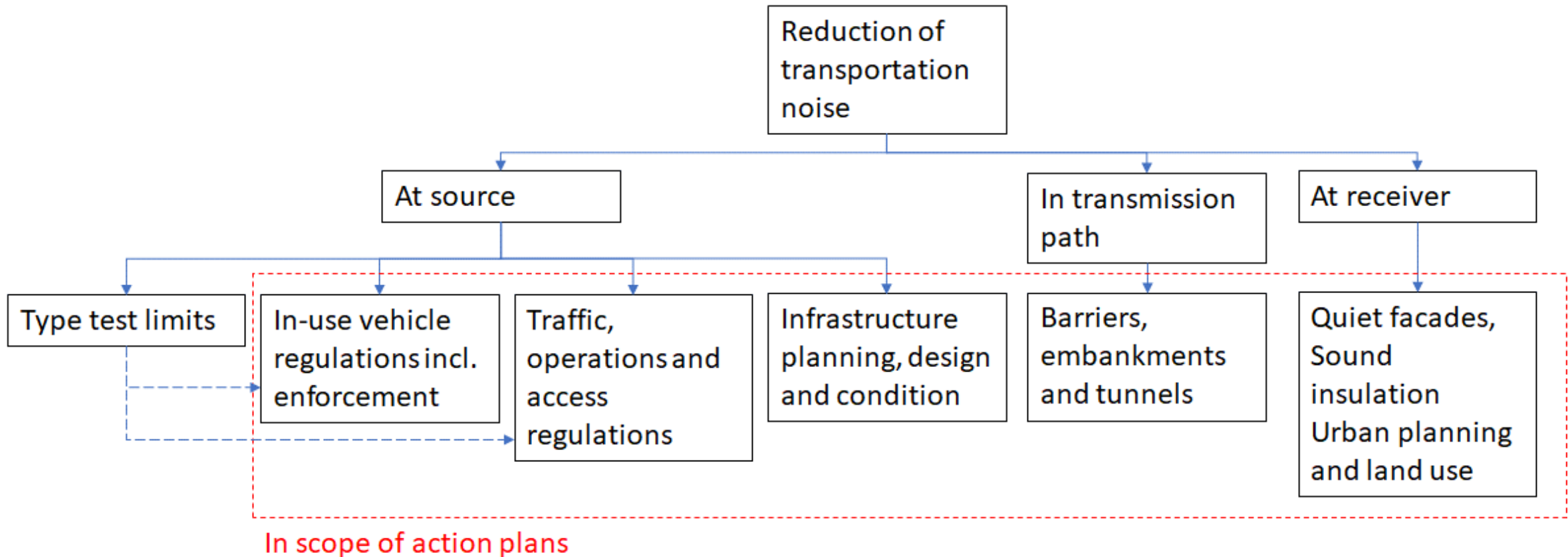
› NOISE ACTION PLAN ANALYSIS - ROAD

- › From analysis of existing action plans in EU27, percentages of abatement solutions found
- › This is indicative and does not represent the actual extent and implementation level
- › Often multiple authorities involved
- › Little check on implementation
- › Issue of funding

Road noise abatement measure	Percentage in NAPs
Traffic management, flow, routing and other	18.2%
Traffic restrictions, access, vehicle types and other	4.1%
Speed limits	7.2%
Electrification	2.5%
Tyre noise reduction	0.9%
New bypass roads	3.4%
Quiet road surfaces	11%
Infrastructure measures, incl. reconstruction, renewal, land use	15.1%
Other spatial planning	3.2%
Quiet areas	5.2%
Noise barriers	7.7%
Soundproof windows	3.4%
Other building insulation and design	2.7%
Public communication and awareness	7.2%

REDUCTION OF TRANSPORTATION NOISE

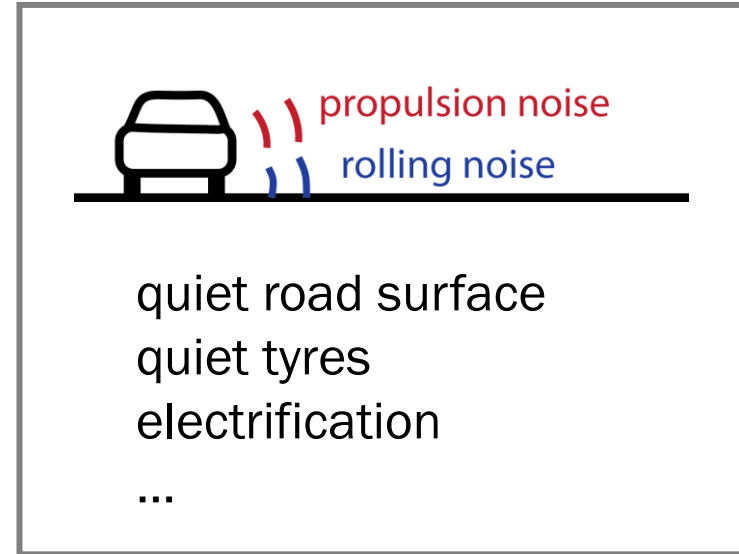
GENERIC OVERVIEW



NOISE ABATEMENT SOLUTIONS FOR ROAD TRAFFIC SELECTED FOR SCENARIO ANALYSIS

Scenario	Description
A - Quiet roads	The fractions of roads with a quiet surface are increased, for arterial roads, motorways and rural roads. The length percentages rise from 5% to 22.5% in 2035, by a factor of 4.5
B - Quiet tyres	The tyre labels for the three vehicle types are gradually decreased from 70/72/75 (baseline) to 66/69/70 in the period 2020-2024, and remain constant after 2024.
C - Vehicle limits	Vehicles comply faster with new vehicle emission limits, i.e. larger part of the fleet with lower noise emission. 2-4 dB lower type test levels (Lurban) by 2026
D - Electrification	Electrification is faster, with more hybrid and electric vehicles in 2035. cars to 50%, vans to 41%, buses to 57%, lorries and trucks to 46%
E - Barriers	The fractions of roads with noise barriers are increased, by a factor of 2.5 in 2030
F - Speed restriction	Vehicle speeds in all urban areas are reduced. 30->50, 80->50, 110->80 km/h
G – Car-free zones	New car-free zones in urban areas are created by means of traffic access restrictions and traffic rerouting. Extra 2.5% of the total area of 400 END cities. Exposure reduced by 2.5%.
H - Quiet facades	More quiet façades of dwellings are created. 30% of the dwellings without quiet façade in 2020 will have a quiet façade in 2035. About 2 dB reduction at the most-exposed façade
I - Dwelling insulation	More dwellings are insulated. The percentage of dwellings with insulation is increased by 10% in 2035 (compared with baseline), for road types 5-8.
J - Reception limits	Reception limits are introduced: 60 dB Lden and 55 dB Lnight in 2035.

HEALTH BURDEN ANALYSIS – ROAD TRAFFIC



EU health burden

annoyance

sleep disturbance



1.7 million
healthy life years

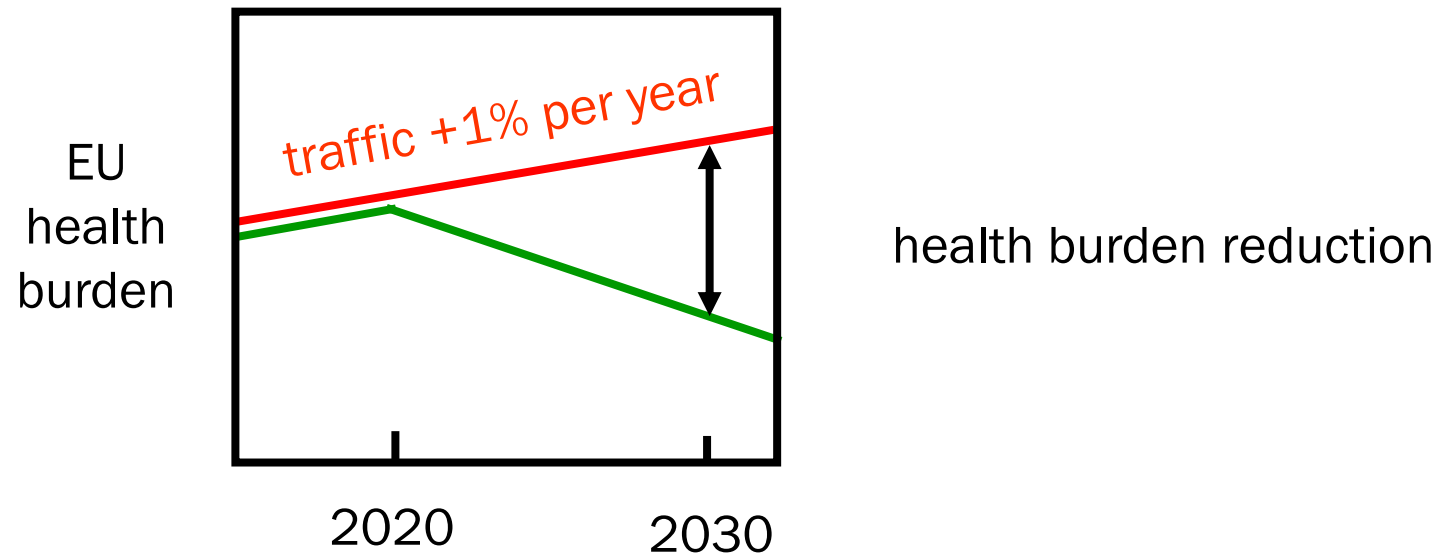
20-50%
reduction

2020









2030

HEALTH BURDEN SCENARIOS

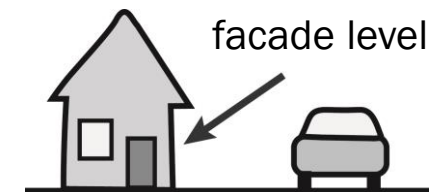
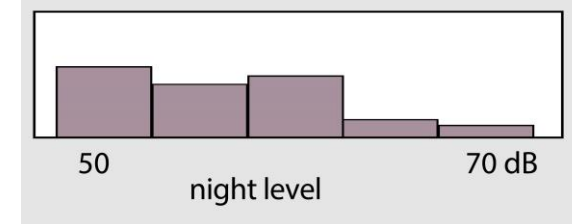
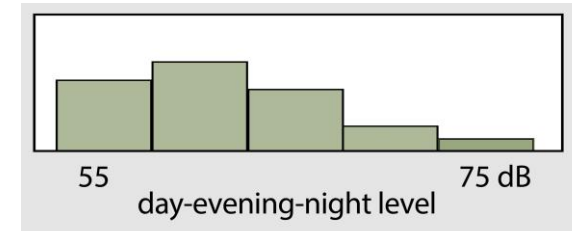
- baseline scenario
- scenario with single or combined noise abatement solutions



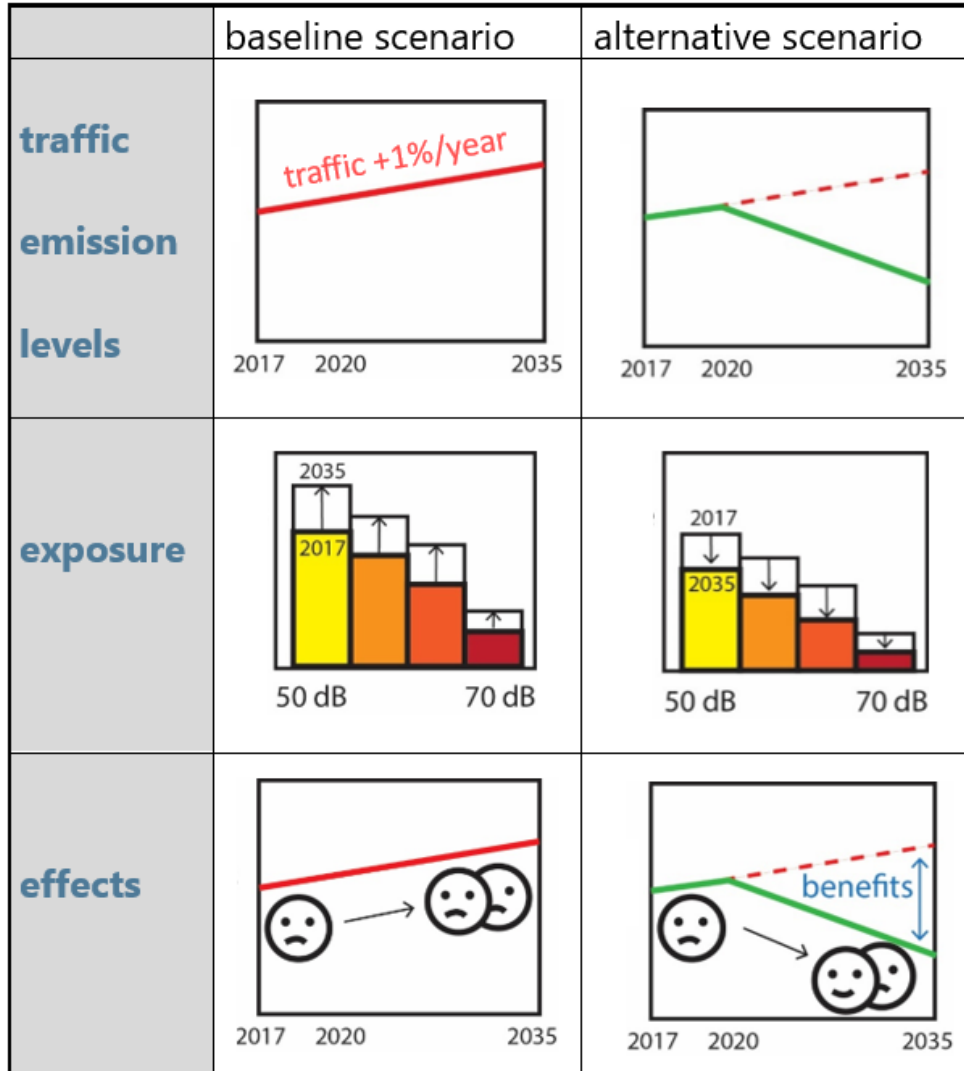
EU HEALTH BURDEN

traffic		road network
emission		 propulsion noise rolling noise
levels		noise map 
exposure		 exposed
effects		healthy life years, Euros - annoyance - sleep disturbance - myocardial infarction

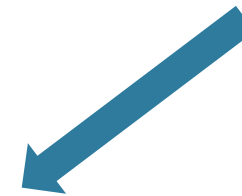
445 million people EU noise mapping 2017 exposure distributions



HEALTH BURDEN REDUCTION BASED ON CHANGES IN OVERALL EXPOSURE DISTRIBUTIONS

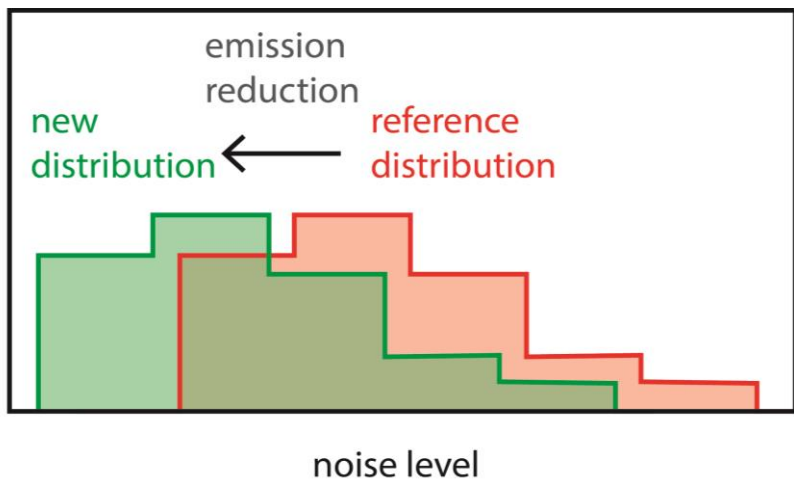
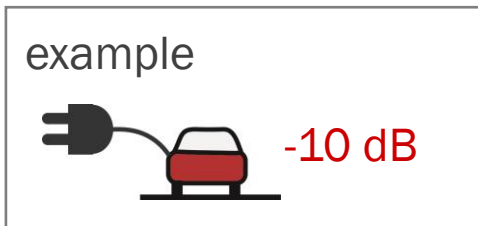


EU exposure distributions 2017
(for whole EU)



exposure changes
2017 - 2035

EXPOSURE CHANGES



road types

residential, main, arterial, motorway (urban)
motorway, main road (non-urban)

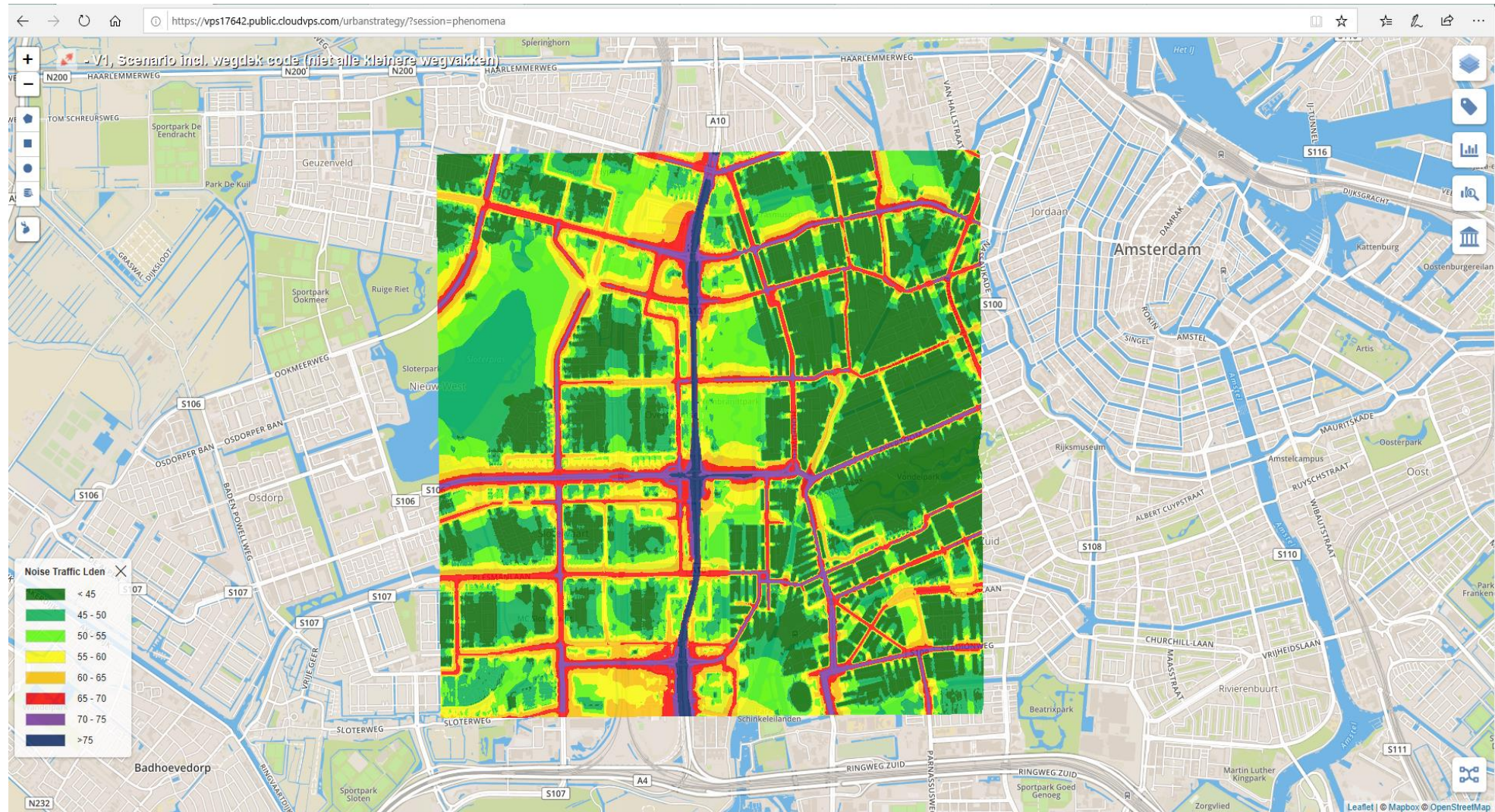
Crossos+
road surface
quiet tyres
vehicle emission limits



2015 / 2016 / 2022 / 2026 / hybrid / electric

TEST SITE ANALYSIS

ON SECTIONS OF NOISE MAPS, VARIATIONS

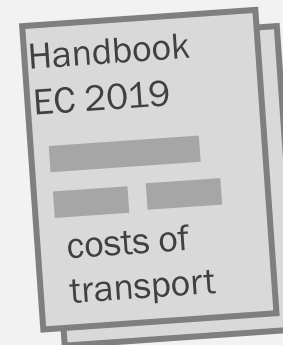


QUANTIFYING HEALTH EFFECTS

traffic
emission
levels
exposure
effects

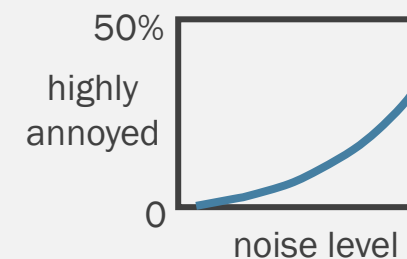
Method 1. Handbook

Euros



Method 2. EU project Heimtsa

annoyed
sleep-disturbed
myocardial infarction



DALY

1 year highly annoyed = 0.02 DALY

Euros

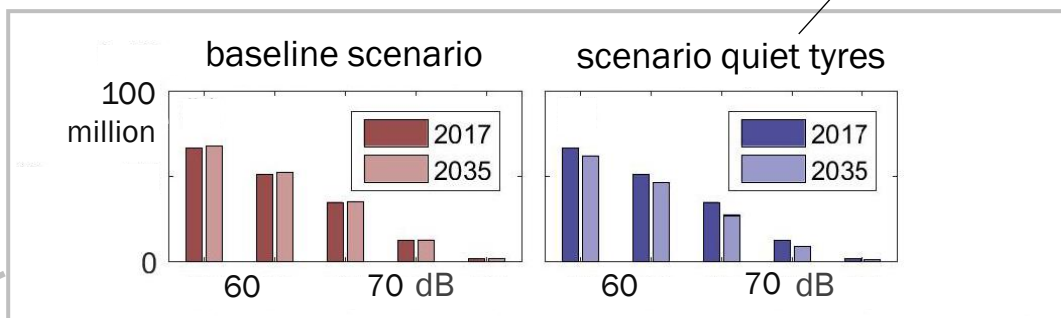
1 life year = 40 000 Euro

1 year highly sleep-disturbed
= 2% GDP per employee

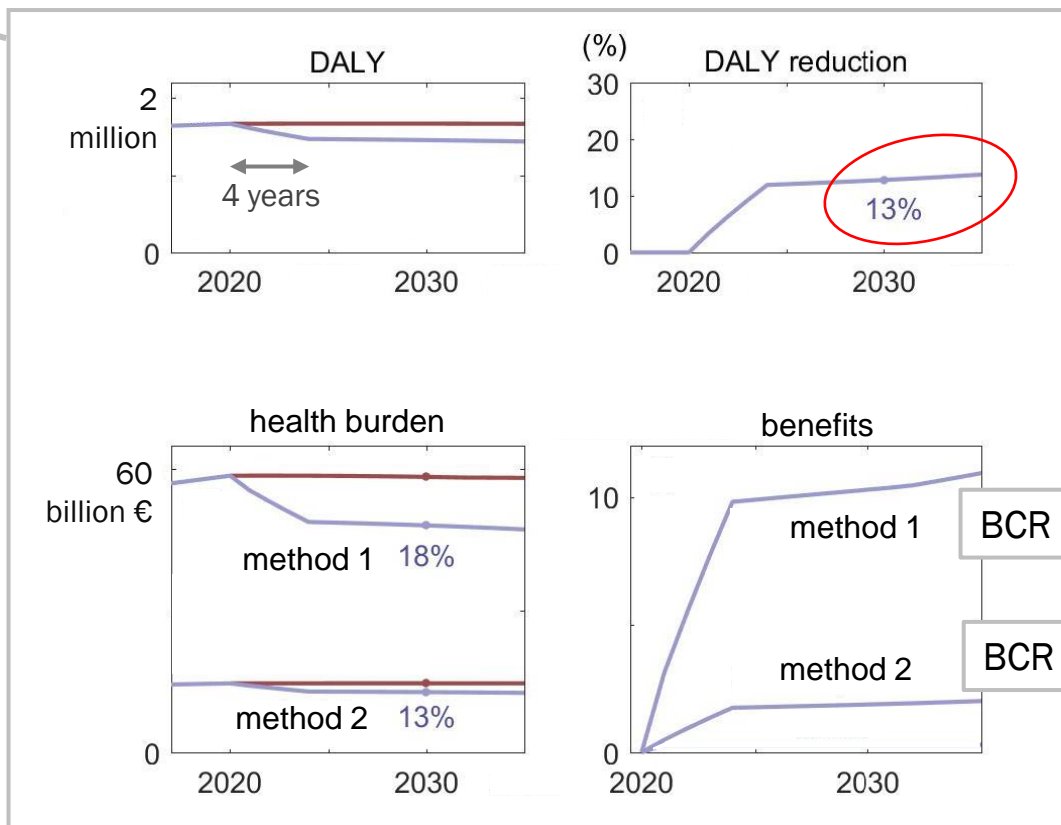
DALY = Disability Adjusted Life Year = healthy life years

RESULTS – EXAMPLE

- traffic
- emission
- levels
- exposure
- effects



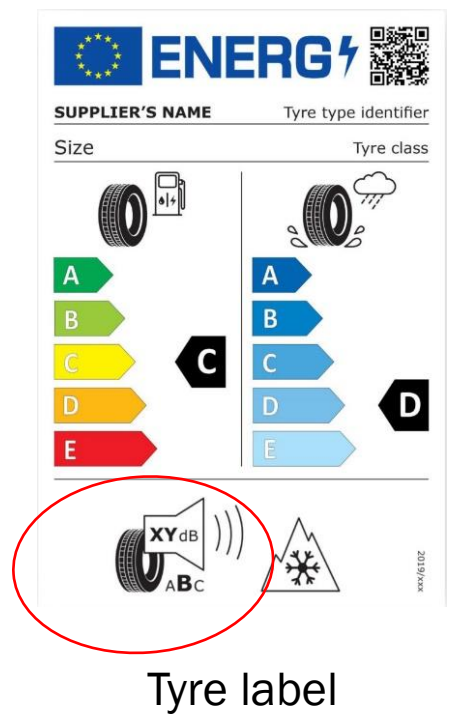
4 dB reduction



BCR = 30.3

BCR = 5.5

BCR = benefit-to-cost ratio



Tyre label

› **BASELINE SCENARIO**

Vehicle sound limits: as foreseen in 540/2014/EU

Tyre limits: unchanged

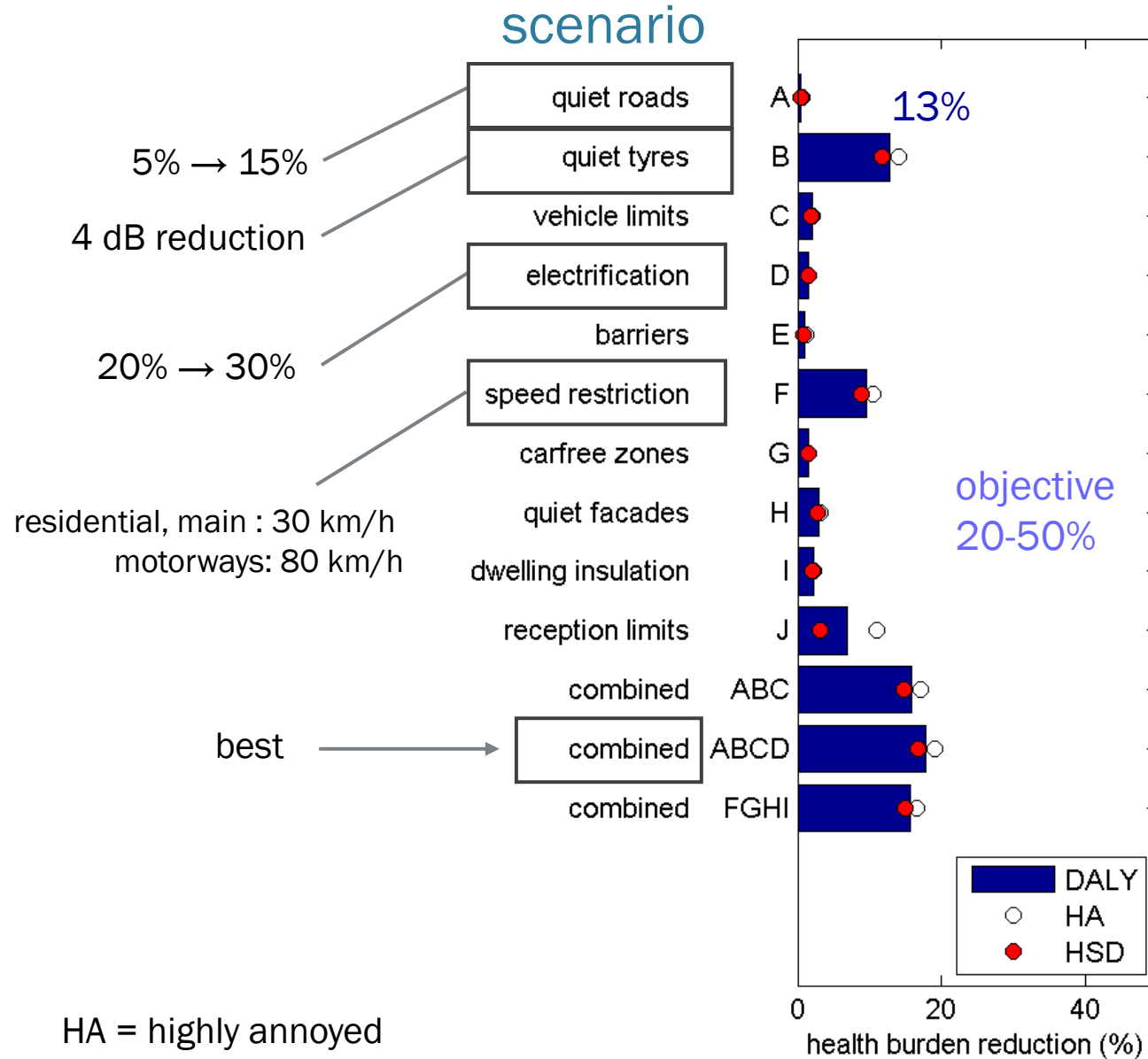
Road traffic 1% annual growth

EU population 0.1% annual growth

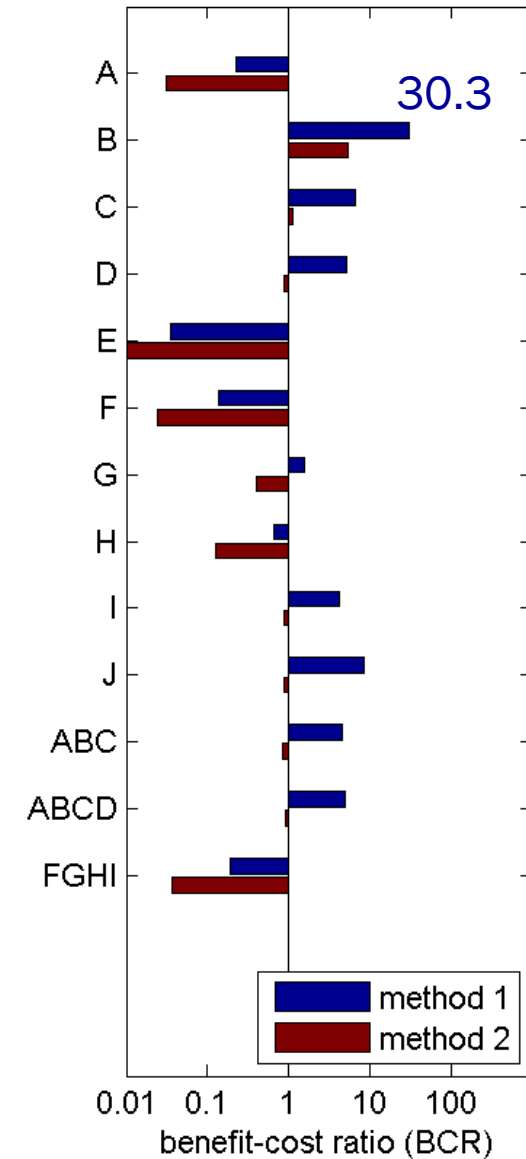
Vehicle fleet 20% 80% in 2030



SCENARIO AND CBA RESULTS



HA = highly annoyed
HSD = highly sleep disturbed



HEALTH BURDEN REDUCTION FOR ROAD TRAFFIC NOISE

Percentage HB reduction of road traffic noise in 2030

Scenario	Highly annoyed persons (%)	Highly sleep-disturbed persons (%)	DALYs (%)	Monetized health burden (method 1 / 2) (%)
A quiet roads	0.6	0.4	0.5	1.0 / 0.5
B quiet tyres	14.0	11.8	12.8	17.6 / 12.8
C vehicle limits	2.0	1.9	2.0	2.7 / 1.9
D electrification	1.5	1.5	1.5	2.1 / 1.5
E barriers	1.1	0.8	0.9	1.6 / 0.9
F speed restriction	10.5	8.9	9.6	13.3 / 9.6
G car-free zones	1.5	1.5	1.5	1.5 / 1.5
H quiet facades	3.1	2.8	3.0	3.8 / 2.9
I dwelling insulation	2.3	2.1	2.2	2.6 / 2.2
J reception limits	11.1	3.2	6.9	19.3 / 7.7
ABC combined	17.2	14.8	15.9	21.5 / 15.8
ABCD combined	19.2	16.7	17.9	24.0 / 17.8
FGHI combined	16.6	14.9	15.7	20.0 / 15.7

› SCENARIO CONCLUSION FOR ROAD TRAFFIC



- › To achieve a health burden reduction in the range 20-50%, options ABCD together with FGHI are recommended
 - Quiet road surfaces
 - Quieter tyres
 - Vehicle sound limits
 - Electrification
 - Speed and access restrictions
 - Sound insulation and quiet facades

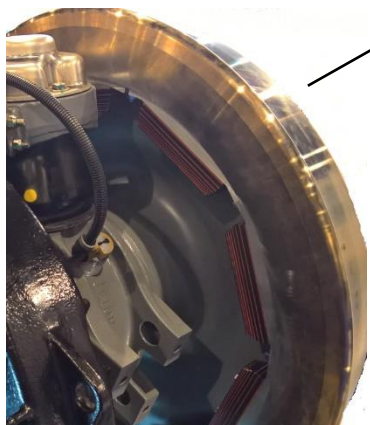
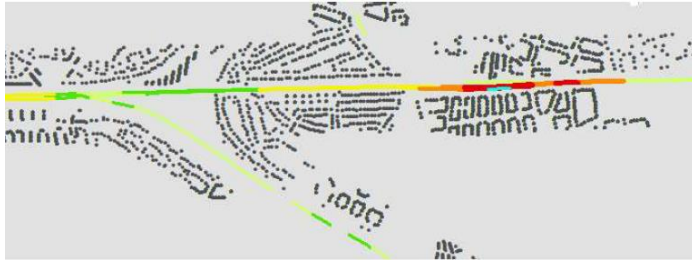
› OBSERVATIONS

- › Combined solutions are required
- › Both powertrain noise and rolling noise need reducing
- › Quiet road surfaces are of course still effective at local level where possible and shown cost-effective - moreso at higher speeds
- › Local solutions such as FGHI (speed and access restrictions, insulation) are also effective to reduce health burden but are not possible everywhere, not all implemented in the short term and can be less cost-effective
- › Noise reception limits are already in place in many countries but differ, so a minimum reception limit would be required, but allowing already existing stricter limits
- › Noise barriers are have restricted application in urban areas

› **OBSERVATIONS / FAQ**

- › Quiet road surfaces seem to score relatively low, reason?
 - › Current implementation level in whole EU is relatively low around 5%, scenario A assumes 15% in 2030
 - › Powertrain noise still remains in the fleet in 2030
 - › Less options for quiet road surfaces for urban streets and some regions
 - › Cost
- › Why do tyres score high?
 - › Short lifespan of tyres -> fast replacement in fleet -> rapid benefits
 - › Effect in whole EU
- › Why do vehicle limits and electrification score relatively low?
 - › Both take longer to impact the whole fleet
 - › Only 20% electrification of fleet in 2030 (?)
 - › Tyre noise remains an important source, especially for heavier cars (electric, SUV)

SCENARIO CONCLUSION FOR RAILWAYS



railway scenario

smooth tracks

smooth wheels

quiet vehicles

quiet tracks

barriers

traffic management

urban planning

dwelling insulation

reception limits

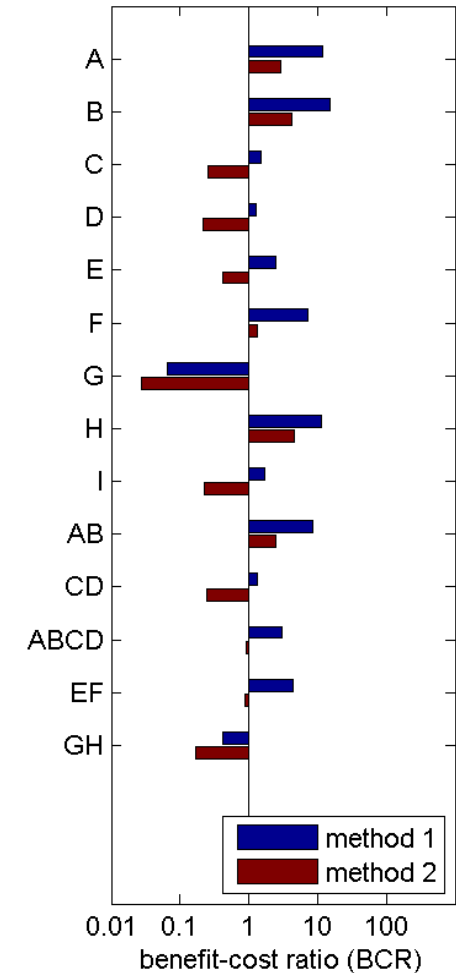
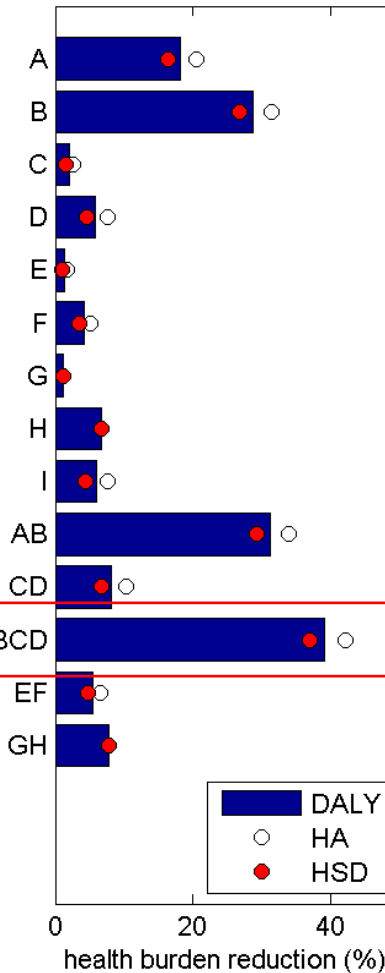
combined

combined

combined ABCD

combined

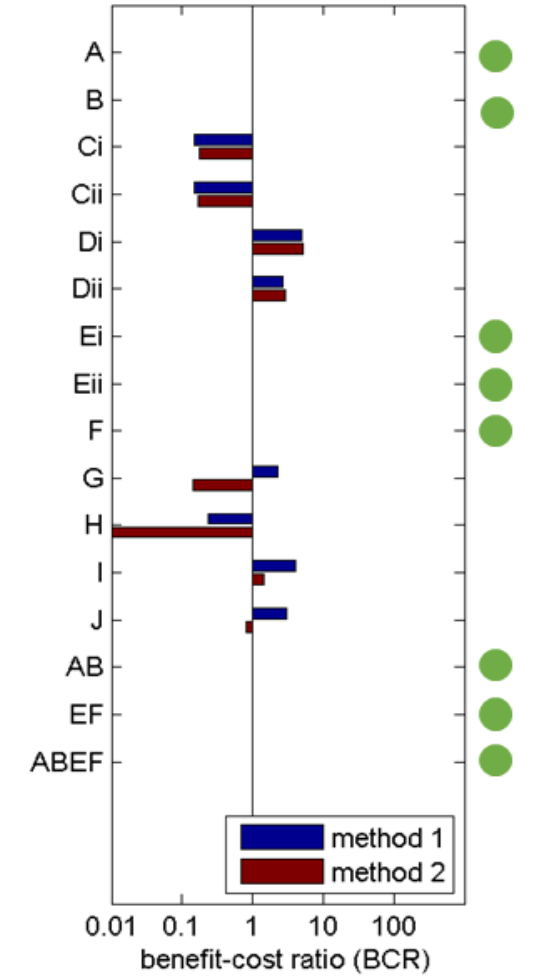
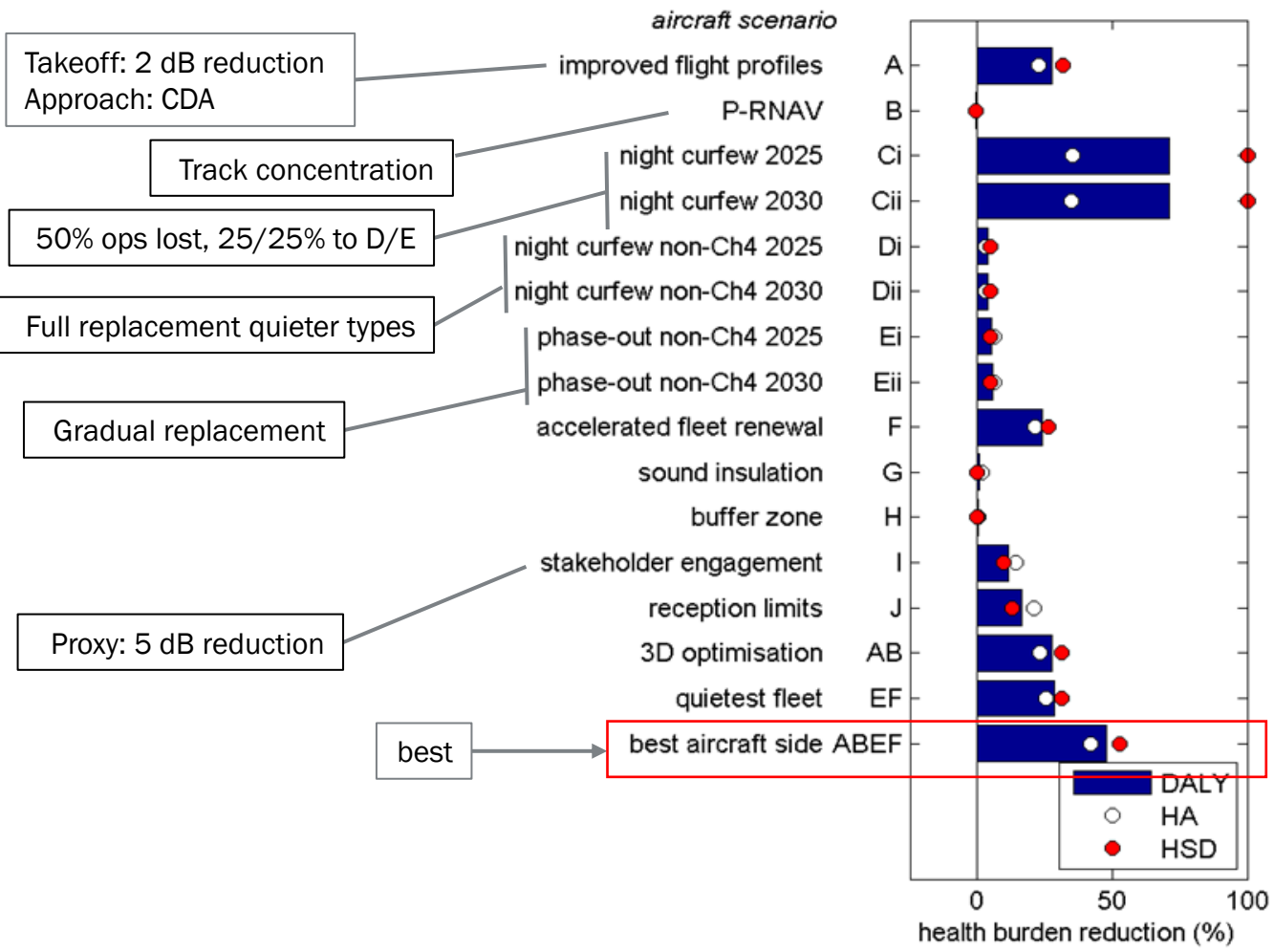
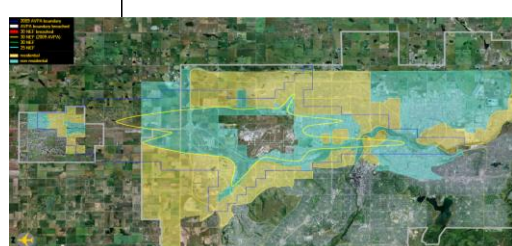
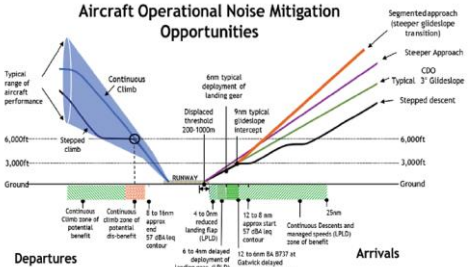
combined



SCENARIO CONCLUSION FOR AIRCRAFT



Aircraft Operational Noise Mitigation Opportunities



› **POLICY RECOMMENDATIONS - GENERAL**

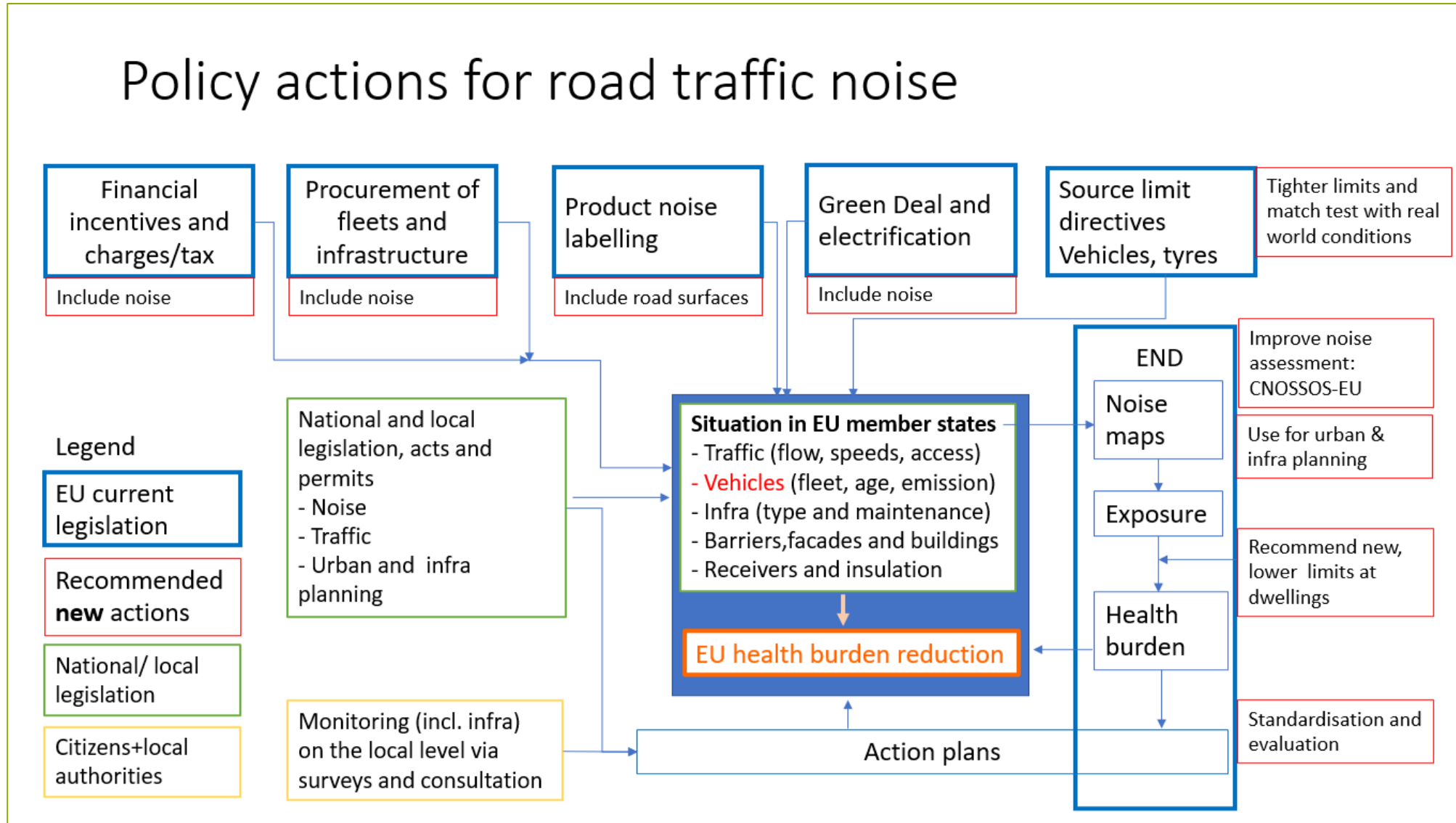
- › Standardisation, streamlining and **mandatory evaluation of noise action plans**
- › Extend the **scope of the END** to urban planning, infrastructure planning and land use
- › Introduction of **EU noise reception limits** at dwellings, or a **target for the reduction of health burden**
- › Improve coherence between **noise prediction models and vehicle type tests**
- › Include noise requirements in **public procurement procedures** for vehicles and transport infrastructure
- › Enhance EU **financial incentives and charges related to noise emission**



Zaragoza local site
noise map
(Tecnalia)

› POLICY RECOMMENDATIONS – ROAD TRAFFIC NOISE

Policy actions for road traffic noise



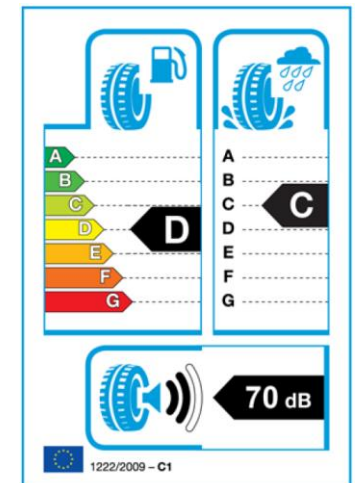
› VEHICLE SOUND LIMITS RECOMMENDATIONS



- › Reduced vehicle sound limits should focus on:
 - › Available space for new limits derived from type test databases;
 - › Available technical potential for further reduction;
 - › Potential of electric and hybrid vehicles; and
 - › Potential of the reduced tyre contribution, especially in combination with road surfaces.
- › 1-2 dB beyond Phase 3 limits expected to be feasible, but also LWOT besides Lurban
- › The full speed/acceleration/rpm range must be covered to achieve reductions in real world noise exposure (gap between real noise, type test and mapping)
- › In synergy with the Green Deal, propulsion noise should be reduced even if electrification is not as fast as foreseen
- › More detailed analysis in parallel study on M and N category vehicle sound limits (EU DG GROW 2021)

TYRE ROLLING SOUND LIMITS RECOMMENDATIONS

- › Further reduction from stage 2 limits in UNECE Regulation 117 and referred to by EU Regulation 2019/2144 regular review for potential reduction
- › Better information on tyre fleet required, and full reduction potential
- › Tyre limits also include aftermarket (replacement) tyres
- › There seems to be room for further reduction based on the label statistics and research
- › Besides tighter limits also incentives required (financial)
- › Noise vs safety: take existing quiet tyres as a starting point
- › Better models and test procedures for tyre noise required, include various road surfaces

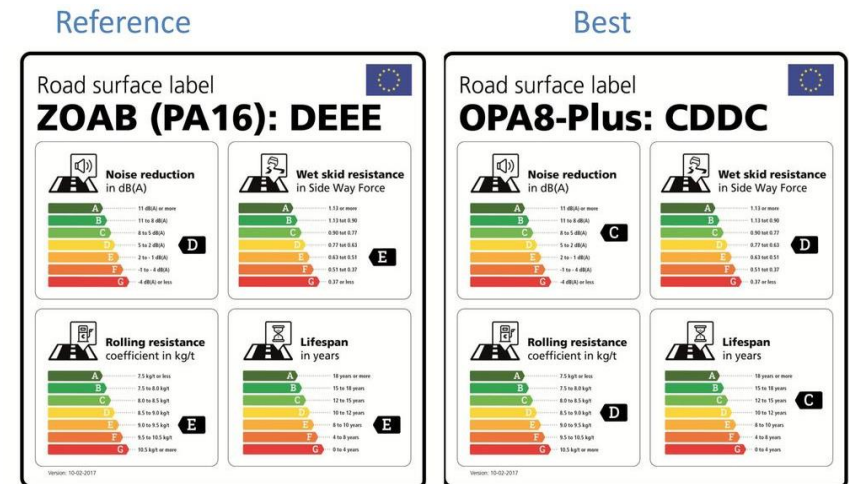


ROAD INFRASTRUCTURE RECOMMENDATIONS



- › Potential inclusion of surface monitoring and/of labelling in Road Surface Quality Directive 2008/96/EC
 - › Monitoring of road surface quality at noise sensitive locations where road/tyre noise is the main source, as a basis for action – wider application
 - › Introduction of a road surface labelling system, in analogy with tyre labelling, as proposed in the Netherlands for example.

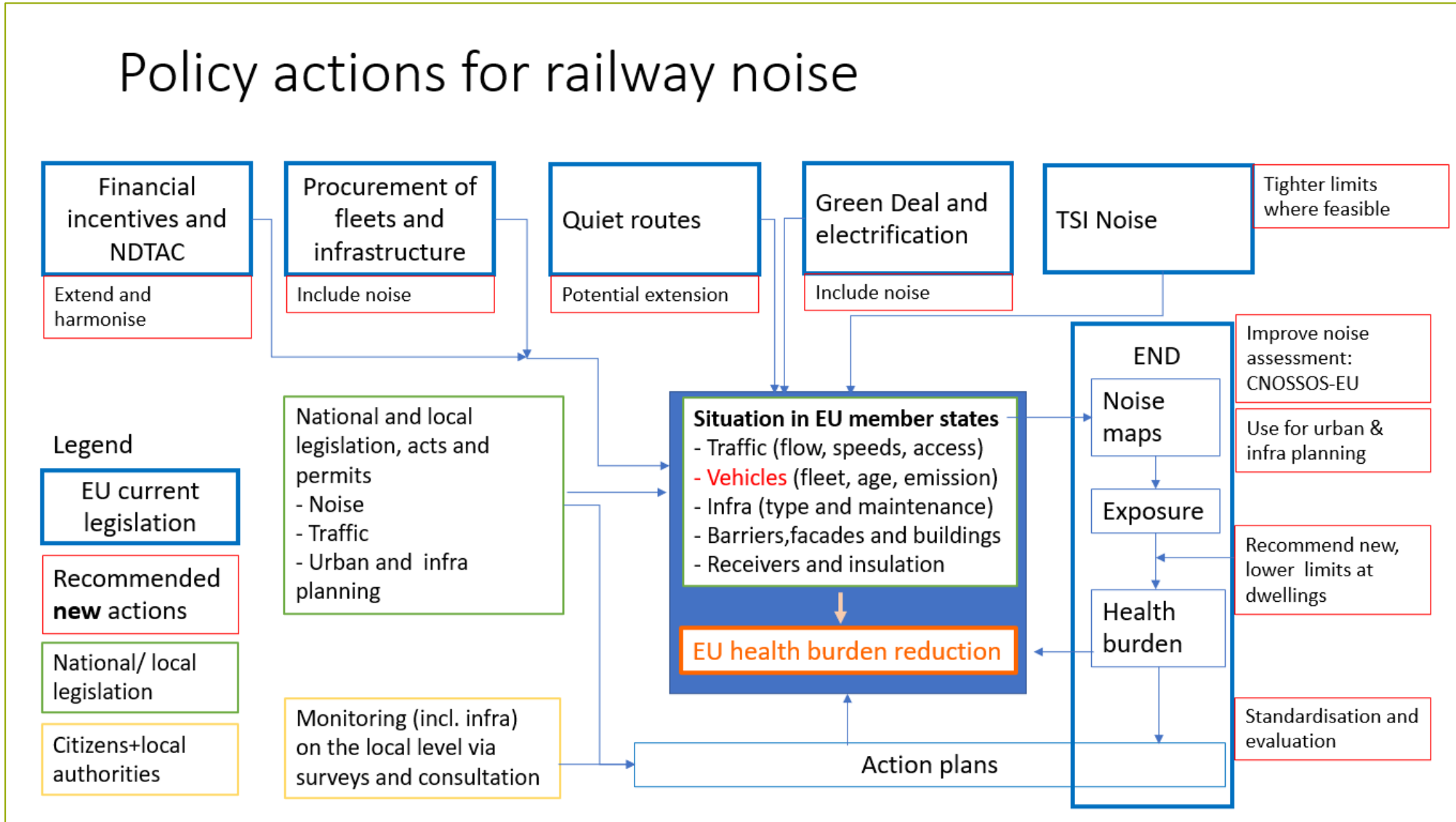
- › Harmonisation of road surface noise indicators
- › Guidelines on degradation and maintenance
- › Review of potential in different member states



Proposed road surface label

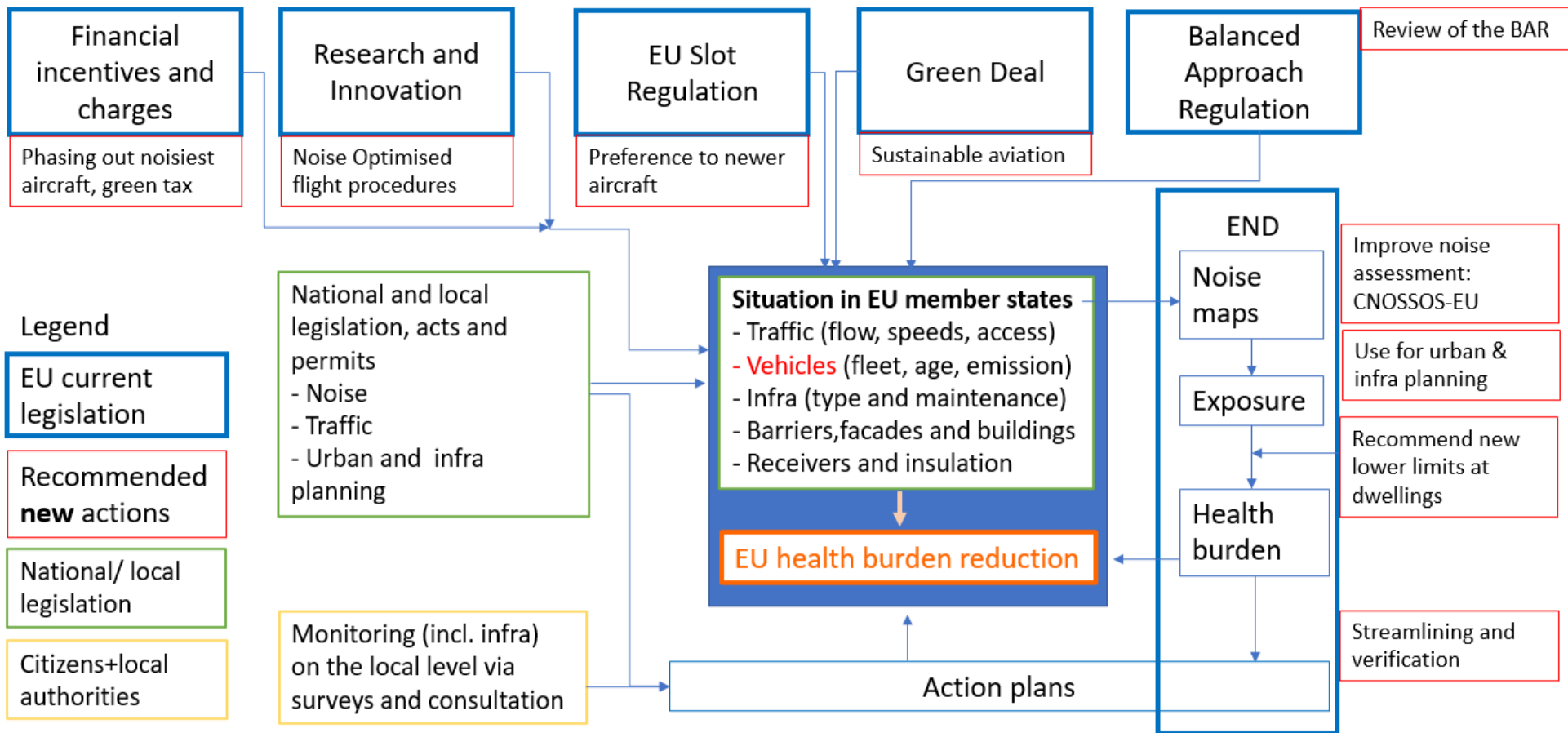
› POLICY RECOMMENDATIONS – RAILWAY NOISE

Policy actions for railway noise



› POLICY RECOMMENDATIONS – AIRCRAFT NOISE

Policy actions for aircraft noise



› CONCLUSIONS

- › Recommendations on best scenarios given voor road, railway and aircraft noise to achieve health burden reduction of 20-50%
- › HB reduction of more than 20% by 2030 requires combined solutions
- › The findings are intended for EU level, but for some countries best practice may differ depending on regional factors
- › Recommendations on improvements to EU legislation
- › Ongoing discussion on vehicle noise limits, tyre noise limits, binding action plans, Green Deal
- › If electrification is faster, tyre noise still remains

- › Phenomana study report available at
- › <https://op.europa.eu/en/publication-detail/-/publication/f4cd7465-a95d-11eb-9585-01aa75ed71a1/language-mlt>

› THANK YOU FOR YOUR ATTENTION !

› Thanks to all involved contributors:

› VVA: Eszter Kantor, Magdalena Klebba

› TNO: Erik Salomons, Henk Verhagen

› Anotec: Nico van Oosten

› Tecnalia: Itziar Aspuru, Pilar Fernandez Alcala

› UAB: Nuria Blanes Guardia, Jaume Fons Esteve

› And others

› Any Questions?

