Transmitted by the expert from the Netherlands

3 September 2015

Informal document **GRB-62-14-Add.1**
(62nd GRB, 1-3 September 2015,
agenda item 9)

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# A Policy Indicator for Road Traffic Noise Emission

GRB 62, Geneva, September 1-3, 2015

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- Policy Indicator outline
- Scenarios for 2030
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# Background

- As an environmental factor, noise is second only to air pollution for impact on public health
- 3 million people annoyed by road traffic noise in the Netherlands, 1.5 million sleep disturbed
- Most cost-effective means of mitigation are reduction of noise at source for vehicles, tyres and road surfaces
- Survey data, noise mapping and action plans (END) available
- But: Integrated noise policy is lacking
- Link needed between the various noise source mitigation measures and health effects at national level
- ***What are the effects of vehicle and tyre noise limits on average façade noise levels, annoyance and sleep disturbance?***



# Policy indicator

- Determines effect of noise control at source on average noise levels at the dwelling façade and on estimated numbers of annoyed and sleep disturbed people, for all roads
- Indicative large scale estimate, not for use in individual situations or small areas



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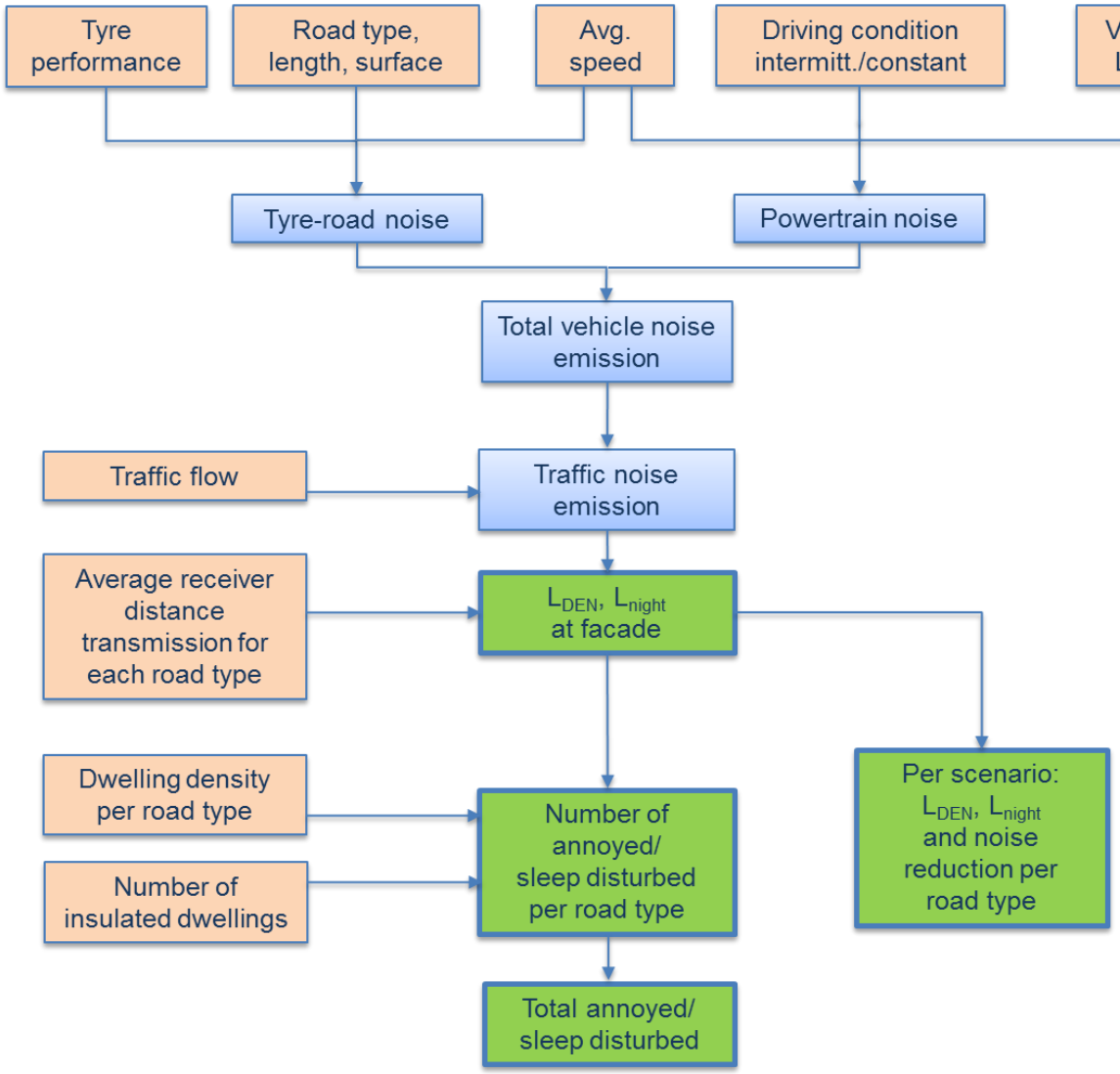
# Model for Policy Indicator




- Based on EU and NL traffic noise prediction methods
- Use tyre label, vehicle limits and infra parameters
- Predict average $L_{den}$ and $L_{night}$ at façade for each road type
- EU dose-effect relationships for percentages annoyed and sleep disturbed



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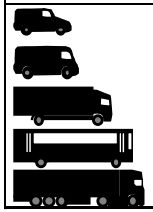
# Road data and traffic characteristics

| Road / traffic type | Residential street | Residential street | Main street | Main street | Arterial road | Urban motorway | Rural motorway | Rural main road | Total |
|---|---|---|---|---|---|---|---|---|---|
| Vehicle operating condition | accelerating | free flow | accelerating | free flow | free flow | free flow | free flow | free flow | |
| Speed range km/h | v<50 | v<50 | v≈50 | v≈50 | 60<v<80 | v=100 / 80 | v=120 / 80 | 60<v<80 | |
| Speed LV km/h | 30 | 50 | 50 | 50 | 80 | 100 | 115 | 80 | |
| Speed MV km/h | 30 | 40 | 40 | 50 | 70 | 85 | 85 | 80 | |
| Speed HV km/h | 30 | 40 | 40 | 50 | 70 | 85 | 85 | 80 | |
| Total road length | 15569 | 31610 | 7061 | 14336 | 3284 | 332 | 2185 | 32606 | 106982 |
| Percentage of total road length | 15% | 30% | 7% | 13% | 3% | 0% | 2% | 30% | |
| Selected road length (km) | 12455 | 25288 | 6355 | 12902 | 2627 | 265 | 1529 | 16303 | 77724 |
| Percentage of total selected road length | 16% | 33% | 8% | 17% | 3% | 0% | 2% | 21% | |
| Average number of exposed inhabitants/km | 115 | 115 | 273 | 273 | 300 | 400 | 400 | 40 | |
| Characteristic distance from road (m) | 15 | 15 | 15 | 15 | 15 | 50 | 50 | 50 | |
| Annoyance penalty, dB | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | |
| Noise sources | | | | | | | | | |
|  | Powertrain + tyre/road | Tyre/road + powertrain | Powertrain + tyre/road | Tyre/road + powertrain | Tyre/road | Tyre/road | Tyre/road | Tyre/road | |
|  | Powertrain | Powertrain + tyre/road | Powertrain | Powertrain + tyre/road | Powertrain + tyre/road | Powertrain + tyre/road | Powertrain + tyre/road | Powertrain + tyre/road | |



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# Road types

Residential road
- intermittent
- free flow

Main road
- intermittent
- free flow

Arterial road
free flow

Urban motorway
free flow

Rural road
free flow

Rural motorway
free flow



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# Spreadsheet overview

## Policy Indicator for Road Traffic Noise

TNO v5d June 2015

### Vehicle and Tyres

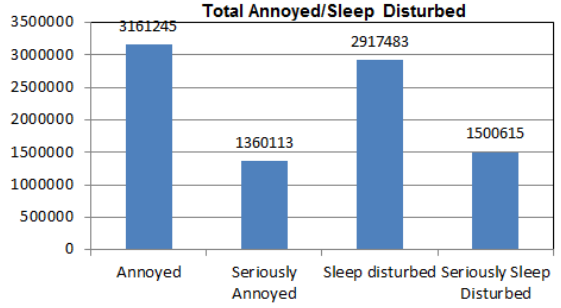
| Vehicle | Approved for limits 2015 | Approved for limits 2016 | Approved for limits 2020/22 | Approved for limits 2024/26 | Hybrid | Electric | |
|---|---|---|---|---|---|---|---|
| Cars (C1) | 100% | 0% | 0% | 0% | 0% | 0% | 100% |
| Vans (C2) | 100% | 0% | 0% | 0% | 0% | 0% | 100% |
| Buses (C3) | 100% | 0% | 0% | 0% | 0% | 0% | 100% |
| Lorries (C3) | 100% | 0% | 0% | 0% | 0% | 0% | 100% |
| Trucks (C3) | 100% | 0% | 0% | 0% | 0% | 0% | 100% |

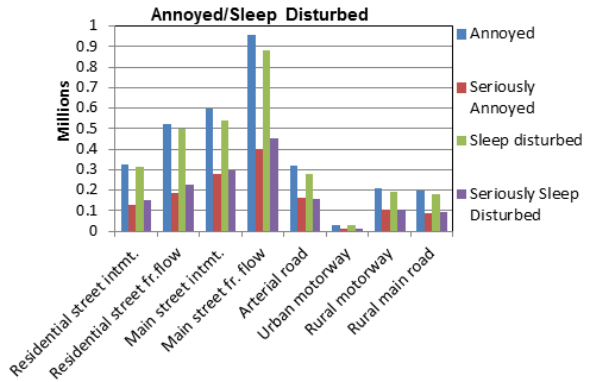
Restore defaults

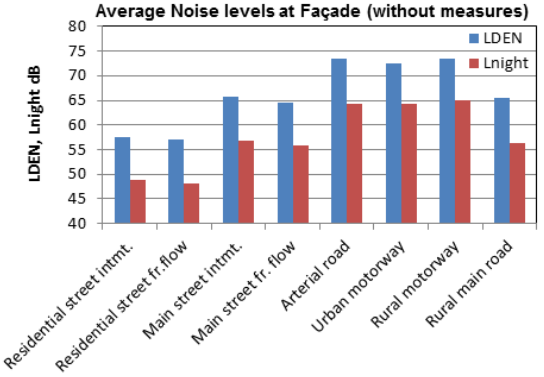
| Tyres | Type | min | max | Selected | Current |
|---|---|---|---|---|---|
| Restore defaults | C1 | 66 | 74 | 70 | 70 |
| | C2 | 69 | 76 | 72 | 72 |
| | C3 | 70 | 78 | 75 | 75 |

### Infrastructure

| Road type | Resi-dential street | Main road | Arterial road | Urban motor-way | Rural motor-way | Rural road | Total km | |
|---|---|---|---|---|---|---|---|---|
| Road length inhabited (km) | 37743 | 19257 | 2627 | 265 | 1529 | 16303 | 77724 | Restore defaults |
| | | | | | | | Total exposed | |
| Exposed/km | 115 | 273 | 300 | 400 | 400 | 40 | 11755426 | Restore defaults |
| %Insulated dwellings | 0.0% | 2.0% | 1.0% | 1.6% | 1.0% | 1.0% | 127357 | Restore defaults |
| Length of quiet road surface (km) | 0 | 9628 | 2627 | 265 | 1150 | 5380 | | Restore defaults |
| Type | DAB | DGD | ZOAB | ZOAB2L | ZOAB | DAB | | |
| km barrier length | 0 | 250 | 500 | 133 | 750 | 250 | | Restore defaults |





# Scenarios for 2030

| Scenario | Description |
|---|---|
| 1. Situation in 2015 | Fleet composition, road infrastructure, mitigation measures and demographics in the Netherlands in 2015. |
| 2. 2030 including 1% growth | 1% growth in traffic, no extra measures and autonomous intake of quieter vehicles and tyres, with a fleet distribution as in Table 3. |
| 3. 2030 Sc.2 + quiet vehicles | Scenario 2 with 3 dB quieter vehicles compared to the EU-limits for 2024/2026 (Table 2). |
| 4. 2030 Sc.2 + quiet tyres | Scenario 2 only with quieter tyres. Tyres 2 dB quieter than the limits for 2020 proposed by the Netherlands (Table 4). |
| 5. 2030 Sc.2 + quiet road surfaces | Scenario 2 with wider application of quiet road surfaces only (2-layer ZOAB with fine top layer), on all roads with dwellings and speed limit of 50 km/h or more, except calmer streets in residential areas. |
| 6. 2030 Sc.2 + all measures | Combination of scenarios 2,3,4 and 5. |



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# EU limit values converted to emission for 3 vehicle categories and scen.3 quiet vehicles

| | EU limits | | | | | Equivalent limit values | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Vehicle class EU Regulation | 2015 Current | 2016 New vehicle types | New vehicle types from 2020 and new regulation from 2022 | New vehicle types from 2024 and new regulation from 2026 | Vehicle category for NL calculation method | 2014/15 | 2016 | 2020 | 2024 | Scenario 3 2030+quiet vehicles |
| M1 (PMR≤120kW/t) | 72 | 72 | 70 | 68 | LV (Light) | 72.3 | 72.1 | 70.2 | 68.3 | 65.3 |
| M1 (120<PMR≤160kW/t) | 73 | 73 | 71 | 69 | | | | | | |
| M2 (m ≤ 2,5t) | 74-75 | 72 | 70 | 69 | | | | | | |
| M2 (2,5t<m≤3,5t) | 75 | 74 | 72 | 71 | | | | | | |
| N1 (m ≤ 2,5t) | 73 | 72 | 71 | 69 | | | | | | |
| N1 (2,5t < m ≤ 3,5t) | 74 | 74 | 73 | 71 | | | | | | |
| M2 (3,5t<m≤5t, Pn≤135kW) | 76 | 75 | 73 | 72 | MV (Medium) | 76.9 | 77.6 | 75.8 | 74.7 | 71.7 |
| M2 (3,5t<m≤5t, Pn>135kW) | 76-78 | 75 | 74 | 72 | | | | | | |
| M3 (Pn≤150kW) | 77-78 | 76 | 74 | 73 | | | | | | |
| M3 (150<Pn≤250kW) | 79 | 78 | 77 | 76 | | | | | | |
| M3 (Pn>250kW) | 79-81 | 80 | 78 | 77 | | | | | | |
| N2 (Pn≤135kW) | 75-77 | 77 | 75 | 74 | | | | | | |
| N2 (Pn>135kW) | 78-80 | 78 | 76 | 75 | | | | | | |
| N3 (Pn≤150kW) | 78-79 | 79 | 77 | 76 | HV (Heavy) | 80.7 | 82.2 | 80.7 | 78.7 | 75.7 |
| N3 (150<Pn≤250kW) | 81-83 | 81 | 79 | 77 | | | | | | |
| N3 (Pn>250kW) | 81-83 | 82 | 81 | 79 | | | | | | |

(Table 2)



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# Fleet composition (scen.2) and tyre limits (scen.4)

(Table 3)

| Vehicle/Tyre | Approved for 2015 limits | Approved for 2016 limits | Approved for 2020/22 limits | Approved for 2024/26 limits | Hybrid | Electric |
|---|---|---|---|---|---|---|
| Cars/C1 | 0% | 30% | 45% | 20% | 3% | 2% |
| Vans/C2 | 0% | 30% | 45% | 20% | 3% | 2% |
| Buses/C3 | 0% | 30% | 45% | 20% | 3% | 2% |
| Lorries/C3 | 0% | 30% | 45% | 20% | 3% | 2% |
| Trucks /C3 | 0% | 30% | 45% | 20% | 3% | 2% |

(Table 4)

| Tyre class | EU/UN Regulation 117 for 2016 | NL proposal for 2020 | Scenario 4 2030+quiet tyres |
|---|---|---|---|
| C1 | 70-74 | 67-71 | 65-69 |
| C2<br>Traction tyres | 72-74<br>73/73/75 | 70-72<br>71/73/73 | 68-70<br>+2 |
| C3<br>Traction tyres | 73/73/74/75<br>+2 | 69/71/71<br>71-73 | 67/69/69<br>+2 |



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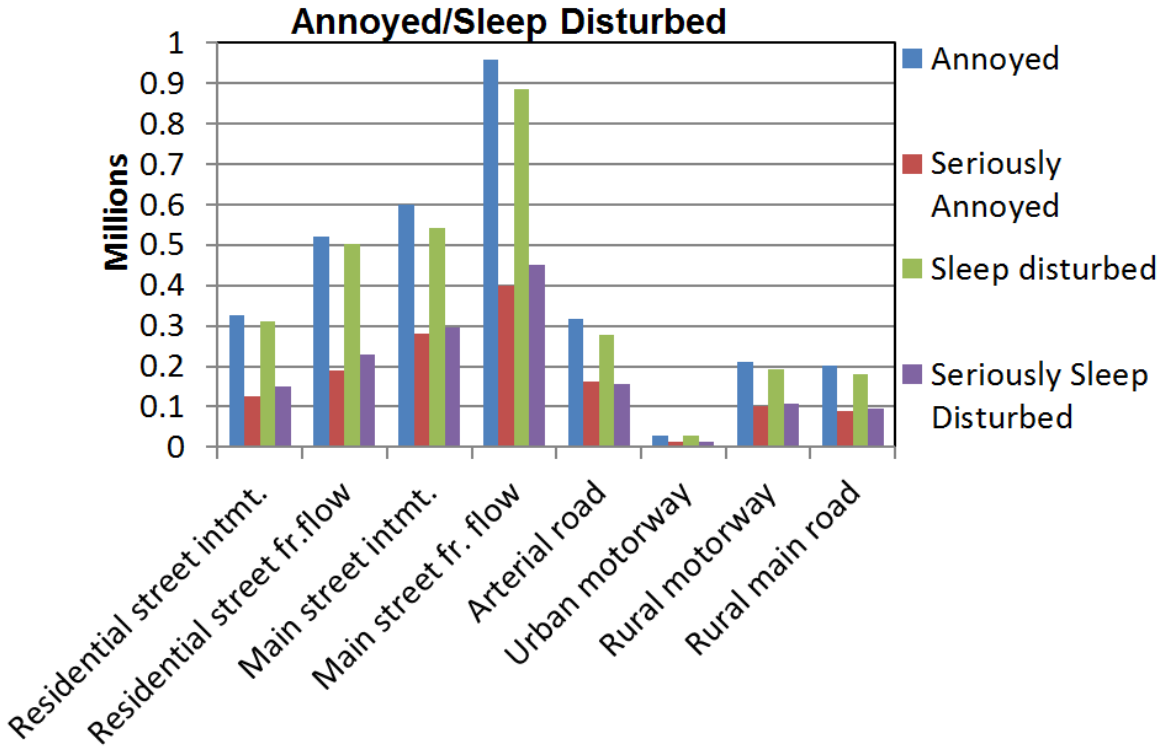
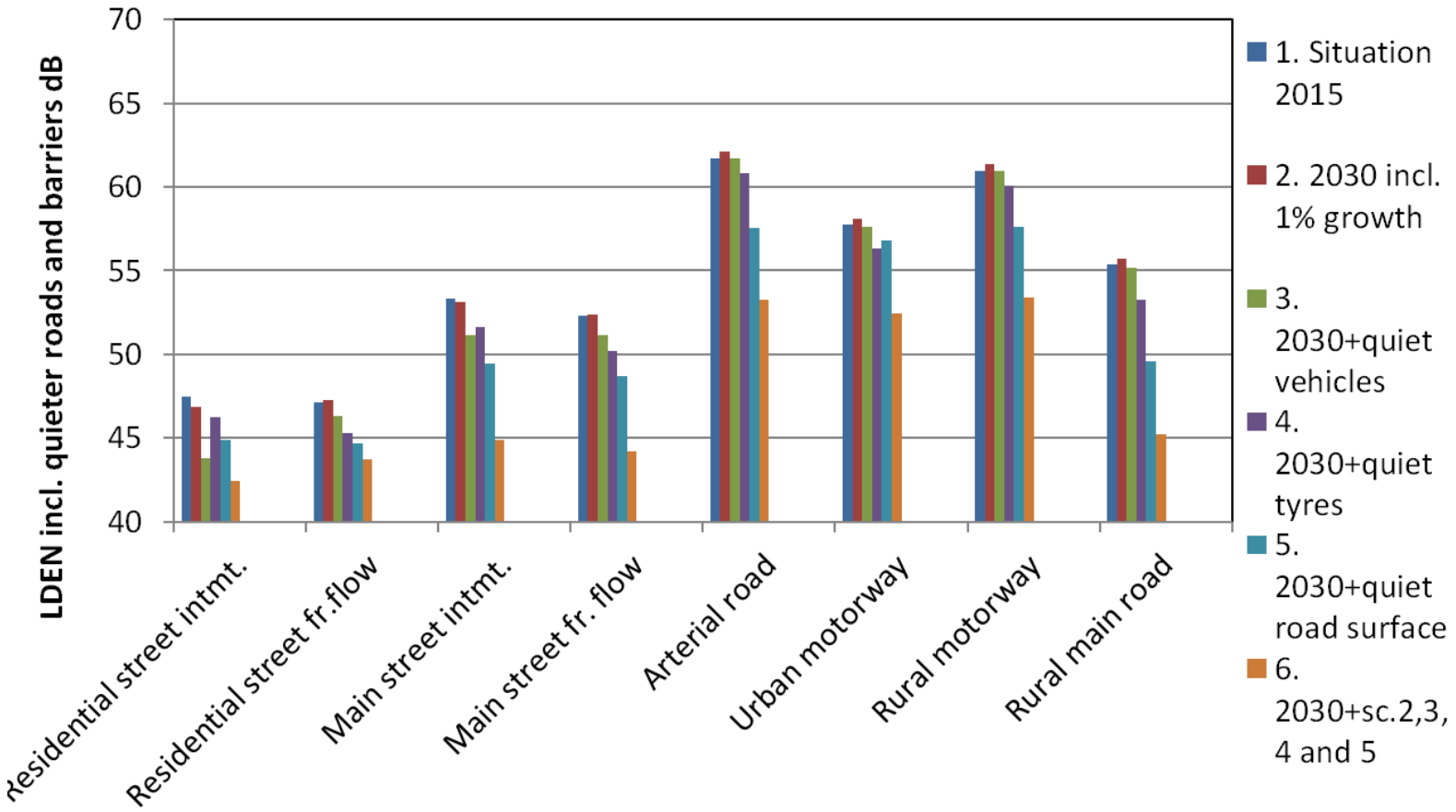
# Analysis results

- Numbers of annoyed and sleep disturbed for each road type in scenario 1, 2015



# Façade noise levels for each scenario and road type





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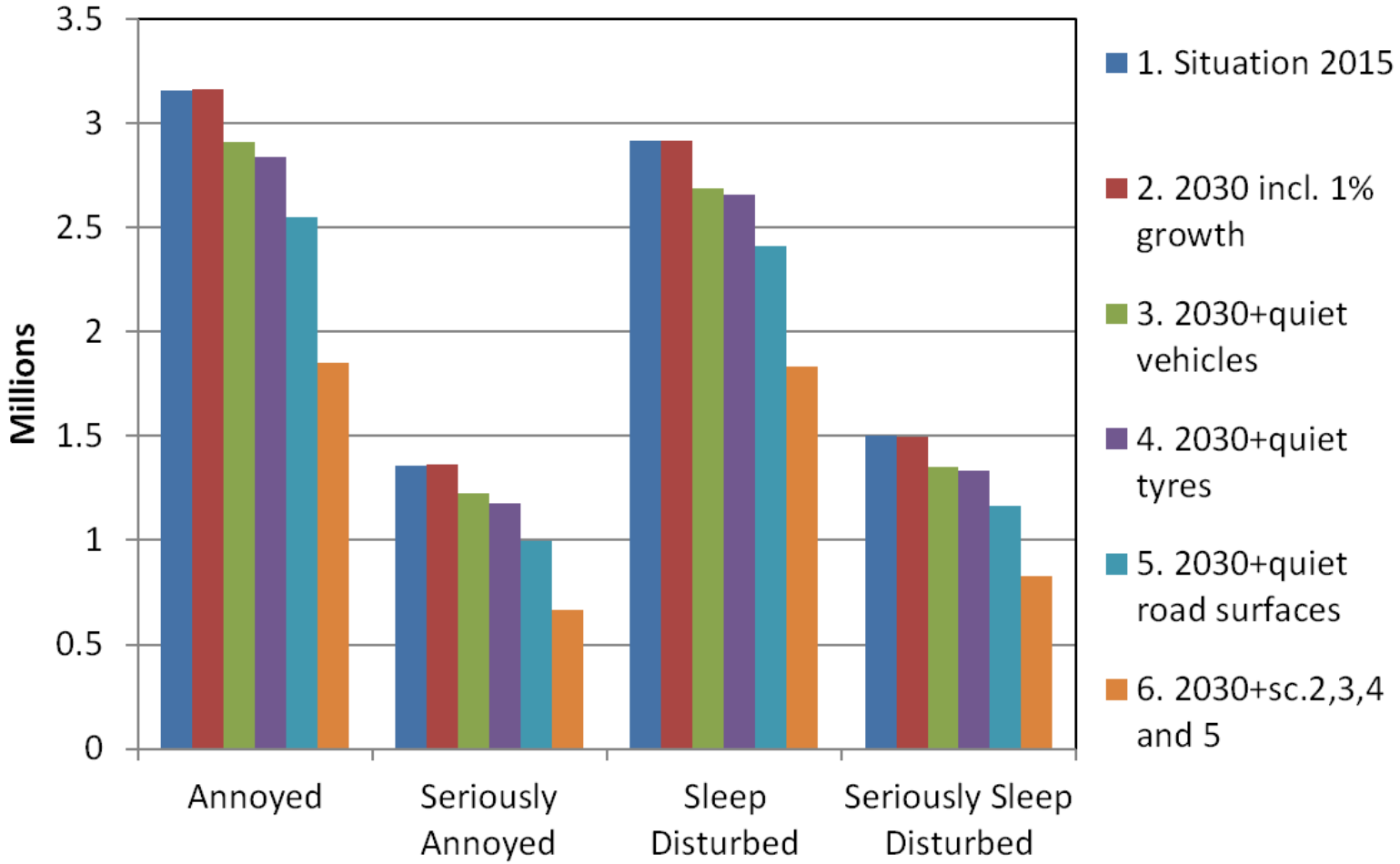
# Total numbers annoyed and sleep disturbed for each scenario





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# Total numbers annoyed and sleep disturbed for each scenario and reductions

| Scenario | Annoyed | Reduction from Sc.1 | Seriously Annoyed | Reduction from Sc.1 | Sleep Disturbed | Reduction from Sc.1 | Seriously Sleep Disturbed | Reduction from Sc.1 |
|---|---|---|---|---|---|---|---|---|
| 1 | 3161245 | | 1360113 | | 2917483 | | 1500615 | |
| 2 | 3165333 | -0.1% | 1364278 | -0.3% | 2914577 | 0.1% | 1499111 | 0.1% |
| 3 | 2914022 | 8% | 1222993 | 10% | 2687540 | 8% | 1354446 | 10% |
| 4 | 2840506 | 10% | 1176935 | 13% | 2660222 | 9% | 1335718 | 11% |
| 5 | 2550716 | 19% | 995040 | 27% | 2411667 | 17% | 1166955 | 22% |
| 6 | 1854576 | 41% | 664176 | 51% | 1832317 | 37% | 831292 | 45% |



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# Discussion

- Both individual and combined mitigation measures can be assessed
- Besides noise limits, the public can also be encouraged to buy better tyres. Calculations with the Policy Indicator show that the Dutch awareness campaign 'Choose the best tyre' makes sense.
- Voluntary change to quieter vehicles can be incentivised, such as by introducing a vehicle noise label.
- The Policy Indicator shows that both tightening limits and incentivising quiet tyres and quiet vehicles is effective
- The European Commission has the obligation to
  - evaluate and revise the Regulation on General Safety 661/2009 including tyre noise
  - perform an assessment of a vehicle noise label in relation to the Regulation on Vehicle Noise  540/2014



# Conclusions

- The Policy Indicator can be used to underpin focused and integral policies for noise emission derived from health-related targets.
- It has been applied for the Netherlands, showing potential reduction of upto 50% in annoyed and sleep disturbed people if tighter limits for vehicles and tyres are introduced and road surfaces are improved.
- NL proposals for tighter vehicle and tyre noise limits are underpinned by the results
- Incentivising quieter tyres and vehicles is both effective for public health and cost-effective
- The Policy Indicator could also be applied for the whole EU, showing a far larger impact for tens of millions of people



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# Thank you for your attention!