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Agenda item 3(b))

Impact assessment of the policy options
Venoliva Study

Michael Dittrich, TNO
September 7th 2010, Geneva

TNO | Knowledge for business

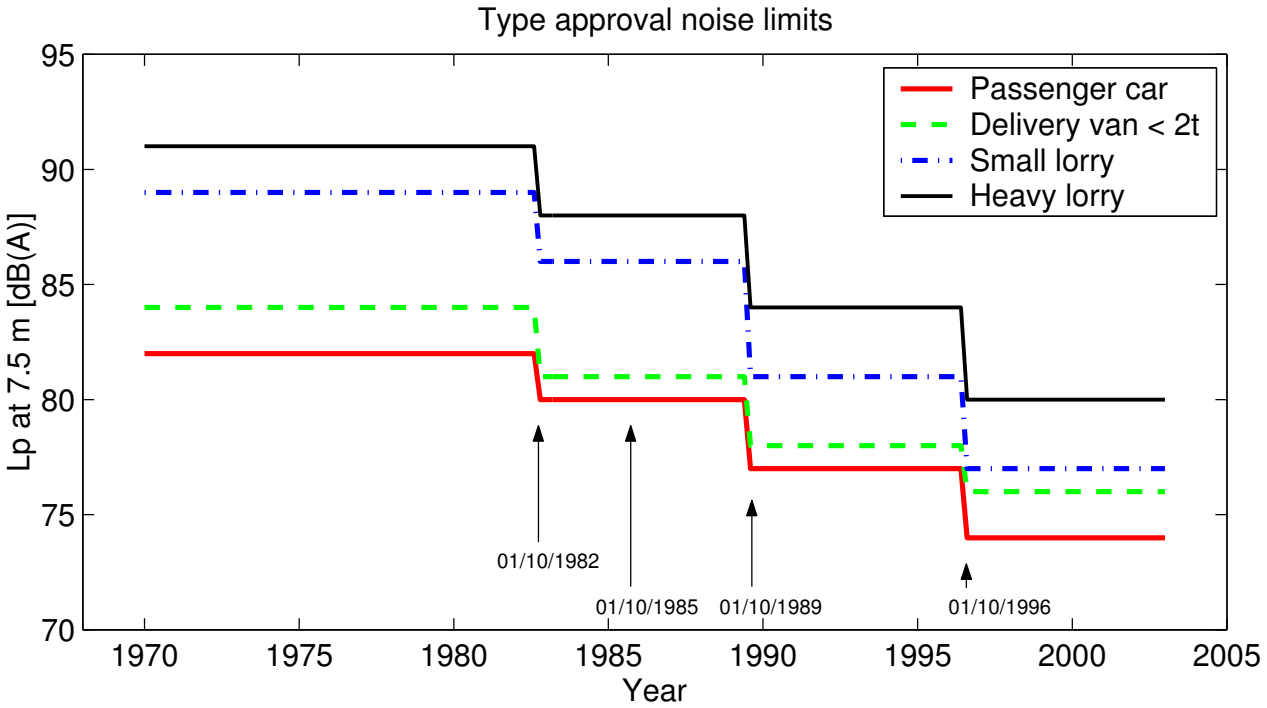
Topics

- Policy goals and trends
- Main impacts of the policy options
- Environmental impact
- Social and health impact
- Economic impact, overall costs and benefits
- Summary

References: Eurostat, EU Position papers, WHO reports and guidelines + publications

Policy aims of the Directive 70/157/EC+ amendments

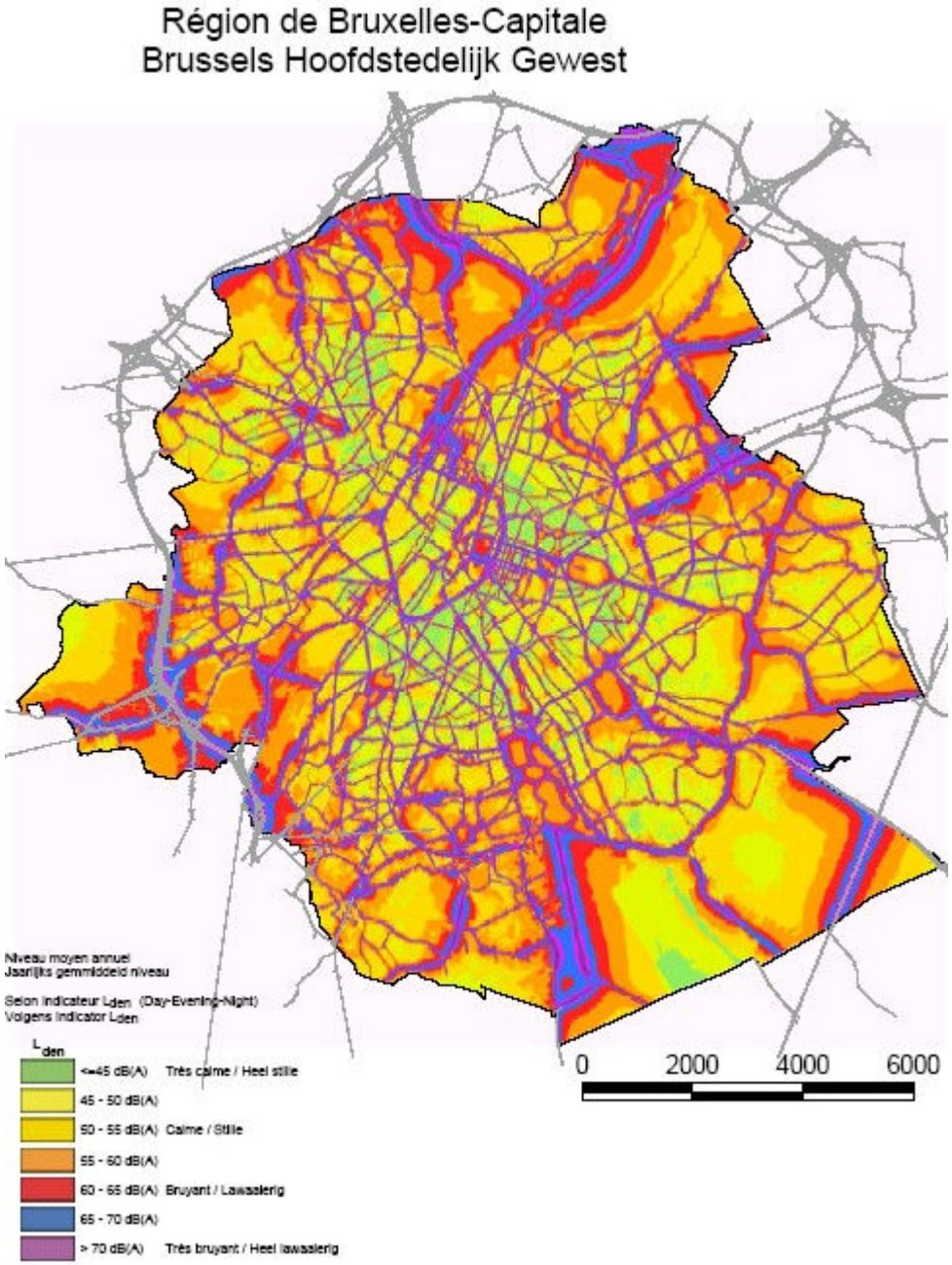
- Ensure that vehicle noise limits of individual states did not form barriers to trade
- Tighten the noise limits to reduce environmental noise
- No strong link made with the Environmental Noise Directive END 2002/49/EC



History

Motor vehicles exterior noise	**Directive / amendment**
70/157/EC	Directive on the approximation of the laws of the Member States relating to the permissible sound level and the exhaust system of motor vehicles
73/350/EC	Adapting 70/157/EC to technical progress
77/212/EC	Amendment of 70/157/EC
81/334/EC	Adapting 70/157/EC to technical progress
84/372/EC	Adapting 70/157/EC to technical progress
84/424/EC	Amendment of 70/157/EC
89/491/EC	Adapting 70/157/EC (e.a.) to technical progress
92/97/EC	Amendment of 70/157/EC
96/20/EG	Adapting 70/157/EC to technical progress
1999/101/EC	Adapting 70/157/EC to technical progress
2007/34/EC	Amending 70/157/EEC for the purpose of technical progress; introducing test method B for the purpose of monitoring from 6 July 2008 until 6 July 2010
2007/46/EC	Framework Directive - establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles
Tyres	
92/23/EC	Directive relating to tyres for motor vehicles and their trailers and to their fitting
2001/43/EC	Amendment of 92/23/EC introducing noise limits for tyres
Regulation (EC) No 661/2009	Concerning type approval requirements for the general safety of motor vehicles etc., including stricter limit values for tyre rolling noise, that will become valid from 1 November 2012, 1 November 2013 and 1 November 2016.
Environmental noise	
2002/49/EC	Directive relating to the assessment and management of environmental noise

Noise mapping



Trends

- Infrastructure
  - More traffic volume, roads and exposed citizens
  - More abatement measures
    (barriers, insulation, road surfaces, traffic measures)
- Vehicles
  - More diesel engines, more vans, wider tyre
- Public
  - Increased awareness and response, property valuation
- Academia
  - Extensive R&D on road traffic noise and its effects
- Government/legislation
  - END directive (Noise mapping and action plans),
    Tyre directive, costs for abatement measures
  - Urgency due to evidence of health effects and costs
- Industry/technical
  - Available solutions incl. quieter diesel engines, years of R&D, both tyre and powertrain noise, increased legislation
  - Recession, drop in demand
  - Devt. Alternative powertrains (hybrid, electric)

Main impacts of reduced vehicle noise emission

Stakeholder	+/-	Effect
1. The public	+	a) Improved sleep, reduced stress, improved health and quality of life; indirectly, savings on health and effectiveness at work and school.
	+	b) Increased property value.
	+	c) Improved living, work and recreation environment.
2. Road, national and local authorities	+	a) Reduced need for noise abatement programmes (barriers, road surfaces, sound insulation) and cost saving; easier planning of new or upgraded roads.
	+	b) Less local protest.
	+	c) Less need for regulation and enforcement.
3. Health authorities and government	+	a) Reduced healthcare costs.
4. The automotive industry (OEMs, tyre and supplier industry)	-	a) Increased costs for extra noise control including design, testing and materials; in particular for vans, lorries, buses and trucks.
	-	b) Balancing of noise requirements with other design constraints such as weight, fuel consumption, cooling and space.
	+	c) Improved environmental image as a sales point; reduced interior noise.
	-	d) In some cases, conflict with sound perception of SUVs, sports and luxury cars.
	-	e) Tampering or cycle beating may occur to avoid noise reduction cost/effort.
5. Consumer market	-	a) Cars: very small price increase.
6. Professional market	-	a) Price increase, mainly for vans, lorries, trucks and buses.
	+	b) Some market advantage for new fleets, for example rental cars or vans, buses, delivery or municipal vehicles in urban environment or quiet areas. Benefits from tax incentive programmes or privileged access to sensitive areas.

Environmental impact - Approach (1)

- Assess L_{DEN}, L_{night}, L_{Amax} exposure levels along typical road types
- Importance of urban roads: great length in EU, many exposed people
- Distinction between roads with accelerating and intermittent traffic and free flowing traffic
- Intermittent traffic mainly for urban residential and urban main roads upto 50 km/h, powertrain noise dominant on 33% of road length, elsewhere tyre/road noise
- Put vehicle categories into max. 5 groups
- Noise from 2-wheelers not included
- Noise from illegally modified vehicles not included
- Incidentally noisy vehicles due to driving behaviour result only in single events, no effect on L_{DEN}

Environmental impact – Approach(2)

- Calculation depends on
- road type
- vehicle type and speed
- traffic type: intermittent or free flowing
- traffic intensity in vehicles/hour for each vehicle type and for day/evening/night periods
- a representative noise emission level for each vehicle type in each road situation
- relevant road length in the EU27
- average distance of dwelling facades to the road

Environmental impact – Approach(3)
Vehicle groups

	Group	Categories in the Directive
	Passenger cars	Cat M1 + Cat M1G
	Vans	Cat N1 + Cat N1G + Cat M2 < 3,5 t
	Buses and coaches	Cat M2 > 3,5 t + Cat M3
	Lorries	Cat N2
	Heavy Duty Vehicles (HDVs)	Cat N3 + Cat N3G

Environmental impact – Approach(4) Road types

Residential road
- intermittent
- free flow

Main road
- intermittent
- free flow

Arterial road
free flow

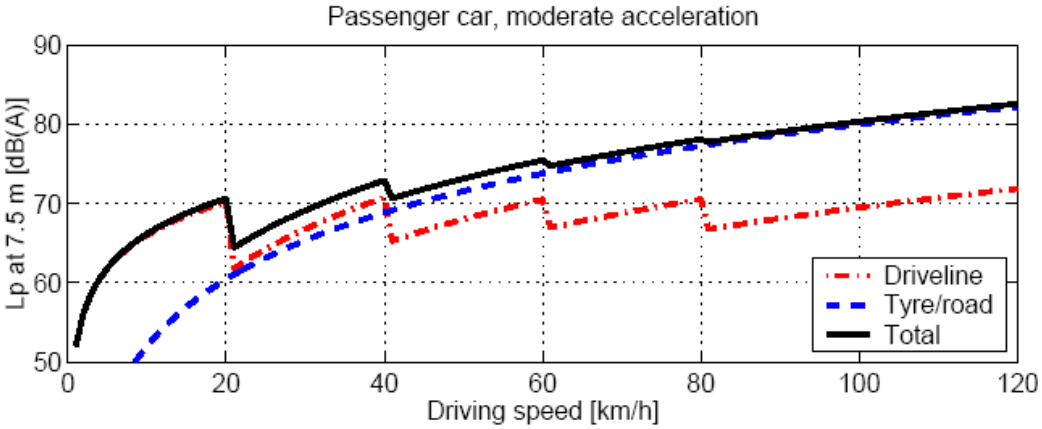
Urban motorway
free flow

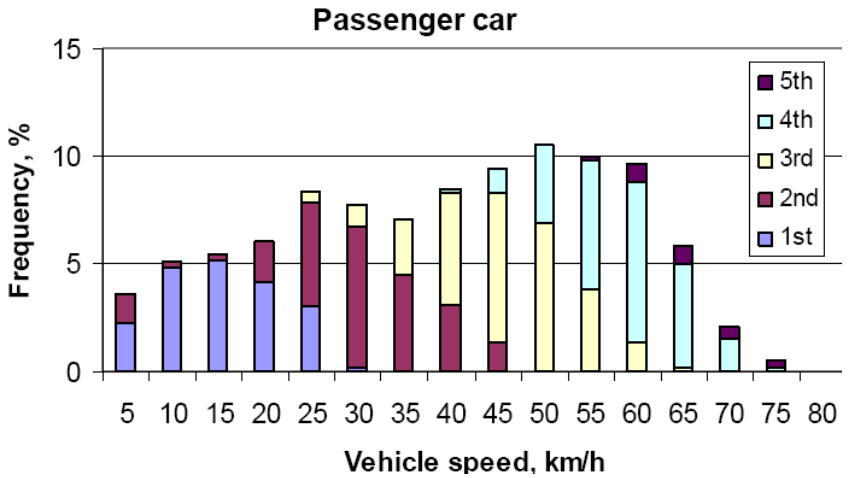
Rural road
free flow

Rural motorway
free flow

Environmental impact – Approach(5)
Distinguish road sections with intermittent traffic

- A separate part of the population is affected by powertrain noise from intermittent traffic
- Potentially large numbers of people are effected
- Urban roads with frequent acceleration and braking due to junctions, crossings, traffic lights, obstacles, congestion
- Assumed portion: 33%



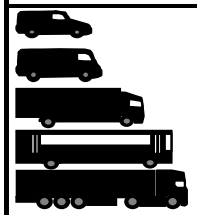


Relevant road length for EU27

- Deduct stretches of road that are uninhabited, very quiet (non through roads) or not relevant,, e.g. road parts with commercial or municipal buildings

Road type	Assumed % length	Road length kkm	Adjustment	Deduct	Effective length kkm	%intermittent	%freeflow
Residential	33,0%	1661	nonresid., restricted or low intensity	35%	**1079**	**33%**	67%
Main	5,0%	252	nonresid.	20%	**201**	**33%**	67%
Arterial	2,0%	101	nonresid.	10%	**91**	**0%**	100%
Urban Mwy	0,1%	5	nonresid.	20%	**4**	**0%**	100%
Rural Mwy	1,9%	96	nonresid.	50%	**48**	**0%**	100%
Rural road	58,0%	2919	nonresid.	50%	**1459**	**0%**	100%
Total	100,0%	**5032**			**2882**		

Environmental impact - Road types and characteristics

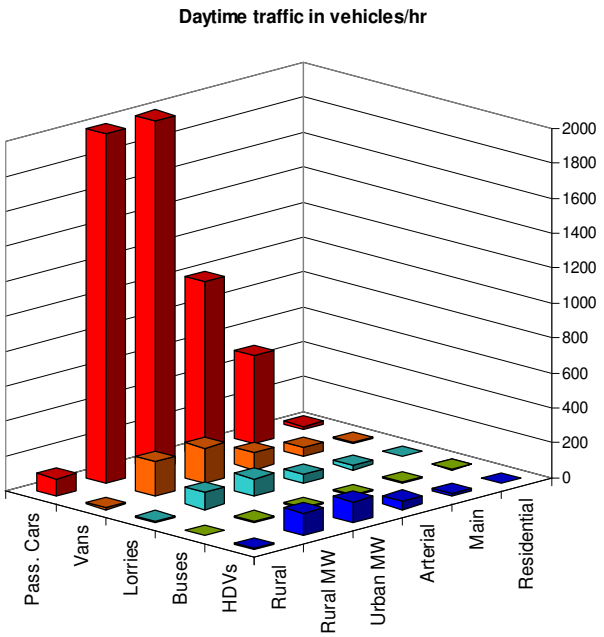
Road type	Residential (urban/ suburban)	Residential (urban/ suburban)	Main roads (urban/ suburban)	Main roads (urban/ suburban)	Arterial roads (urban/ suburban)	Urban motorways (urban/ suburban)	Rural motorways	Rural roads	Total
Traffic type	intermittent	free flow	intermittent	free flow	free flow	free flow	free flow	free flow	
Speed range	V<50	V<50	V<50	V<50	50<V<70	70<V<120	80<V<130	50<V<100	
Full road length(km)	547998	1112603	83030	168576	100643	5032	95610	2918633	5032125
Percentage of total road network	11%	22%	2%	3%	2%	0,1%	2%	58%	100%
Selected road length (km)	356199	723192	66424	134861	90578	4026	47805	1459316	2882401
Percentage of selected road network	12%	25%	2%	5%	3%	0,1%	2%	51%	100%
Estimated avg. exposed inhabitants/km	250	250	500	500	500	1000	50	20	
Typical distance to road (m)	15	15	15	15	15	50	50	50	
Applied penalty, dB	3	0	3	0	0	0	0	0	
Noise sources									
	Powertrain, tyre	Tyre, powertrain	Powertrain, tyre	Tyre, powertrain	Tyre	Tyre	Tyre	Tyre	
	Powertrain	Powertrain, tyre	Powertrain	Powertrain, tyre	Powertrain, tyre	Powertrain, tyre	Powertrain, tyre	Powertrain, tyre	

Environmental impact – traffic intensity

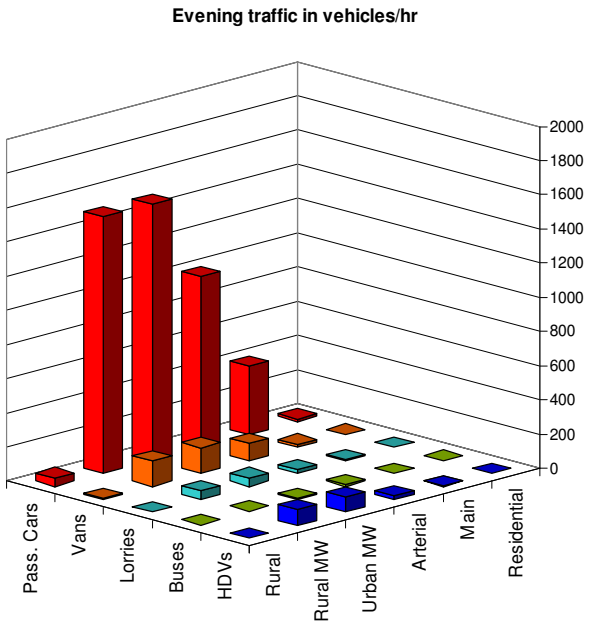
	Residential	Main	Arterial	Urban MW	Rural MW	Rural
Typ.speed	<50	<50	50-70	70-120	80-130	50-100
	Typical traffic intensities N/hour					
DAY 12h	Intmt.+free	Intmt.+free	Free	Free	Free	Free
Pass. Cars	20	500	1000	2000	2000	100
Vans	4	50	100	200	200	10
Lorries	0,2	25	50	100	100	10
Buses	0,1	4	10	10	10	2
HDVs	0,1	15	50	120	130	5
EVE 4h						
Pass. Cars	15	400	1000	1500	1500	50
Vans	2	20	100	150	150	5
Lorries	0,01	4	20	50	50	2
Buses	1	2	10	6	6	2
HDVs	0,01	5	20	90	90	2
NIGHT 8h						
Pass. Cars	2	50	200	500	500	16
Vans	1	5	20	50	50	2
Lorries	0,01	2	17	35	35	1
Buses	0,5	1	5	4	4	1
HDVs	0,01	2	8	50	50	1

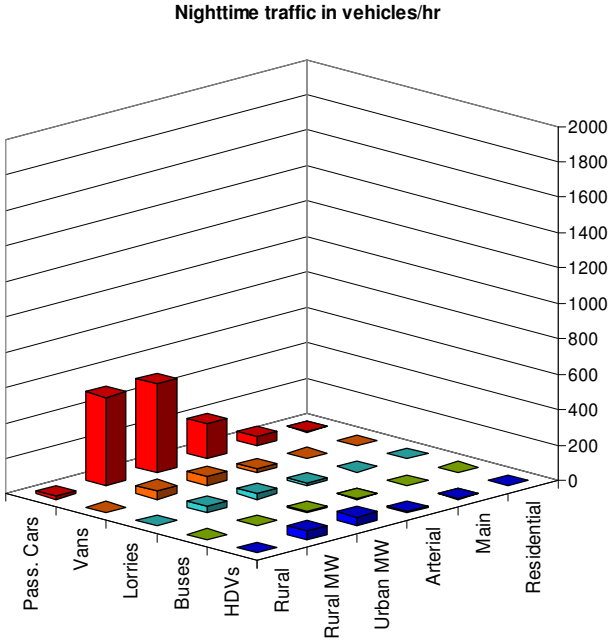
Traffic intensity vehicles/hr

Day



Eve





Night

Environmental impact – Approach(7)
Vehicle emission data

- Determine $L_{Amax,rep}$ representative of real operating conditions for each vehicle type
- For policy option 1, based on Method A values
- For other options, based on Method B values
- Method B WOT test values for intermittent traffic, and for larger vehicles all traffic
- Method B constant speed test values for cars and vans for free flowing traffic

- Start with 2 noise emission levels for real traffic from UBA/Steven database (accelerating+free flow traffic)
- Project average change of type test values on real traffic data
- Assume:
  a) Constant speed test result will follow tyre directive (rolling noise)
  b) WOT test result will follow limit value reductions for vehicle test

Environmental impact – Approach(8)
Estimation of noise level at façade of dwelling

- Determine L_{Ax} (SEL) level for representative distance, only for first row of dwellings:
  $L_{Ax,rep} = L_{Amax,rep} - 10\,lg(d/7{,}5)+5$ for d=15m and speeds upto 50 km/h
  and
  $L_{Ax,rep} = L_{Amax,rep} - 10\,lg(d/7{,}5)+7$ for d=50m and speeds above 60 km/h

- Determine L_{DAY}, L_{EVE},L_{Night} for period T from

$$L_{eq} = 10lg\left(\sum_{k=1}^{K}\sum_{i=1}^{N_k} 10^{LAx,i/10}\right) - 10lgT$$

  with N_k= number of pass-bys with same L_{Ax} level
  K = number of vehicle types

- Determine L_{DEN} from
  $L_{DEN} = 10\,lg\,[(12/24).10^{Lday/10} + (4/24).10^{(Leve+5)/10} + (8/24).10^{(Lnight+10)/10}]$

- Reflections and other attenuation effects are neglected
- Average noise emission per vehicle and street type assumed

Environmental impact – Results
L_{DEN}, L_{night} , annoyance and sleep disturbance

LDEN	Resid.int.	Resid.free	Main int.	Main free	Arterial	Urban MW	Rural MW	Rural	MHAnnoyed	MAnnoyed
Option 1	54,4	52,3	67,3	65,3	74,1	71,5	73,6	55,0	55	119
Option 2	56,2	54,1	68,9	67,0	75,7	73,1	75,2	56,6	64	133
Option 3	54,4	52,3	67,3	65,3	74,1	71,5	73,6	55,0	55	119
Option 4	51,6	49,8	64,4	62,9	71,7	69,1	71,1	52,7	44	99
Option 5	50,4	49,4	63,2	62,7	71,4	68,9	70,9	52,3	41	95
LNIGHT									MHSD	MSD
Option 1	45,7	43,1	57,0	54,8	65,0	63,4	65,3	46,3	27	60
Option 2	47,5	44,9	58,4	56,4	66,7	64,9	66,9	47,8	30	66
Option 3	45,7	43,1	57,0	54,8	65,0	63,4	65,3	46,3	27	60
Option 4	43,0	40,7	54,2	52,4	62,7	61,0	62,9	43,9	22	51
Option 5	41,9	40,1	52,9	52,1	62,4	60,7	62,6	43,5	22	49

dLDEN	Resid.int.	Resid.free	Main int.	Main free	Arterial	Urban MW	Rural MW	Rural	diff MHA	diff MA	diff MHA	diff MA
Option 1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0%	0,0%
Option 2	-1,8	-1,8	-1,5	-1,7	-1,6	-1,6	-1,7	-1,5	-8,7	-14,1	-13,6%	-11,9%
Option 3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0%	0,0%
Option 4	2,8	2,5	2,9	2,4	2,4	2,4	2,4	2,4	11,4	19,5	26,1%	19,6%
Option 5	4,0	2,9	4,2	2,6	2,7	2,7	2,7	2,7	13,5	23,6	32,8%	24,7%
dLNIGHT									diff MHSD	diff MSD	diff MHSD	diff MSD
Option 1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0%	0,0%
Option 2	-1,8	-1,8	-1,4	-1,6	-1,6	-1,5	-1,6	-1,5	-3,2	-6,1	-10,8%	-9,3%
Option 3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0%	0,0%
Option 4	2,7	2,5	2,8	2,4	2,4	2,4	2,4	2,3	4,2	8,4	18,7%	16,4%
Option 5	3,8	3,1	4,0	2,7	2,7	2,7	2,7	2,7	5,0	10,3	23,3%	20,9%

Environmental impact – single event results

- Assumption:
  reduction in limits leads to reduction in powertrain noise even at off-cycle conditions including aggressive driving

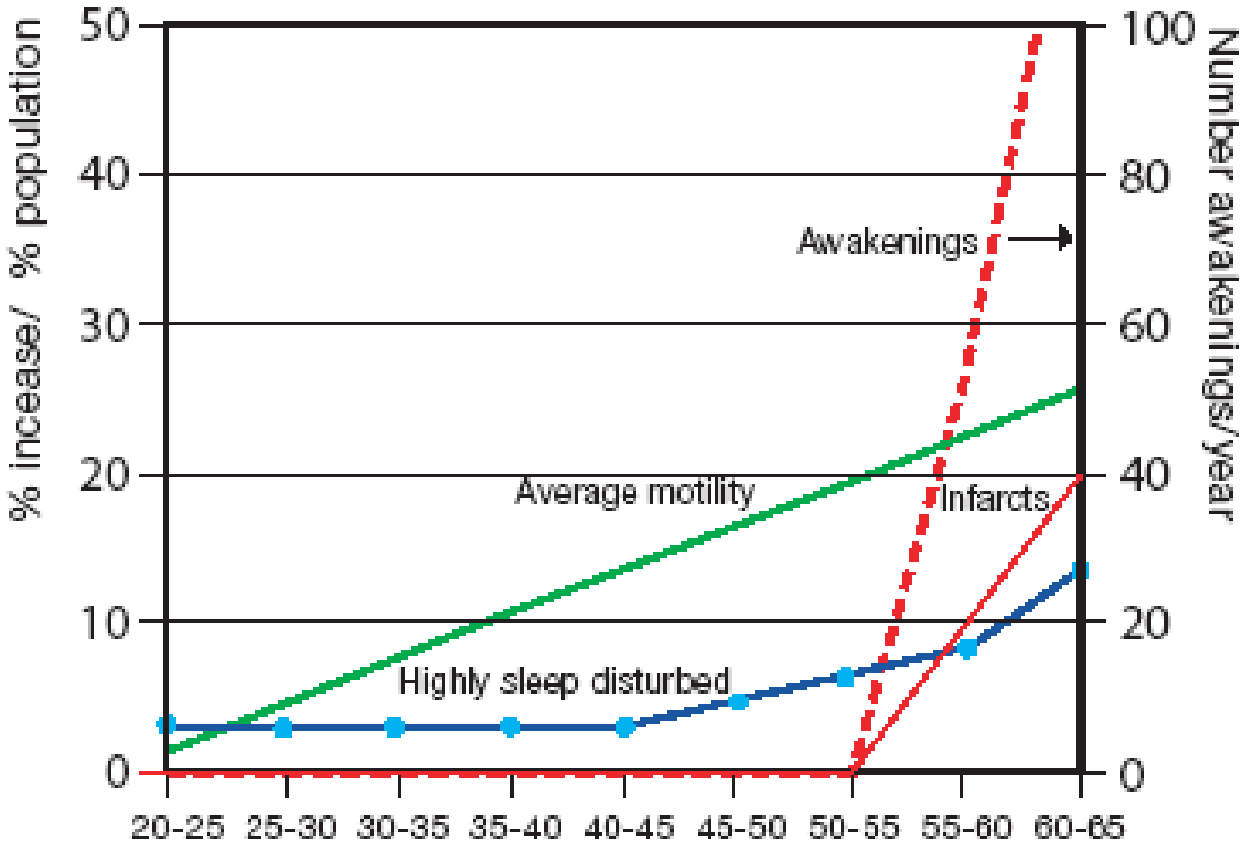
dLmax	Cars	Vans	Buses	Lorries	HDVs
Option 1	0,0	0,0	0,0	0,0	0,0
Option 2	-2,0	-2,8	-1,4	-2,0	1,0
Option 3	0,0	0,0	0,0	0,0	0,0
Option 4	3,2	3,2	3,0	2,0	2,0
Option 5	4,6	4,4	4,0	3,0	3,0

Social and health impact of road traffic noise

- Annoyance and stress (home and elsewhere)
- Sleep disturbance (night and sensitive locations)
- Concentration (schools and work)
- Speech intelligibility and communication
- Quality of life, living, working and recreational environment

- Health risks:
- Increased awakenings (sleep disturbance) and motility
- Hypertension (high blood pressure)
- Myocardial hart disease (hart attacks)
- Premature death or lost healthy years

Social and health impact – night time noise

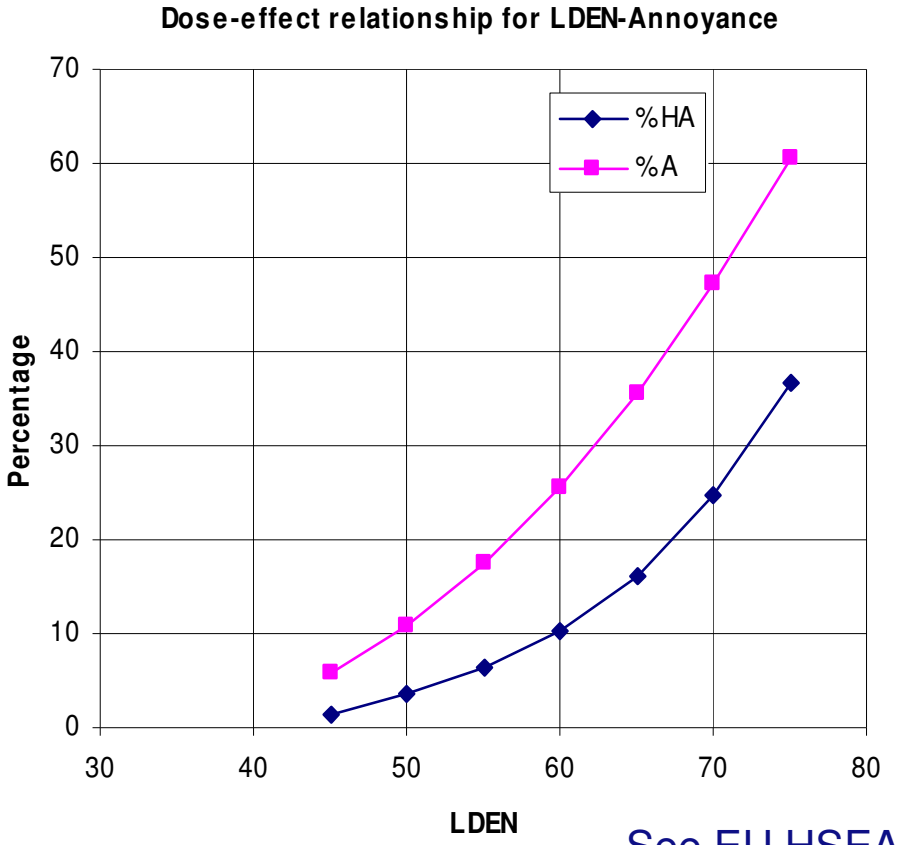


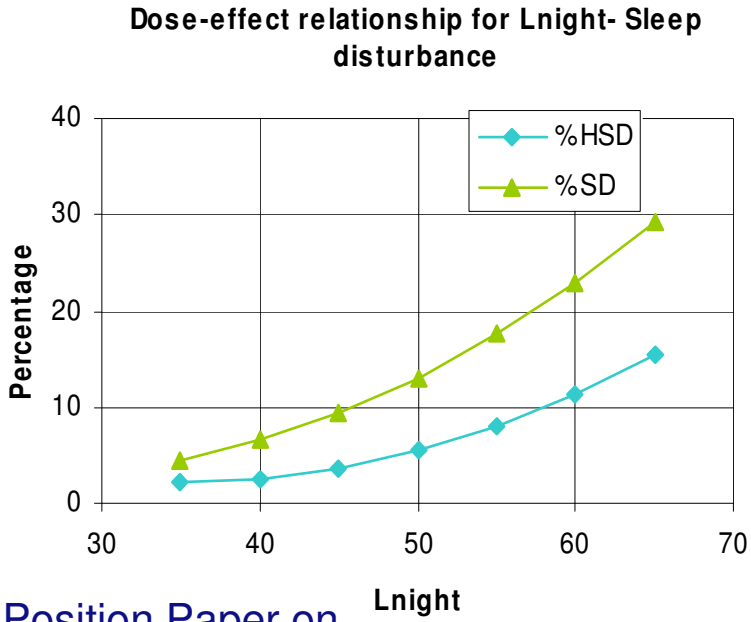
From: WHO Night Noise Guidelines 2009

Dose-effect relationships

- % Highly Annoyed and Annoyed People (%HA), (%A)
  dose-effect relationship with L_{DEN}

- % Highly Sleep Disturbed and Sleep Disturbed People (%HSD), (%SD)
  dose-effect relationship with L_{night}



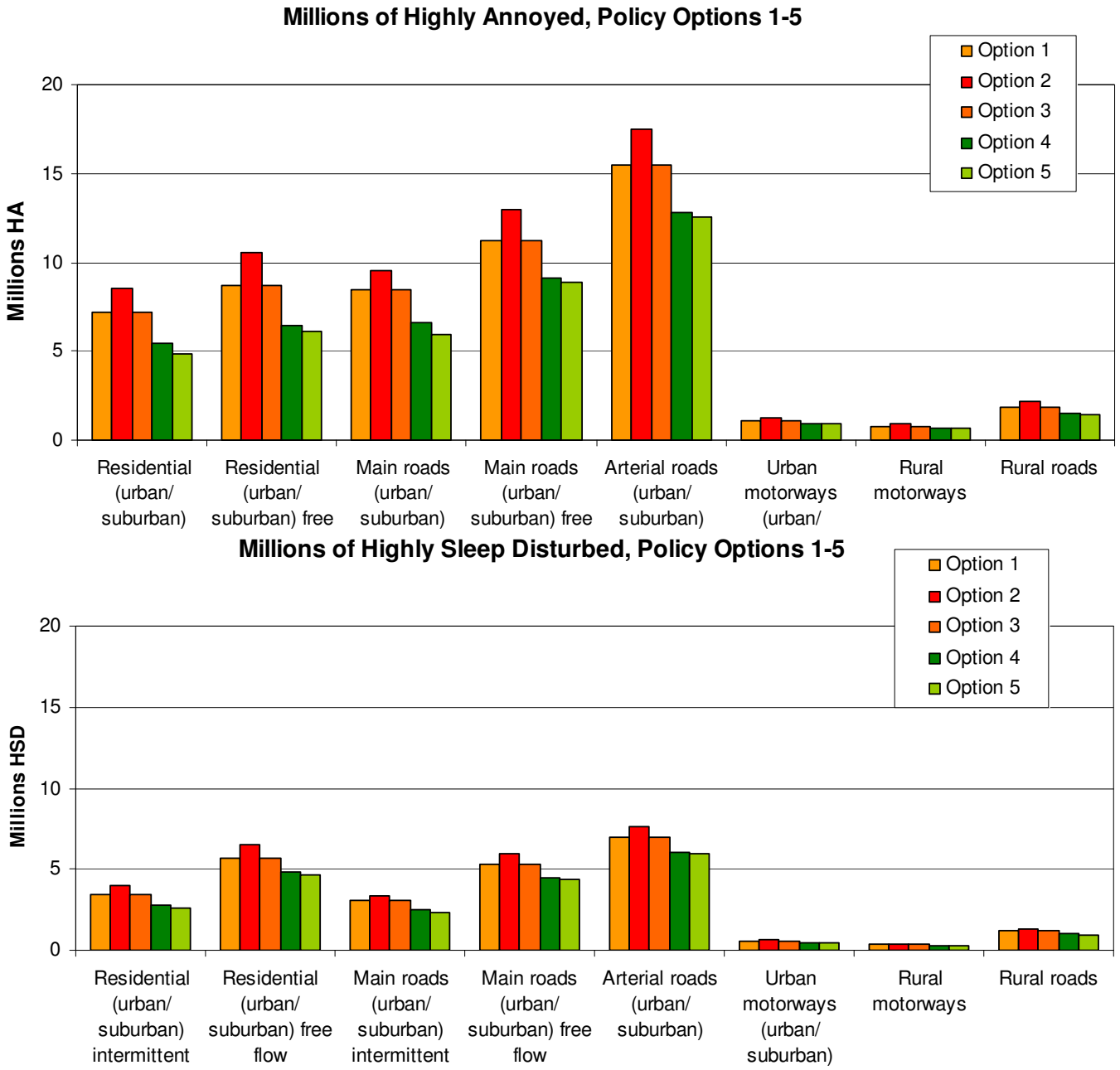


See EU HSEA Position Paper on Dose-effect relationships 2002+2004

Social and health impact

Numbers of highly annoyed and highly sleep disturbed people for each road type and policy option

Around 30% is due to intermittent traffic noise



Health impact in terms of DALYs

- Disability Adjusted Life Years (based on WHO studies)
- Measure for quantifying the environmental burden of disease
- Applied here to the effects due to traffic noise exposure
- Proportional to the percentage of highly annoyed and highly sleep disturbed people, duration and and severity of disease.
- Estimated impact for policy options, change in DALYs for EU27:

Reduced DALYs	Lower estimate	Upper estimate
Option 1	0	0
Option 2	-95.000 (increase)	-1.142.000 (increase)
Option 3	0	0
Option 4	125.000	1.496.000
Option 5	149.000	1.788.000

(large uncertainty due to estimate of disease severity)

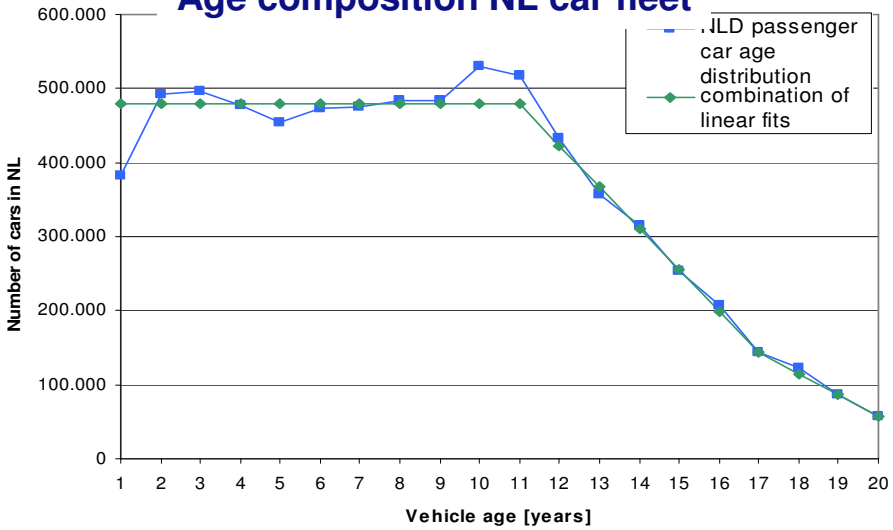
Time delays and factors increasing environmental, social and health impacts

- Effective reduction of powertrain noise:
  Replacement of the vehicle fleet: vehicle lifetime of 12 years
- Effective reduction of tyre noise by replacement of tyres:
  tyre lifetime = 4 years;
  Introduction of new tyre noise limits in 2012/2013/2016 (-4 dB)

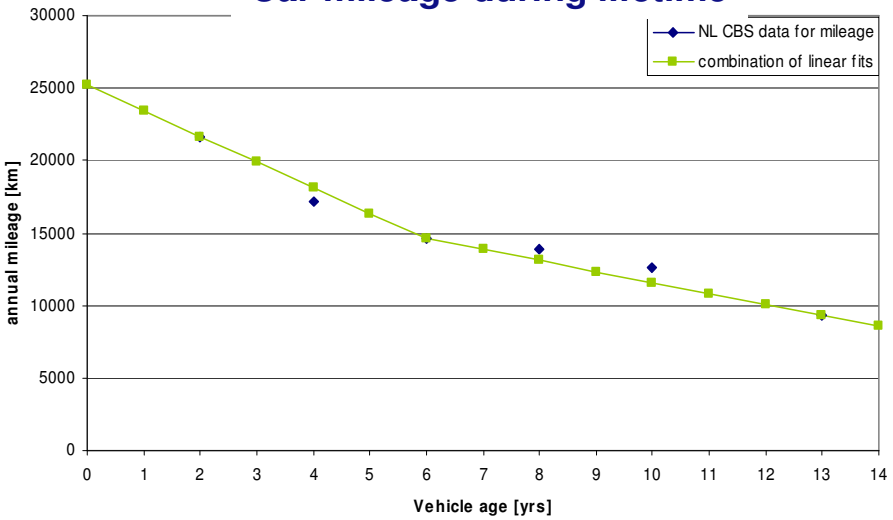
- Options 4,5 will take around 10 years to have a noticeable effect on L_{DEN} levels in intermittent traffic
- Free flow traffic will benefit from new tyre noise limits from around 2013+2 = 2015
- Annual traffic increase of 1,6% causes 0,6 dB average increase in L_{DEN} over 10 years

Fleet composition, mileage and growth effects

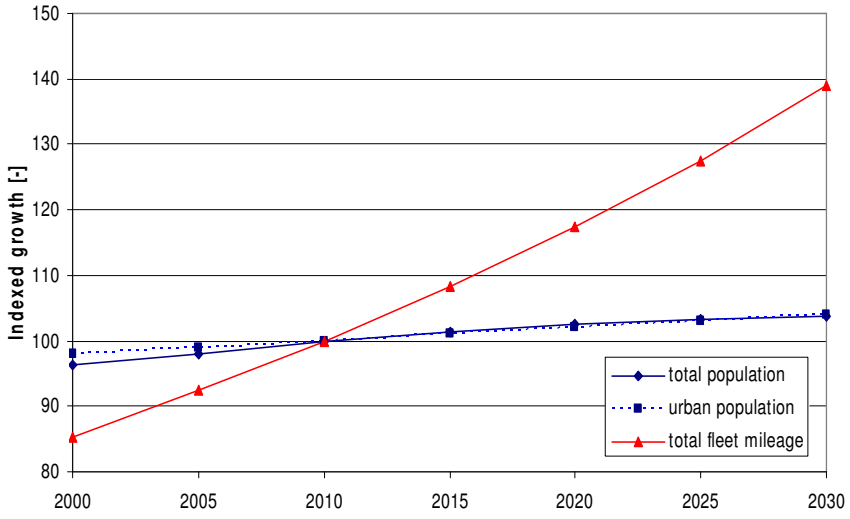
Age composition NL car fleet



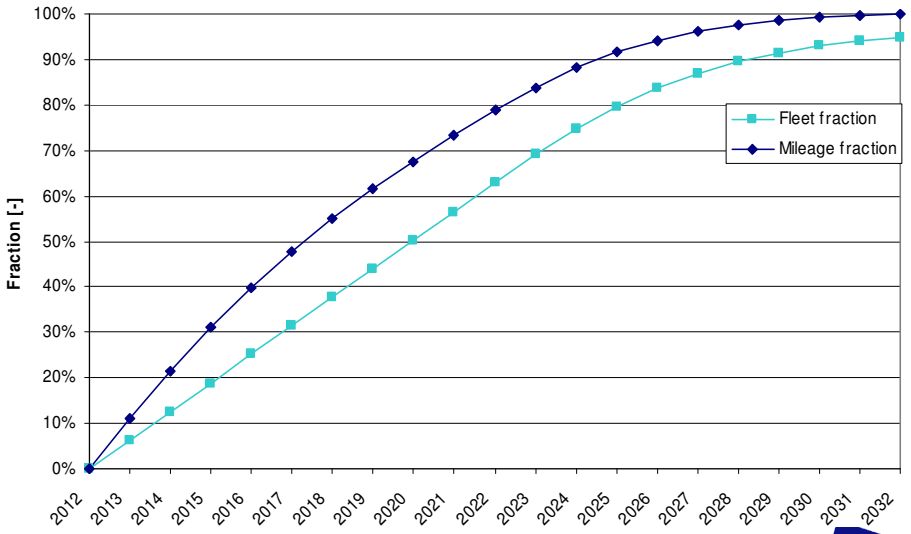
Car mileage during lifetime



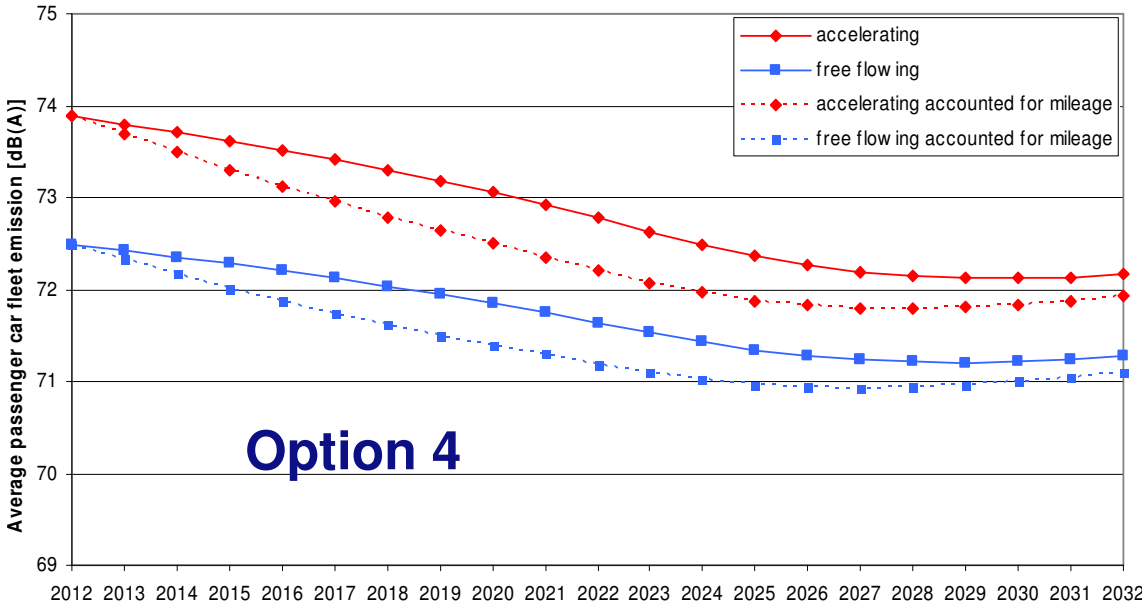
Population and vehicle mileage growth

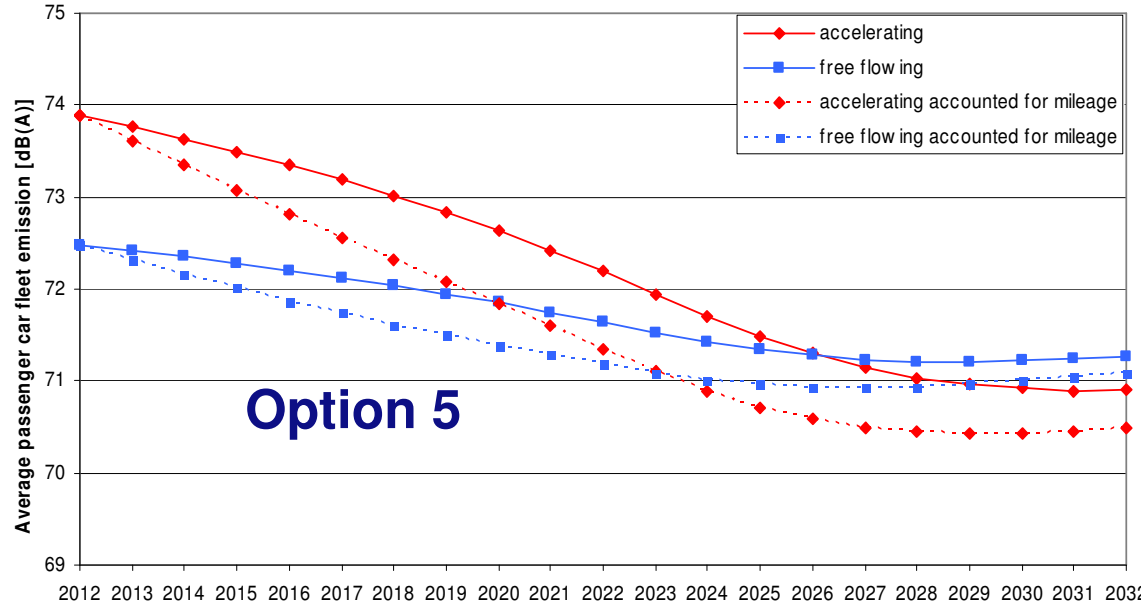


Market penetration quieter cars



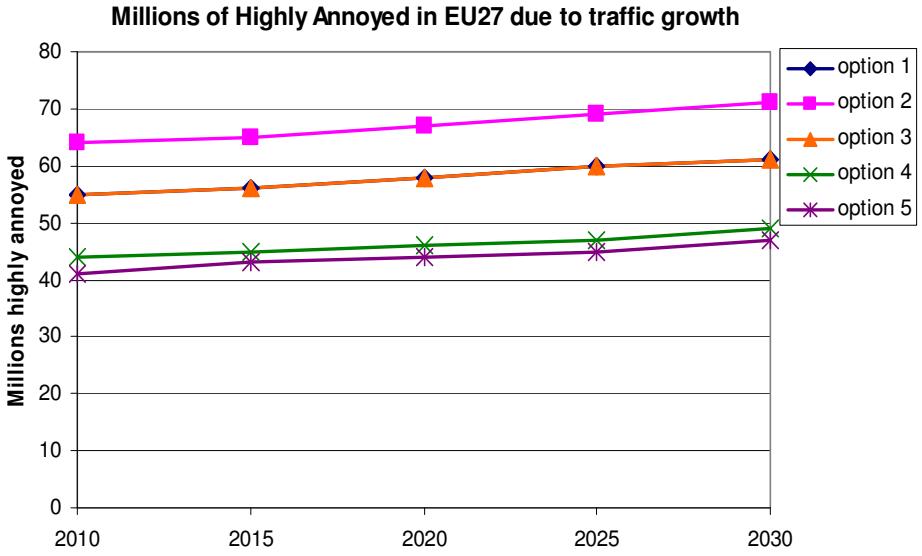
Decrease in average fleet noise emission for cars, 2012-2030

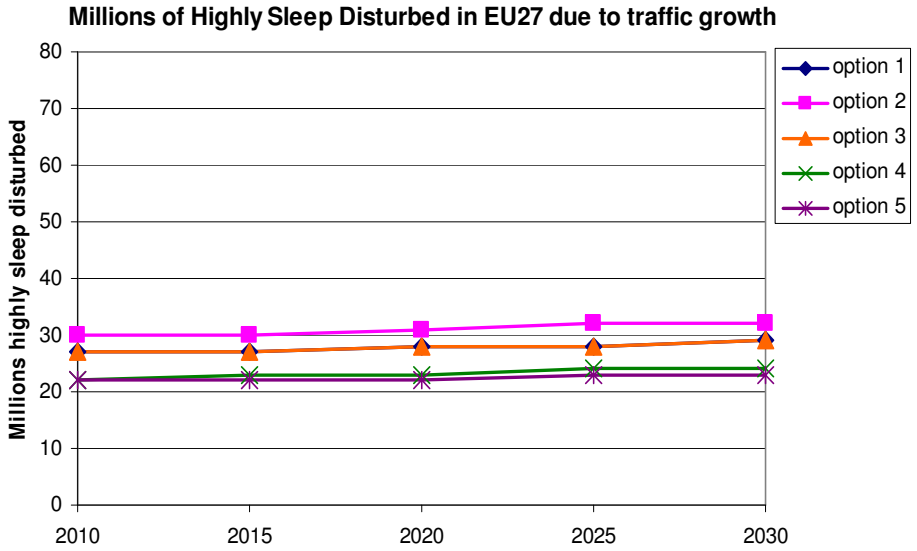




Future development of affected people

- Highly annoyed (HA) and highly sleep disturbed (HSD) people in millions in the next decades due to traffic growth





- Increase of 3 million HA and 1 million HSD in 2020 due to growth

Economic impact - approach

- Costs for industry:
  - additional development costs
  - additional production and materials costs

- Benefits for society:
  - WTP/hedonic pricing of noise reduction per household
  - Health costs not included in hedonic pricing
  - savings on noise abatement

- Appraisal period: 2010-2030 (complete life cycle of vehicles is covered);
- Discount rate of 3%
- Interest rate set at 1% (conservative growth rate of the GDP per annum);
- Population growth estimated at 1%
- Assess Benefit to Cost Ratio (BNR) over appraisal period

Economic impact - Industry

- Additional costs for OEMs due to noise reduction:
  - unit production costs: extra materials and manufacturing mostly for powertrain noise reduction
  - development, engineering and testing costs for new and upgraded models, spread over series. Limited costs as most technology is available.

- Additional unit production costs far outweigh the other costs for large series
- Exterior noise reduction may also result in interior noise reduction, in which case there is a positive market effect
- Additional costs for tyre industry and suppliers are deemed negligable
- Costs are finally borne by the market

Additional Industry Costs - Development

- Development costs increase exponentially with noise reduction, as suggested by ACEA:

- $C_{dev,j} = n_j \cdot C_{dj} \cdot 2^{(NRj-1)}$, $NR_j = NR_j - NR_{0,j}$

where

- $C_{dev,j}$ = additional development cost for vehicle models of group j
- n_j= number of new vehicle models of group j produced in the EU27
- C_{dj} = development cost for 1 vehicle model of group j for first dB reduction, 1 manyear + facility costs, approximately €150.000,-.
- NR = total required exterior noise reduction in dB
- NR_0 = margin of noise reduction achievable with available technology, ~2dB

Annual development costs over 7 year period

Vehicle group j	n_j	C_{dj} (€)	NR_0 dB	NR option 4, dB	Additional devt. Cost (M€)	NR option 5, dB	Additional devt. Cost (M€)
Cars	225	150.000	2	3,2	37,6	4,6	101,3
Vans	8	150.000	2	3,2	1,3	4,4	3,1
Buses	10	150.000	2	3,0	1,5	4,0	3,0
Lorries	10	150.000	2	2,0	0,8	3,0	1,5
HGVs	15	150.000	2	2,0	1,1	3,0	2,3
Total/year (M€)					42,3		111,1
Over 7 years (M€)					296,4		777,9

Additional Industry Costs - Production and materials

- $C_{prod,j} = m_j \cdot C_{pj} \cdot NR$

  where
- m_j = number of vehicles of group j produced per annum
- C_{pj} = average additional production cost per dB of noise reduction, 20 Euro per unit/dB for cars and vans and 120 Euro per unit/dB for other vehicles
- NR = exterior noise reduction on the vehicle

- These costs diminish linearly to 0 after production cycle of 7 years, i.e. solutions are fully integrated in production

Costs in first production year

Vehicle group j	Number produced m_j	Additional Cost C_{pj} (€)	NR option 4 dB	Additional production cost (M€)	NR option 5 dB	Additional production cost (M€)
Cars	14500000	20	3,2	916	4,6	1330
Vans	2200000	20	3,2	139	4,4	192
Buses	30000	120	2,4	11	3,4	14
Lorries	100000	120	2,0	24	3,0	36
HGVs	100000	120	2,0	24	3,0	36
Total(M€)				1113		1608

Combined industry costs

- Including interest

M€	Option 4				Option 5			
Year	Development	Production	Total	+interest 1%	Development	Production	Total	+interest 1%
2010	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
2011	42,3	0,0	42,3	42,8	111,1	0,0	111,1	112,2
2012	42,3	0,0	42,3	43,2	111,1	0,0	111,1	113,4
2013	42,3	1113,2	1155,5	1190,5	111,1	1608,3	1719,4	1771,5
2014	42,3	954,2	996,5	1037,0	111,1	1378,5	1489,6	1550,1
2015	42,3	795,1	837,5	880,2	111,1	1148,8	1259,9	1324,2
2016	42,3	636,1	678,4	720,2	111,1	919,0	1030,1	1093,5
2017	42,3	477,1	519,4	556,9	111,1	689,3	800,4	858,1
2018	42,3	318,1	360,4	390,3	111,1	459,5	570,6	617,9
2019	0,0	159,0	159,0	173,9	0,0	229,8	229,8	251,3
2020	0	0	0	0	0	0	0	0,0
2021	0	0	0	0	0	0	0	0,0
2022	0	0	0	0	0	0	0	0,0
2023	0	0	0	0	0	0	0	0,0
2024	0	0	0	0	0	0	0	0,0
2025	0	0	0	0	0	0	0	0,0
2026	0	0	0	0	0	0	0	0,0
2027	0	0	0	0	0	0	0	0,0
2028	0	0	0	0	0	0	0	0,0
2029	0	0	0	0	0	0	0	0,0
2030	0	0	0	0	0	0	0	0,0
Total M€	339	4453	4791	5035	889	6433	7322	7692

Benefits for society – hedonic pricing

- The annual hedonic pricing benefit BHP is (see EU pos.paper)

  $B_{HP} = V_{HP} * N_h * NR$

  where
- V_{HP} = value of hedonic pricing in Euros per household per dB per annum: € 25/dB/household from 2002 adjusted by growth at 1%.
  2010 : € 27,- 2020 : €29,80.

- N_h= number of households (calculated per road type and length)
  188 million , 10% not exposed, 2,4 persons per household, so 451 million people exposed.

- NR= noise reduction in dB (L_{DEN}).

- So for 2010, N_h =27*451m/2,4 = 5074 M € /dB
  which is similar to the FEHRL study (2006).

- Calculation for a noise reduction of 2,5 dB for option 4
  and for 3,1 dB for option 5

Benefits for society – health

$$B_{health} = (NR * PR)\sum_{i} VLYL_i + COI_i$$

	IHD	HBP
LYL_i	17.900	46.300
HD_i	50.000	240.000
CH_i	€ 670	€ 540

- B_{health} = health benefit
- NR = noise reduction in dB
- PR = per dB prevalence (occurrence) reduction factor = 0.02
- $VLYL_i$ = Value of Life Years Lost for illness i,
  ischemic heart disease (IHD) or high blood pressure related disease (HBP).
- COI_i = Cost Of Illness i for IHD or HBP.
- Value of life years lost $VLYL_i = V_i * LYL_i$
- V_i = the value of 1 life year lost at € 63.250 and
  LYL_i the number of life years lost:
- Cost of Illness $COI_i = CH_i * HD_i$, where
- HD_i = the number of hospital days / disease / year and
- CH_i = the cost of one day of hospital treatment

Bhealth = 84,5 M€/dB/annum

- Reference: WHO report on on valuation of transport related health effects (2008) + extrapolation from Swiss data

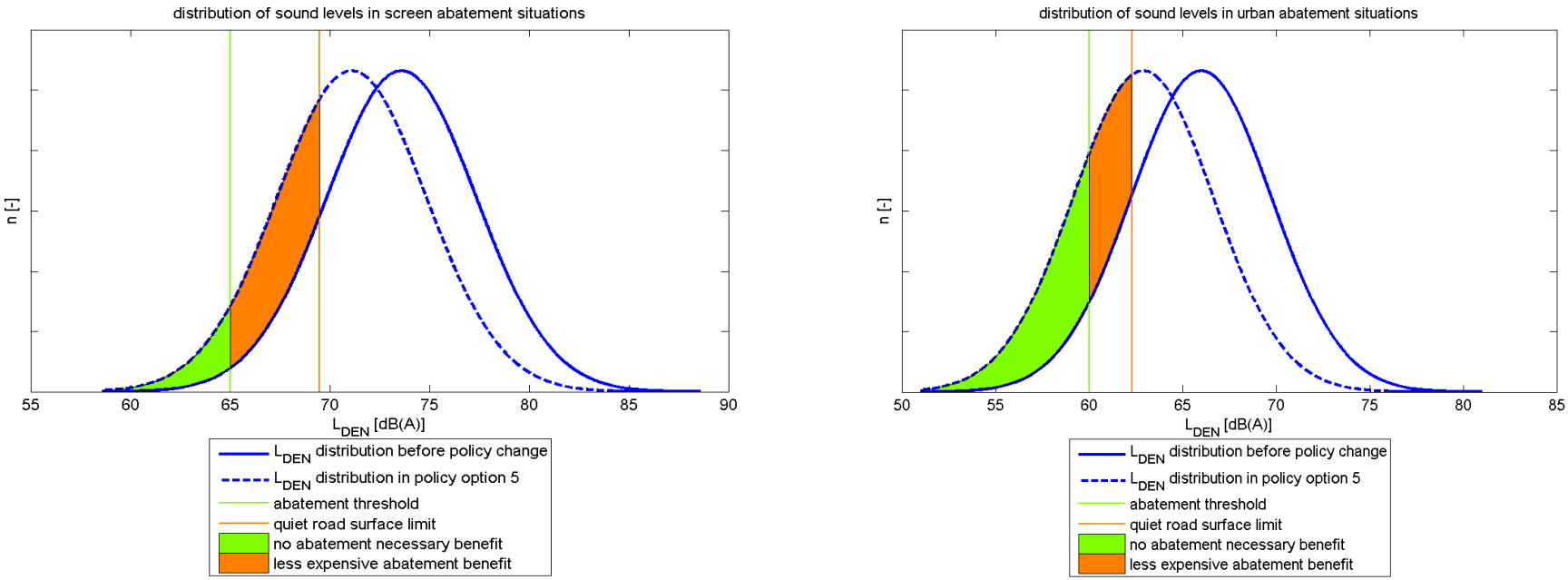
Benefits for society – Abatement savings

- Savings on noise barriers, quiet road surfaces, dwelling insulation
- Traffic restrictions, rerouting and speed restrictions have relatively low costs and are not always applicable
- Typical reductions:

	Noise barriers	Quiet road surfaces	Dwelling insulaltion
Motorways and arterial roads	10-15 dB	Upto 5 dB	Upto 30 dB
Urban roads	Not applicable	2,3 dB	Upto 30 dB
Cost estimate	€ 580000/km	€ 750000/km	€ 5000/dwelling

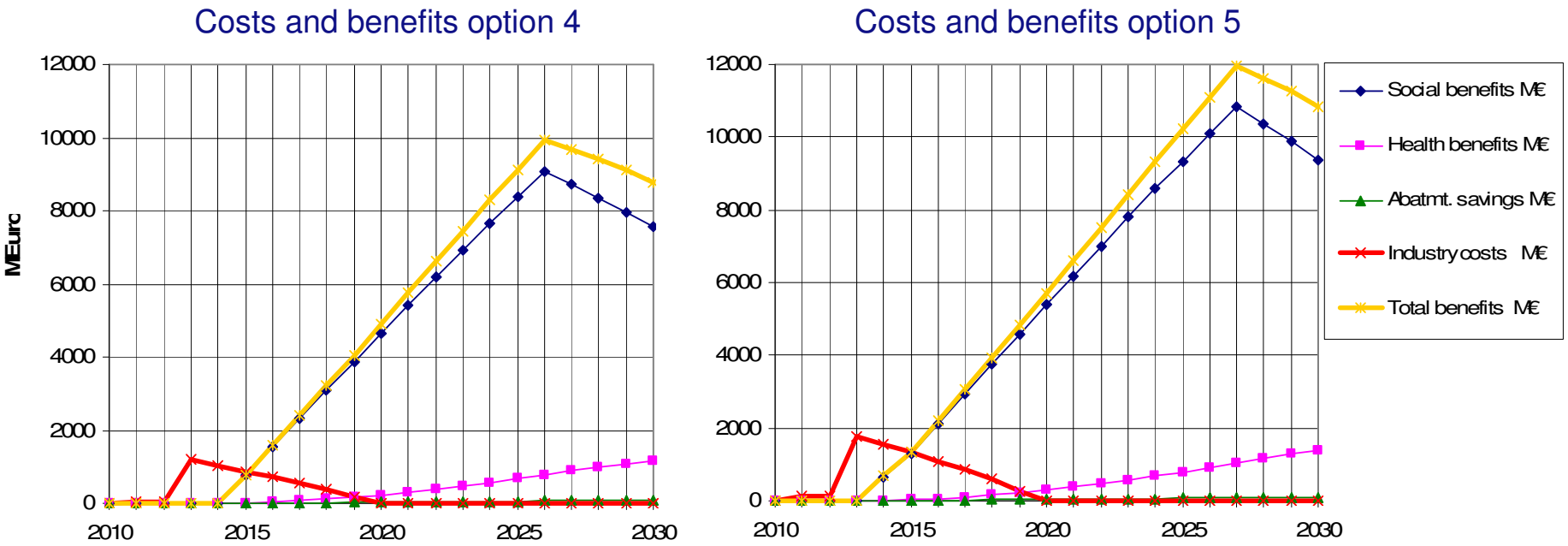
- Savings are based on **avoided** or **reduced** need for abatement.
- Financial data on noise abatement varies strongly per member state and region and is hard to obtain.
- Same annual spending on abatement is assumed, e.g. 500 **M€** on barriers/annum
- Total annual savings on all abatement measures are estimated for the EU27 in 2010 at **58 M€ for policy option 4 and 79 M€ for policy option 5.**

Benefits for society – Abatement savings



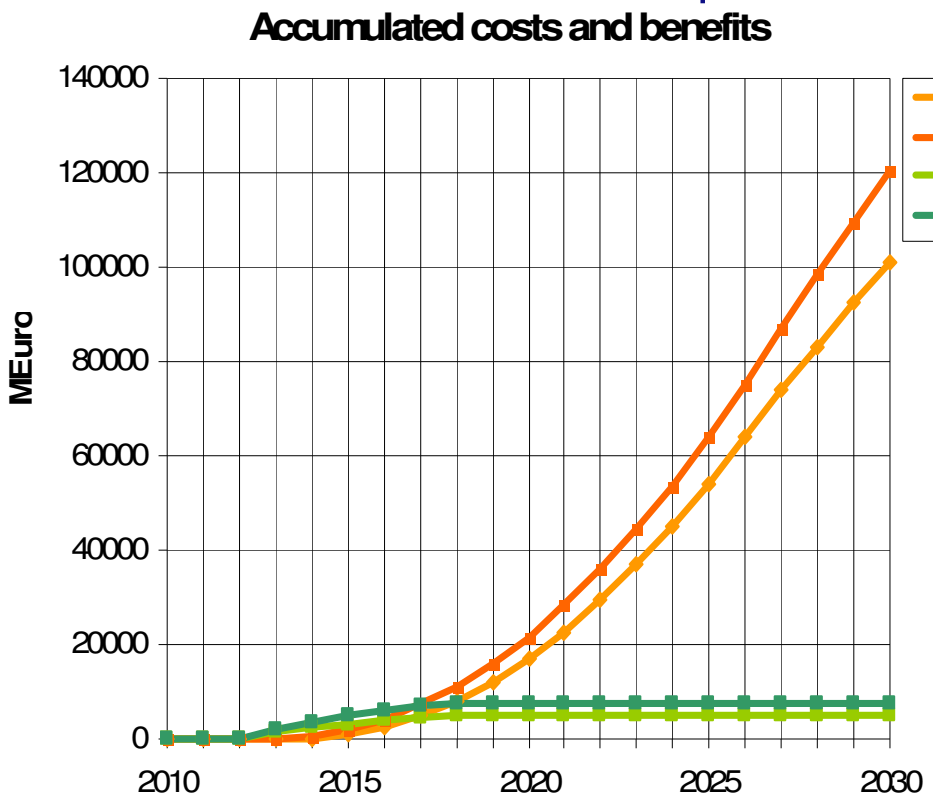
- Approach: specify typical noise action level at which abatement is required
- Assume normal distribution for such situations
- Calculate avoided and reduced abatement of costs

Costs and benefits over time for options 4,5



Accumulated costs and benefits and Benefit/Cost ratio

- Accumulated societal benefits and industry costs of policy options 4 and 5, Net present value in 2030 (BCR = Benefit - Cost Ratio)
- Benefits outweigh costs by factor 16-20
- Benefits/valuation may be higher, industry costs may be lower if ineterior noise also improves



	Benefits M€	Cost Industry M€	BCR
Option 1	0	0	-
Option 2	0	0	-
Option 3	0	0	-
Option 4	101084	5035	20,1
Option 5	120547	7692	15,7

Impact assessment – Summary (Environmental impact)

- Determined for L_{DEN}, L_{night} and single event levels and for various road and traffic types
- Cars mostly dominate L_{DEN} and L_{night} levels.
- Facade L_{DEN} levels around 52-74 dB , L_{night} levels around 43-65 dB. Lower levels on residential and main roads than arterial roads and motorways, but many exposed people there
- Environmental benefit only for options 4 and 5 (highest).
- Reductions in L_{DEN} and L_{night} on average 2,5 dB for option 4 and 3,1 dB for option 5.
- On roads where powertrain noise is dominant, 2,8 dB for option 4 and 4 dB for option 5.
- Part of reduction from tyre directive, but powertrain noise also important esp. vans, lorries, HGVs and buses.
- Traffic growth can diminish the gained noise reduction by 0,6 dB in 10 years
- Single event levels which are important for incidental noise reduce 2-3,2 dB for option 4 and 3-4,6 dB for for option 5.

Impact assessment – Summary (Social/health impact)

- In EU27 Currently 55 million people highly annoyed, 27 million highly sleep disturbed.
- 44/22 million for option 4 and 41/22 million for option 5.
- 6,5 million DALYS annually related to annoyance and 3 million DALYS related to sleep disturbance.
- Options 4 and 5 reduce the number of DALYs by 0,1-1,4 million for option 4 and by 0,1-1,6 million for option 5.
- Options 4 and 5 will generally reduce stress levels and improve health and quality of life in living, working and recreational environment

Impact assessment – Summary (Economic impact)

- Society benefits due to hedonic pricing (largest), health benefits and abatement savings
- Industry costs due to additional development and production and materials costs, mostly for powertrain noise. Lower costs per unit for cars and vans. Costs finally for the market.
- Accumulated costs amount to 5 billion Euros for option 4 , 7,7 billion Euros for option 5.
- For cycle of 3+7 years , mainly additional production costs diminishing over production cycle.
- Benefits are 101 billion Euros for option 4 and 120 billion Euros for option 5 over the period 2010-2030.
- Benefits outweigh the costs for industry by a factor 20,1 for option 4 and a factor 15,7 for option 5. Costs preceed benefits by several years.