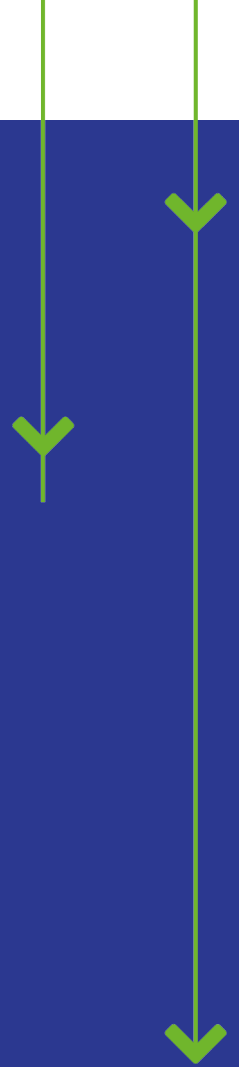


COOL
& LOW NOISE
ASPHALT PROJET
LIFE

—
Socio-economic assessment
- Noise component

1

Introduction: Social cost of noise in Île- de-France



1. INTRODUCTION: SOCIAL COST OF NOISE IN ÎLE-DE-FRANCE

Method used

Évaluation non adaptée	Pas d'études ni de données disponibles	Absence de lien statistique significatif
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Niveau de robustesse des évaluations	Elevé	Moyen	Faible
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Différence significative de méthodologie par rapport à l'étude nationale

Île-de-France		Gène	Perturbations du sommeil	Maladies cardiovasculaires	Troubles de la santé mentale	Obésité	Diabète de type 2	Difficultés d'apprentissage	Déficit auditif	Assurance maladie	Dépréciation immobilière	Perte de productivité	Dépenses de lutte contre le bruit
Transports	Routier	OMS 2018	OMS 2018	OMS 2018 (CPI et AVC)	Lan, 2020	Foraster, 2018	Eze, 2017	Exposition Ecophon 2019 Transfert courbe dose réponse bruit aérien		Enquête CREDOC/Bruitparif 2017 pour médication Données observatoire suisse + SCANSanté pour hospitalisation	Beimer, 2017	Hafner, 2017	
	Ferré	OMS 2018	OMS 2018	OMS 2018 (CPI)				Exposition Ecophon 2019 Transfert courbe dose réponse bruit aérien		Enquête CREDOC/Bruitparif 2017 pour médication Données observatoire suisse + SCANSanté pour hospitalisation	Sedoarisoa, 2017	Hafner, 2017	
	Aérien	DEBATS 2020	OMS 2018	OMS 2018 (CPI) DEBATS 2020 (pour HTA)			Eze, 2017	Stansfeld, 2005		Enquête CREDOC/Bruitparif 2017 pour médication Données observatoire suisse + SCANSanté pour hospitalisation	Sedoarisoa, 2017	Hafner, 2017	
Milieu professionnel	Travail	Enquête CREDOC/Bruitparif 2017							de Vervasdoué, 2016	Indemnisation surdités professionnelles : Données DGT 2018 Accidents du travail : Données DARES 2007 et étude SUMER 2017		Si, 2020	
	Scolaire	Enquête CiDB/Bruitparif 2009						Exposition Ecophon 2019 Transfert courbe dose réponse bruit aérien					
Voisinage	Particuliers	Enquête CREDOC/Bruitparif 2017	Enquête CREDOC/Bruitparif 2017		Jensen, 2018					Enquête CREDOC/Bruitparif 2017 pour médication	Formulation d'hypothèses arbitraires	Hafner, 2017	
	Activités	Enquête CREDOC/Bruitparif 2017	Enquête CREDOC/Bruitparif 2017		Jensen, 2018					Enquête CREDOC/Bruitparif 2017 pour médication	Formulation d'hypothèses arbitraires	Hafner, 2017	
	Chantiers	Hypothèses pour exposition Courbe dose-réponse étude Liu 2017	Extrapolation méthode bruit routier	Extrapolation méthode bruit routier	Extrapolation méthode bruit routier					Enquête CREDOC/Bruitparif 2017 pour médication Données observatoire suisse + SCANSanté pour hospitalisation		Hafner, 2017	
Transverse													Budgets

Bruitparif study (2021)

Social cost of noise in Île-de-France: 42,6 billion €/an

- More than 1/3 of Ile-de-France residents suffer significant effects from noise
- Severe annoyance: 4.5 million people (37%)
- Sleep disturbance: 1.4 million people (12%)
- Obesity: 235,000 people (1.9%)
- Learning difficulties: 360,000 young people
- Anxiety and depressive disorders: 170,000 people (1.4%)
- 100,000 people (0.8%) would take anxiolytics because of noise
- Cardiovascular diseases: 83,000 people (0.7%) including 600 premature deaths attributable to noise
- Diabetes: 13,000 people (0.1%)
- 57,500 years of productivity lost at work due to noise
- 20,000 work-related accidents directly linked to noise
- 112 new cases of occupational deafness each year



Contribution of road noise

➤ 18,1 Billion €

➤ 43%

Work/School: €5.3bn/year - 12%

Work: €3.9bn/year - 9%

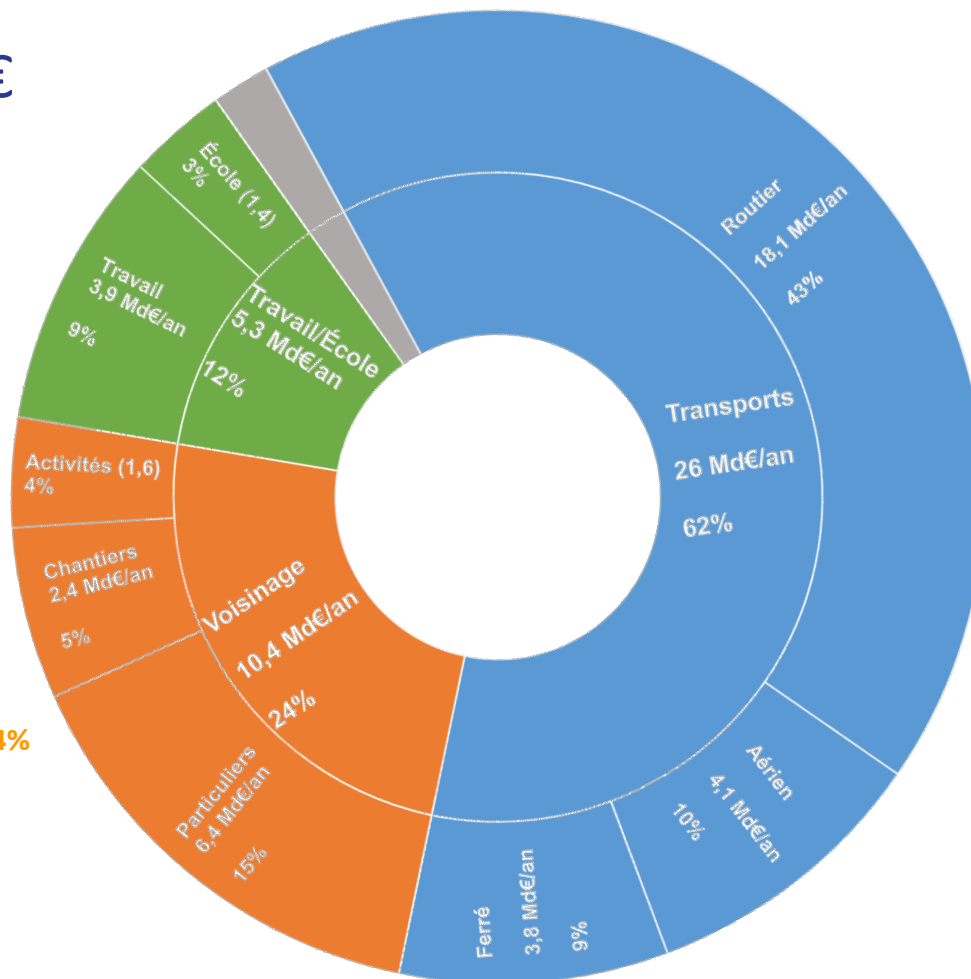
School: €1.3bn/year - 3%

Neighbourhood: €10.4bn/year - 24%

Individuals: €6.4bn/year - 15%

Worksites: €2.4bn/year - 5%

Activities: €1.6bn/year - 4%



Transports: €26bn/year - 62%

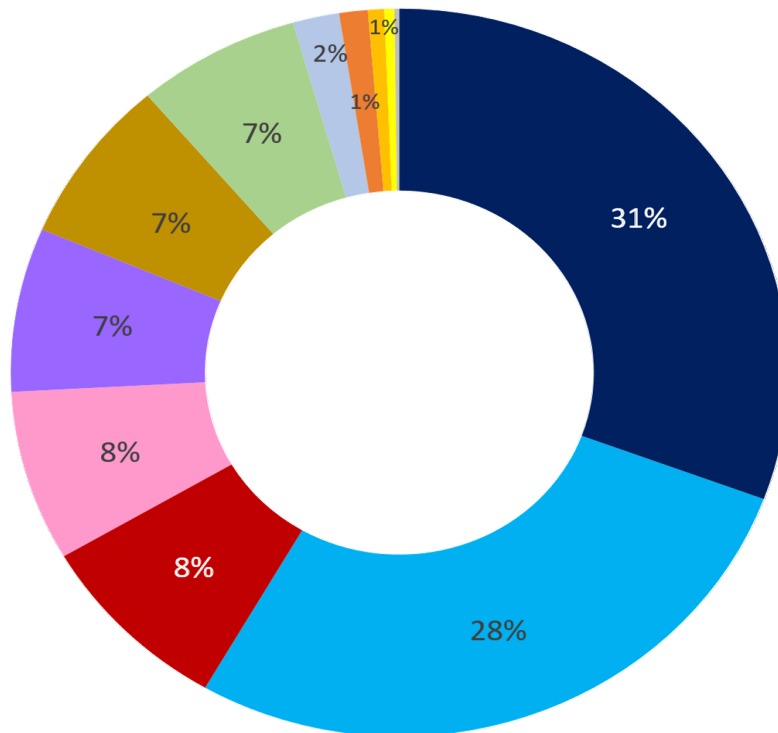
Road: €18bn/year - 43%

Aircraft: €4.1bn/year - 10%

Rail: €3.8bn/year - 9%

Costs of different noise effects

- Sanitary costs: 35,8 Bn€/an (84%)
- Non-sanitary costs: 6,8 Bn€/an (16%)



- Sleep disturbances: €13.1bn/year
- Annoyance: €11.8 Bn/year
- Cardiovascular diseases: €3.58bn/year
- Psychological disorders: €3.2bn/year
- Obesity: €3.1bn/year
- Property depreciation: €3.1bn/year
- Loss of productivity: €2.9bn/year
- Noise prevention policy: €0.8bn/year
- Hearing loss: €0.5bn/year
- Learning difficulties: €0.3bn/year
- Health insurance: €0.2bn/year
- Diabetes: €0.1bn/year

Costs of different noise effects

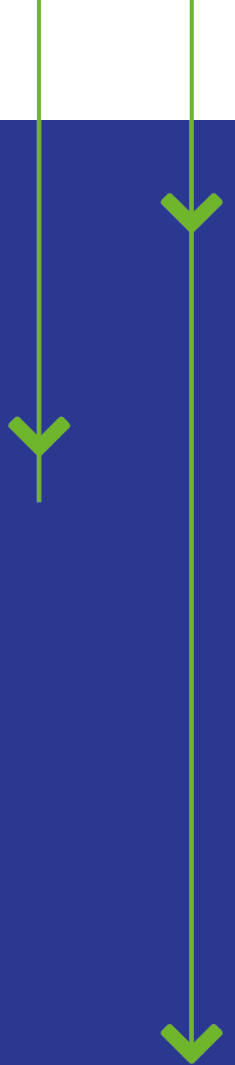
- 1st factor: Sleep disturbance (€13.1bn/year or 31%)
- 2nd factor: Annoyance (11.8 billion €/year or 28%)
- ...
- 7th factor: Loss of productivity (€2.9 billion/year or 7%)



- These 3 factors represent a cost of €27.8bn/year (66%)
- **First 3 factors considered in the LIFE Cool & Low Noise Asphalt project**

2

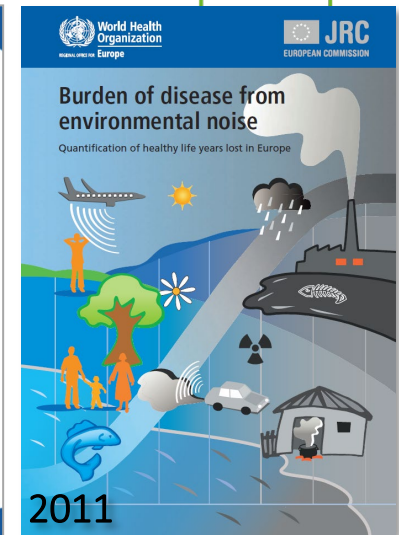
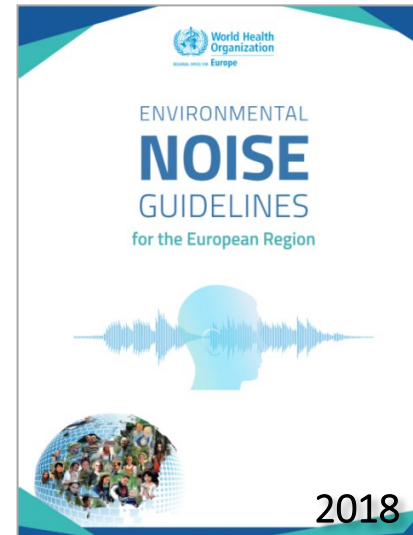
Assessment method



Sanitary costs

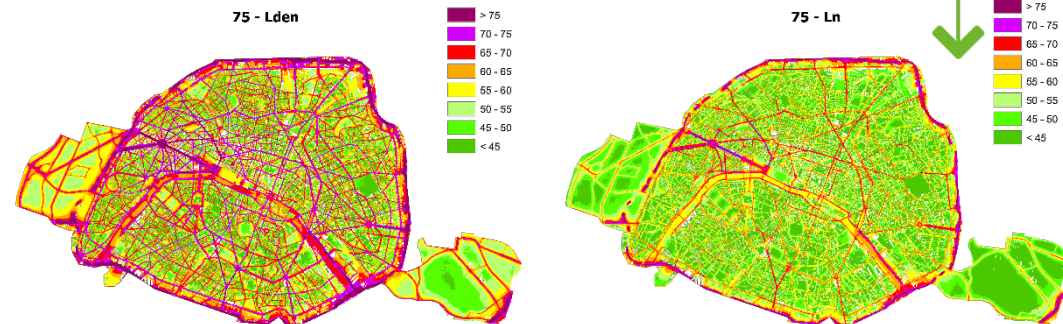
WHO method

- LIFE Cool & Low Noise Asphalt project
- 2 factors taken into account
- Sleep disturbances
- Annoyance



Strategic noise maps

- European Directive 2002/49/CE
- Road noise - City of Paris (2023)
- Lden and Ln indicators
- Population exposure statistics



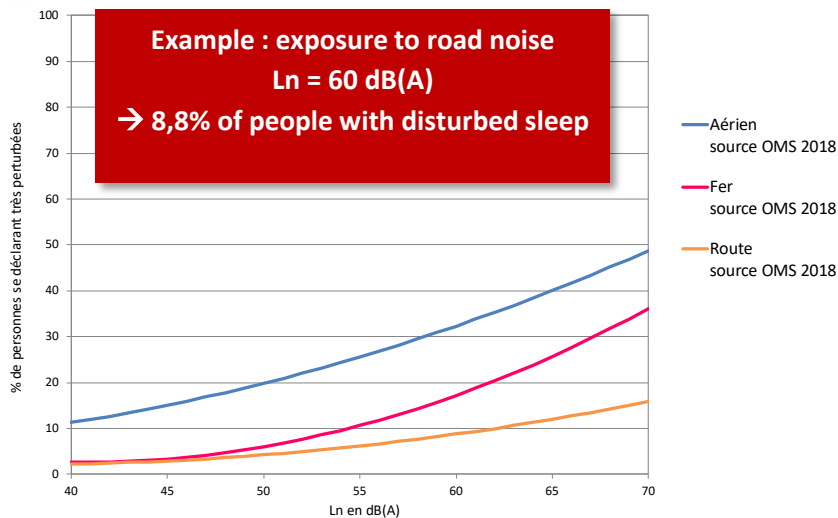
Sanitary costs

WHO method (2018)

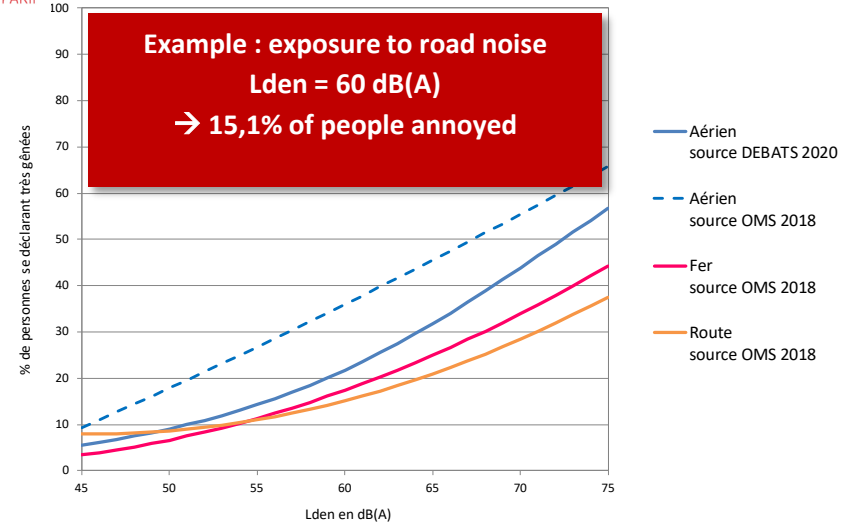
- Road noise
- Relationship between noise exposure levels (Ln) and sleep disturbance
- Relationship between noise exposure levels (Lden) and annoyance



Relations dose-effet pour les perturbations du sommeil selon les sources de transports



Relations dose-effet pour la gêne selon les sources de transports



Sanitary costs

WHO method (2018)

- Quantification of years of healthy life lost per year (DALYs)
- DALY : Disability Adjusted Life Years)
- Unit used by WHO to measure healthy life expectancy

- DW : Disability Weight
- DW = 0 → Unimpaired health and DW = 1 → Death
- Sleep disturbances (DW = 0,07)
- Annoyance (DW = 0,02)

- **Work of the Quinet Commission (2020)**
- **1 year of healthy life lost estimated at 132 k€**

Non-sanitary cost

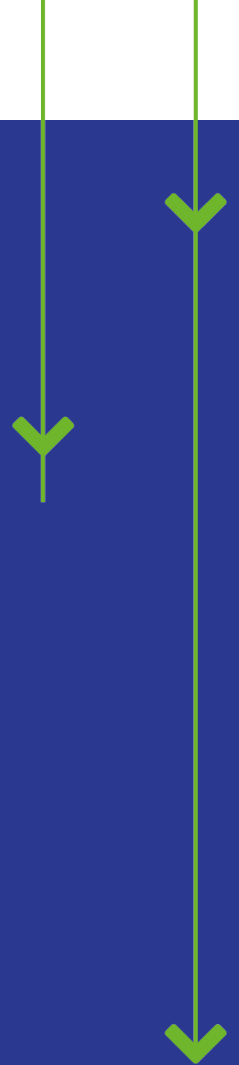
Loss of productivity

- Road noise
- Working people affected by sleep disturbances
- Productivity loss estimated at 2.4% according to a study published in 2017

Hafner, M., Stepanek, M., Taylor, J., Troxel, W. M., & Van Stolk, C. (2017). Why sleep matters - the economic costs of insufficient sleep: a cross-country comparative analysis. Rand health quarterly.

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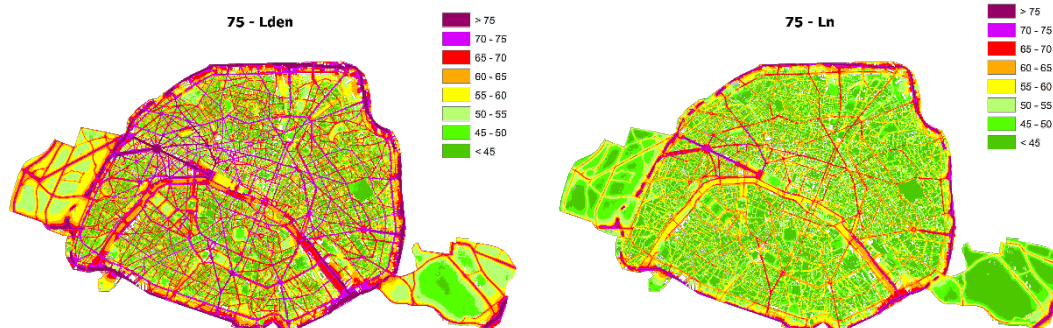
Application to the LIFE Cool & Low Noise Asphalt project



Reduction of road noise at night

Δ Ln compared to the initial	State zero	2019	2020	2021	2022
SMAPhon	-3.1	-2.7	-2.1	-2.4	-2.1
BBphon+	-2.3	-1.4	-1.0	-1.4	-1.2
PUMA	-1.1	-1.1	-1.3	-1.4	-1.6
Average (+ 0,137 dB/year)	-2.18	-2.04	-1.90	-1.77	-1.63

Δ Ln compared to the reference	State zero	2019	2020	2021	2022
SMAPhon	-1.3	-1.1	-0.7	-0.6	0.2
BBphon+	-1.4	-1.1	-1.1	-0.5	-0.3
PUMA	-	-	-	-	-
Average (+0.328 dB/year)	-1.39	-1.06	-0.73	-0.41	-0.08



- Correction of exposure levels (Ln and Lden)
- Correction of population exposure statistics to road noise

Reduction of road noise at night

Replacement of existing pavements with innovative solutions

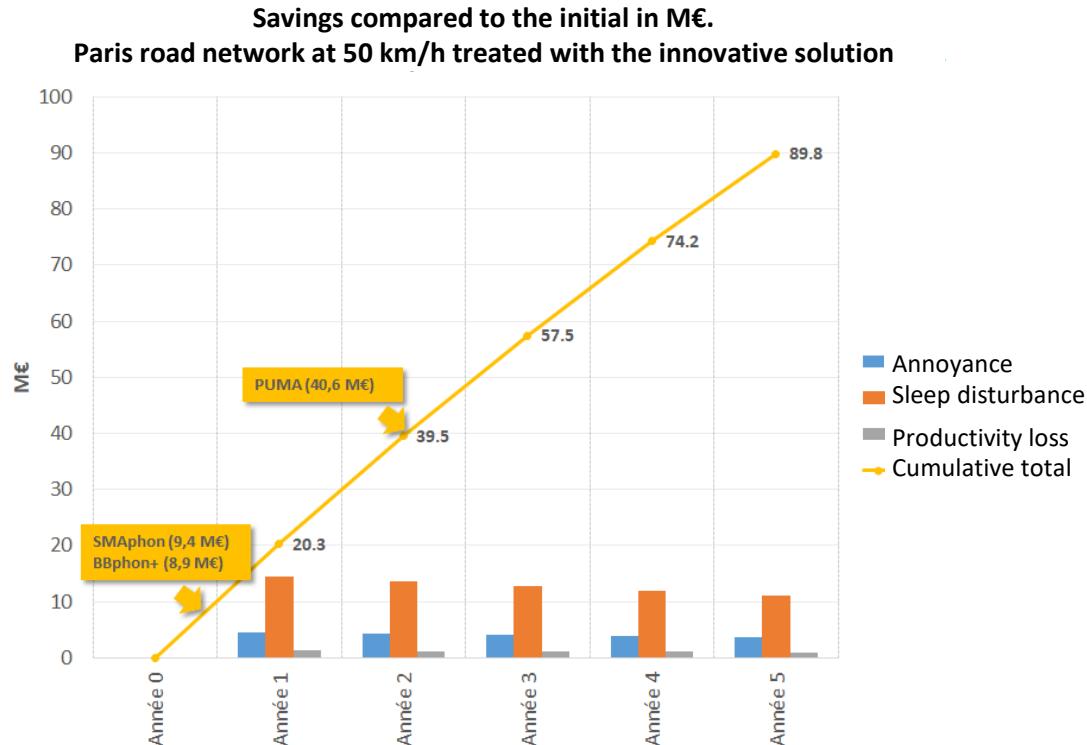
- **Scenario 1** : Parisian road network at 50 km/h (10% of the road surface)
- **Scenario 2** : The entire Parisian road network (approximately 1600 km)



Reduction of road noise at night

Remplacement of existing pavement by innovative solutions

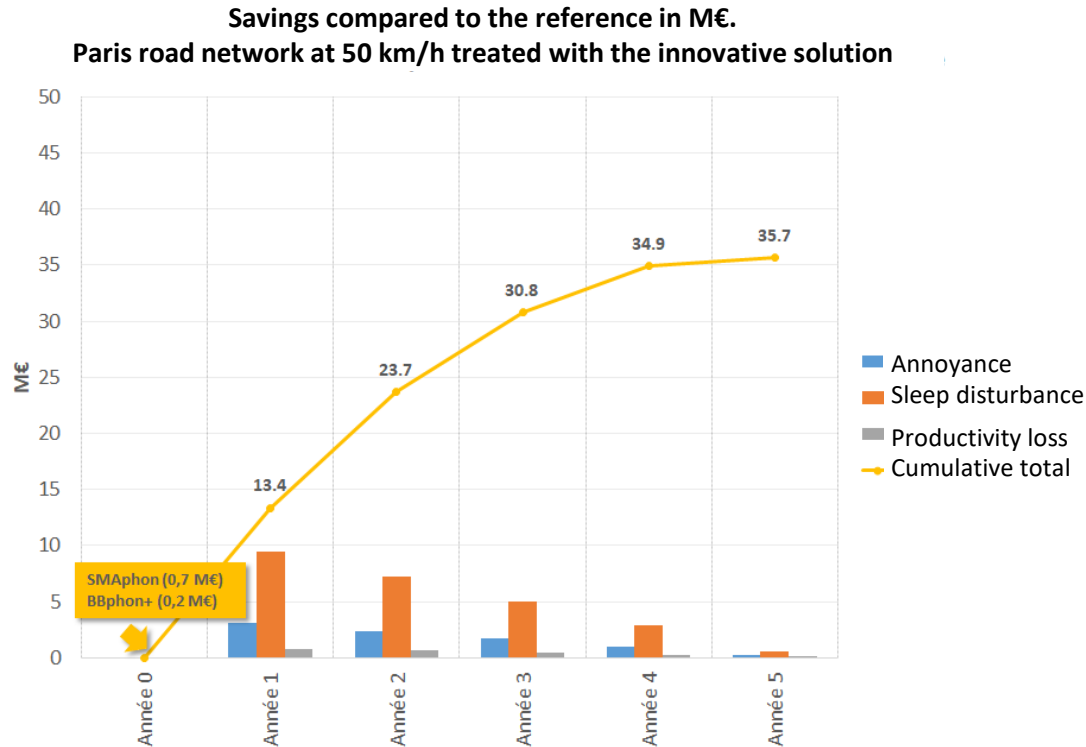
- **Scenario 1** : Parisian road network at 50 km/h (10% of the road surface)
- Investment depreciated after one year for SMAphon and Bbphon+ about two years for PUMA.



Reduction of road noise at night

Remplacement of existing pavement by innovative solutions

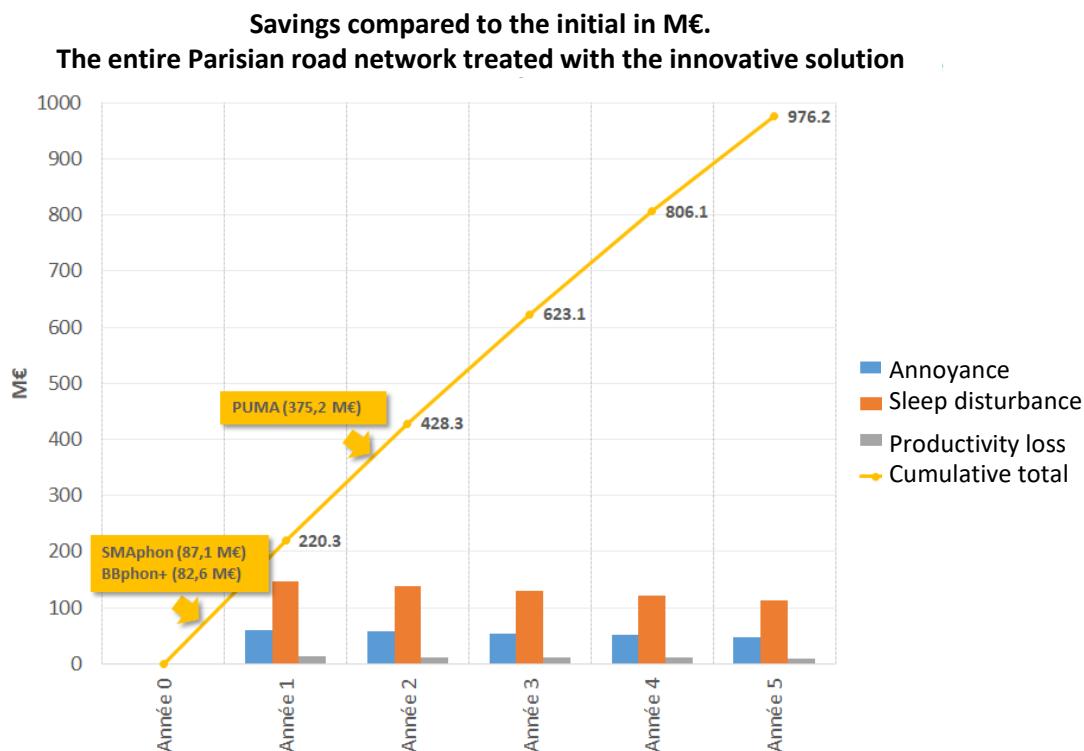
- **Scenario 1** : Parisian road network at 50 km/h (10% of the road surface)
- The extra cost of innovative asphalt mixes is depreciated during the first year



Reduction of road noise at night

Remplacement of existing pavement by innovative solutions

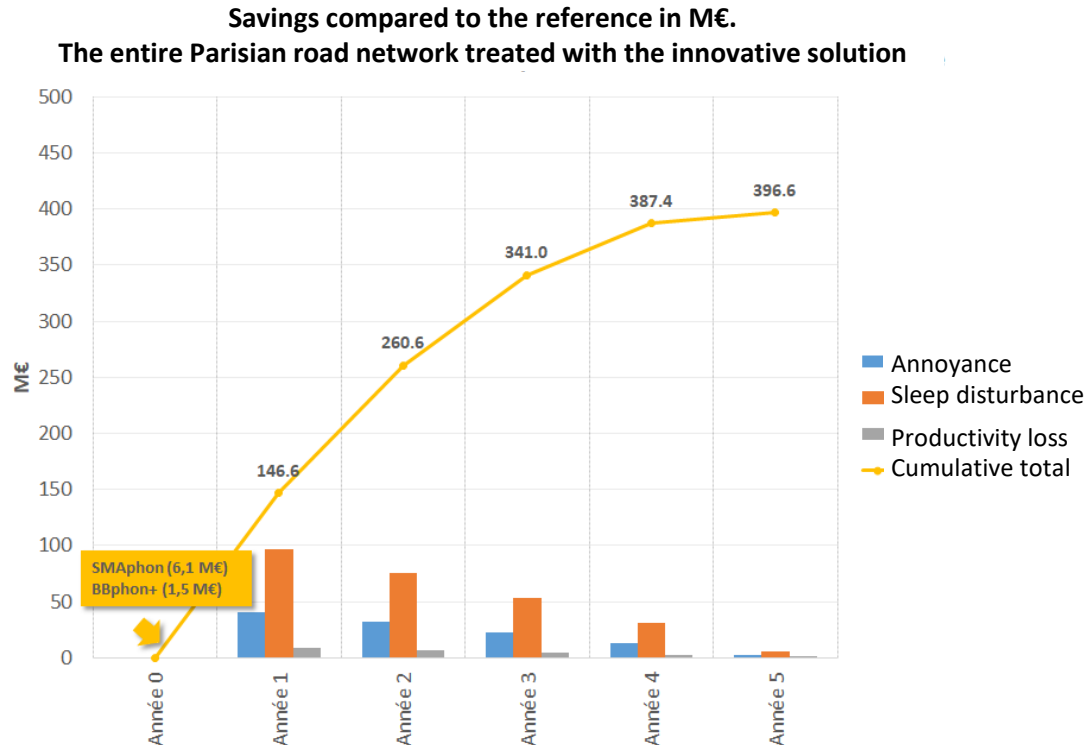
- **Scenario 2** : The entire Parisian road network (approximately 1600 km)
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Reduction of road noise at night

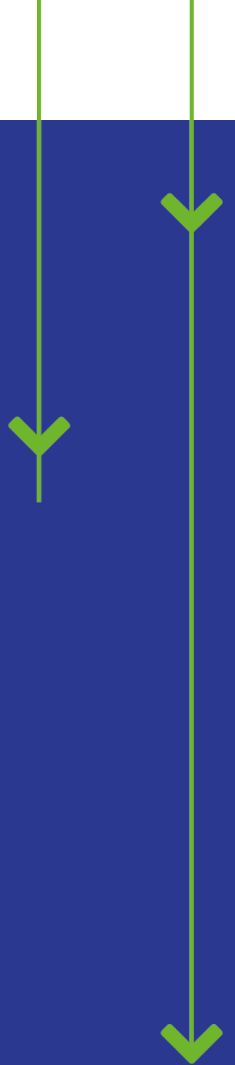
Remplacement of existing pavement by innovative solutions

- **Scenario 2** : The entire Parisian road network (approximately 1600 km)
- Surcoût des enrobés innovants amorti dès la première année



4

Perspectives



Replicability strategy

- If the pilot project is successful, the entire Parisian road network could eventually benefit from an asphalt mix with acoustic and thermic properties.
- Example for European local authorities and professionals.



Road management policy

- Today, durability is estimated, depending on the materials used and the traffic parameters, to be around 15 years for a conventional bituminous road mix and 30 years for a conventional asphalt mix.
- From a socio-economic point of view, the first results of the LIFE Cool & Low Noise Asphalt project argue in favour of a more frequent renewal of pavements by means of the proposed innovative solutions.
- On a European scale, there is no doubt that in the future this type of assessment will also be a useful decision-making tool for road network managers in dense urban areas, in terms of road maintenance and renewal policy.



AFTER LIFE 5 years

- Study of an intermediate scenario (**scenario 3**)
- Finalisation of the Socio-Economic Assessment in June 2023
- Continued monitoring of facade acoustic performance after June 2023
- Further quantification of socio-economic impacts (2027)



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Thank you for your attention



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