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Département fédéral de l'environnement, des transports,
de l'énergie et de la communication DETEC
Office fédéral de l'environnement OFEV
Division Bruit et RNI

Low noise asphalt in CH
Life Cycle Assessment and
Life Cycle Costing
(LCA & LCC)

03.06.2024 GRBP - Task Force – Dr. Sophie Hoehn – Head of section road noise, Swiss Federal Office

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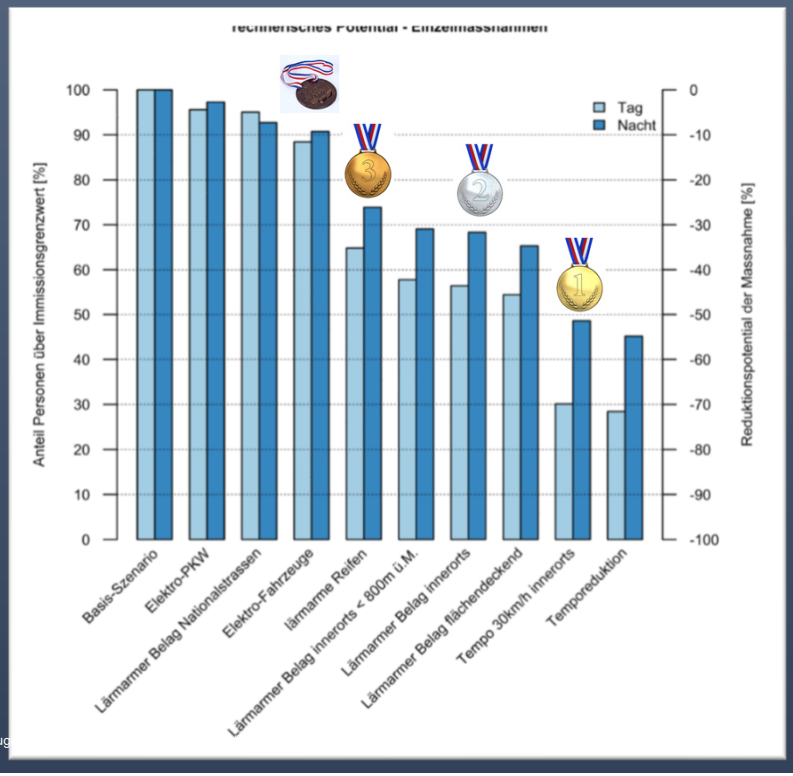
Noise and NIR Division

Swiss road noise abatment strategy



- **Measurements at source, where the noise is emitted**

The Winner : Speed reduction (30 km/h)

The second one: low noise Asphalt

The third: low noise tyres

The fourth: Electric vehicles

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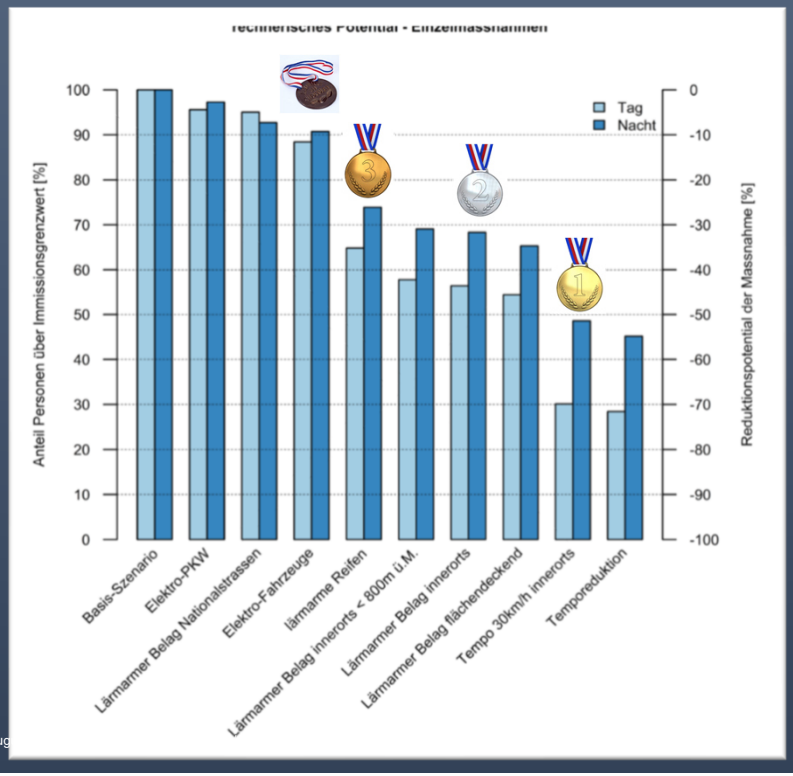

Shorter Life time; what about environmental impact ?

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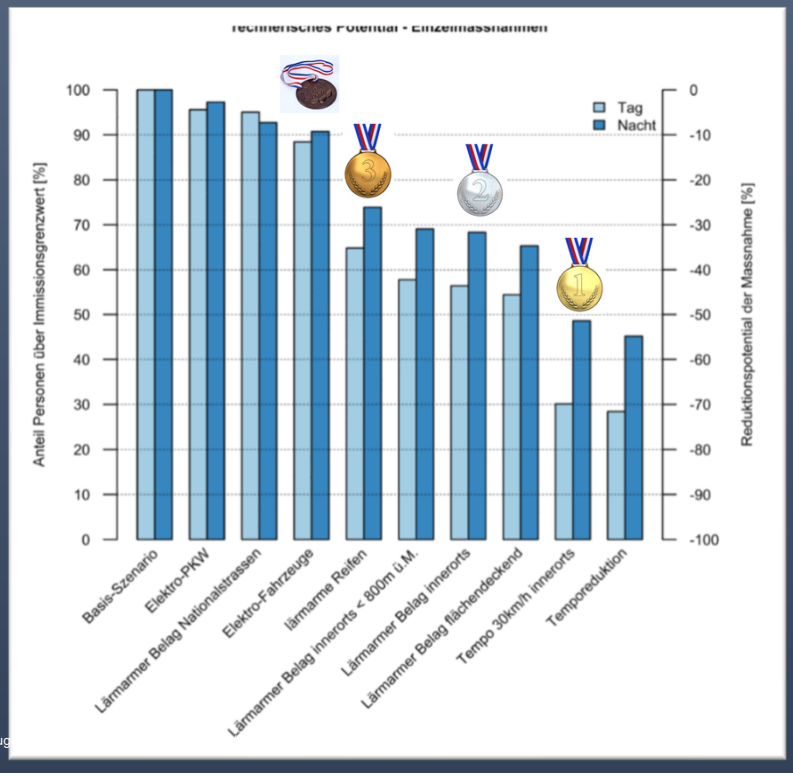

Life Cycle Analysis and Life Cycle Costs !!

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LCA and LCC Methode following ISO 14040

Goal and Framework	Create a life cycle inventory	Impact assessment	Interpretation
Ecological comparison of 4 asphalt types Per ‘1 km road*year, incl. use’ Main street in locality centre Current technologies	Interviews with partners Database DETEC:2021 for Background data Details, e.g. recycling credits received by the user Modelling noise, tyre abrasion, fuel consumption; pavements data (G+P group) Software open LCA 2.0	EIP’21 (Environmental Impact Points) Climate Energie consumption Costs 'internal'+external* Open LCA 2.0 / Excel*	Evaluation Sensitivity analyses Report Critical Review

Central Bases and specifications

- **Base situation:**
  - cantonal road (or comparable), urban 50 km/h, 8000 vehicles/day, 6% heavy vehicles
- **Extended system consideration:**
  - included -> use of the road (fuel, noise, tyres, external costs, ...)
- **Without additional noise protection measures:**
  - No speed reduction, no noise barrier, etc
- Without traffic jams, noise during construction activity, etc

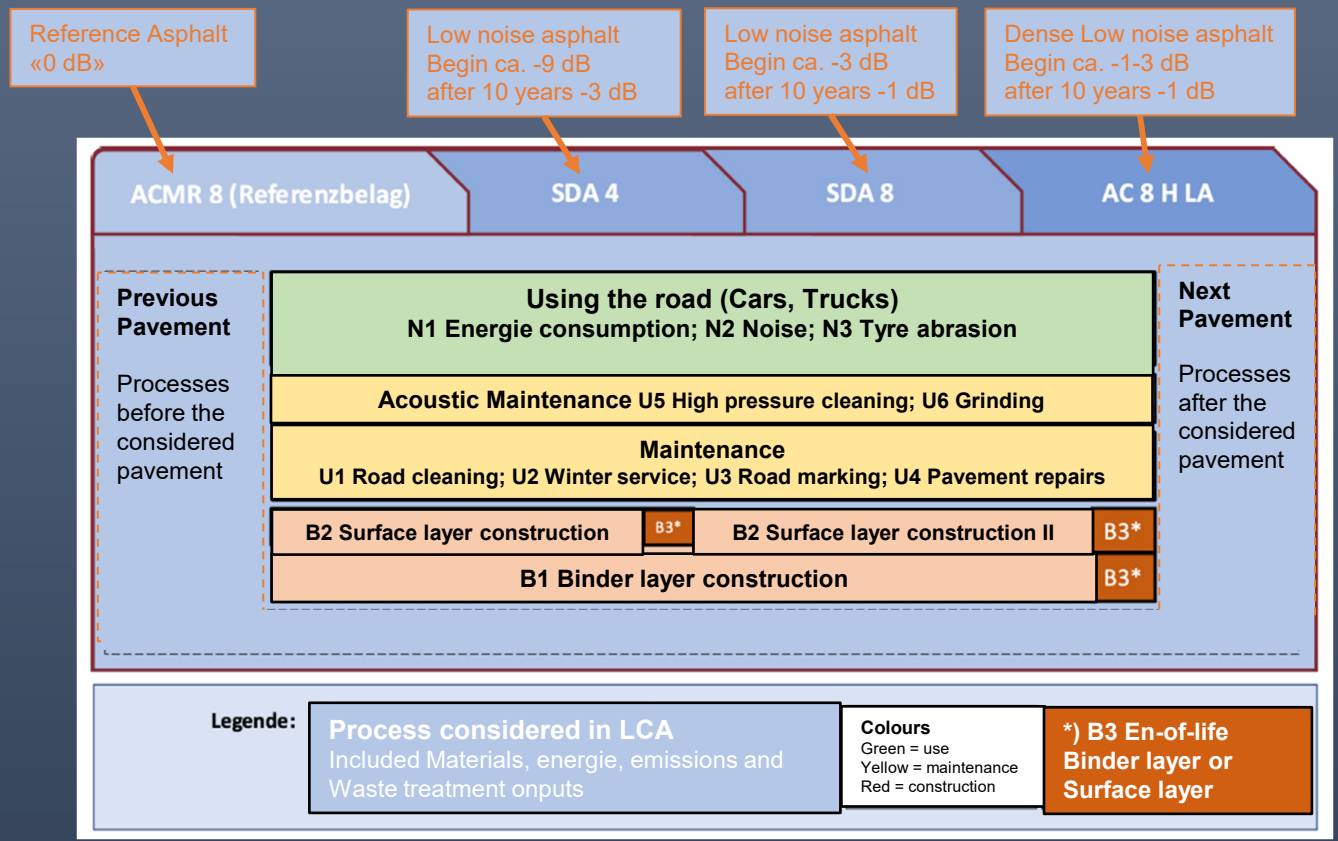
Also to be taken into account:

- special asphalt from canton Zürich: AC 8 H LA but without long-term measurement data on acoustic ageing yet available, results are not statistically strong

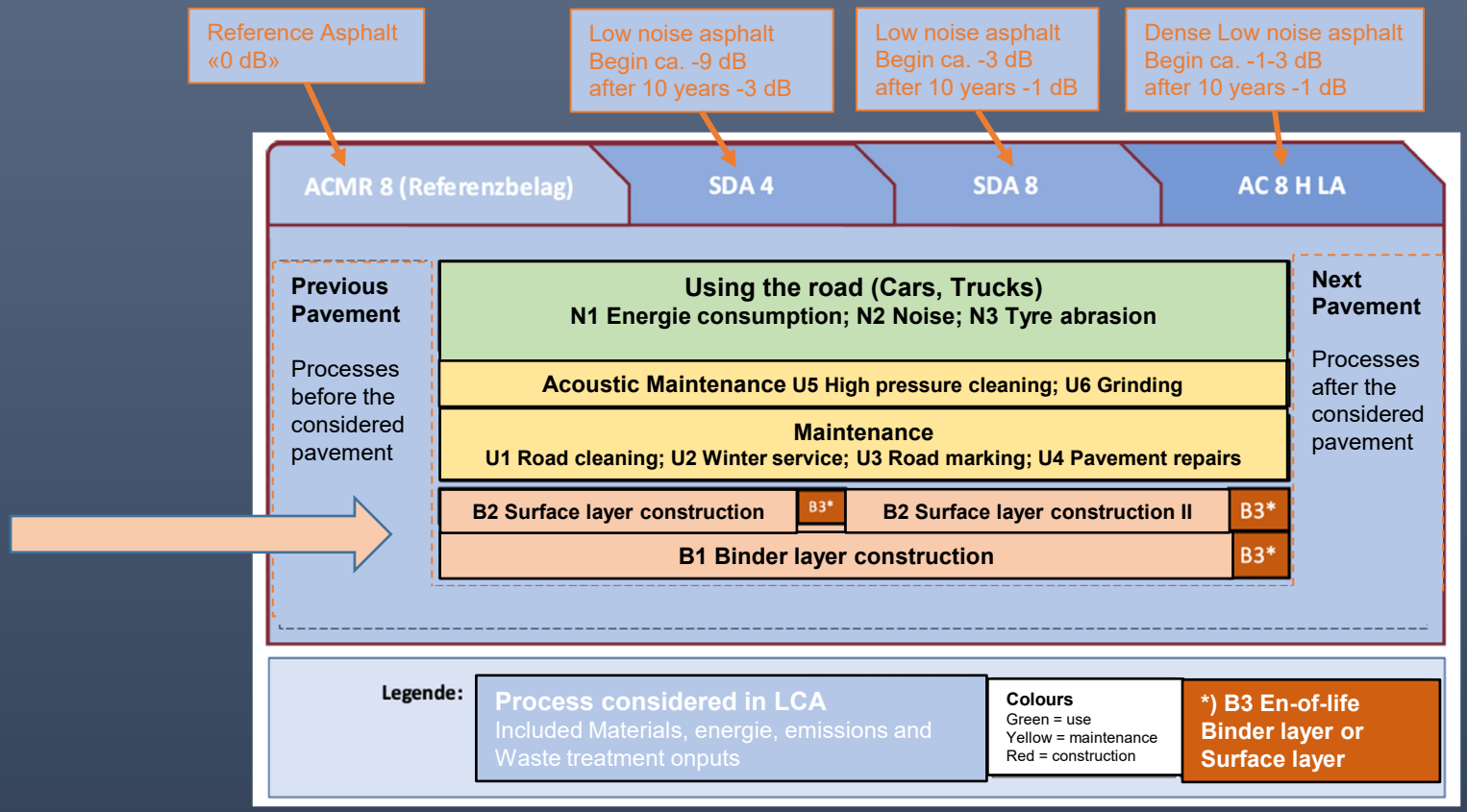
Modelling principles of important processes

Process	LCA	LCC
Road noise	• Pavement Acoustic ageing model • Average effect (dB)	
	• Average noise value • Veh-km-eq as noise ecological Life Cycle factor	• sonBASE15: Distribution of residents and flats according to noise immission class • Distribution adjusted to average effect • ‘Person dB’, ‘Apartment dB’ • External noise costs according to VSS 41 828
Fuel consumption	• Rolling resistance values per asphalt • Vehicle weight and engine efficiency by type and drive type • Share of rolling resistance in the energy requirement	
	• Veh-km-eq	• CO2 / PM10 / Nox / Zn -> external costs following VSS 41 828 • Direct fuel costs

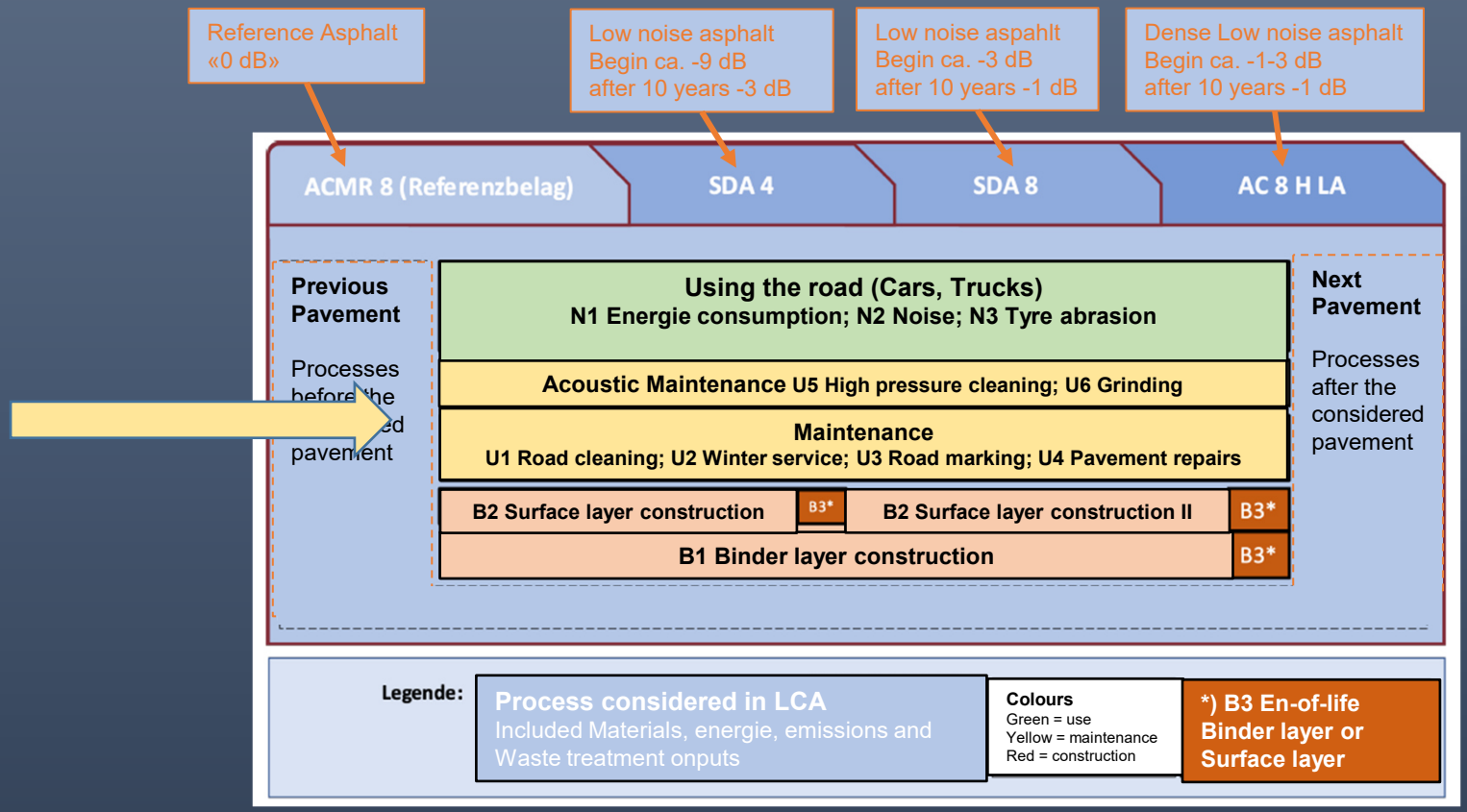
Processes & Analyses



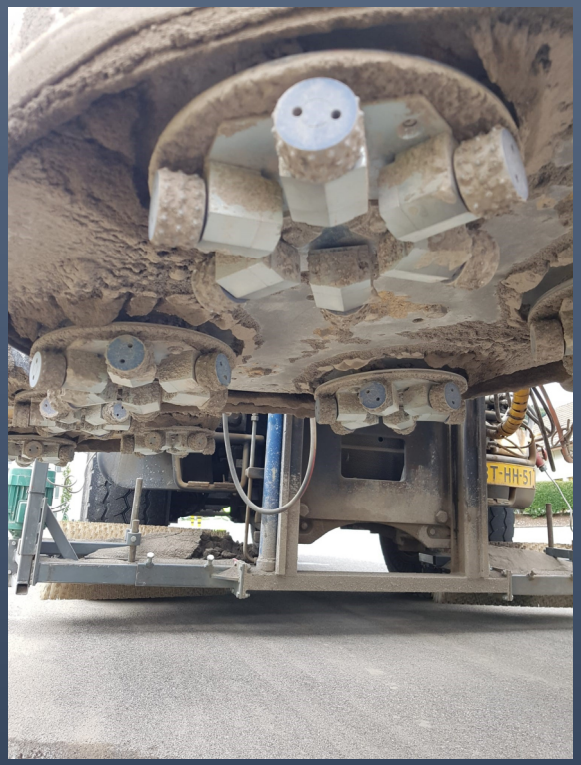
Processes & Analyses



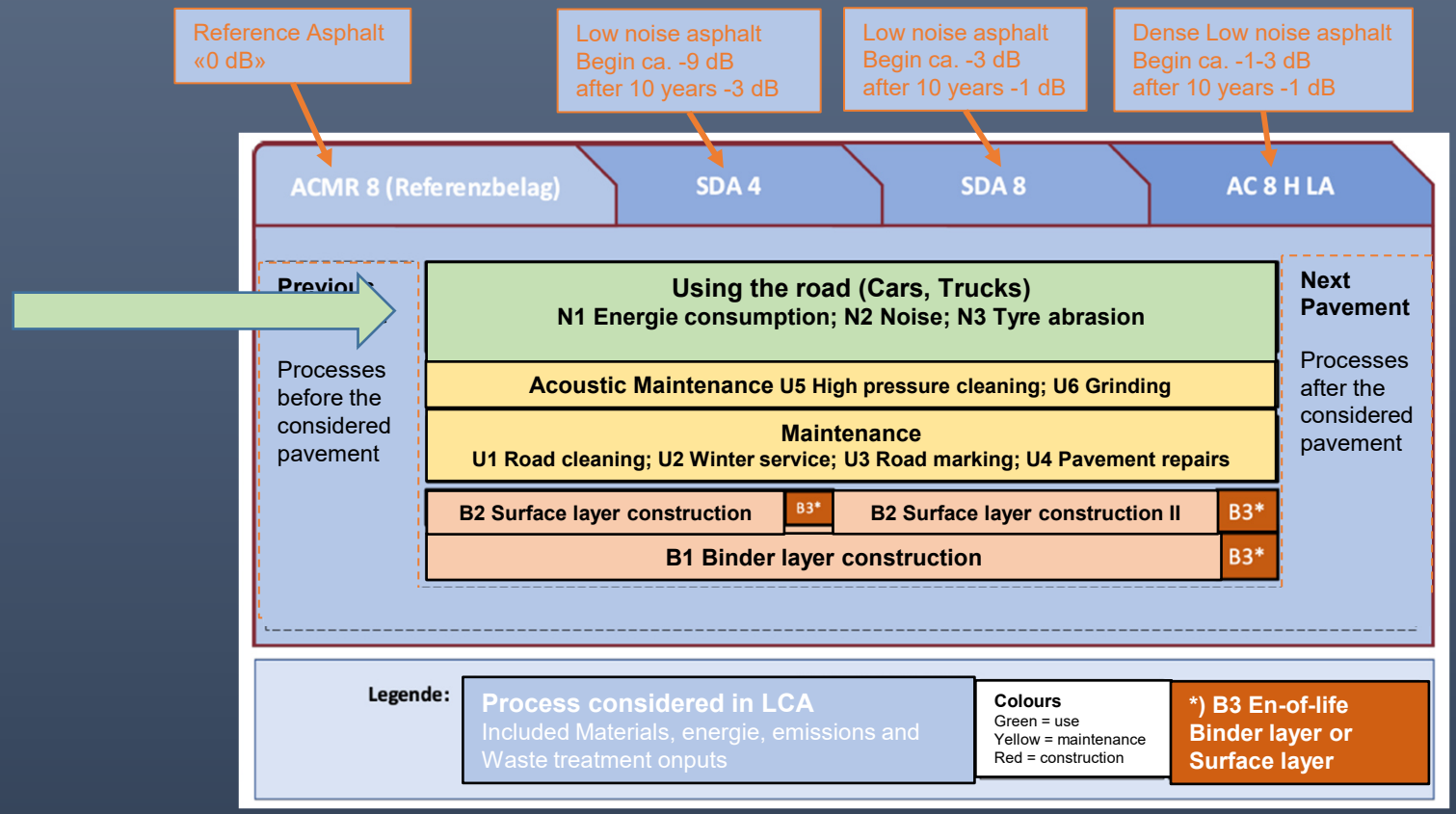
Processes & Analyses



Acoustic maintenance through grinding



Processes & Analyses



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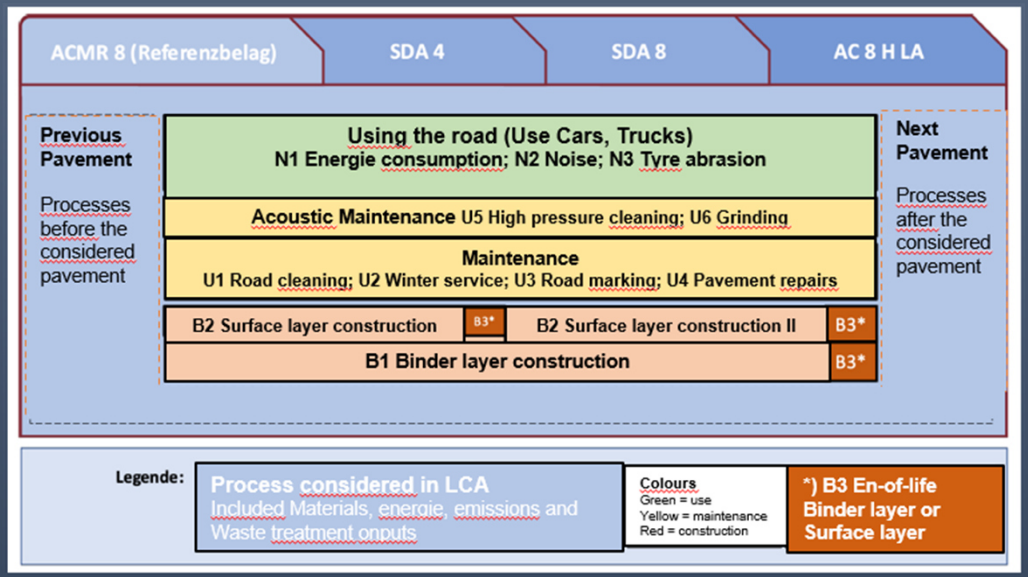
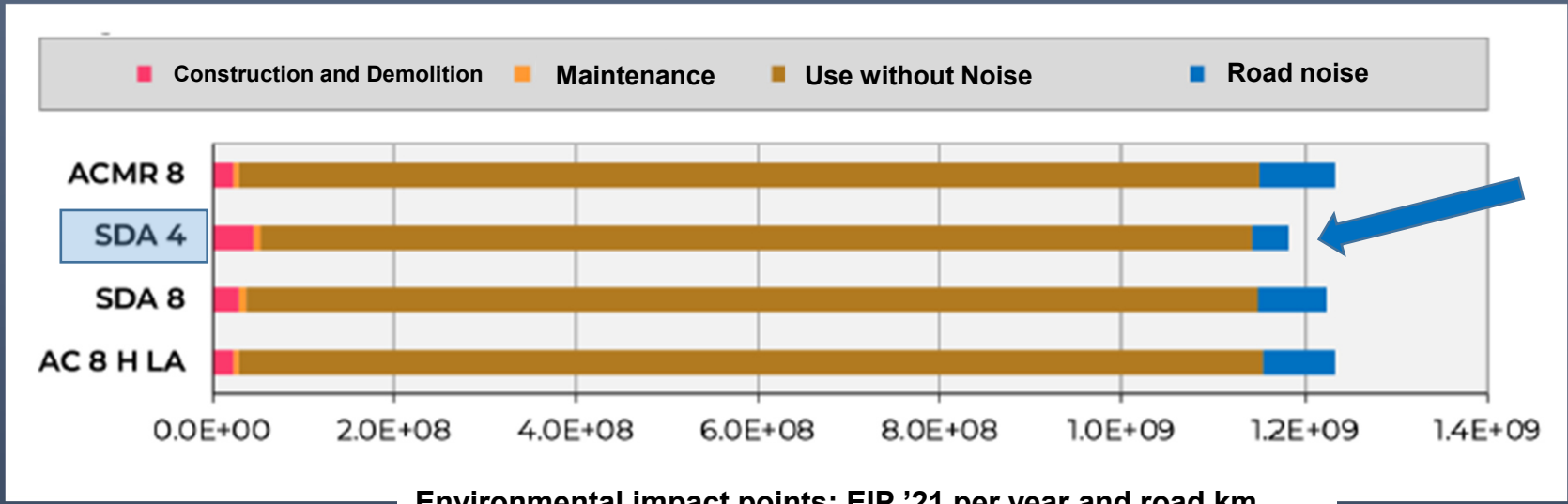


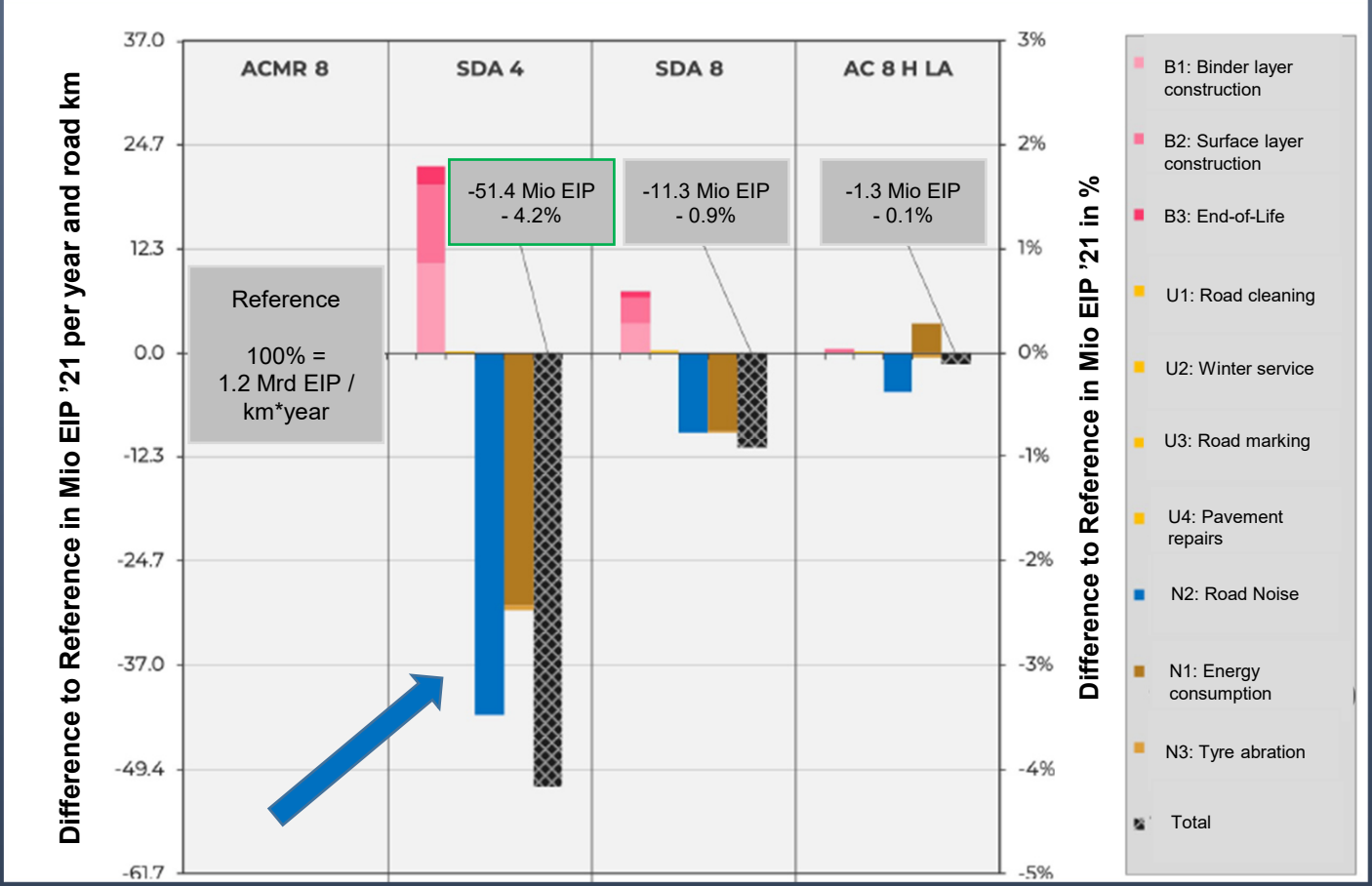
1) EIP' 21	Environmental impact (incl. Noise)
2) CO2e / GHG (Emissions)	Global warming
3) nePE	Primary energy requirements non-renewable
4) LCC	**Costs:** - **Internal direct** - **External indirect (incl. Noise)**

Results - EIP’21

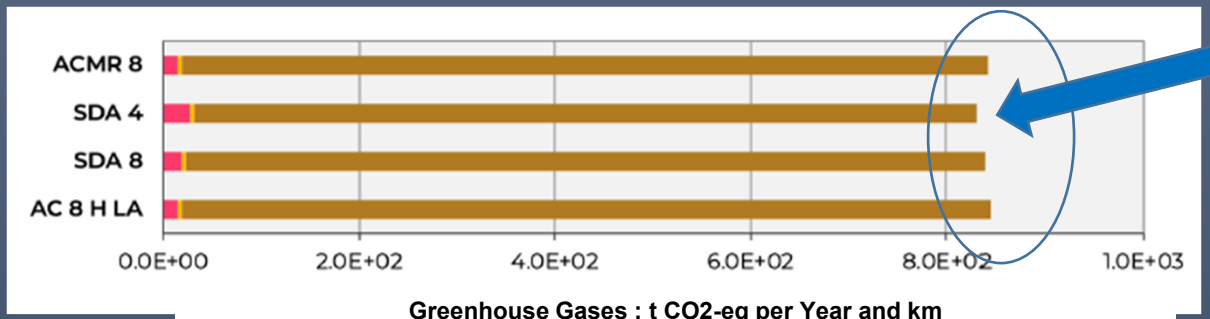


Environmental impact points: EIP ’21 per year and road km

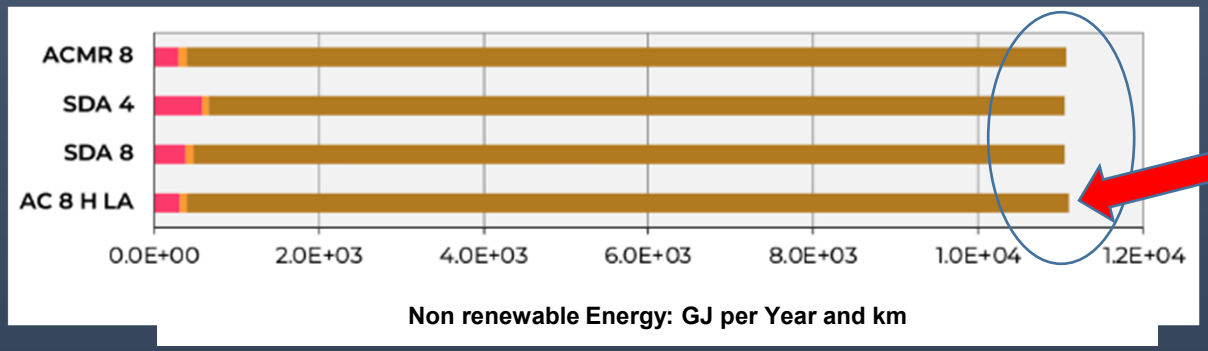
Results - EIP'21



Results – GHG [CO2-eq] & nePE [GJ]

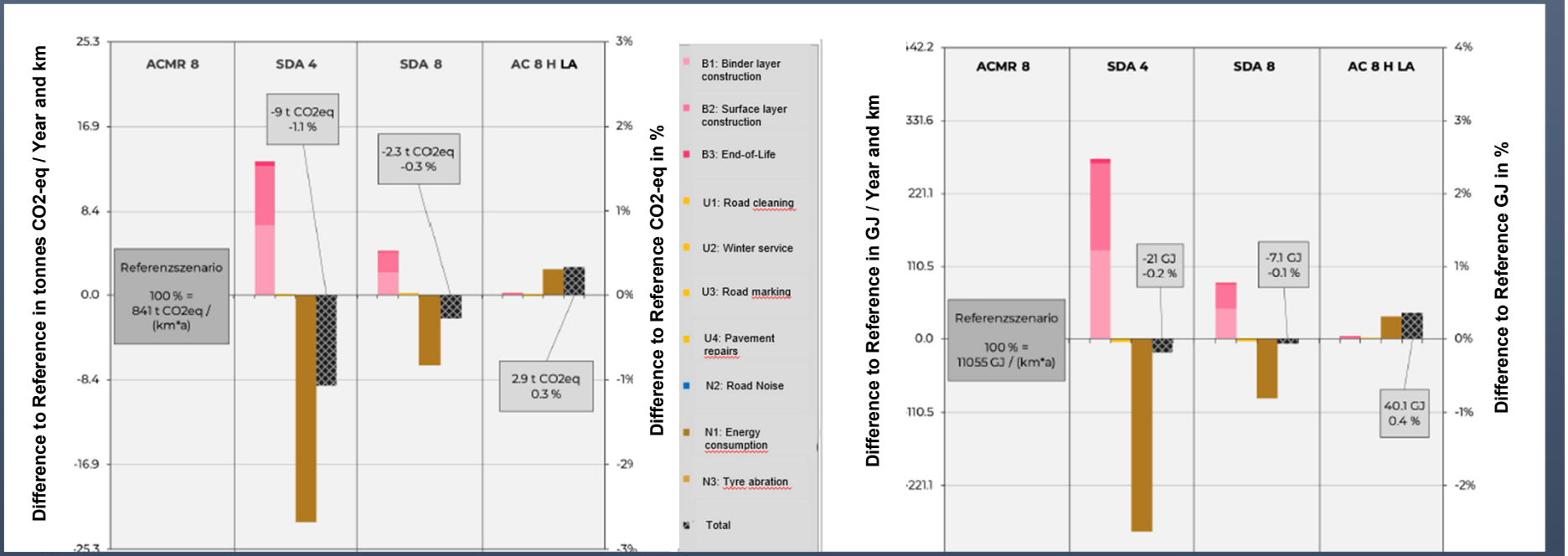


Greenhouse Gases : t CO2-eq per Year and km

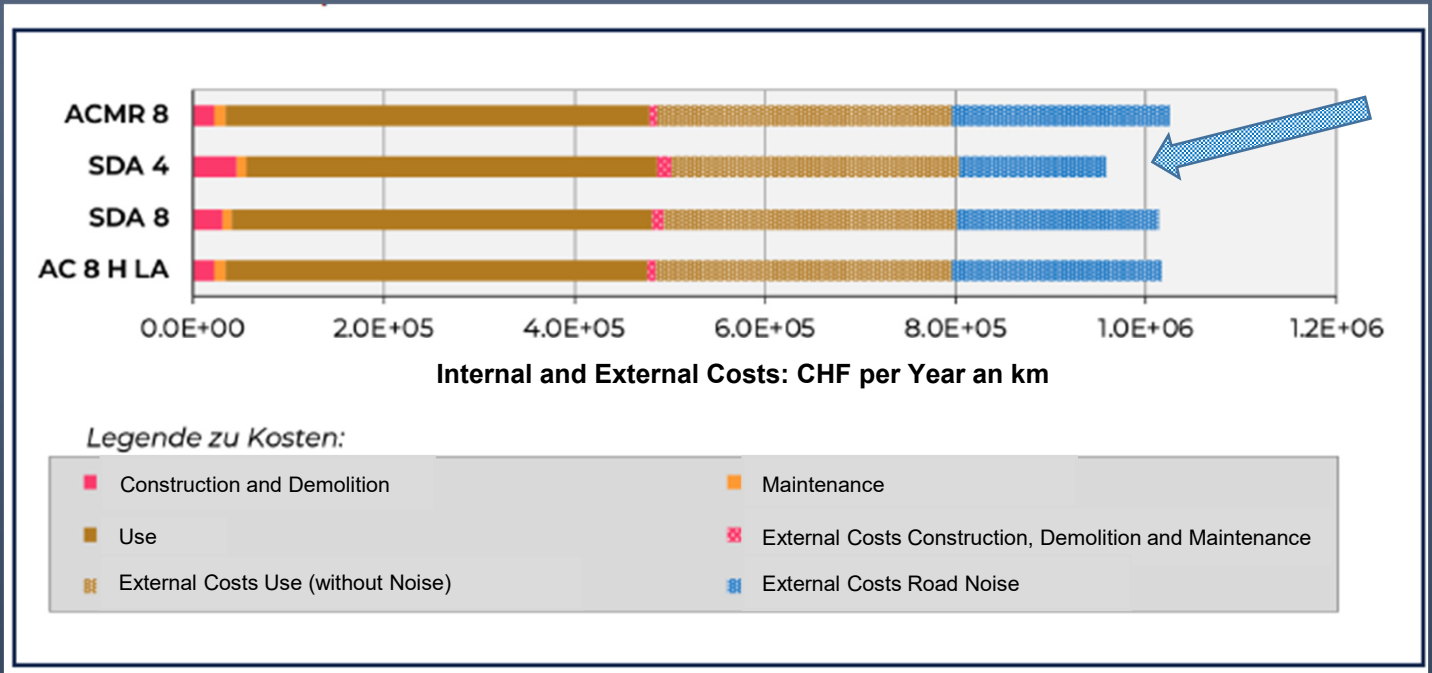


Non renewable Energy: GJ per Year and km

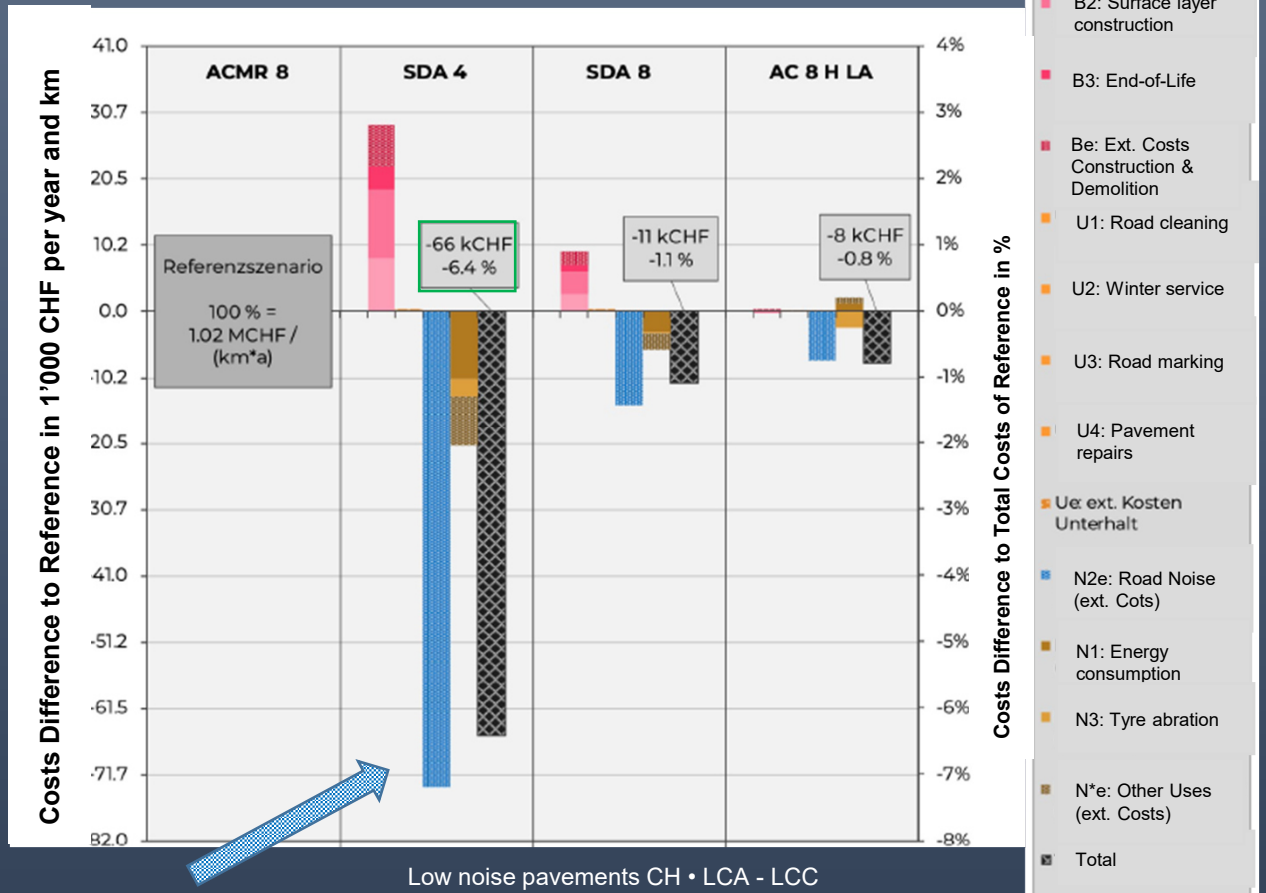
Results – GHG [CO2-eq] & nePE [GJ]



Results - LCC


ACMR 8
SDA 4
SDA 8
AC 8 H LA
0.0E+00
2.0E+05
4.0E+05
6.0E+05
8.0E+05
1.0E+06
1.2E+06
Internal and External Costs: CHF per Year an km
Legende zu Kosten:
Construction and Demolition
Maintenance
Use
External Costs Construction, Demolition and Maintenance
External Costs Use (without Noise)
External Costs Road Noise

Results - LCC


ACMR 8
SDA 4
SDA 8
AC 8 H LA
Referenzszenario
100 % =
1.02 MCHF /
(km*a)
-66 kCHF
-6.4 %
-11 kCHF
-1.1 %
-8 kCHF
-0.8 %
Costs Difference to Reference in 1'000 CHF per year and km
Costs Difference to Total Costs of Reference in %
41.0
30.7
20.5
10.2
0.0
-10.2
-20.5
-30.7
-41.0
-51.2
-61.5
-71.7
-82.0
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
-5%
-6%
-7%
-8%
B1: Binder layer construction
B2: Surface layer construction
B3: End-of-Life
Be: Ext. Costs Construction & Demolition
U1: Road cleaning
U2: Winter service
U3: Road marking
U4: Pavement repairs
Ue: ext. Kosten Unterhalt
N2e: Road Noise (ext. Cots)
N1: Energy consumption
N3: Tyre abration
N*e: Other Uses (ext. Costs)
Total

Main Results - Summary

Life Cycle Analysis

1. SDA 4: results in the lowest environmental impact (EIP) of all four pavements
2. SDA 8: has a similar effect to SDA 4, but much less
3. AC 8 H LA: similar to ACMR 8, but low data basis
4. The four pavements are very similar in terms of CO2e and energy

Life Costs Cycle

1. SDA 4 is the most expensive to build, but reduces costs for road users and noise costs (Health of people and building value)
2. Total costs Low noise Pavement (especially SDA 4) lower than ACMR 8

Appreciation of the Results

❑ Environmental impact decreases with Low noise pavement, esp. for SDA 4

.. Pollution from construction increases
.. Impacts from fuel consumption and noise decrease

➞ SDA 4 is advantageous overall ecologically in EIP

❑ Change costs and cost distribution, especially for SDA 4

.. Building owners: direct construction costs increase
.. Road users: Direct costs for energy + tyres decrease
.. Society: External costs from noise and energy consumption fall

➞ Direct costs are shifted
➞ External costs decrease
➞ Total costs of SDA 4 are lower

Appreciation of the Results

- SDA 8: similar to SDA 4, but weaker (EIP: -6 % vs. -1 %)
- AC 8 H LA: similar to ACMR 8; long-term noise protection potential still unknown
- Alternative noise protection measures would also be necessary in some cases

Conclusion

1) SDA 4 are no worse overall ecologically than standard pavements

2) SDA 4 is the most expensive to build, but reduces costs for road users and the costs from noise impact

Critical Review

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This study fulfills the criteria of the ecoinvent guidelines and the ISO standard and is highly detailed and complete and has a high level of detail and completeness. In addition, it was carefully and is well documented.

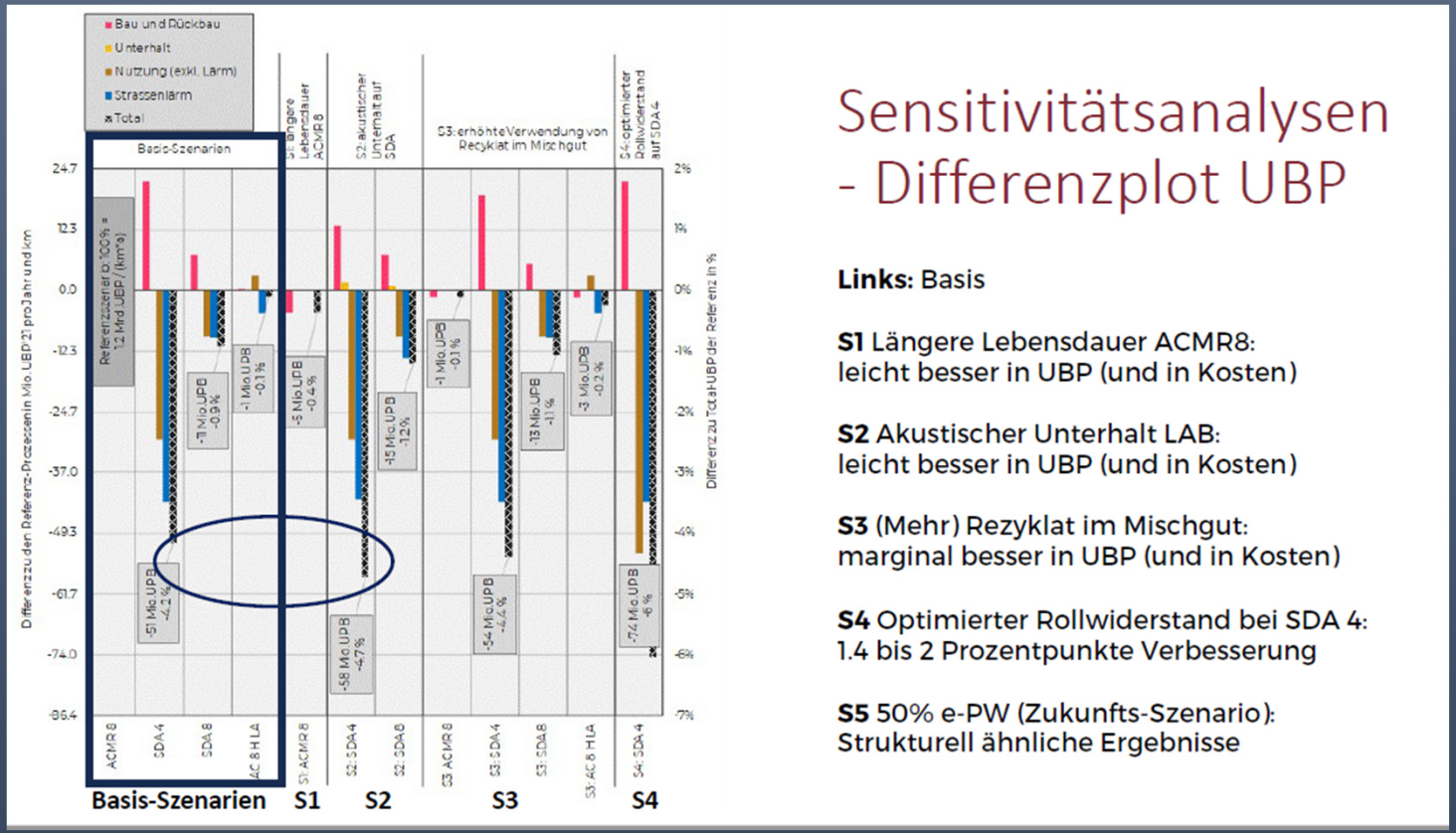
During the review, the reviewer was provided with all the necessary data and documents and all questions and ambiguities were immediately considered and discussed.

The reviewer therefore assumes that the inventories compiled can be included in the DETEC database can be included.


THANK YOU!

Internet links

- Lärmarme Strassenbeläge (admin.ch)
- Lärmarme Strassenbeläge – Ökobilanz und Lebenszykluskosten (PDF, 3 MB, 08.03.2024)



Sensitivitätsanalysen - Differenzplot UBP

Links: Basis

S1 Längere Lebensdauer ACMR8:
leicht besser in UBP (und in Kosten)

S2 Akustischer Unterhalt LAB:
leicht besser in UBP (und in Kosten)

S3 (Mehr) Rezyklat im Mischgut:
marginal besser in UBP (und in Kosten)

S4 Optimierter Rollwiderstand bei SDA 4:
1.4 bis 2 Prozentpunkte Verbesserung

S5 50% e-PW (Zukunfts-Szenario):
Strukturell ähnliche Ergebnisse