EuLA
25 years

# Improved environmental footprint & road durability using hydrated lime in hot mix asphalt (HMA)

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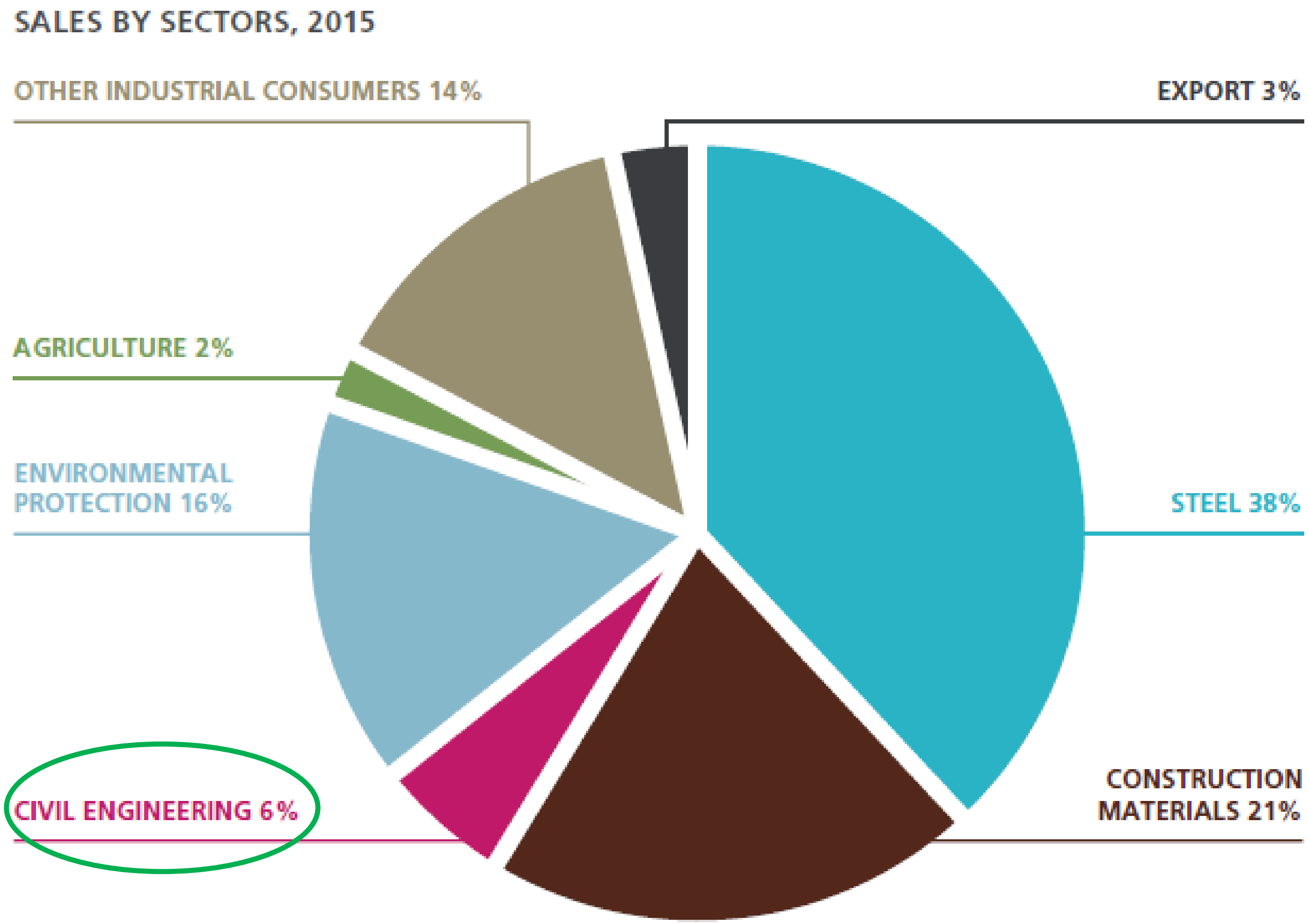
# Presentation layout

- Lime uses/markets
- HMA LCA: Goal & Scope
- HMA LCA: System Boundaries
- HMA LCA: Functional unit
- HMA LCA: Assumptions
- HMA LCA: Results
- Conclusions
- Questions?

# Lime main markets



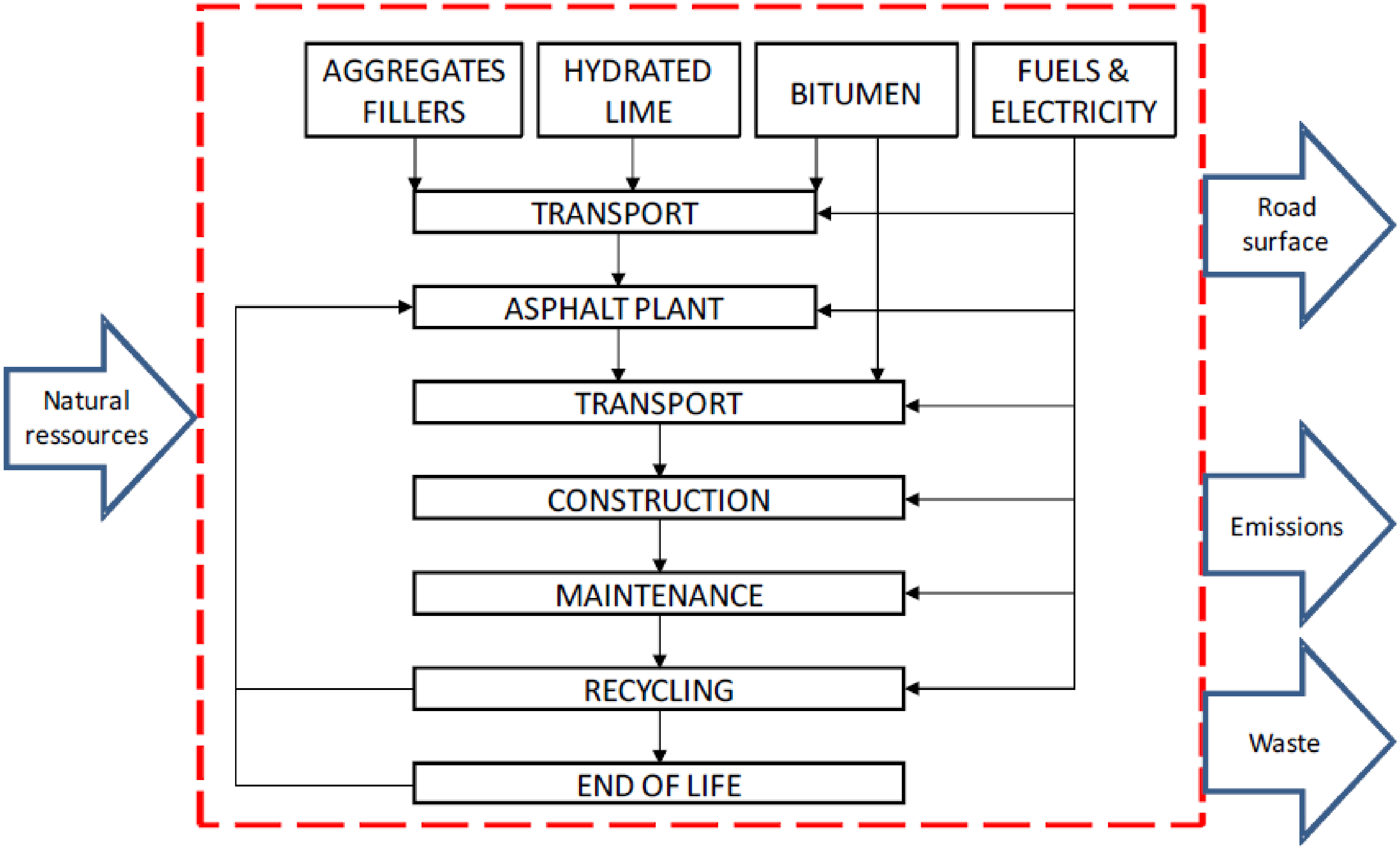
# HMA: Goal & Scope

To compare the environmental performances of Hot Mix Asphalt (HMA) used for the top asphalt layer **with** or **without** addition of **hydrated lime** The LCA study to be compliant with ISO 14040-14044 standard

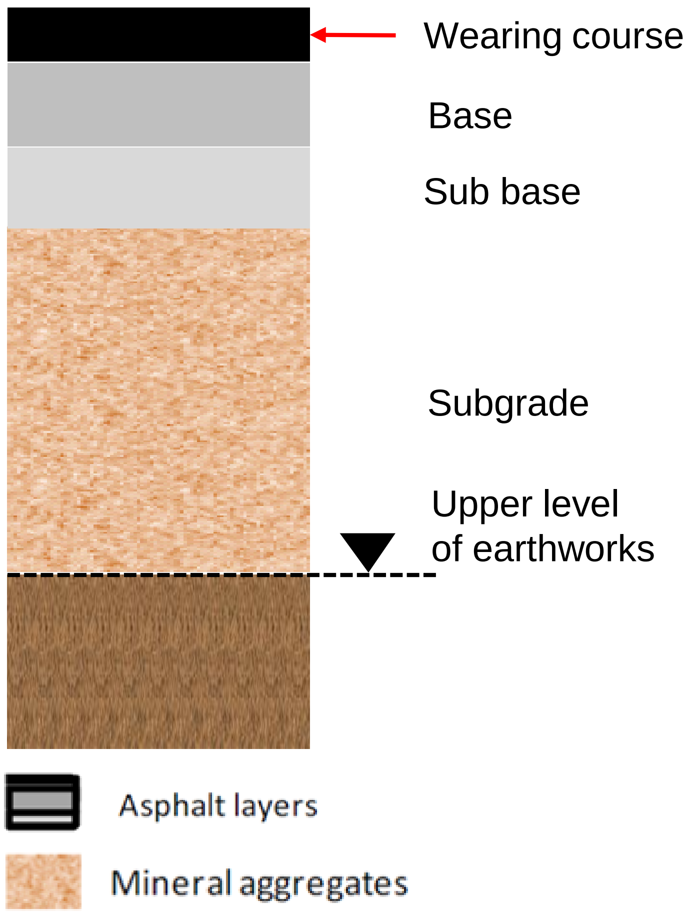
| | Classical HMA (without lime addition) | Modified HMA (with lime addition) |
|---|---|---|
| Bitumen | 5% | 5% |
| Sand | 38% | 38% |
| Fine gravel | 26% | 26% |
| Coarse gravel | 29% | 29% |
| Filler | 2% | 0.5% |
| Hydrated lime | 0% | 1.5% |

# HMA: System Boundaries

**Cradle** (extraction) **to end of life** (road)



# HMA LCA: Functional unit




One kilometre of French lane of road surface

Width of 3.5 meters (representing a road surface of 3 500 $m^2$)

HMA Wearing course 8 cm

Life span: 50 years (corresponding for the whole road)

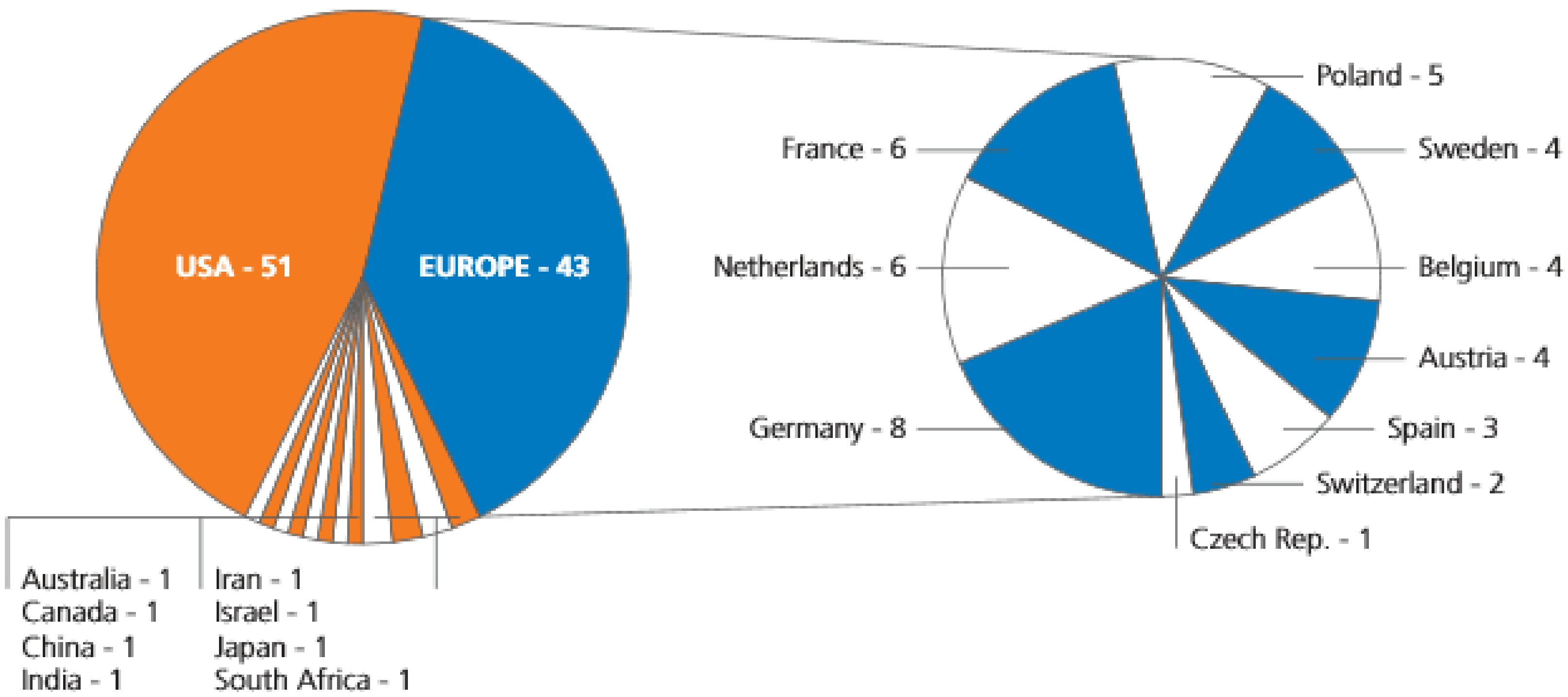
Construction practice & maintenance scenario similar to published LCA study

(Bilal et al., 2009)

Ref: Bilal, J., Grosshenny, V., Lecouls, H., Le Noan, C., Marcilloux, J., Quéro, J.-F., Verhée, F., 2009. Caractéristiques environnementales des matériaux routiers –Rectitatif – analyse de Cycle de Vie des enrobés bitumineux: vers un amendement Matériaux routiers à la norme NF P01 010, Union des Syndicats de l'Industrie Routière Française (USIRF) – French Trade Association of road contractors. Rev. Gén. Routes Aérodromes 872 (in French).

# Hydrated lime in literature

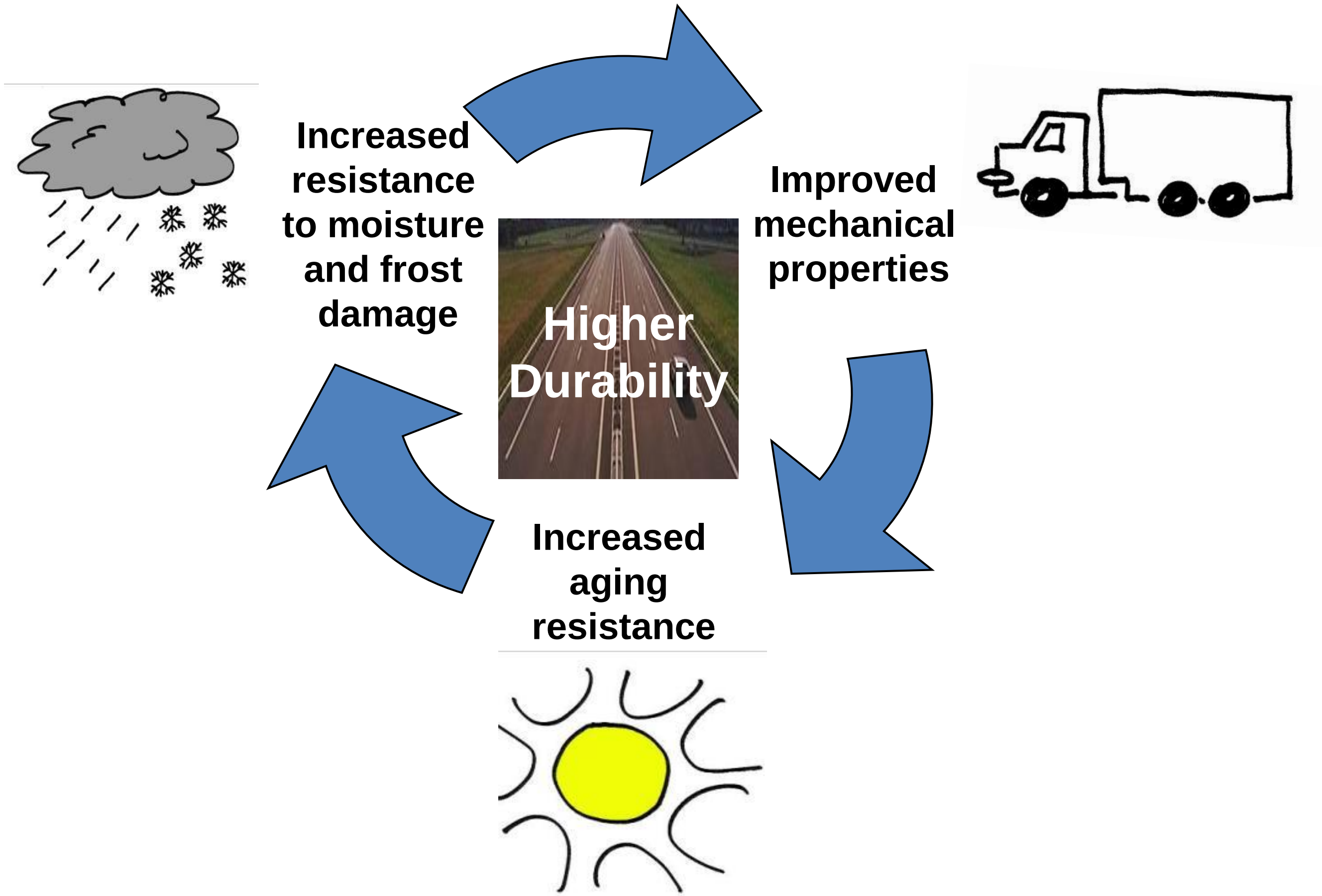
110 publications (reports, peer-review).
Origin of first author for the publications shown in the graph below




*Ref: EuLA critical literature review: Hydrated lime, a proven additive for durable asphalt pavements; source: [www.eula.eu](http://www.eula.eu)*

# Hydrated lime in literature

More than 100 technical papers revised. Based on science and testimonies from users Hydrated lime is a multifunctional additive that **increases** asphalt mixture **durability with 25% thanks** to:

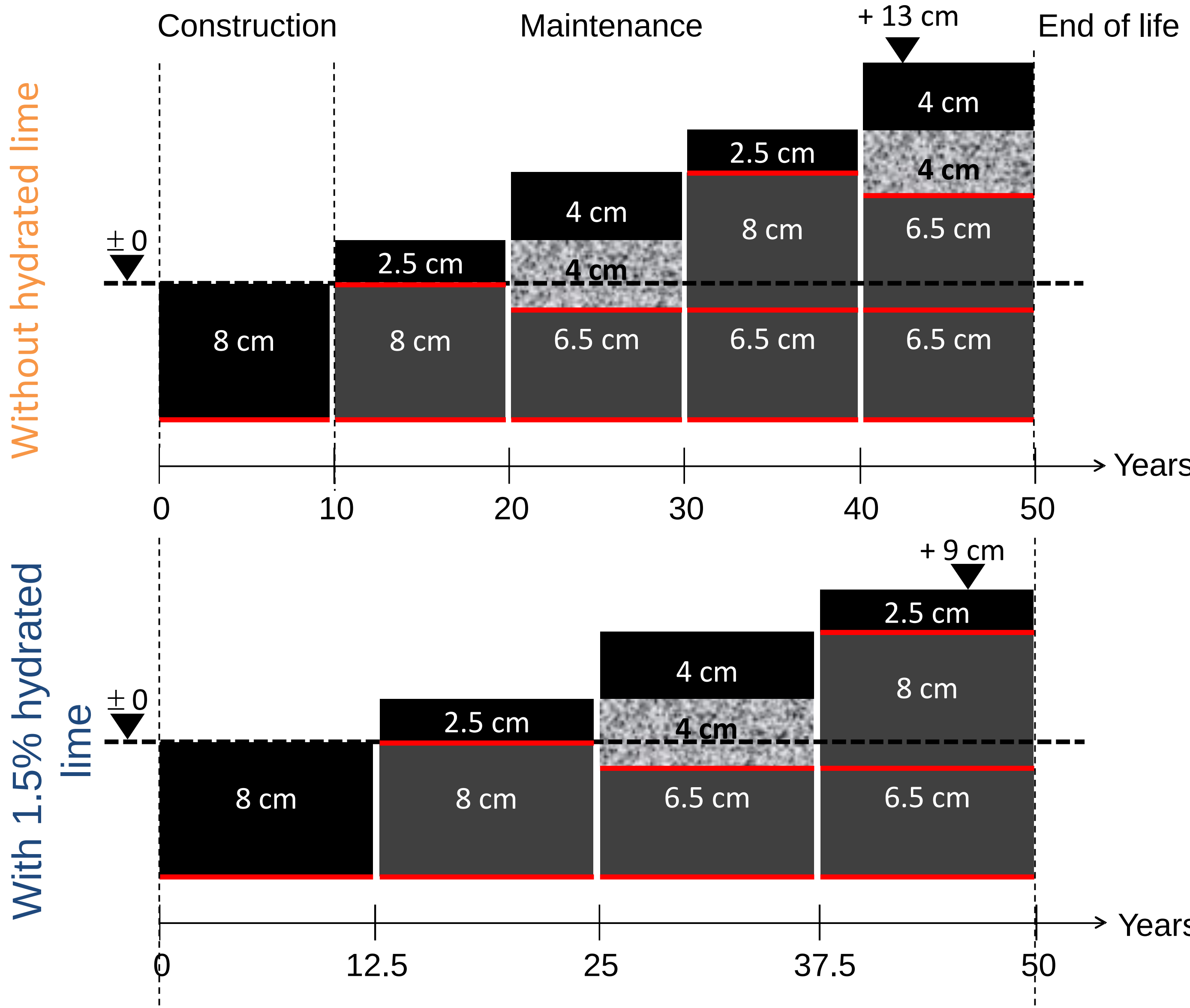



*EuLA critical literature review: Hydrated lime, a proven additive for durable asphalt pavements, source: [www.eula.eu](http://www.eula.eu)*

# HMA LCA: Life span between maintenaces

**Classical HMA** has a life span of the surface layer of **10y**

**Modified HMA** (+1.5% lime) has a life span of **12.5y** due to the increases the life span by 25%



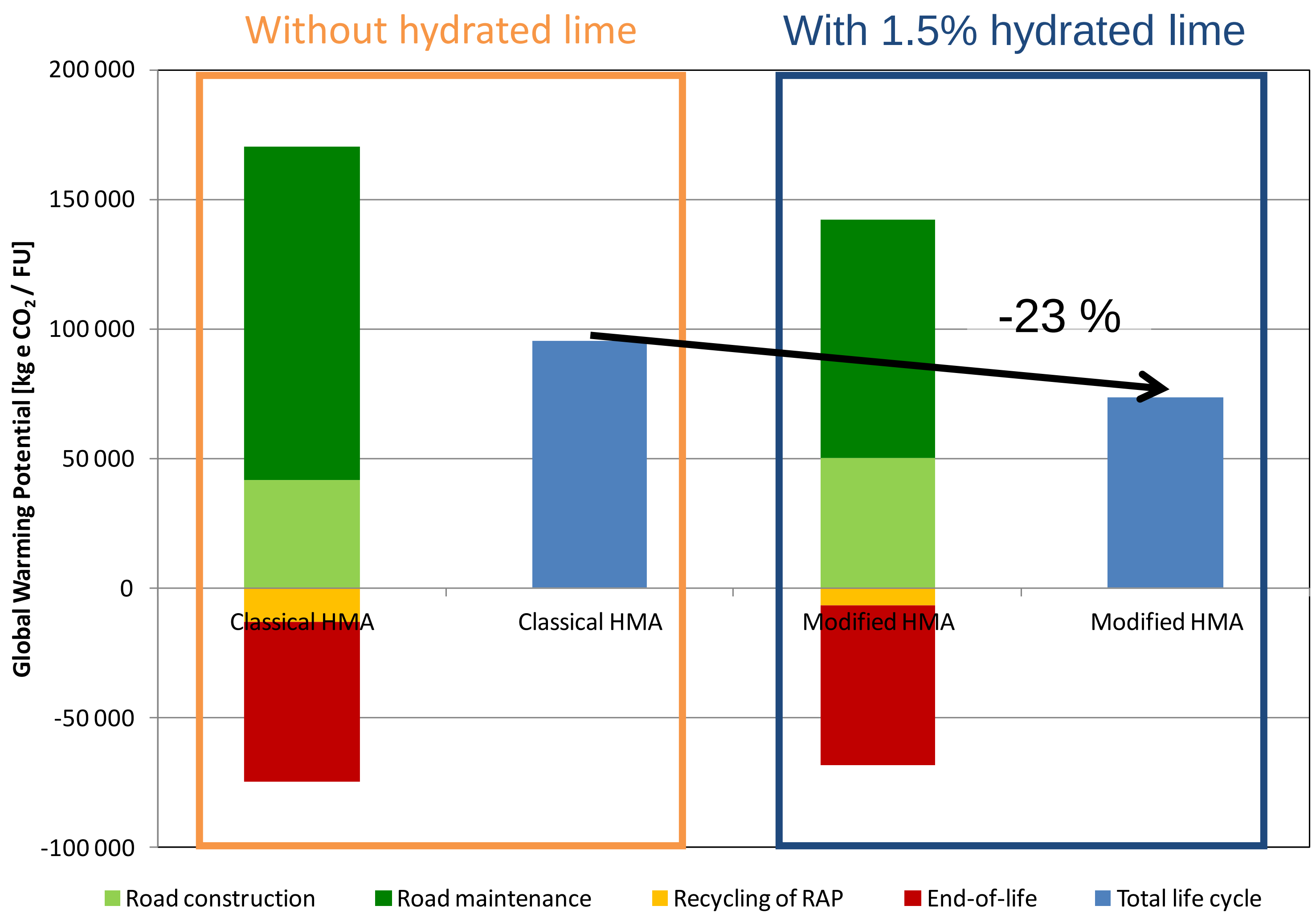

Schlegel T., Puiatti D., Ritter H.-J., Lesueur D., Denayer C., Shtiza A. 2016. The limits of partial life cycle assessment studies in road construction practices: A case study on the use of hydrated lime in Hot Mix Asphalt. Transportation Research Part D: Transport and Environment. Volume 48, Pp. 141–160. Open access.

# HMA LCA: Assumptions

Following assumptions are made for the:

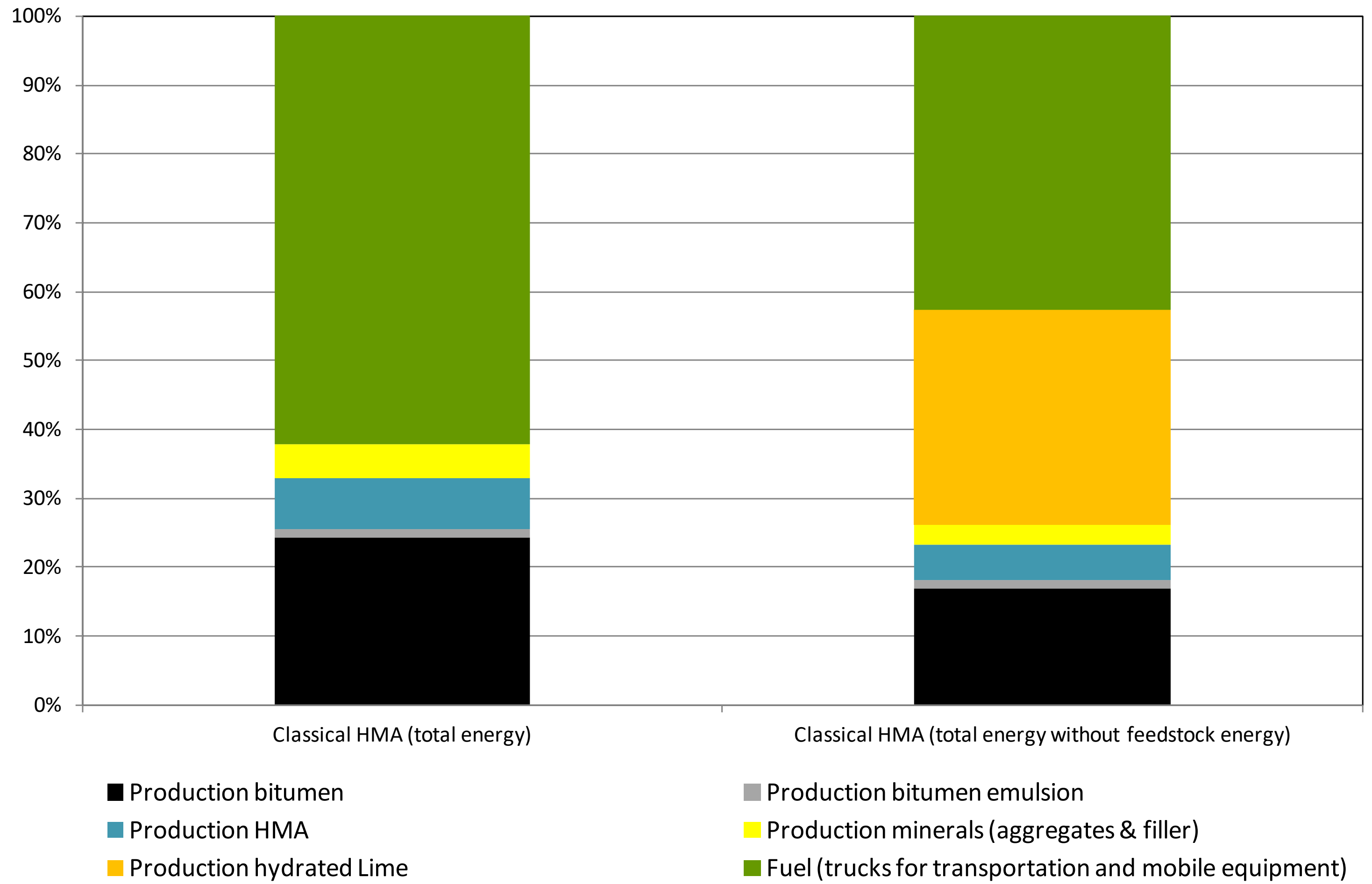
1. Recycling of the Reclaimed Asphalt Pavement (RAP):
   - 50% of the RAP reused for the production of new HMA (replacement of virgin bitumen, sand, gravel and filler)
   - 50% of the RAP reused as sand / gravel for external uses (substitute to sand / gravel)
2. End-of-life of the road (50 years):
   - The asphalt layers will not be removed
   - The surface layers do replace the sub base layer of the future new road.

# HMA LCA: Results Global Warming Potential ($CO_2$)



# HMA LCA: Results from modelling

Contribution analysis for the **Global Warming Potential** (100 years)



# HMA LCA: Sensitivity analysis

1. Use another LCI dataset for the production of bitumen in order to investigate the impact of lower energy consumptions

2. Change energy consumption and type of fuels used in the HMA plant as this process represents an important contributor

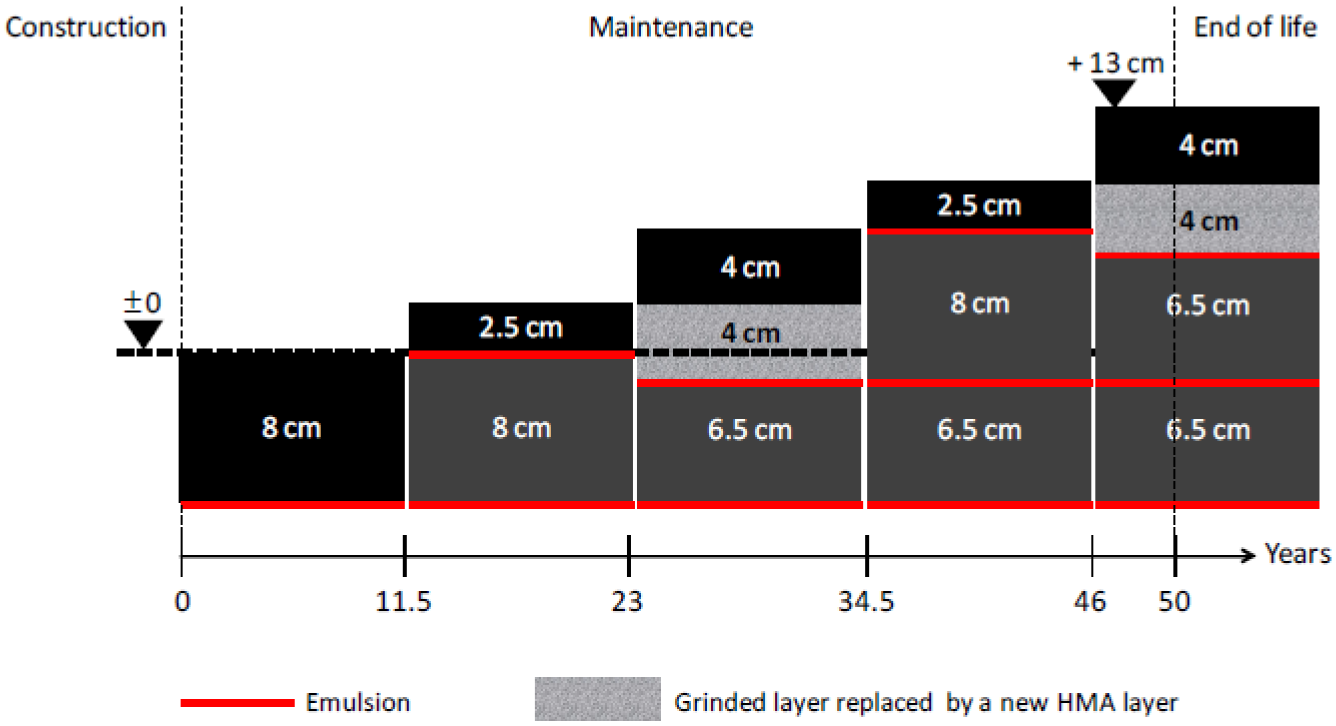
3. Modify transport distances of the aggregates & sands

4. Shorter or longer intervals for the maintenance of the modified HMA

   Base case: 25%
   Shorter: 15%
   Longer: 35%

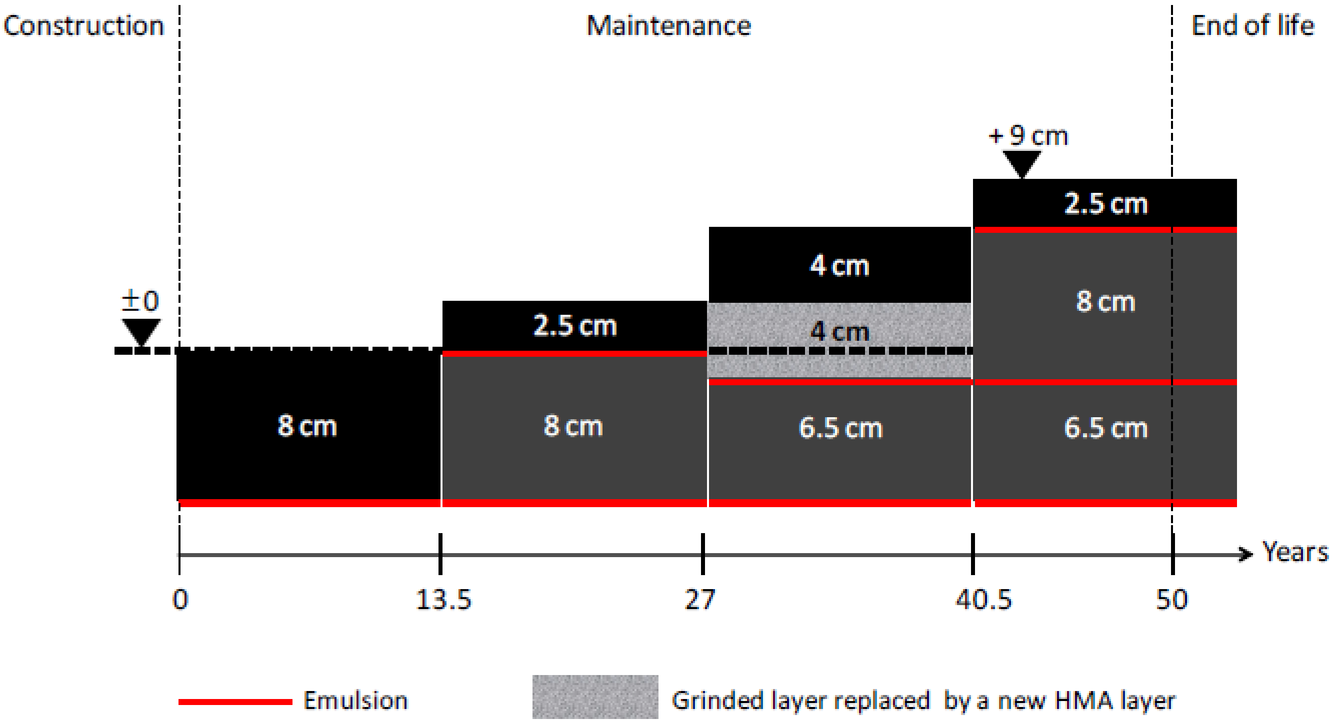
# Sensitivy analysis: Maintenance scenario shorter

Maintenance scenario of wearing course of modified HMA with an increase in the life time **of 15% instead of 25%**



# Sensitivy analysis: Maintenance scenario longer

Maintenance scenario of wearing course of modified HMA with an increase in the life time **of 35% in stead of 25%**




The LCA report and the associated data have undergone an external critical review by TNO

# HMA LCA: Conclusions

The key outcome of this LCA study is that for the full life cycle of a road (construction + maintenance stages) the use of modified HMA (i.e. with 1.5% lime) in the wearing course has clearly the lower **environmental footprint** for the main environmental impact categories:

- energy consumption (with & without inclusion of the feedstock energy of bitumen);
- climate change;
- abiotic depletion;
- air acidification, photochemical oxidant formation;
- stratospheric ozone depletion & and
- eutrophication

Thanks to the longer durability of the modified HMA (hydrated lime) and to less maintenance operations (**less cost**), the traffic jams will be reduced.

Less traffic jams will have **lower societal impacts** (i.e. fuel consumption and emissions) and should therefore result in societal benefits.

# Questions?

**For information:**

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# List of References

References:


- Bilal, J., Grosshenny, V., Lecouls, H., Le Noan, C., Marcilloux, J., Quéro, J.-F., Verhée, F., 2009. Caractéristiques environnementales des matériaux routiers –Rectitatif – analyse de Cycle de Vie des enrobés bitumineux: vers un amendement Matériaux routiers à la norme NF P01 010, Union des Syndicats de l'Industrie Routière Française (USIRF) – French Trade Association of road contractors. Rev. Gén. Routes Aérodromes 872 (in French).

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- Schlegel T., Puiatti D., Ritter H.-J., Lesueur D., Denayer C., Shtiza A. 2016. The limits of partial life cycle assessment studies in road construction practices: A case study on the use of hydrated lime in Hot Mix Asphalt. Transportation Research Part D: Transport and Environment. Volume 48, Pp. 141–160. Open access.