RAP-ELT

Production of modified asphalt and increase of the percentage of reclaimed asphalt pavement recycling, by using crumb rubber

Project Code: Τ1ΕΔΚ-01656

Ευρωπαϊκή Ένωση
Ευρωπαϊκό Ταμείο Περιφερειακής Ανάπτυξης
ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
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ΓΓΕΤ
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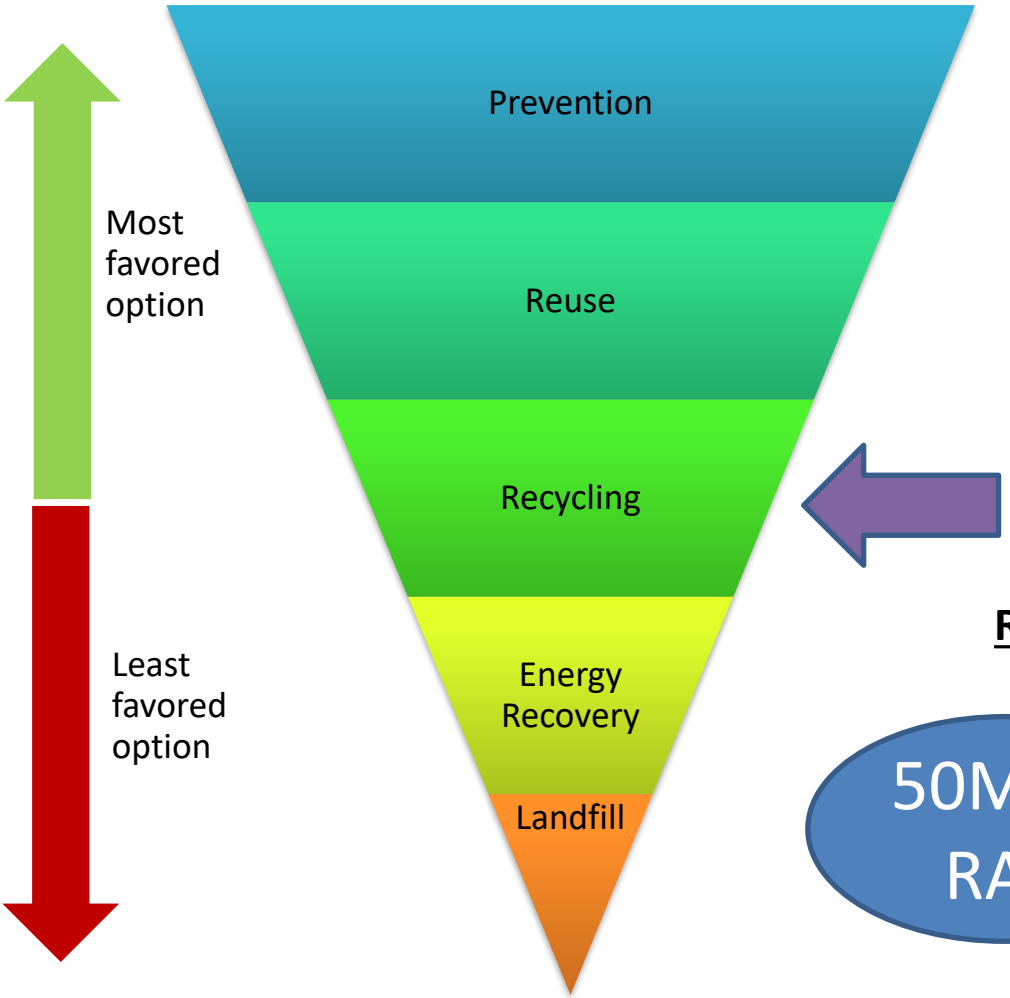
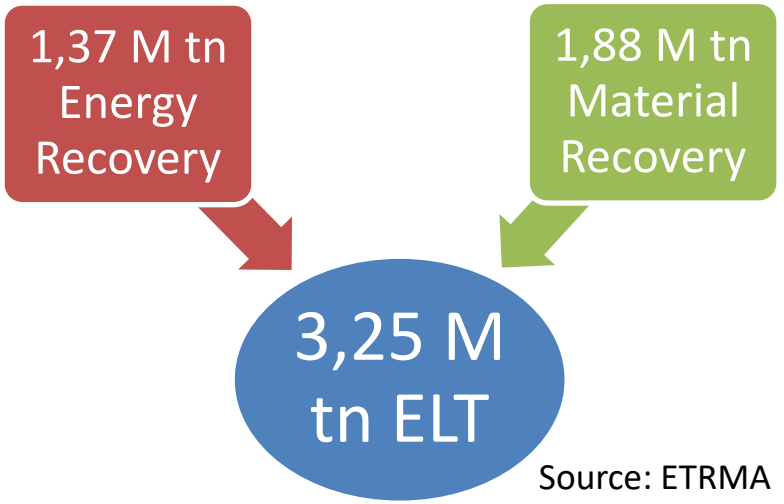
ανάπτυξη - εργασία - αλληλεγγύη
Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

Introduction

Waste management hierarchy (Directive 2008/98/EC)

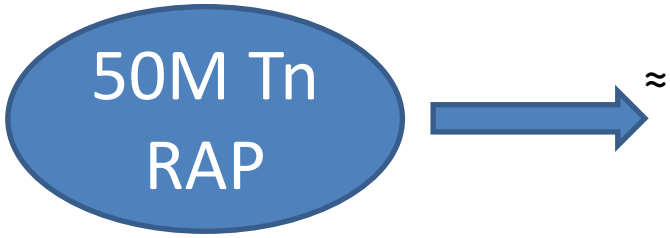


End of Life Tyres (EU 2019)



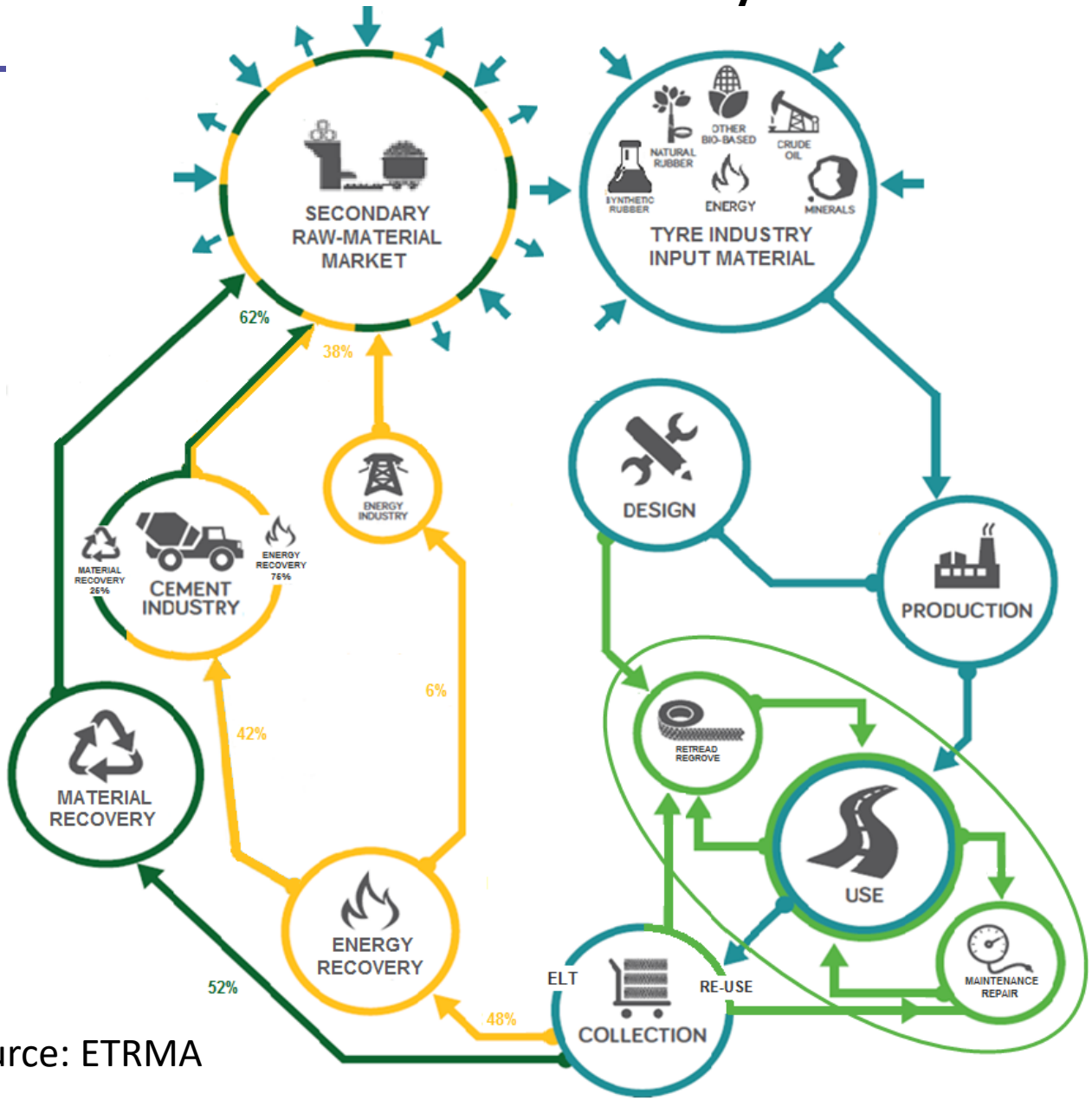
Source: ETRMA

Reclaimed Asphalt Pavement (EU 2019)



Source: EAPA

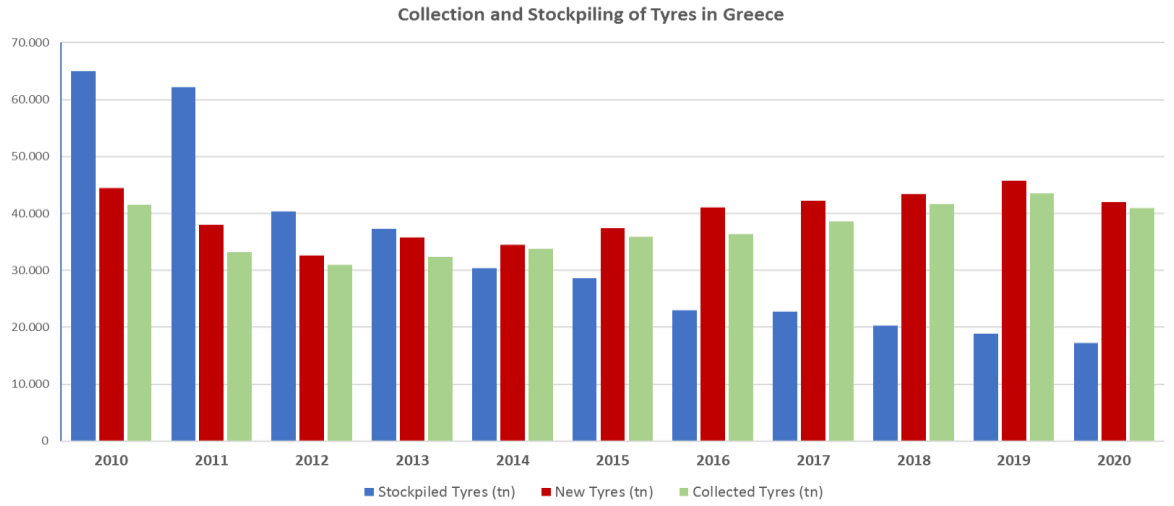
Circular Economy Plan

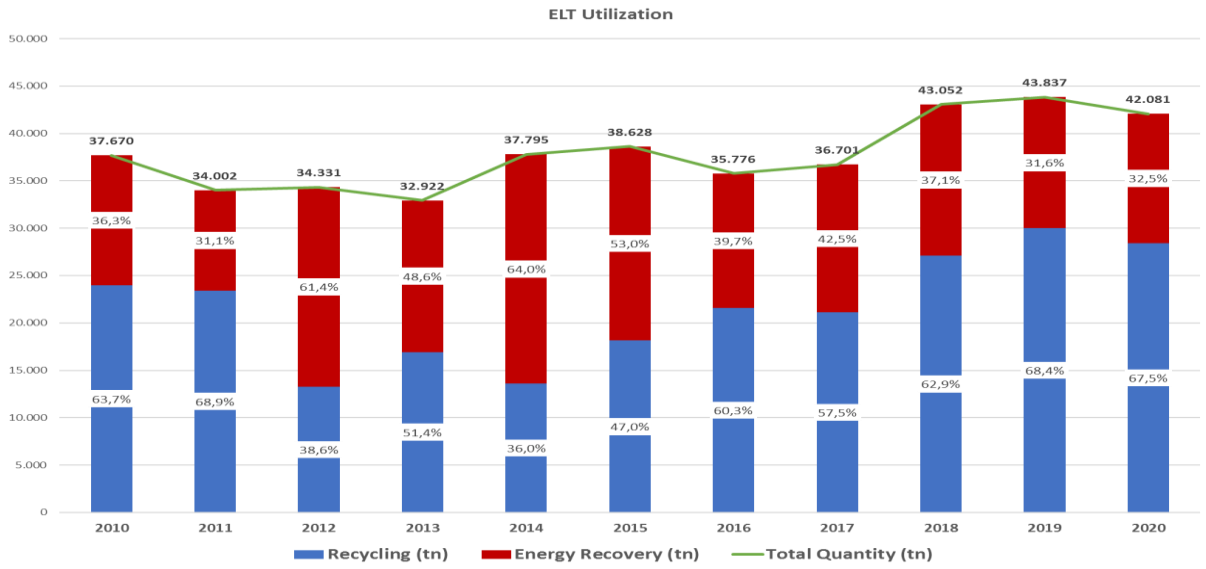


Source: ETRMA

End of Life Tyres (ELT)

- Tyres that cannot be reused
- No longer accepted in landfills (Directive EU 31/99)
- Management
  - Use “as is”
  - Mechanical grinding
  - Energy Recovery(TDF)
  - Pyrolysis





ELTs : Composition

Rubber

- Recycling

Steel

•Recycling

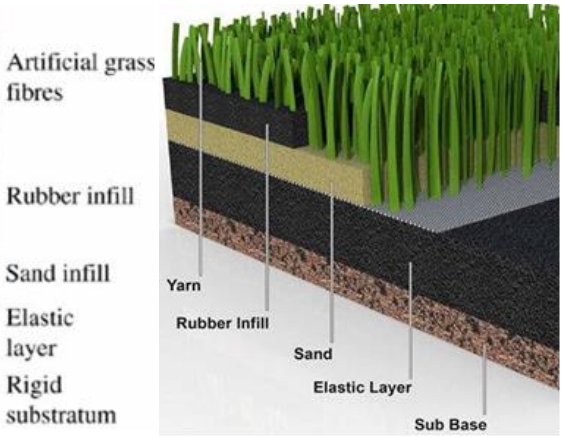
Textile

•Sound and thermal insulation

•Energy recovery

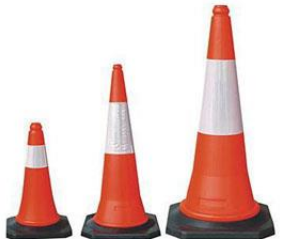
Uses of crumb rubber/rubber powder

- Artificial turf



- Asphalt

- Thermoplastic elastomers



- Rubber floor tiles

- Concrete
  - ↓ weight
  - ↑ resistance to cracking
  - ↑ capacity for deformation

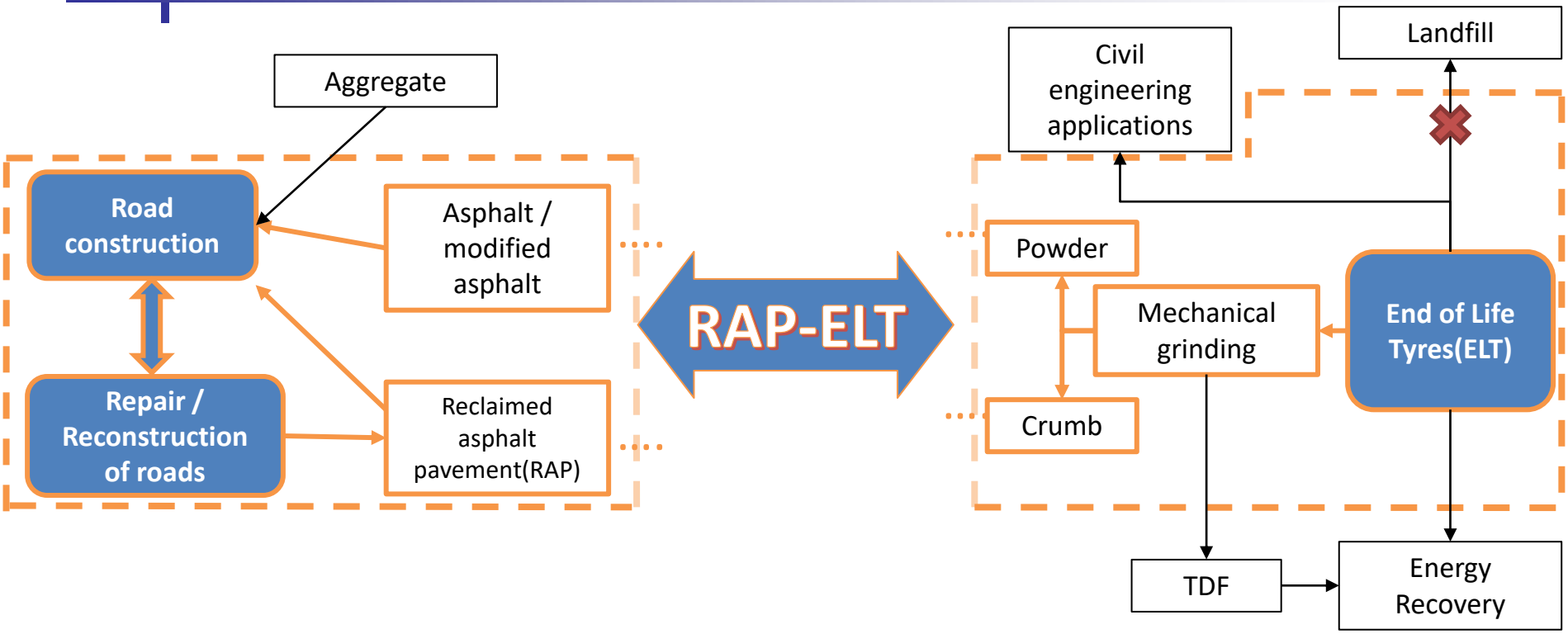
http://www3.lgm.gov.my/irpec/prd_railpads.html

Reclaimed Asphalt Pavement (RAP)

- Material from the removal of asphalt pavement (asphalt and aggregates)
- Contains high quality aggregate covered in asphalt
- Typical use of RAP up to 30%
- Main barrier :
  ↑ asphalt stiffness

Source: https://www.dot.state.mn.us/mnroad/projects/RAP/index.html

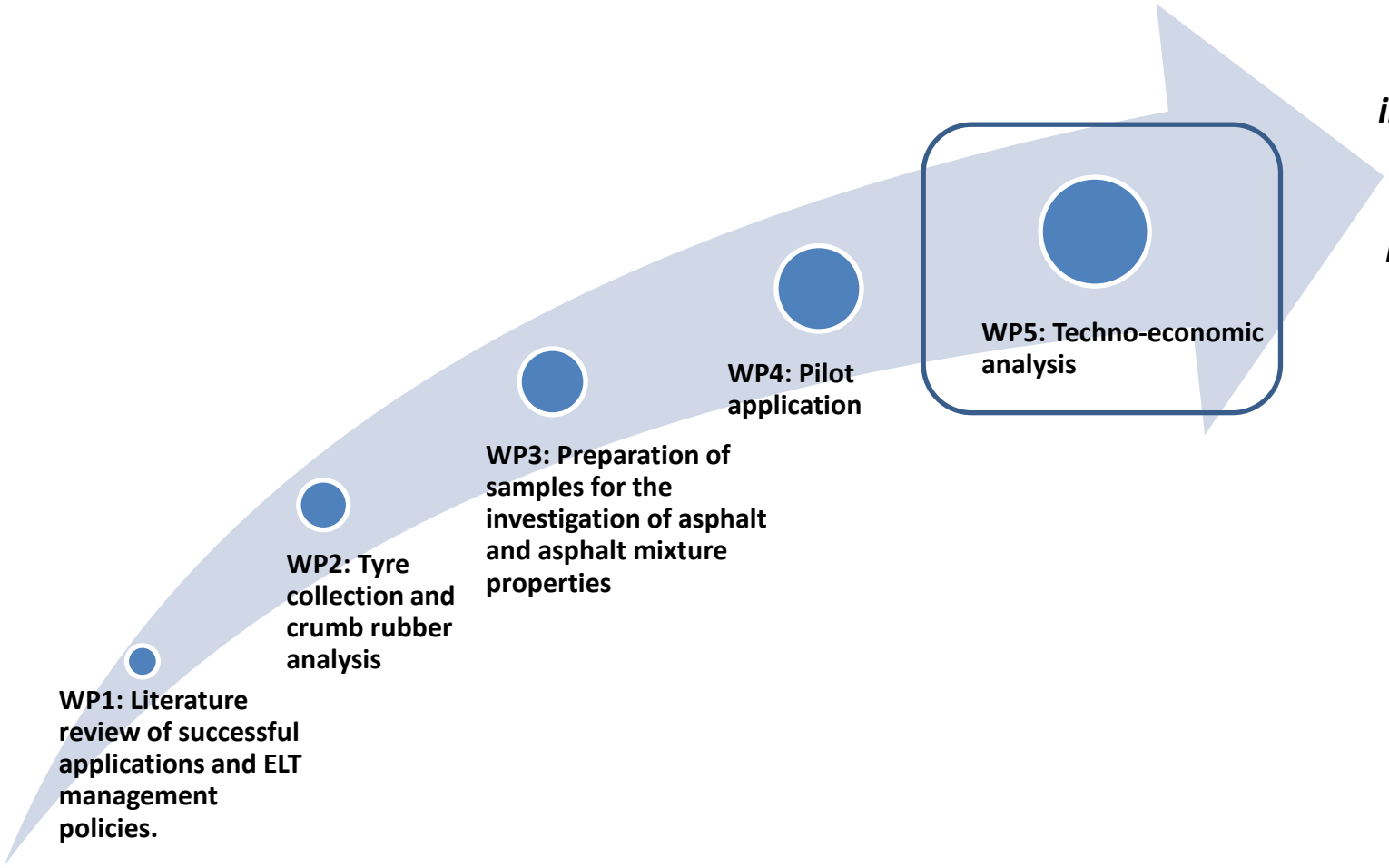
Scope



Investigation of the possibility of increasing RAP's participation in the production of asphalt mixtures due to the modification of asphalt with crumb rubber :

- Asphalt pavement with superior characteristics
- Utilization of two waste flows (ELT and RAP)
- Utilization ELTs with techniques more environmentally efficient compared to energy recovery

Project Structure - Objectives



Crumb rubber modified asphalt pavements

- Wet process:
  - Mix with bitumen at high temperatures (up to 200°C)
  - Production of modified asphalt
- Dry process:
  - Substitution of coarse aggregate with crumb rubber
  - Production of modified asphalt mixture

- Main advantages:
  - Increased lifetime of the pavement
  - Higher resistance in high temperatures (reduced rutting) and low temperatures (reduced cracking)
  - Reduced noise from vehicle traffic
  - Reduced “spraying” from vehicle traffic on wet roads

Modified asphalt

- ELTs was grinded (0,0-0,4 mm) in RETIRE (Drama)
- The crumb rubber was delivered to Netoil SA (Tripoli)
- The crumb rubber (5%w/w of modified asphalt) and the asphalt was mixed in a low shear mixer at 180oC until homogenized (3hours)
- The modified asphalt was delivered to the asphalt plant of ASFALTER SA (Aspropirgos)

Pilot application in Aspropirgos

- Types of asphalt mixtures :

1. Conventional asphalt mixture (≈100m - 50mm)
2. Modified asphalt mixture with crumb rubber (≈150m -50mm)
3. Modified asphalt mixture with crumb rubber and 30% RAP(≈100m -50mm)
4. Modified asphalt mixture with crumb rubber and 50% RAP(≈150m -50mm)

- ASFALTER SA produced the 4 asphalt mixtures using conventional asphalt,modified asphalt, primary aggregates and secondary aggregates(RAP) accordingly.

- The temperature of asphalt mixtures was 170^{o}C.

Measurements

- Skid Resistance (Grip tester)
- Rutting Resistance – Wheel bolts (Walking Profiler)
- Environmental Noising (Nti xl2-sound level meter, Bruel & Kjaer 4230-Sound level calibrator)

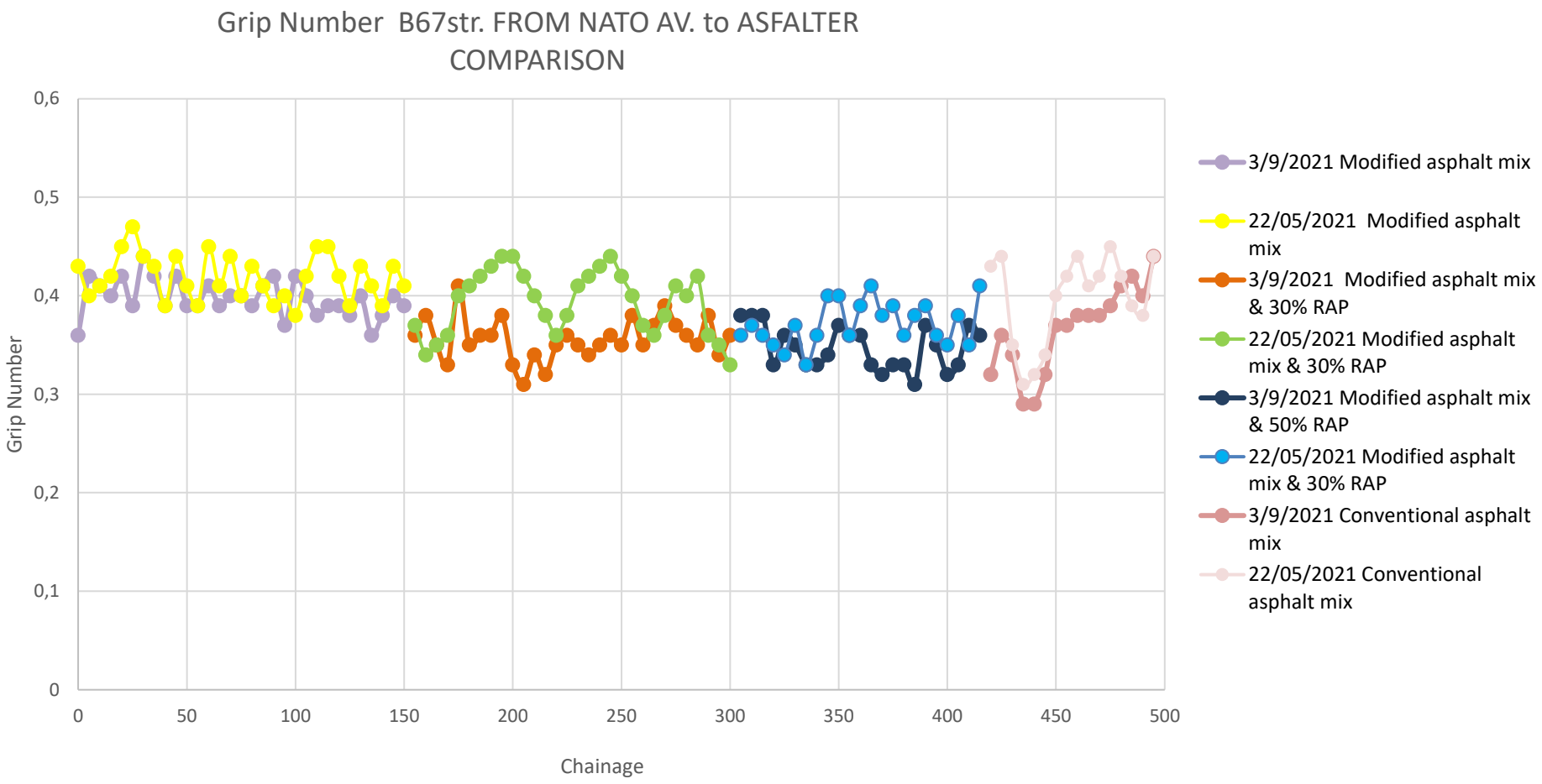
Grip tester

Nti xl2(left), Bruel & Kjaer 4230 (right)

Walking Profiler

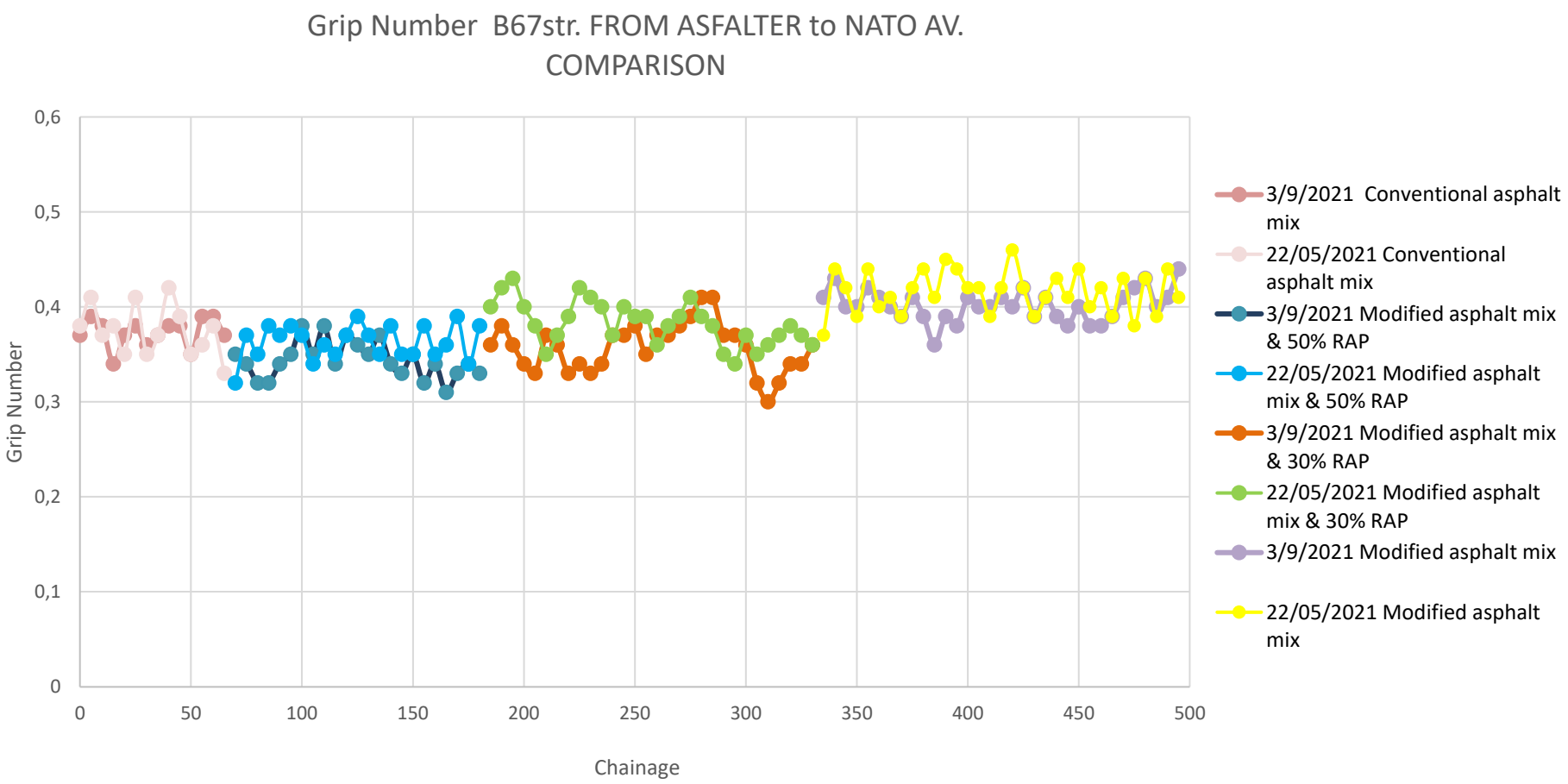
Results – Skid resistance

Grip number ↑ ↔ Rolling resistance ↑



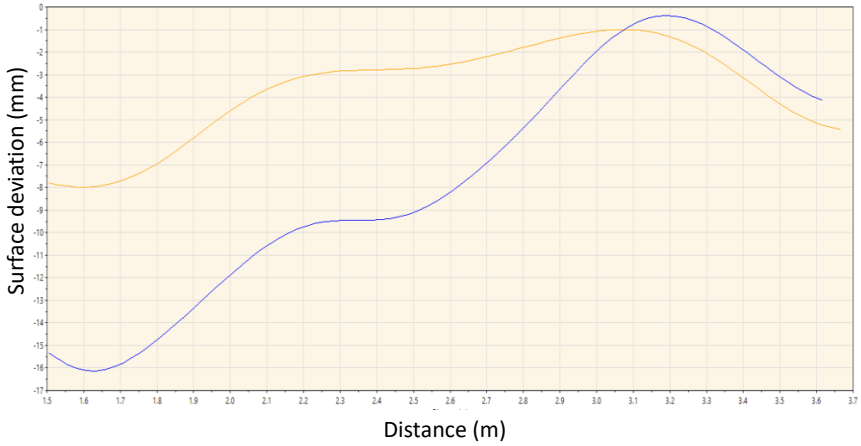
Results – Skid resistance

Grip number ↑ ↔ Rolling resistance ↑

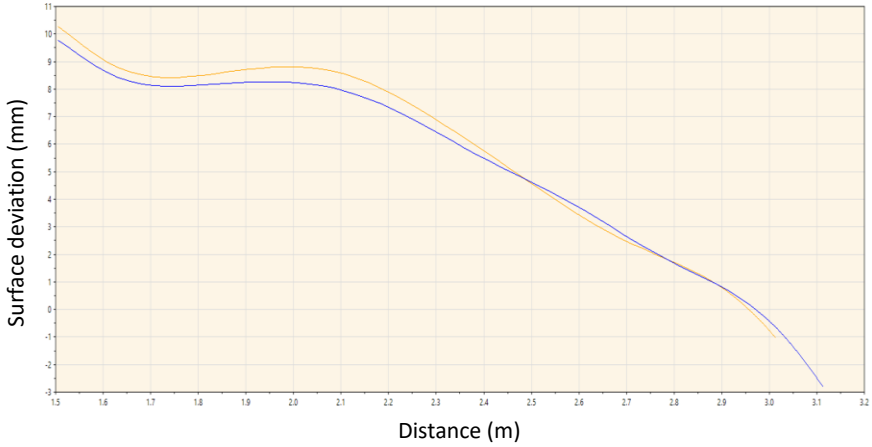


Results – Rutting resistance

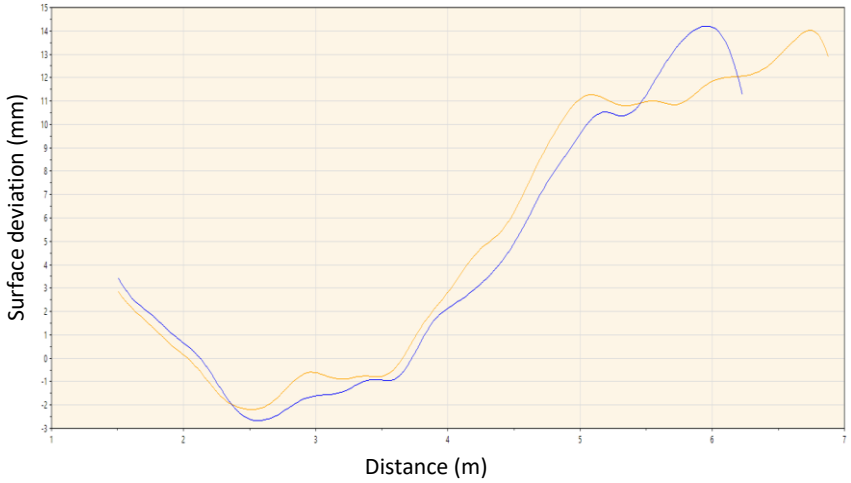
Conventional asphalt mixture



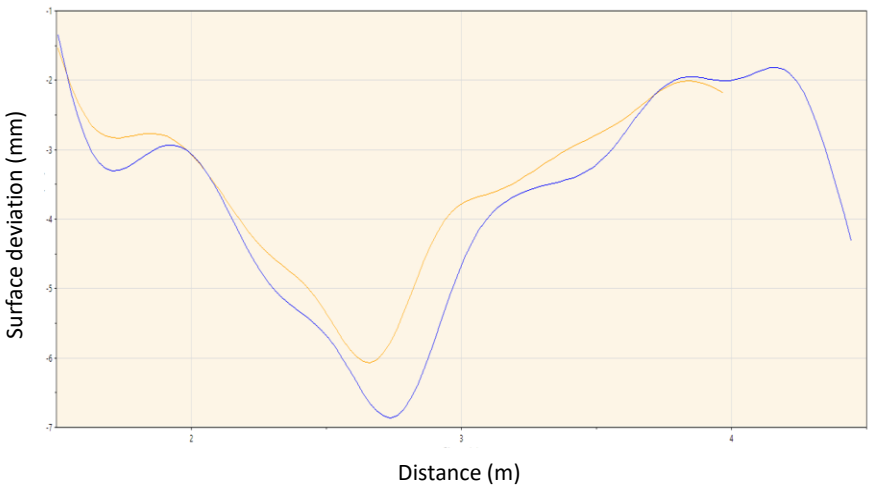
Modified asphalt mixture with crumb rubber and 50% RAP



Modified asphalt mixture with crumb rubber and 30% RAP

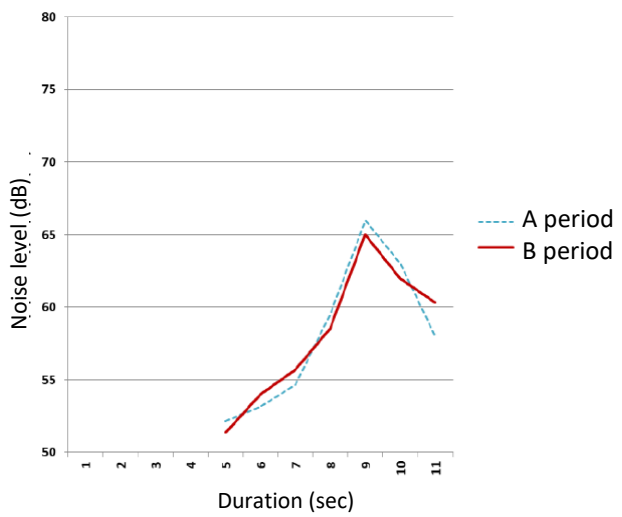


Modified asphalt mixture with crumb rubber

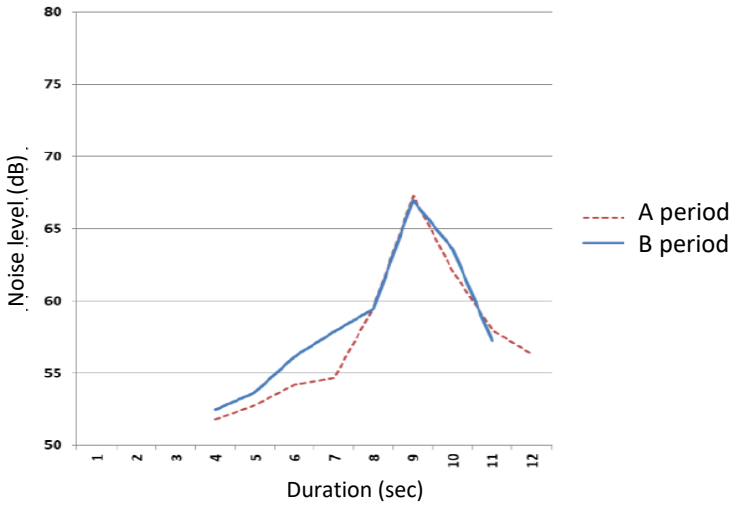


Results – Noising (POV, 40Km/Hr)

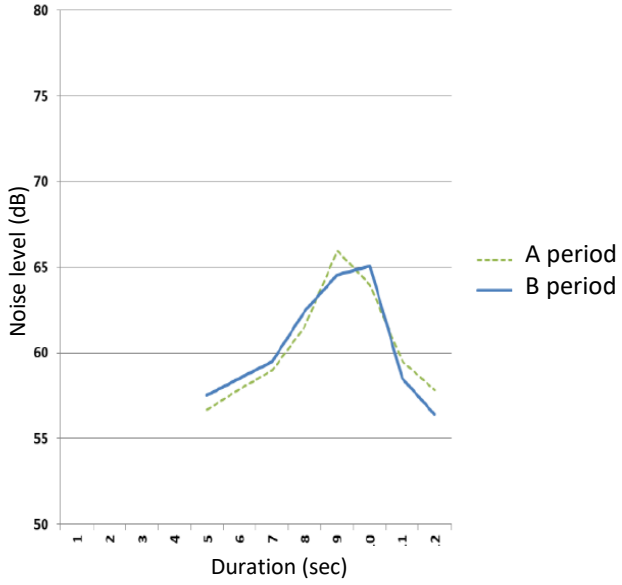
Conventional asphalt mixture



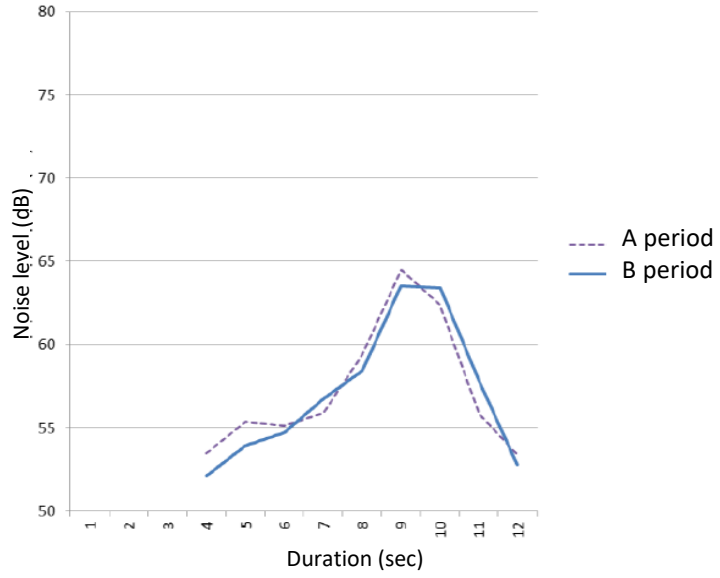
Modified asphalt mixture with crumb rubber and 50% RAP



Modified asphalt mixture with crumb rubber and 30% RAP



Modified asphalt mixture with crumb rubber



Conclusion

- Positive results

Skid resistance

Best performance: Modified asphalt mix with crumb rubber

Rutting resistance

No significant differences between modified mixes

Wheel bolt : Conventional asphalt mix

Noising

Best performance: Modified asphalt mixture with crumb rubber

Next Steps

- Additional measurements after a longer period of time
- Life cycle cost analysis
- Life cycle assessment
- Scaling up the pilot application

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With the co-funding of Greece and European Union

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