LIFE E-VIA project

Electric Vehicle noise control by assessment and optimisation of tyre/road interaction

(LIFE18 ENV/IT/000201)

http://life-evia.eu http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=7210

Actions in progress (A2, B1, C2)

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21th February 2020

PARTNERS AND WEBSITES

- Partners:
  - COMUNE DI FIRENZE
  - IPOOL(iPOOL S.r.l.), Italy
  - UNIRC (Universita' Mediterranea di Reggio Calabria), Italy
  - CRD(Continental Reifen Deutschland GmbH), Germany
  - VIENROSE(Vie en.ro.se Ingegneria srl), Italy
  - IFSTTAR(Institut français des sciences et technologies des transports, de l'aménagement et des réseaux), France
- Websites:
  - http://life-evia.eu
  - http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=7210

OBJECTIVES

- The project **objectives** are (hereafter BEV/PHEV cars are generally referred to as electric vehicles, EV):
- To reduce noise for roads inside very populated urban areas through the implementation of a mitigation measure aimed at **optimizing road surfaces and tyres of EVs**. Two road surfaces, at least 5 different EV types, one reference ICE Vehicle (ICEV) and at least 3 types of tyres per vehicle type (including tyres specifically designed for EVs) will be tested
- To estimate the mitigation efficiency and potential of tyres, pavements and traffic (traffic spectrum, speeds, handling conditions) at a higher and comprehensive level: a Life Cycle Analysis (LCA) and a Life Cycle Cost Analysis (LCCA) will be performed to demonstrate the individual and synergistic efficiency of pavement surfaces, tyres and vehicles (including the comparison between internal combustion vehicles, mixed traffic, and EV traffic)
- To contribute to EU legislation effective implementation (EU Directives 2002/49/EC and 2015/996/EC), providing rolling noise coefficients within the Common Noise Assessment Method (CNOSSOS-EU), specifically tuned for EVs which are actually in need of data for practitioners, agencies, and departments aiming at developing future scenarios
- To contribute to national and Italian regional policies, issuing guidelines about use and application of the methodology output of the project, which will be adopted, through the Regional Env. Agency (ARPAT), supporting the project, by Tuscany Region, strongly interested in noise issues (partner of LIFE NEREIDE and Leopoldo project, and issued a law about control of road pavements with CPX method). Calabria Region and Città of Reggio Calabria also expressed their interest
- To raise people's awareness of noise pollution and health effects explaining the opportunities provided by EVs through specific dissemination and promotional events, also investigating people perception regarding noise in terms of soundscape methodology and involving them in noise data acquisition
- To demonstrate and promote sustainable road transport mobility (electric), reducing noise emission by 5 dB(A) at receivers roadside and achieving also CO_2 emissions reduction (21%), based on the Italian context (LPG, CNG, Hybrid, EV, petrol cars, diesel cars) and the concerned literature
- To encourage low-noise surfaces implementation in further EU and extra-EU scenarios, demonstrating durability and sustainability, through in-depth LCA&LCCA

OBJECTIVES IN PRACTICE..

Objectives	
2 pavement solutions	P
5 different EV types	EV
One reference ICE vehicle	ICE
3*6=18 types of tyres	T
LCA and LCCA (synergistic efficiency of pavement surfaces, tyres and vehicles)	
Providing rolling noise coefficients within the Common Noise assessment Method (CNOSSOS-EU)	
Contributing to national and Italian regional policies	
raise people's awareness of noise pollution and health effects	
Reducing noise emission by 5 dB(A) at receivers roadside and achieving also CO_2 emissions reduction (21%),	
low-noise surfaces: implementing in further EU and extra-EU scenarios, and demonstrating durability and sustainability, through in-depth LCA&LCCA	

OBJECTIVES IN PRACTICE..

Experiments

2 pavement solutions

5 different EV types

One reference ICE vehicle

3*6=18 types of tyres

Analyses

LCA and LCCA

CNOSSOS-EU coefficients

Results

low-noise, durable, and sustainable surfaces.
National and Italian regional policies.
Raise people's awareness

In practice

Reducing noise emission by 5 dB(A).

CO2 emissions reduction (21%).

Action A2

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21th February 2020

PAVEMENT SOLUTIONS?

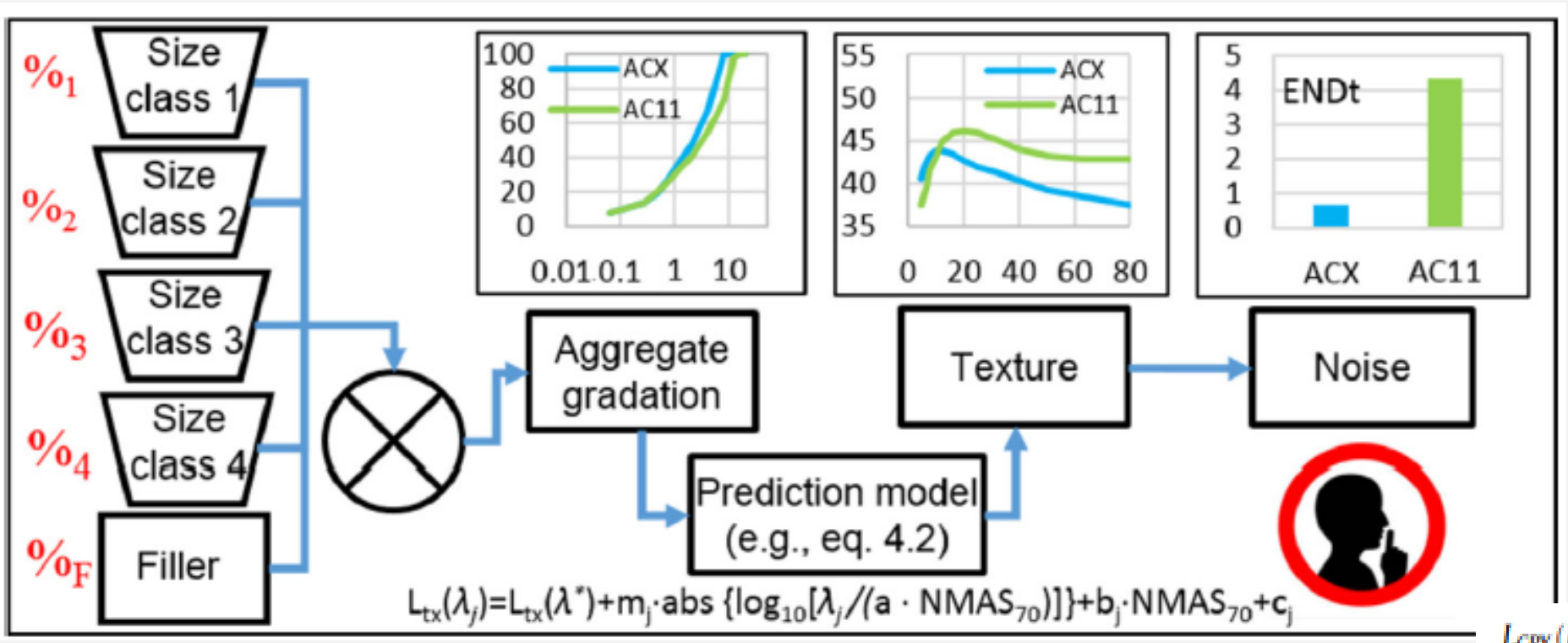
Reference	Type of solutions	Thickness (mm)	Maximum aggregate size or NMAS (mm)	Texture (mm) or/and air void content (%)	Noise reduction (dB)
(Praticò et al., 2013)	PERS	30	2mm (rubber) 8 mm (aggregate)	30-35%	5-15 (vs. DAV)
	RAC (O)	30	12 (as OGFC)	14-20%	6
	RAC(G)	30-50	12 (as DGFC)	4%	
	SMA 0/16	30-50	16 mm	4%	-1 ~ -2
	SMA 0/11	30-50	11	4%	0
	SMA 0/8	30-50	8	4%	1
	SMA (general)	30-50	5-16 mm	0.5-1.5 mm (4%)	-2 ~ -1
	DAC 0/11 or DAC 0/8	30	8/11	0.8 mm (4%)	0
	PAC 0/8	45	16	25%	3
	PAC 0/11	45	11	25%	4
	PAC 0/8	45	8 mm	25%	5
	TPA	25 (top)+ 45 (bottom)	8 (top) 16 (bottom)	20% (top) 25% (bottom)	4-6 (vs. DAC)
	Thin layers	5- 8 mm	5 – 8 mm	5 -15%	3-7
	Bardon	25 – 35 – 50 mm c.a.	14	SH=2mm	3 (vs. HRA)
	Masterflex	(15-50 mm)	6-10-14	2 mm	5-6 (vs. DAC)
	Novachip	(12 – 25 mm)	6 mm; 9 mm; 12mm; (1/4 – 3/8 – 1/2)	Texture similar to PAC	1 (VS. PCC/DAC)
	MASTERpave	(20 mm – 50 mm -75 mm)	6 – 14 – 20 mm	1.5-2	4
	UL-M	20 – 50 mm	6 mm – 10 mm – 14mm	1.5 mm	5-7 (vs. DAC)
	MicroFlex		6 mm	AV=13%	3.9-4.9 (vs, DAC)
	Colsoft	20-30 mm	6 mm – 10 mm	2 mm	3~5 (vs. DAC)
	Rugosoft	20-50 mm	Unknown	Unknown	5~7 (vs. DAC)
	Nanosoft	25-40 mm	4 mm	Unknown	9
	MICROVIA	10-30 mm	6 mm	0.8 mm	Unknown
	Rollpave	30 mm	6 mm	Unknown	4.3
	Nobelpave	NA			
	Surface dressing	3~20 mm	3~20 mm		+2~-3 dB
	Porous cement concrete	80	9.5 mm	20-25%	4~8
	Portland cement concrete - general			4%-25%	-2~8

PAVEMENT SOLUTIONS?

Reference	Type of solutions	Thickness (mm)	Maximum aggregate size or NMAS (mm)	Texture (mm) or/and air void content (%)	Acoustic indicator used	Noise reduction (dB)	Noise increase (dB/year)
(Donavan and Janello, 2018)	ARFC	25 mm	9.5 mm	20-21%	CPX/OBSI	/	0.5 dB/Year
(Anderson et al., 2013; Pierce et al., 2009)	OGFC-AR	19 mm	9.51 mm		OBSI	4.3 (vs. HMA)	2.1
	OGFC-SBS	19 mm	9.51 mm		OBSI	3.4 (vs. HMA)	1.45
	HMA	30 mm	12.5 mm		OBSI	/	1.03
(Bendtsen et al., 2010, 2009; Illingworth &Rodkin, 2002)	OGAC	25 mm	9.5 mm	/	/	/	0.11-0.19
(Bendtsen et al., 2010, 2009; Rochat et al., 2010)	DGAC	30 mm	12.5 mm	9%	SPB	/	0.24*-0.29**
	OGAC	30 mm	12.5 mm	15%	SPB	1.7 (vs. DGAC)	0.20*-0.12**
	OGAC	75 mm	12.5 mm	12%	SPB	3.3 (vs. DGAC)	0.10*-0.31**
	RAC-O	30 mm	12.5 mm	12%	SPB	2.3 (vs. DGAC)	0.40*-0.36**
	BWC	30 mm	12.5 mm	7%	SPB	0.9 (vs. DGAC)	/
(Bendtsen and Nielsen, 2008)	DGAC11	33 mm	11	2.8	SPB/CPX	/	0.72*-0.8**
	UTLAC	22 mm	8	14.4	SPB/CPX	2.2 (vs. DGAC11)	1.06*-0.35**
	OGAC	28 mm	8	15.3	SPB/CPX	2.9 (vs. DGAC11)	0.8*-0.09**
	SMA8	29 mm	8	12.4	SPB/CPX	0.4 (vs. DGAC11)	0.5*-0.21**
	SMA6+	28 mm	6+3/8	3.0	SPB/CPX	1.6 (vs. DGAC11)	0.93*-0.63**
	SMA8+	33 mm	8+8/11	8.7	SPB/CPX	2.5 (vs. DGAC11)	1.32*-0.67**

NOTE. **ARFC**= Asphalt Rubber Friction Course; **OGFC-AR**= OGFC+Asphalt Rubber; **OGFC-SBS**=OGFC+styrene-butadiene-styrene; **HMA**=Hot Mix Asphalt; **OGAC**= Open Graded Asphalt Concrete; **DGAC**= Dense Graded Asphalt Concrete; **RAC-O**=Rubber Asphalt Concrete-Open; **BWC**= Bonded Wearing Course; **UTLAC**= Ultra Thin Layer Asphalt Concrete; **SMA**= Stone Mastic Asphalt; **CPX**= Close Proximity Method; **OBSI**= On Board Sound Intensity Method; **SPB**= Statistical Pass-by Method.
*passenger car; ** multi-axle vehicle

PAVEMENT SOLUTIONS?



Praticò and Briante, 2020.

Del Pizzo et al, 2020.

$$L_{CPX}(HF) = a_{hf} L_{SG,tx}(8\text{mm}) + b_{hf}$$

where:

$L_{CPX}(HF)$ is noise level at high frequency,
$L_{SG,tx,8}$ is the SG texture level at 8 mm,
a_{hf} and b_{hf} are the regression parameters

and:

$$L_{CPX}(LF) = a_{lf} L_{SG,tx}(80\text{ mm}) + b_{lf}$$

EV: Renault FLuence Z.E.

EV *VS.* ICE …(?!)

ICEV: Renault Megane Grandtour

- Czuka et al., 2016: On the basis of current knowledge, it turns out that rolling noise from light electric vehicles does not differ from conventional vehicles.
- Mocanua et al, 2016:
  - EV… **different sizes, masses, weight distribution** and acoustic properties of these types of vehicles,…
  - EV.. are acoustically similar to combustion-based cars at velocities above 30 km/h, but they are significantly less audible at velocities below 30 km/h, therefore an increased risk exists, especially for visually impaired and blind Pedestrians
- EV have **high power-to-weight ratios or rather high torques** that remain relatively constant even at low speeds. Does this potential increase in acceleration performance indeed lead to **higher than normal (with respect to c-cars) accelerations**?
- EV can recuperate kinetic energy from deceleration phases and load the accumulator, thereby improving energy-efficiency. Does recuperation lead to higher than normal (with respect to c-cars) decelerations or cause **abrupt braking**?
- Does the different weight distribution and centre of gravity of e-cars have an effect on the **dynamic behaviour of the car**?

EV *VS.* ICE …(?!)

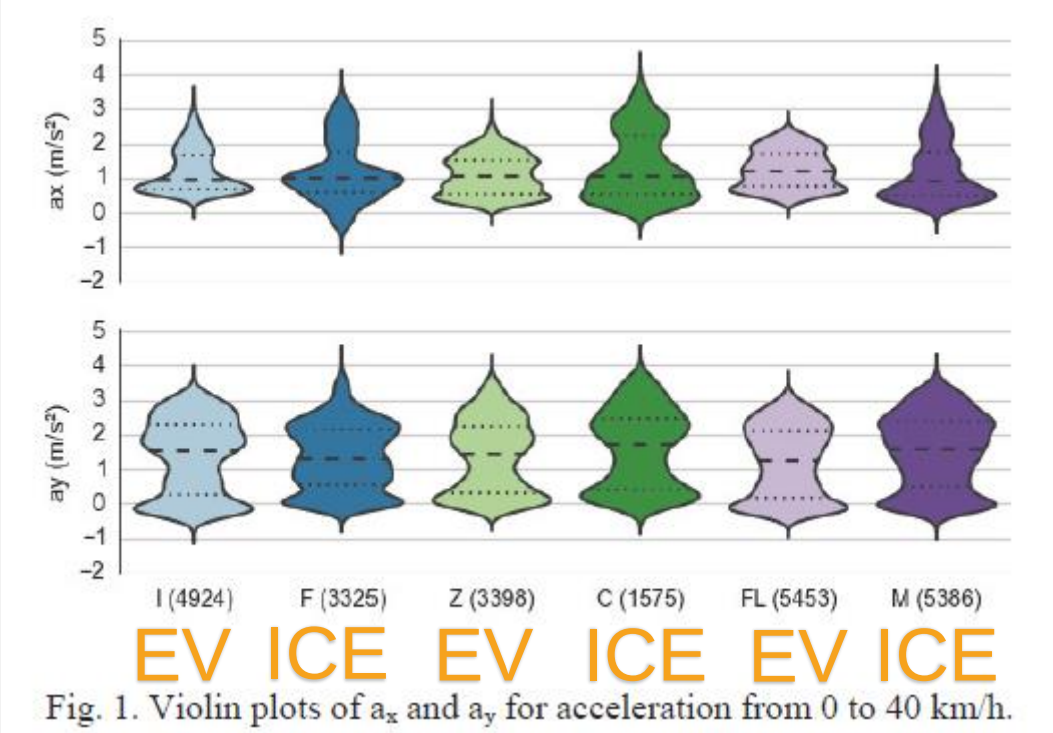


Fig. 1. Violin plots of a_x and a_y for acceleration from 0 to 40 km/h.

- Ax: longitudinal
- Ay: lateral acceleration
- 1) Renault **FL**uence Z.E. - Renault **M**egane Grandtour,
- 2) Renault **Z**oe - Renault Captur and
- 3) Mitsubishi **i**-MiEV - **F**iat 500.

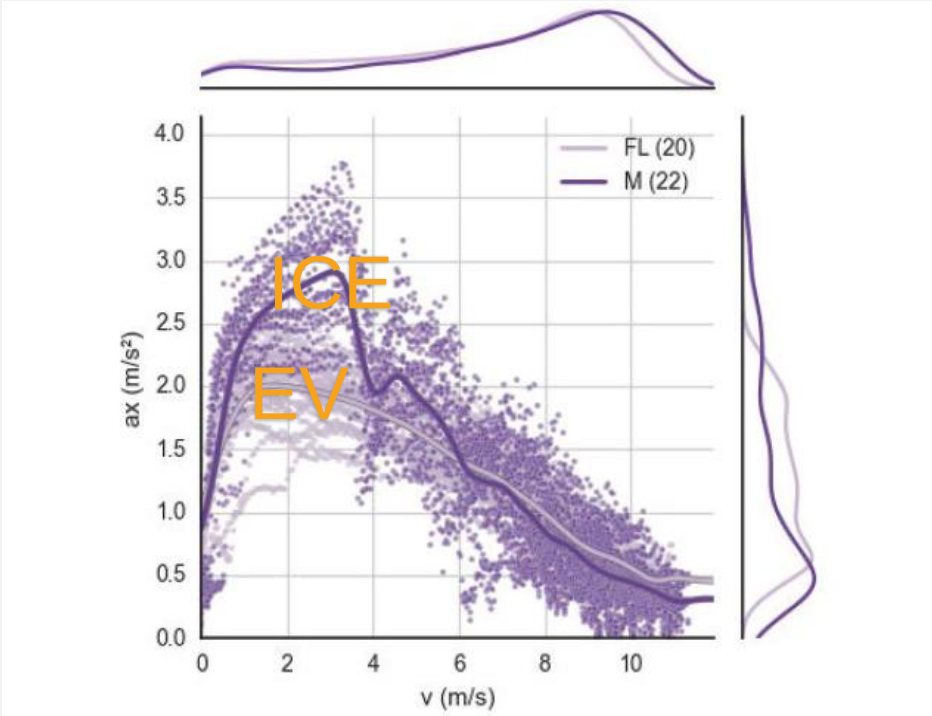


Fig. 2. Joint plot of a_x versus v for acceleration from 0 to 40 km/h, vehicle pair: FL-M.

Mocanua et al, 2016

TYRE SOLUTIONS?

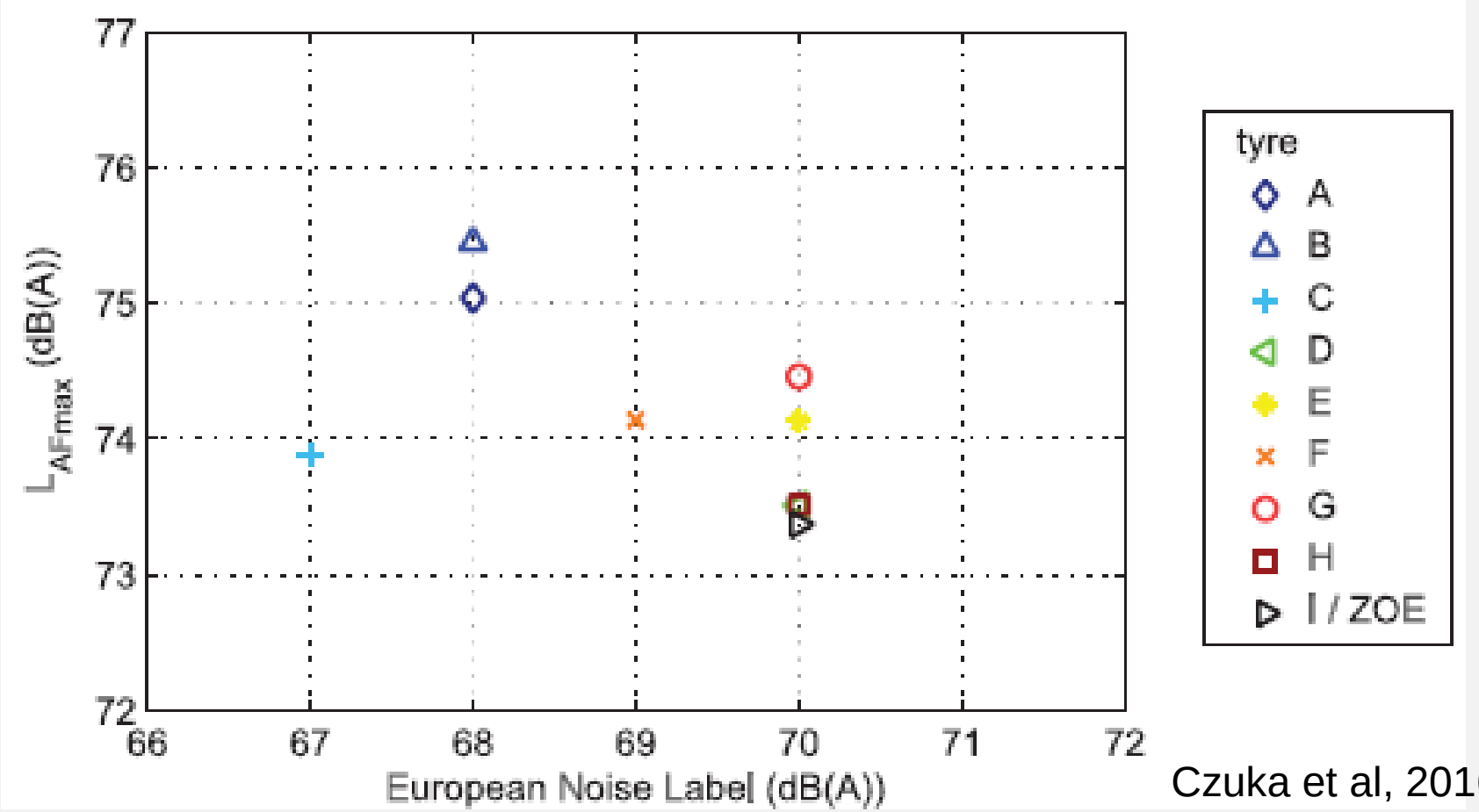


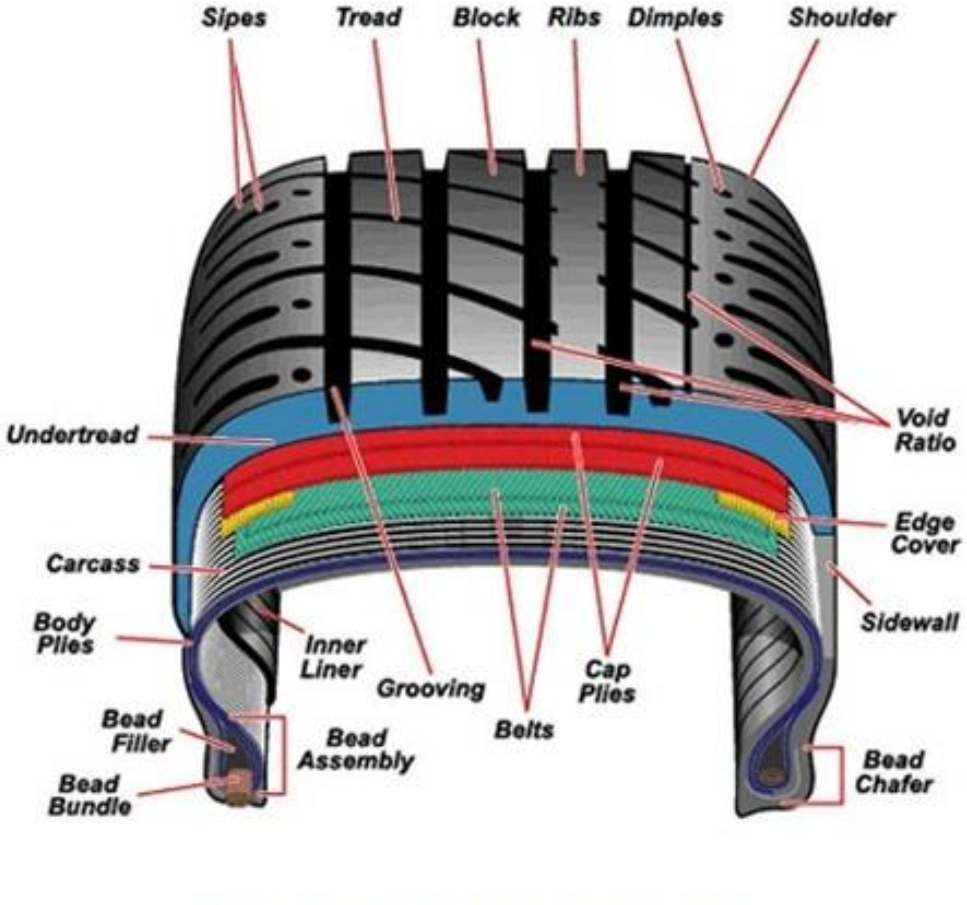
Table 1. Set of tyres selected for the measurements. The EU label is in the format "Rolling Resistance/Wet Grip/Noise Emission".

Abbreviation	Brand	Model	Dimensions	EU Label
A	Dunlop	Sport BluResponse	205/55 R16 91H	B/A/68
B	Goodyear	Efficient Grip	205/55 R16 91H	C/C/68
C	Kumho	Ecowing ES 01 KH27	205/55 R16 91V	B/B/67
D	Pirelli	Cinturato P1 Verde	205/55 R16 91H	B/B/70
E	Toyo	NANOENERGY 2	205/55 R16 91V	A/C/70
F	Bridgestone	Ecopia EP150	205/55 R16 91H	B/B/69
G	Michelin	ENERGY SAVER	205/55 R16 91W	B/A/70
H	Hankook	Kinergy Eco K425	205/55 R16 91H	B/B/70
I	Michelin	ENERGY E-V	195/55 R16 91Q	A/A/70

- Noise levels measured at 80 km/h on AC11 compared with the EU noise labels, for the 8 tyre types fitted to the Fluence Z.E. and 1 tyre fitted to the ZOE (black).
- **EU labels do not properly render the tyre ranking given by the noise measurement on the AC11 surface (?).**

Czuka et al, 2016

TYRE SOLUTIONS?



STRUCTURE OF A TYRE

http://www.mapeng.net/news/mechanical_English_article/2015/7/mapeng_15722145195363.html

- Tread pattern (sipes, ribs)?
- Shoulders?
- Carcass?
- Sidewalls?
- Geometry?

Noise?, Friction?
Rolling resistance?
Holistic approach?

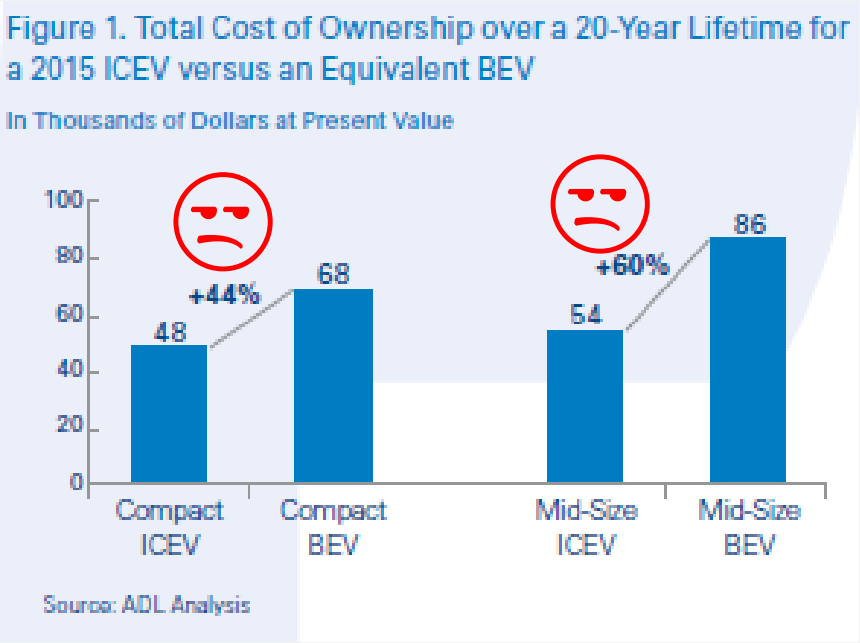
LCA AND LCCA?

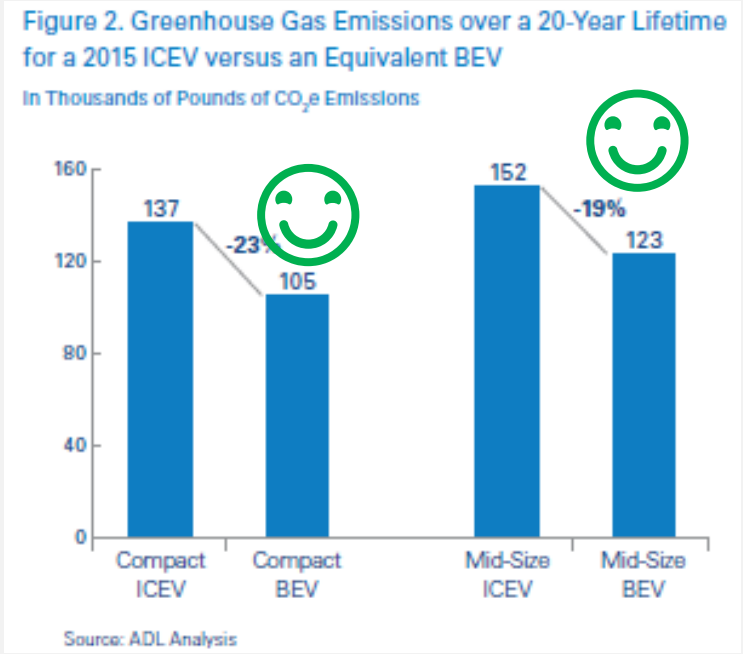
Impact assessment methods and indicators

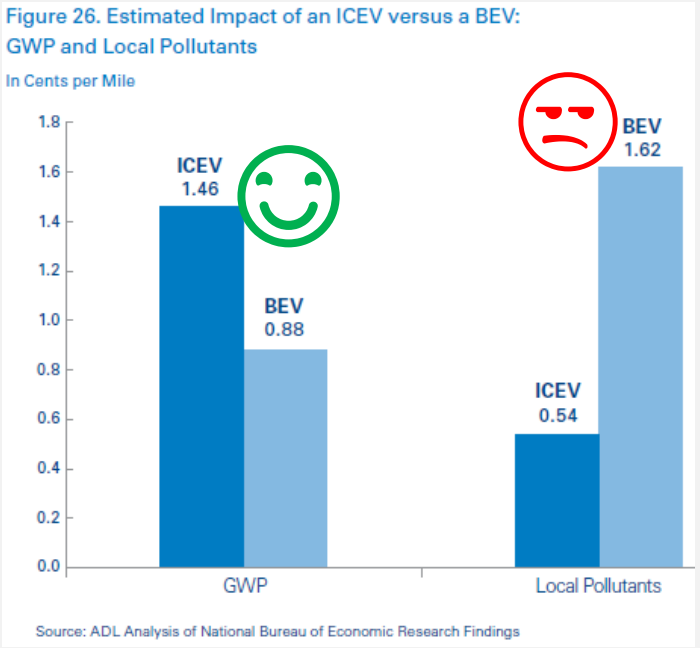
- GER (MJprimary):GER is calculated as the total primary energy demand of the whole life cycle.
- GER: Global Energy Requirement (MJprimary);
- GWP: GlobalWarming Potential (GWP, kg CO2eq);
- AP: Acidification Potential (AP, kg SO2eq);
- NP: Eutrophication Potential (NP, kg PO4eq3−)
- POCP: Photochemical Oxidation Potential (POCP, kg C2H4eq).
- Noise
- Costs..

LCA AND LCC

BUT...







Brennan and Barder

CNOSSOS METHOD

$$L_{W',eq,line,j,m} = L_{W,j,m} + 10 \times \lg\left(\frac{Q_m}{1000 \times v_m}\right)$$

$$L_p = L_W - |10 \cdot \log\left(\frac{Q}{4\pi \cdot r^2}\right)|$$

$$L_{W,j,m}(v_m) = 10 \times \lg\left(10^{L_{WR,j,m}(v_m)/10} + 10^{L_{WP,j,m}(v_m)/10}\right)$$

$$L_{WR,j,m} = A_{R,j,m} + B_{R,j,m} \times \lg\left(\frac{v_m}{v_{ref}}\right) + \Delta L_{WR,j,m}(v_m)$$

$$L_{WP,j,m} = A_{P,j,m} + B_{P,j,m} \times \frac{(v_m - v_{ref})}{v_{ref}} + \Delta L_{WP,j,m}(v_m)$$

Sound power (W) emission

Flow, average speed, and i-th vehicle contribution

I-th Rolling (R) noise	i-th Propulsion (P) noise
Vehicle category (5 categories)	
Speed	
Road surface	
Driving conditions (acc)	Driving cond.(acc, grad)
Tyres and temperature	
Age of pavement (?)	

$$\Delta L_{WR,j,m}(v_m) = \Delta L_{WR,road,j,m}(v_m) + \Delta L_{studded\ tyres,j,m=1}(v_m) + \Delta L_{WR,acc,j,m} + \Delta L_{W,temp}(\tau)$$

$$\Delta L_{WP,j,m}(v_m) = \Delta L_{WP,road,j,m}(v_m) + \Delta L_{WP,acc,j,m} + \Delta L_{WP,grad,j,m}(v_m)$$

WHERE ARE WE GOING NOW?

Museo Nazionale della Magna Grecia- Reggio Calabria-Italy

MAIN PARAMETERS OF THE PROJECT AND GANTT CHART

Action		2019				2020				2021				2022				2023				2024			
Action numbe	Name of the action	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
A. Preparatory actions (if needed)																									
A.1	Electric vehicles and their noise emission			■	■	■																			
A.2	Quiet pavement technologies and their performance over time			■	■	■																			
A.3	Tyre role in the new context of EV and ICEV			■	■	■																			
B. Implementation actions (obligatory)																									
B.1	Tracks design				■	■	■	■	■	■															
B.2	Tyre-pavement coupling study and prototype implementation			■	■	■	■	■	■	■	■	■													
B.3	Pilot area: Implementation. Replication and tranferability						■	■	■	■	■	■	■	■	■	■	■	■							
B.4	Track efficiency tests in the pilot area							■	■	■	■	■	■	■	■	■									
B.5	Soundscape analysis			■	■	■	■	■	■	■	■	■	■	■											
B.6	Evaluation of EV noise emissions							■	■	■	■	■	■	■	■	■									
B.7	Holistic performances of tyres			■	■	■	■	■	■	■	■	■	■	■	■	■	■								
C. Monitoring of the impact of the project actions (obligatory)																									
C.1	Monitoring of the impact of the project actions			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
C.2	Life cycle analysis (LCA) and life cycle costing (LCC)			■	■	■	■	■	■	■	■	■	■	■	■	■	■								
D. Public awareness and dissemination of results (obligatory)																									
D.1	Information and awareness raising activities			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
D.2	Technical dissemination activities to stakeholders			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
E. Project management (obligatory)																									
E.1	Coordination, Monitoring and Project management			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
E.2	After LIFE Plan																■	■							

July, 1st

March, 31st

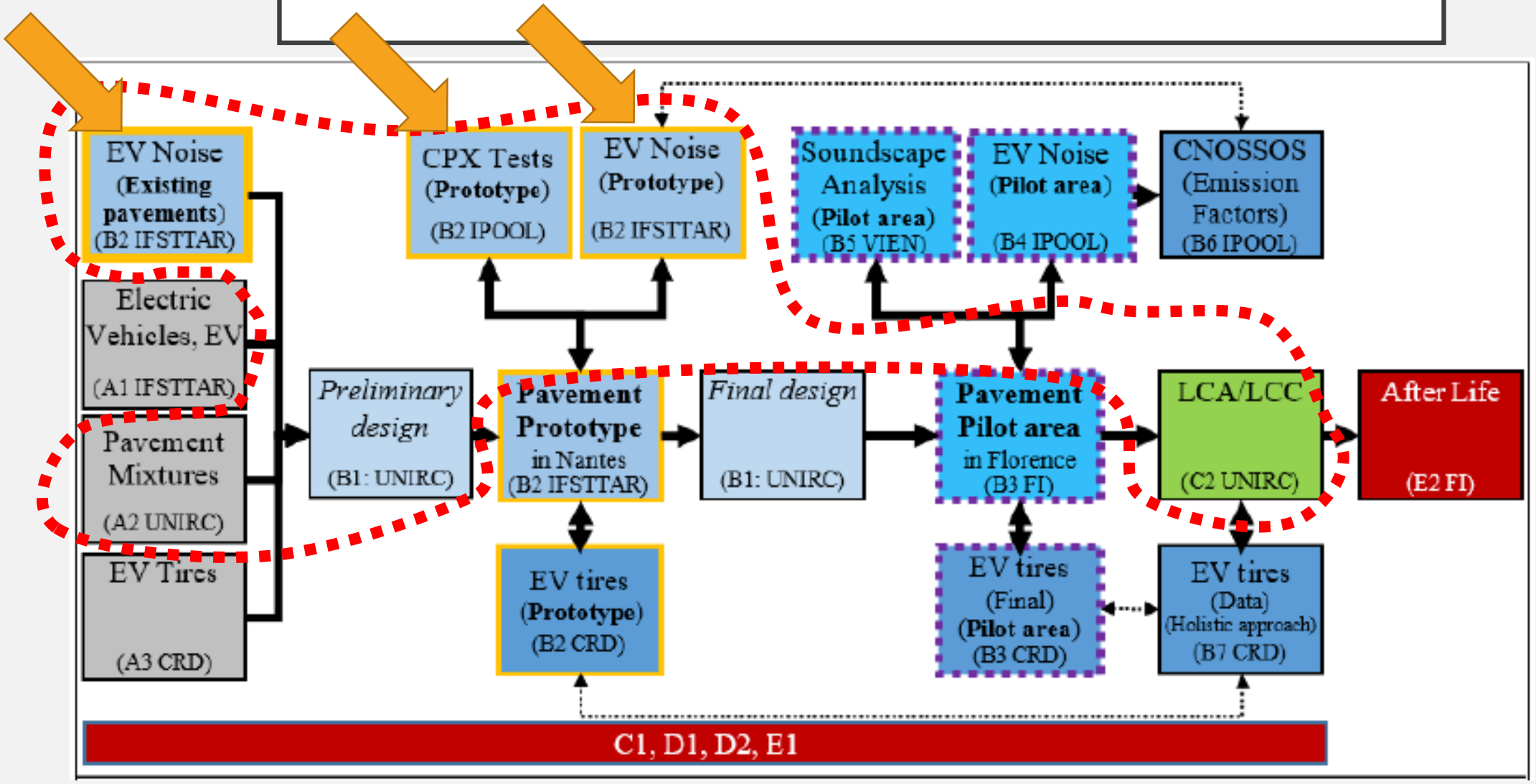
BENEFICIARY RESPONSIBLE FOR IMPLEMENTATION AND INTERACTIONS

- **Project:**
  - **UNIRC (IFSTTAR, IPOOL**):
  - UNIRC gathers and structures available references in the pursuit of the following actions (mainly B1 and C2).
  - IFSTTAR and IPOOL provide advice, support and references **for tyre-pavement interaction (IFSTTAR)** and noise-related issues (IPOOL).
- Actually: Being B2 prodromal to B1 and being this latter studied also in A2, A2 interacts with B2, too

ACTIONS CONNECTED-CONTINUED

- **B2➔B1: Tracks design**. B1 aims at selecting mixtures (volumetrics, materials, and surface texture), for the tracks to be constructed in France and Italy, in order to minimize noise from EV, taking into account the synergy with actions B2. [UNIRC]. B1. Milestone deadline: 31/01/2021?. Report deadline: 31/03/2020? : 31/03/2021?.
- **C2: Life cycle analysis (LCA) and life cycle costing (LCC).** These analyses will evaluate track efficiency from a comprehensive point of view, including soundscape components (B5), thus achieving obj.6 of demonstrating the durability and effectiveness through LCA/LCC. [UNIRC]. C2 Report: deadline: 02/2023 (28/02/2023)?

FLOWCHART


EV Noise (Existing pavements) (B2 IFSTTAR)
Electric Vehicles, EV (A1 IFSTTAR)
Pavement Mixtures (A2 UNIRC)
EV Tires (A3 CRD)
CPX Tests (Prototype) (B2 IPOOL)
EV Noise (Prototype) (B2 IFSTTAR)
Soundscape Analysis (Pilot area) (B5 VIEN)
EV Noise (Pilot area) (B4 IPOOL)
CNOSSOS (Emission Factors) (B6 IPOOL)
Preliminary design (B1: UNIRC)
Pavement Prototype in Nantes (B2 IFSTTAR)
Final design (B1: UNIRC)
Pavement Pilot area in Florence (B3 FI)
LCA/LCC (C2 UNIRC)
After Life (E2 FI)
EV tires (Prototype) (B2 CRD)
EV tires (Final) (Pilot area) (B3 CRD)
EV tires (Data) (Holistic approach) (B7 CRD)
C1, D1, D2, E1

ACTION A2 - QUIET PAVEMENT TECHNOLOGIES AND THEIR PERFORMANCE OVER TIME-REPORT CONTENTS

1. Main parameters of the project and of A2
2. Solutions in the literature (including CR-based ones)
3. Analysis solution-by-solution (Acoustic performance and durability (including preliminary tests); Non-acoustic performance and durability; Corresponding mixture composition; Corresponding agency and user costs)
4. Comparative analyses
5. Raw materials and processes involved and their impact on environmental indicators
6. Research and industrial areas and elements to enhance the formula/processes
7. Their compatibility and perspectives when analysed in terms of 2015/996/EC directive, CNOSSOS-EU mod
8. Their compatibility and perspectives when compared to the transition from the actual spectrum of traffic to a new scenario in which EVs will be an outstanding percentage
9. B2: lesson learned to date and how they impact track design
10. Other emerged issues and perspectives
11. How this report compares to the as-design report stated in the proposal
12. Conclusions (scientific and practical bases to design the tracks)
13. References

(SOME!) REFERENCES

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John W. Brennan, **Timothy E. Barder, Battery Electric Vehicles vs. Internal Combustion Engine Vehicles,** *A United States-Based Comprehensive Assessment*

Action A2

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21th February 2020

“A «low-noise» road surface provide a noise reduction of about 3dB(A) compared with the most common used one”
Sandberg, Tyre/road noise reference book, 2002

The acoustic performances of low-noise pavements over time are specified in the technical report: “Revision of Green Public Procurement Criteria for Road Design, Construction and Maintenance” – Technical report and criteria proposal; EUR 28013 EN June 2016

GPP Lcpx values

At production (within 3 months)

- 90 dB(A) @ 50 km/h,
- 95 dB(A) @ 70 km/h,
- 98 dB(A) @ 90 km/h.

Durability (within 5 years)

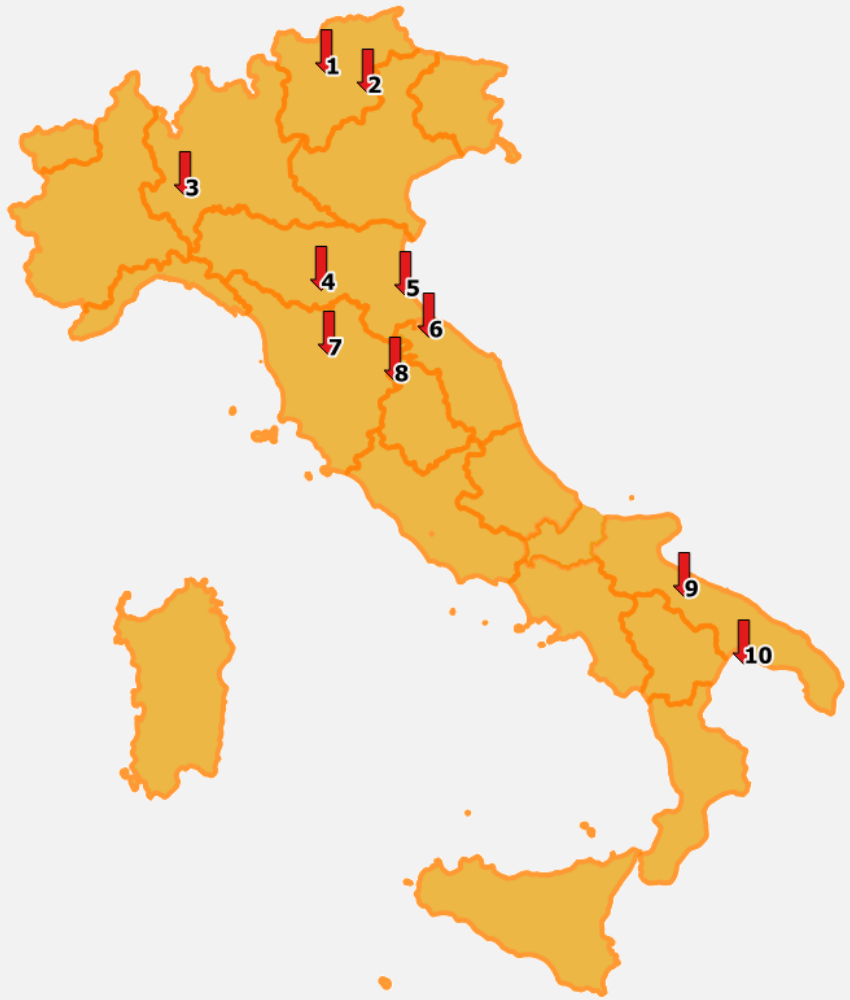
- 93 dB(A) @ 50 km/h
- 98 dB(A) @ 70 km/h
- 101 dB(A) @ 90 km/h.

RUBBERIZED ROAD SURFACES AS MITIGATION ACTION

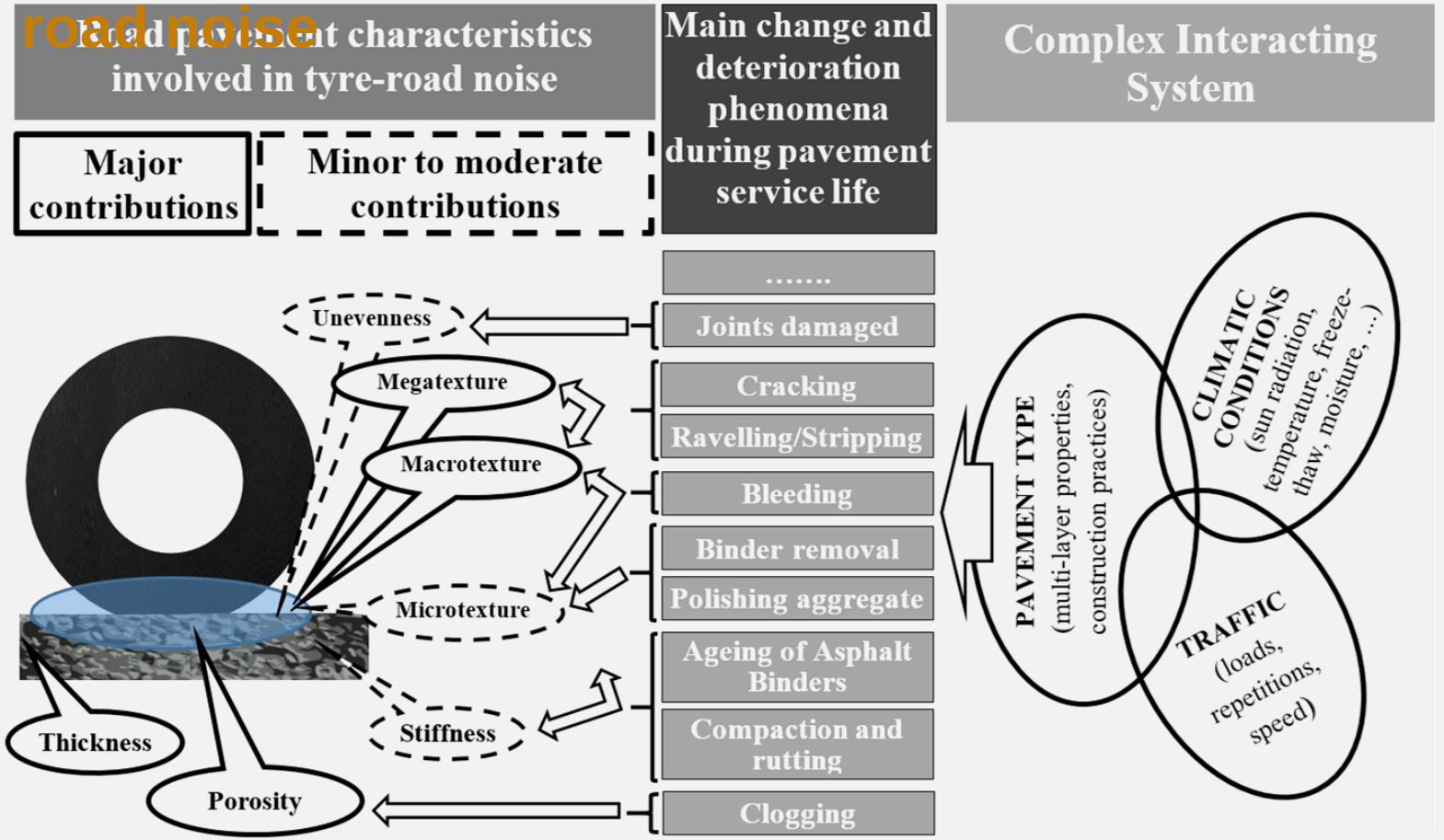
In its previous research experiences, IPOOL has surveyed over time several rubberized road surfaces laid in different sites located in Italy.

Results obtained on each surface allowed comparisons and research on specific topics.

Several research papers have been published on specific international journals or presented in international congresses.

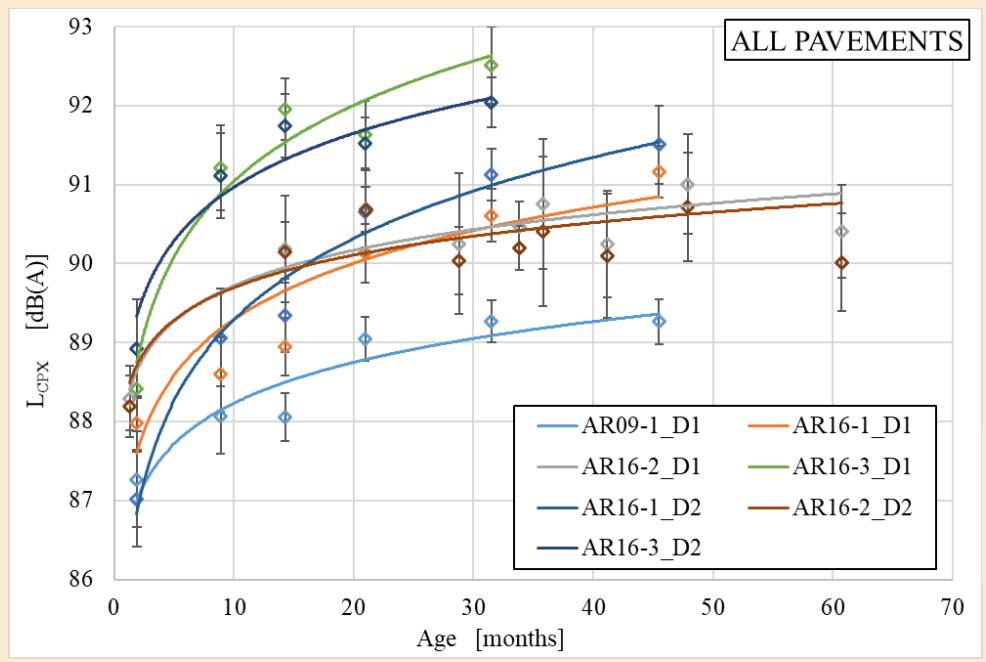


Road pavement characteristics involved in tyre-road noise



G. Licitra, A. Moro, L. Teti, A. Del Pizzo, F. Bianco (2019). "Modelling of acoustic ageing of rubberized pavements". Applied Acoustics 146 (2019) pp. 237–245.

Acoustic ageing trends of rubberized road surfaces



The best model resulted to be the logarithmic one.

$$L_{CPXi} = Y_{0i} + \alpha_i * ln\left(\frac{1+A}{A_0}\right) + \alpha_T \Delta T + \alpha_H \Delta H$$

The coefficient α_i refers to a set of three factors: **pavement type**, **traffic actions** and **climatic parameters**.

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Action B1

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21th February 2020

EXPERIMENTS/ACTIVITIES IN PROGRESS AT UNIRC AS OF FEBRUARY, 2020

- Main actions concerned:
- **A2 (leader)**
- **B1 (leader)**
- **C2 (leader)**

Action		2019				2020				2021				2022				2023				2024			
Action numbe	Name of the action	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
A. Preparatory actions (if needed)																									
A.1	Electric vehicles and their noise emission			■	■	■																			
A.2	Quiet pavement technologies and their performance over time			■	■	■																			
A.3	Tyre role in the new context of EV and ICEV			■	■	■																			
B. Implementation actions (obligatory)																									
B.1	Tracks design				■	■	■	■	■	■															
B.2	Tyre-pavement coupling study and prototype implementation			■	■	■	■	■	■	■	■	■													
B.3	Pilot area: Implementation. Replication and tranferability						■	■	■	■	■	■	■	■	■	■	■	■							
B.4	Track efficiency tests in the pilot area						■	■	■	■	■	■	■	■	■	■									
B.5	Soundscape analysis			■	■	■	■	■	■	■	■	■	■	■											
B.6	Evaluation of EV noise emissions						■	■	■	■	■	■	■	■	■	■									
B.7	Holistic performances of tyres			■	■	■	■	■	■	■	■	■	■	■	■	■	■								
C. Monitoring of the impact of the project actions (obligatory)																									
C.1	Monitoring of the impact of the project actions			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
C.2	Life cycle analysis (LCA) and life cycle costing (LCC)			■	■	■	■	■	■	■	■	■	■	■	■	■	■								
D. Public awareness and dissemination of results (obligatory)																									
D.1	Information and awareness raising activities			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
D.2	Technical dissemination activities to stakeholders			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
E. Project management (obligatory)																									
E.1	Coordination, Monitoring and Project management			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
E.2	After LIFE Plan																■	■							

EXPERIMENTS IN PROGRESS AT UNIRC AS OF FEBRUARY, 2020

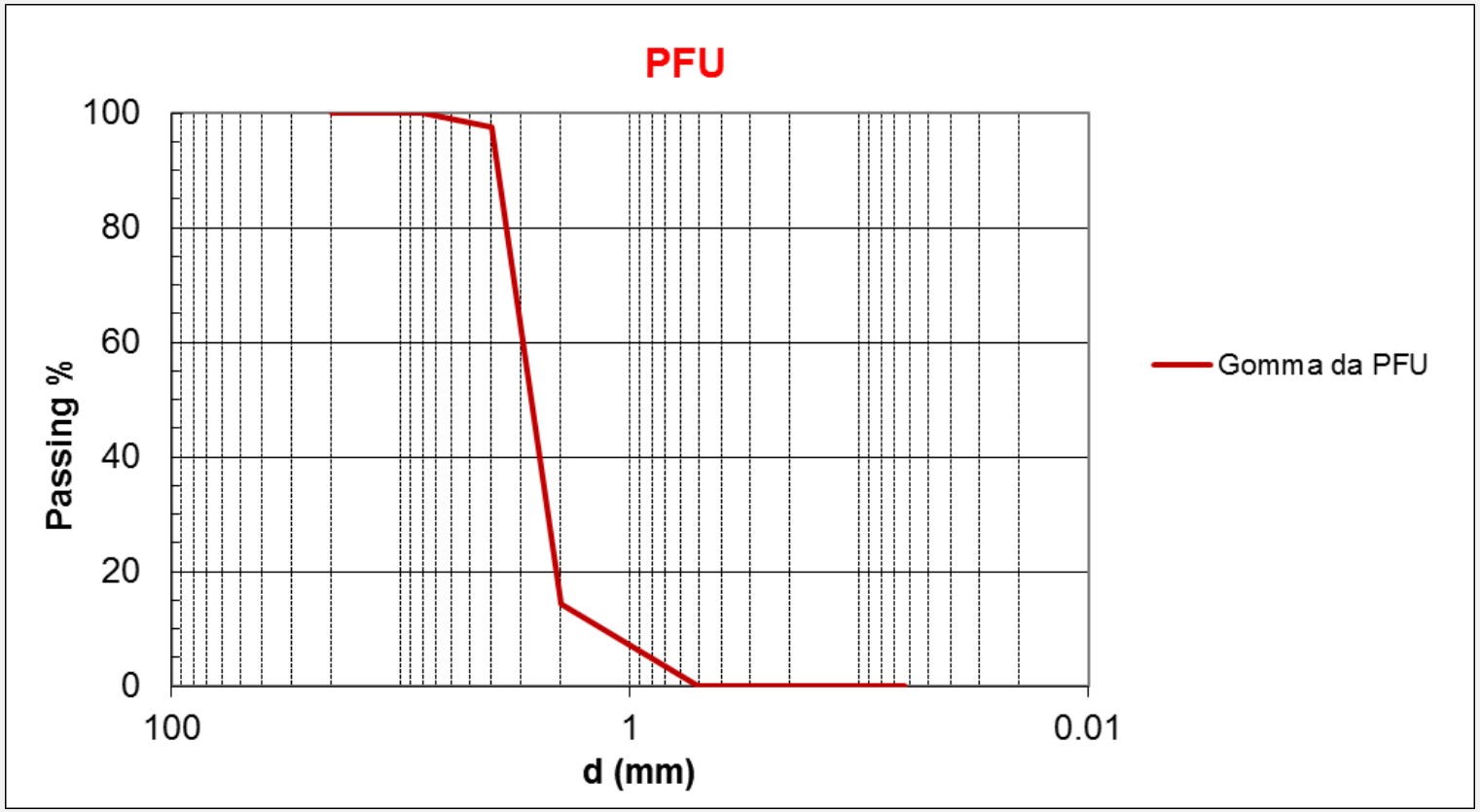
A2 (leader)
B1 (leader)

Summary.

- Two mixes were designed at UNIRC.
- The first mix is made up with traditional aggregates.
- The second mix contains crumb rubber.
- The mix design focused on gradation and asphalt binder percentage.
- The mixes were produced and compacted through a giratory compactor.
- The mixes were investigated by referring to non-destructive properties.
- Each sample is going to be cut into three parts.
- On the top, the middle, and the bottom of each sample other test will be carried out.

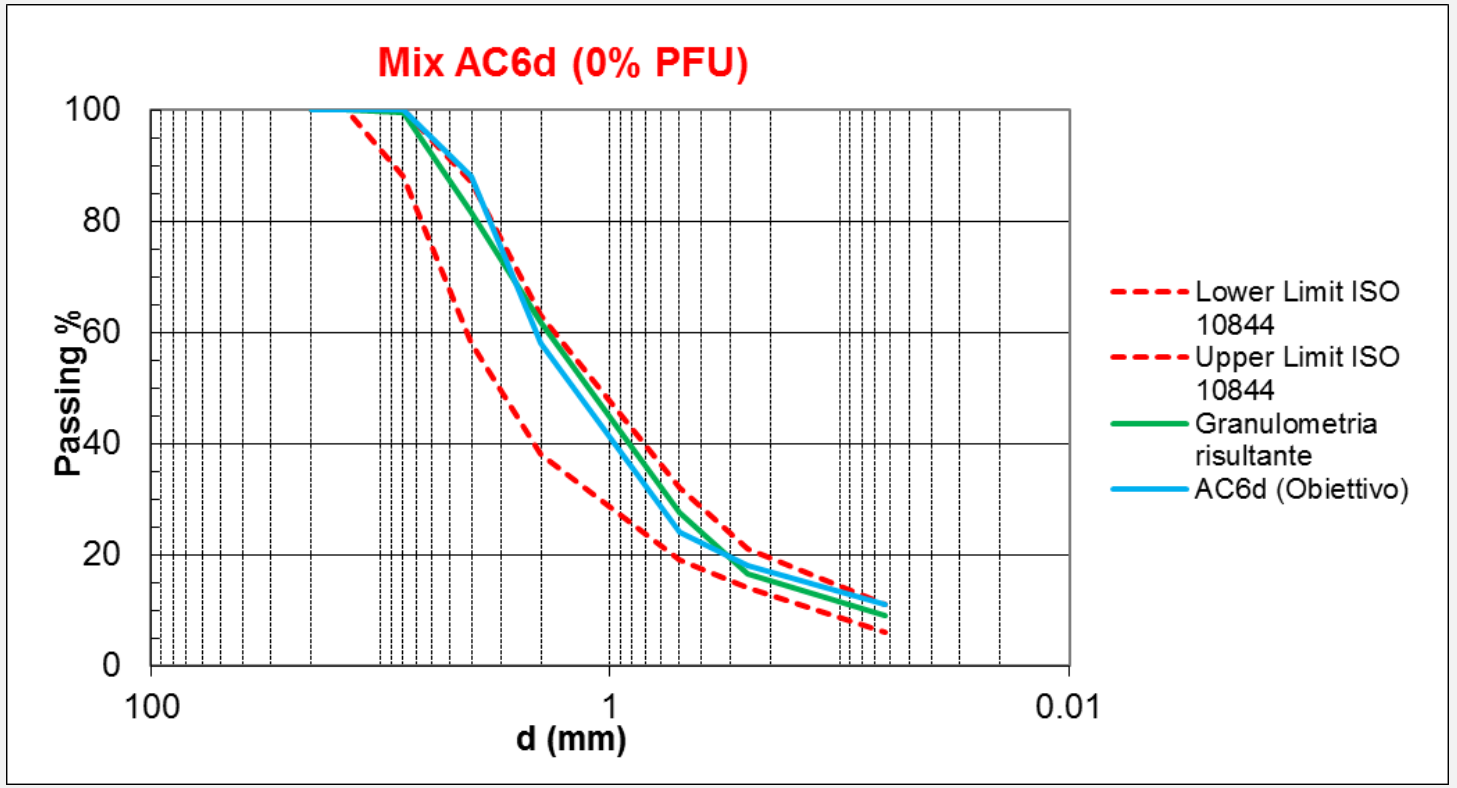
EXPERIMENTS IN PROGRESS AT UNIRC - EXAMPLE OF CRUMB RUBBER GRADATION

A2 (leader)
B1 (leader)



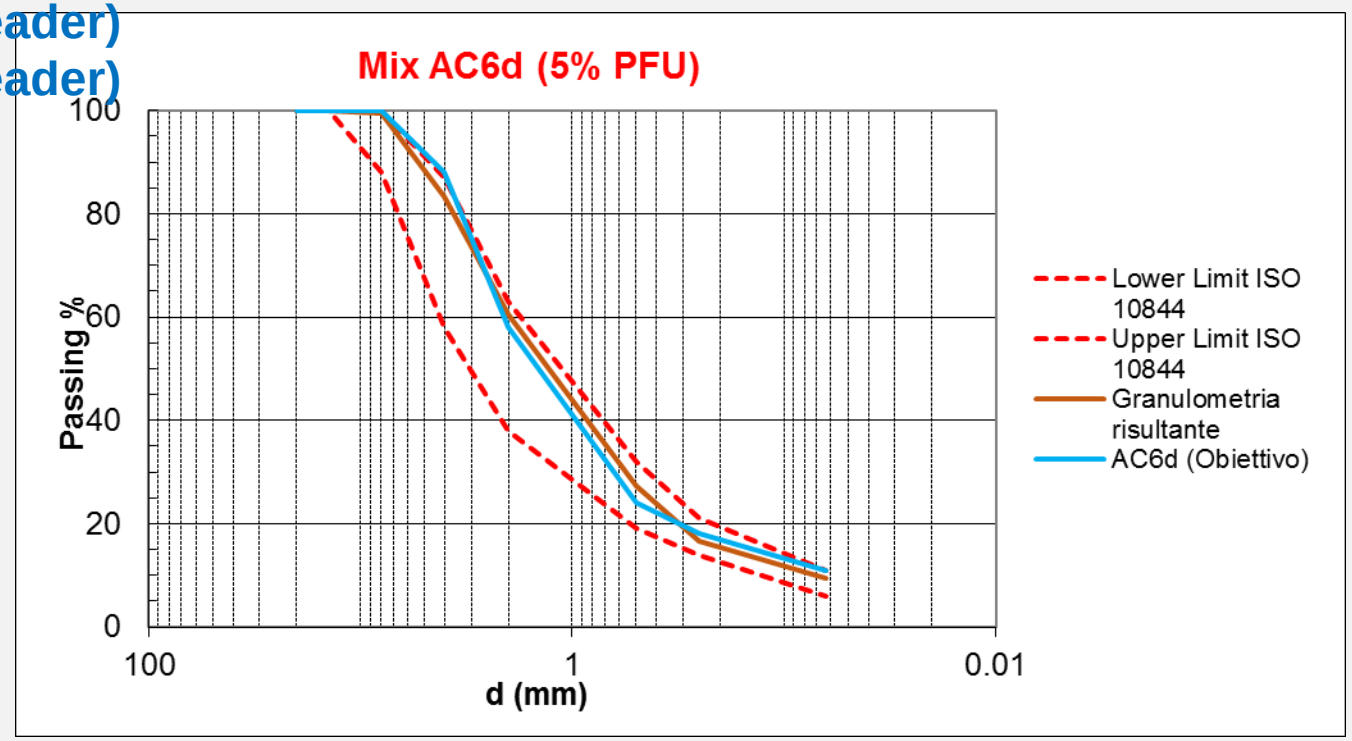
EXPERIMENTS IN PROGRESS AT UNIRC - EXAMPLE OF AGGREGATE GRADATION (0%CR)

A2 (leader)
B1 (leader)



EXPERIMENTS IN PROGRESS AT UNIRC - EXAMPLE OF AGGREGATE GRADATION (5%CR=PFU)

A2 (leader)
B1 (leader)

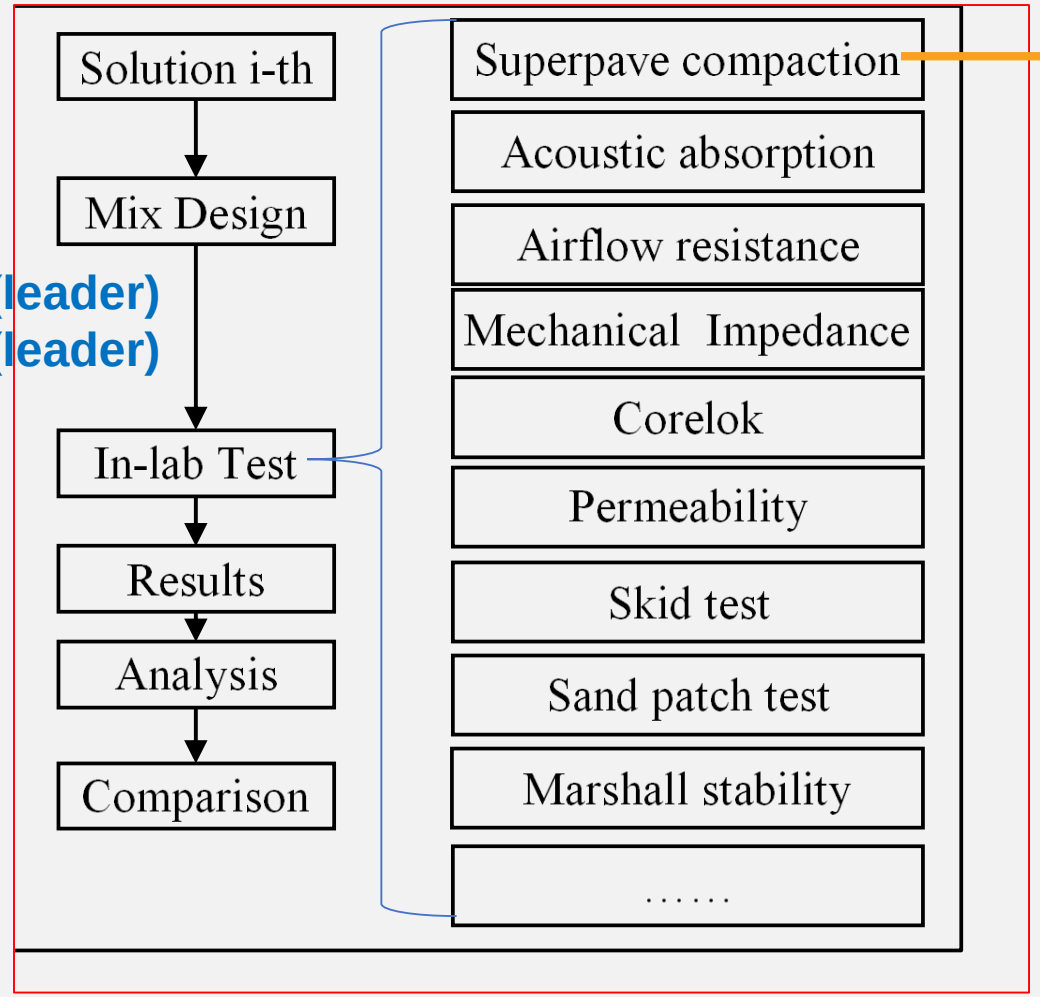


Preliminary experiments -Samples
AC6d_0 % PFU
AC6d_5 % PFU

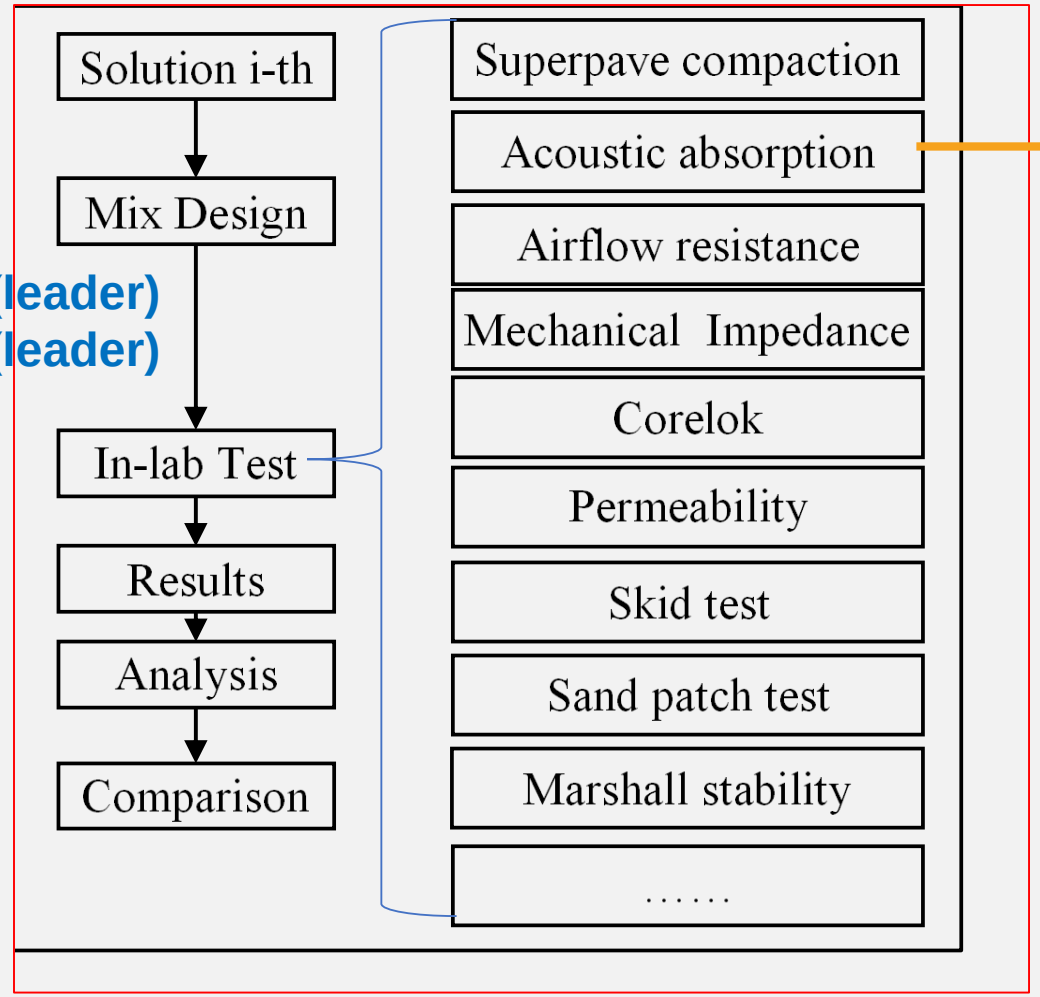
EXPERIMENTS IN PROGRESS AT UNIRC - COMPONENTS

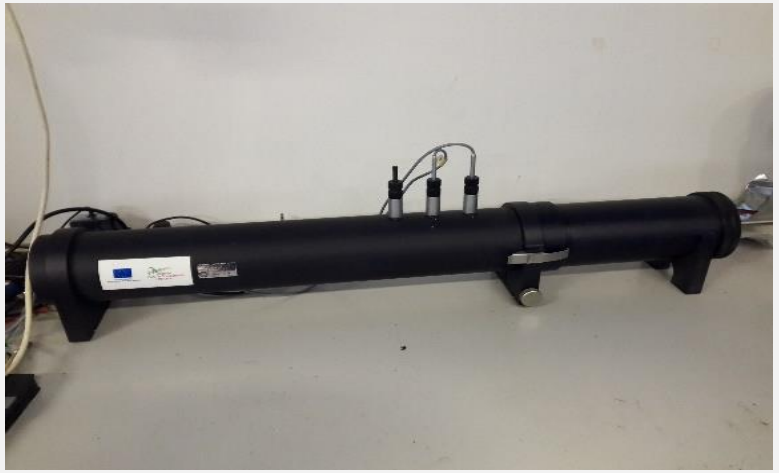
A2 (leader)
B1 (leader)

EXPERIMENTS IN PROGRESS AT UNIRC - PLAN OF EXPERIMENTS



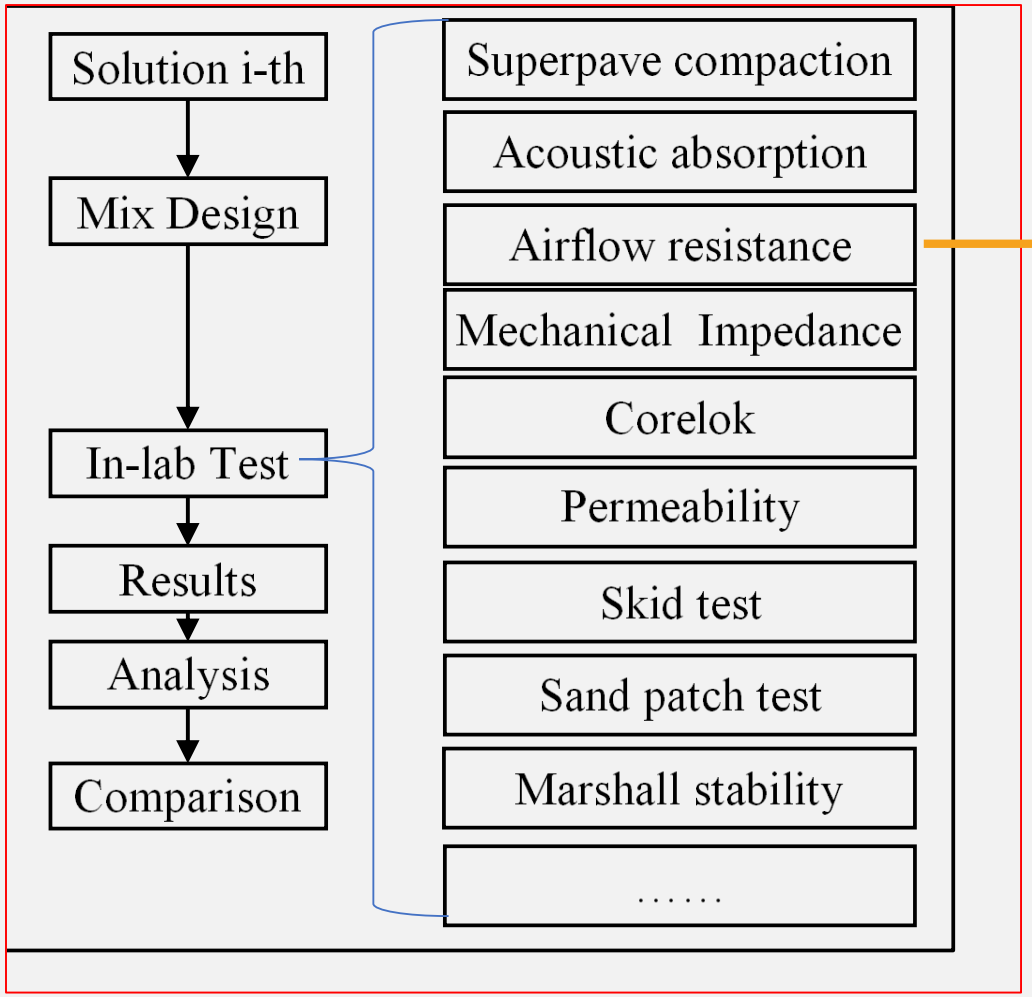
EXPERIMENTS IN PROGRESS AT UNIRC
AIRFLOW RESISTANCE





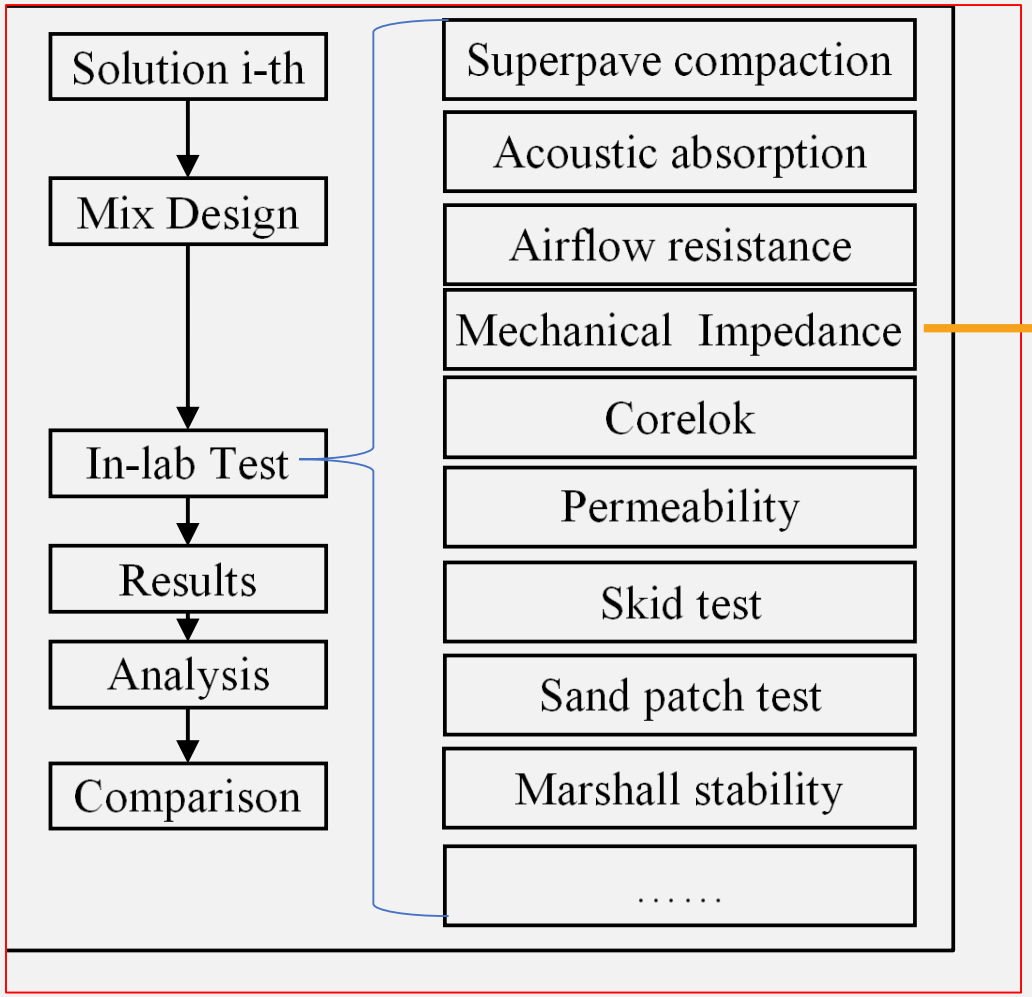
A2 (leader)
B1 (leader)

EXPERIMENTS IN PROGRESS AT UNIRC
AIRFLOW RESISTANCE



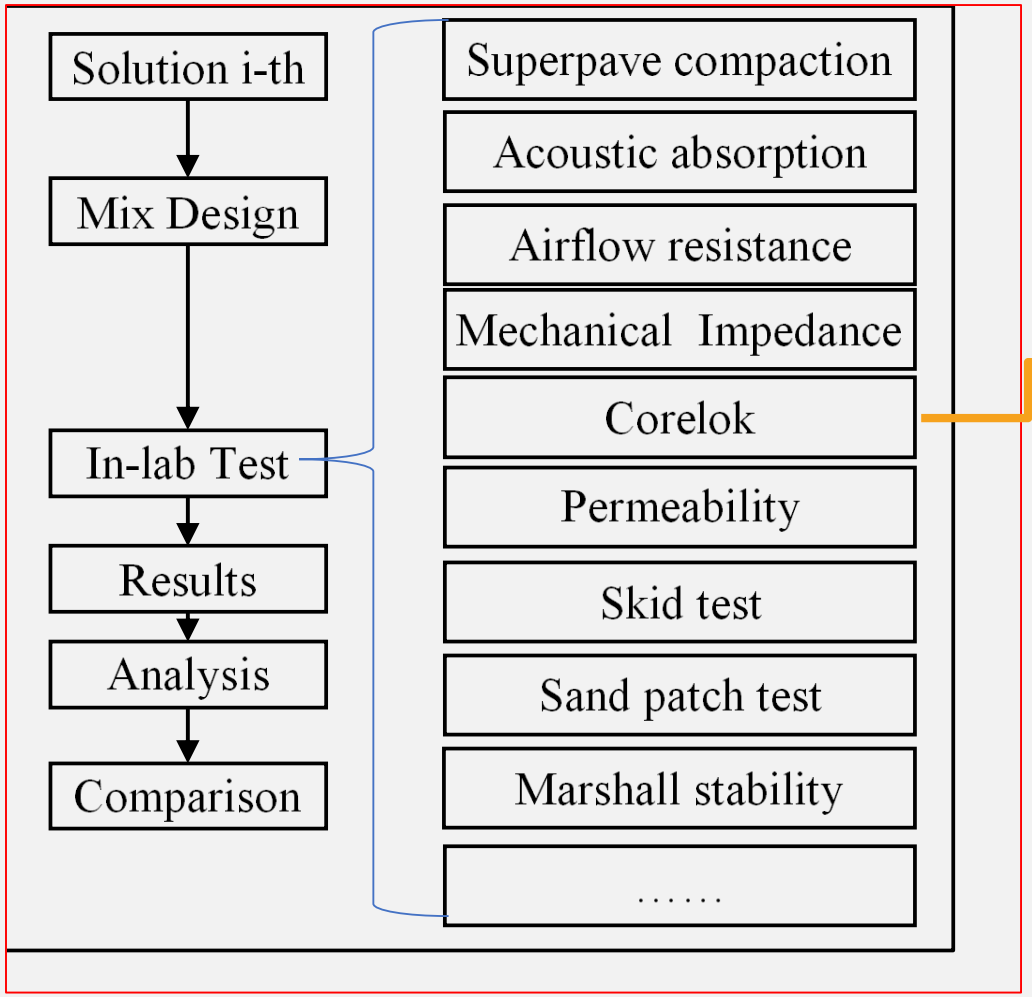
A2 (leader)
B1 (leader)

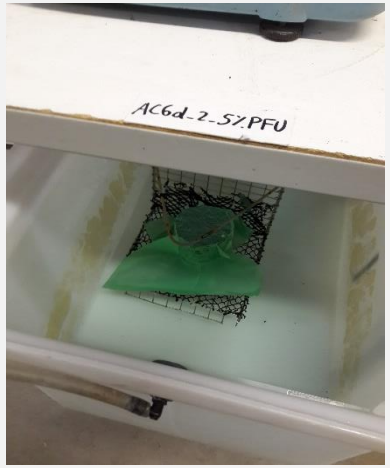
EXPERIMENTS IN PROGRESS AT UNIRC
AIRFLOW RESISTANCE



A2 (leader)
B1 (leader)

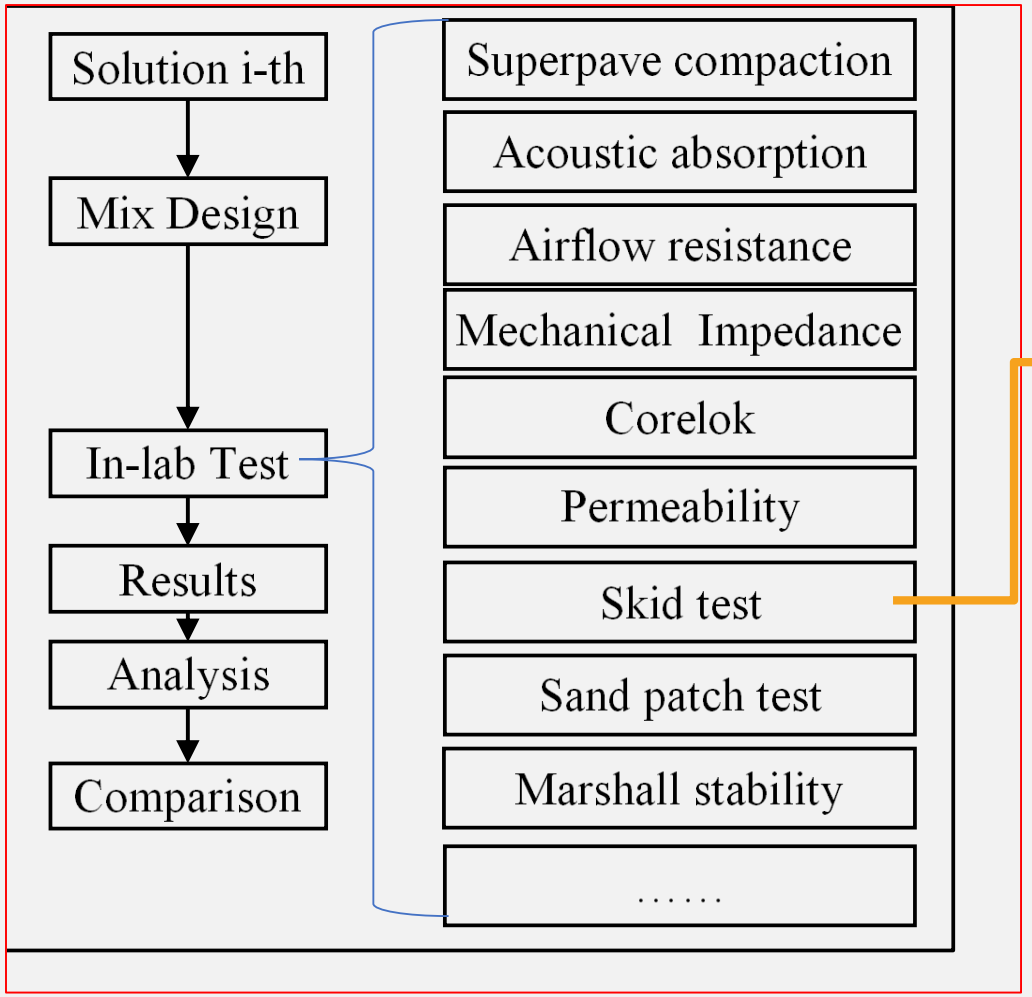
EXPERIMENTS IN PROGRESS AT UNIRC CORELOK MEASUREMENTS





A2 (leader)
B1 (leader)

EXPERIMENTS IN PROGRESS AT UNIRC CORELOK MEASUREMENTS



Action C2

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EXPERIMENTS AND STUDIES IN PROGRESS AT UNIRC

C2 (Leader)

sustainability

MDPI

Article

Energy and Environmental Life Cycle Assessment of Sustainable Pavement Materials and Technologies for Urban Roads

Filippo G. Praticò [1], Marinella Giunta [2,*], Marina Mistretta [3] and Teresa Maria Gulotta [4]

Funding: The authors would like to thank all who sustained them with this research, especially the European Commission for its financial contribution to the LIFE18 ENV/IT/000201 LIFE E-VIA Project into the LIFE2018 programme.

EXPERIMENTS AND STUDIES IN PROGRESS AT UNIRC

C2 (Leader)

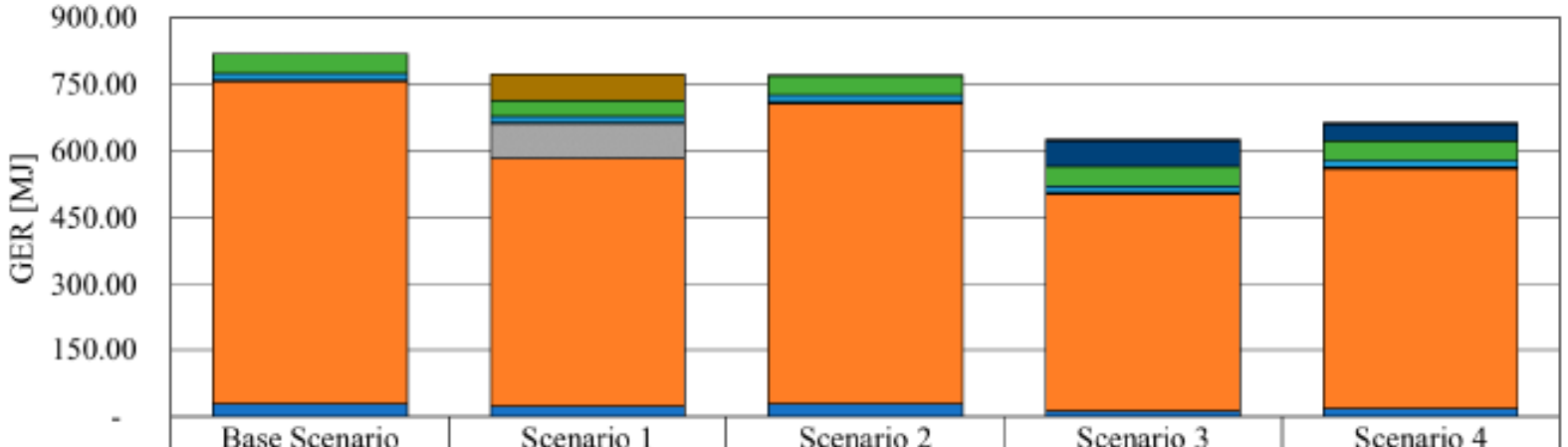
Table 1. Scenarios and materials.

	Scenarios				
	Base	**1**	**2**	**3**	**4**
FC	**PA** AV 18% AG FIL Modified BIT (5% by mix weight) 5% SBS QL FIB	**PWMA** AV 18% AG FIL BIT (5% by mix weight) CR (10% by mix weight) WP (10% by mix weight) QL FIB	**PWMA** AV 18% AG FIL Modified BIT (5% by mix weight) 5% SBS QL FIB Z (0.5% by bitumen weight)	**PWMA** AV 18% AG (45% RAP) FIL Modified BIT (5% by mix weight) 5% SBS QL FIB Z (0.5% by bitumen weight)	**PWMA** AV 18% AG (30% RAP) FIL Modified BIT (5% by mix weight) 5% SBS QL FIB Z (0.5% by bitumen weight)
BC	**DMA** AV 6% AG BIT (5% by mix weight)	**DMA** AV 6% AG FIL BIT (5% by mix weight)	**DWMA** AV 6% AG FIL modified BIT (5% by mix weight) 5% SBS QL Z (0.5% by bitumen weight)	**DWMA** AV 6% AG (45% RAP) FIL modified BIT (5% by mix weight) 5% SBS QL Z (0.5% by bitumen weight)	**DWMA** AV 6% AG (30% RAP) FIL modified BIT (5% by mix weight) 5% SBS QL Z (0.5% by bitumen weight)
UBC	AG	AG	AG	AG 45% RAP	AG 30% RAP

Symbols (see Nomenclature).

EXPERIMENTS AND STUDIES IN PROGRESS AT UNIRC

C2 (Leader)



	Base Scenario	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Z	-	-	1.35	1.35	1.35
WP	-	-	-	-	-
WAT	-	58.04	-	-	-
SBS	0.02	-	0.02	0.02	0.02
REJ	-	-	-	1.72	1.15
RAP	-	-	-	57.47	36.84
QL	44.57	35.84	44.50	44.44	44.66
FIL	14.67	14.22	14.67	14.99	14.88
FIB	2.73	2.29	2.93	2.72	2.73
CR	-	78.14	-	-	-
BIT	728.77	560.11	679.92	490.57	542.57
AG	27.89	23.43	27.92	13.10	18.11

Figure 1. GER of materials production in each scenario (MJ/m^2).

LIFE E-VIA PROJECT

I MONITORING MEETING

21 February 2020

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Ingegneria

Contribution for:

- C1 Action - Monitoring

Action C1 – Monitoring of the impact of project actions Objectives

- 1) Reduction of greenhouse gas emissions (GHG) - A reduction of 29 tons/year of CO2 is estimated. This is due to the progressive transition towards electric and hybrid vehicles in the Italian context and to the use of improved tyres. (32 tons/year 3 years after project end)
- 2) Air quality and emissions - A reduction of 4000 grams/year of PM is estimated, due to the progressive transition towards Evs in the Italian context. (7300 grams/year 3 years after project end)
- 3) Waste management - It is estimated to save 2.4 tons per year of tyres due to the recycling of CR into the friction course and, consequently, to save 200 m3 of landfills per each maintainance cycle.
- 4) Reduced resource consumption (excluding energy) - It is estimated to save 0.1 tons/year of mineral aggregates due to the use of crumb rubber in friction course mixture.
- 5) Communication, dissemination, awareness rising - It is estimated that **20000 (35000 years after project end) entities/individuals will be reached/made aware of the project's outcomes**. The estimation has been based on the experience made by partners on previous LIFE projects and it is based on the several initiatives that are planned to be organized during the project (mainly the EV Festival and the participation to the International Noise Awareness Day). Data about awareness raising will be collected during Action D1 by considering the number of citizens taking part in the several foreseen initiatives.
- It is estimated to have **70000 (170000 3 years after project end) website's visits**, basing on the experience made by partners on previous LIFE projects (data about the website visits will be collected during Action D1).
- Finally, it is estimated that **2000 (5000 3 years after project end) people will change their behaviour concerning EVs** based on the hypothesis that, thanks to the activities to be carried out during D actions and to the letters of support sent to the project coordinator, there will be a changing in the citizens' behaviour in terms of sensibilization to EV and possibly purchasing of an EV in case of need to change their private or business car.

Action C1 – Monitoring of the impact of project actions Objectives

- 6) Noise performance indicators –
- - LDEN/Lnight: the estimation of noise exposure at receivers living by the roadside of the mitigation action will be evaluated within action B6. It is expected to have 5 dBA less than without mitigation at the end of the project and to have still a 3 dBA decrease compared to current values 3 years after project end.
- - LCPX: the measurements carried out within action B4 will allow the evaluation of track efficiency in terms of road/tyre noise. It is expected to have values lower than 90 dBA as required by GPP as initial value after the implementation of new surface. After 3 years a value not greater than LCPX initial value + 2 dB(A) is required by GPP. The increase of EV fleet and the peculiarity of the developed surface might lead also to better values.
- - The number of people positively affected by the reduction of noise (reduction at least 5 dB(A)) at the end of the project is estimated in at least 2000 citizens, based on the evaluation of the number of residents in a buffer of 50 m from the Michelucci street's axis.
- 7) Soundscape improvement - **The improvement of acoustic perception and comfort of a noise-optimized asphalt with respect to a standard one is estimated in a 50% (70% 3 years after project end**). Similarly, **the improvement of acoustic perception and comfort of an EV with respect to a ICEV one is estimated in a 50% (70% 3 years after project end).** These estimations will be verified according to the analysis of the questionnaires that will be collected during the three sub-actions of Action B5.
- **Number of people directly positively affected by the reduction of noise is estimated in 2000 at the end of the project and 7000 3 years after project end**
- 8) Noise-related health effects - It is estimated to have a reduction of 29% in %HSD (Self-reported sleep disturbance), a reduction of 11% in relative risk for hypertension, a reduction of 14% in relative risk of myocardial infarction and a reduction of 25% in the percentage of highly-annoyed people. These are average figures, mainly based on the following primary sources: EEA Technical report No 11/2010; WHO Environmental Noise Guidelines For The European Region, 2018.

Action C1 – Monitoring of the impact of project actions

Activity	Goals	How to do it
Communication, dissemination, awareness rising	20000 (35000 years after project end) entities/individuals will be reached/made aware of the project's outcomes.	Registered participation in congresses, workshop, dissemination activities, meetings, mailing list with confirmation of reading, etc.
	70000 (170000 3 years after project end) website's visits	Counter on website
	2000 (5000 3 years after project end) people will change their behaviour concerning EVs	- Data about purchasing of Evs in Florence - Questionnaires on availability to change behaviour about EVs
Soundscape improvement	The improvement of acoustic perception and comfort of a noise-optimized asphalt with respect to a standard one is estimated in a 50% (70% 3 years after project end). Similarly, the improvement of acoustic perception and comfort of an EV with respect to a ICEV one is estimated in a 50% (70% 3 years after project end).	Questionnaires results
	Number of people directly positively affected by the reduction of noise is estimated in 2000 at the end of the project and 7000 3 years after project end	Questionnaires results

LIFE18 ENV/IT/000201

LIFE E-VIA PROJECT

I MONITORING MEETING

21 February 2020

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Responsible of:

- B5 Action (Soundscape analysis)
- D1, D2 Actions (Dissemination)

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Action B5

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B5.1 Soundwalks and interview during the EV festival
B5.2 Interview in the pilot road on an electric taxi
B5.3 Interview on EV concerning different road pavements

On going state of the art analysis:

- to define the questionnaires structure based on the users' category

- about most recently adopted techniques to organize and guide soundwalks (according to recent carried out projects, events, initiatives, …)

- Inputs from Action A1: methods of investigation, questionnaire's structure

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Action D1

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Project's logo

4 initial proposals

1

2

3

4

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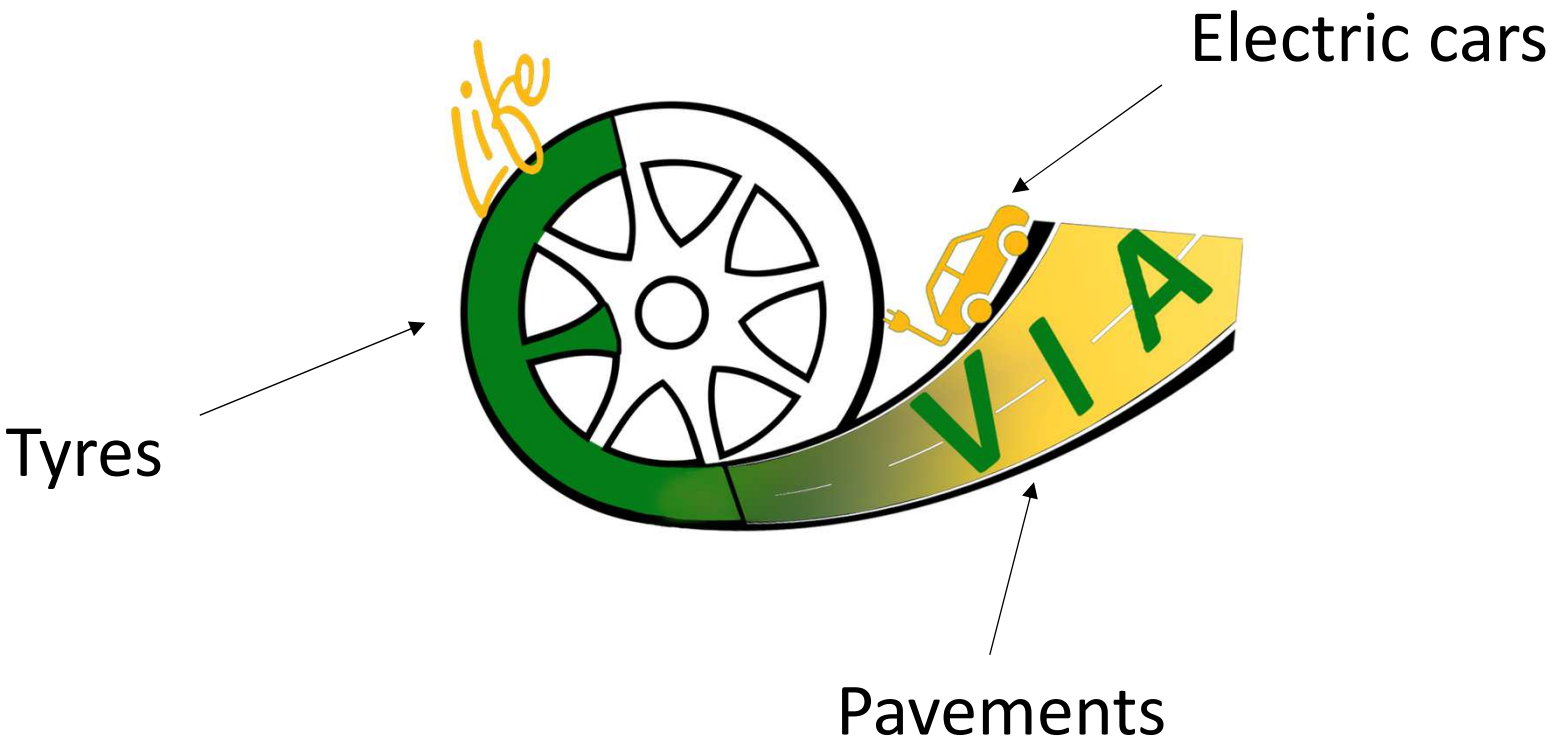
Project's logo

The definitive one



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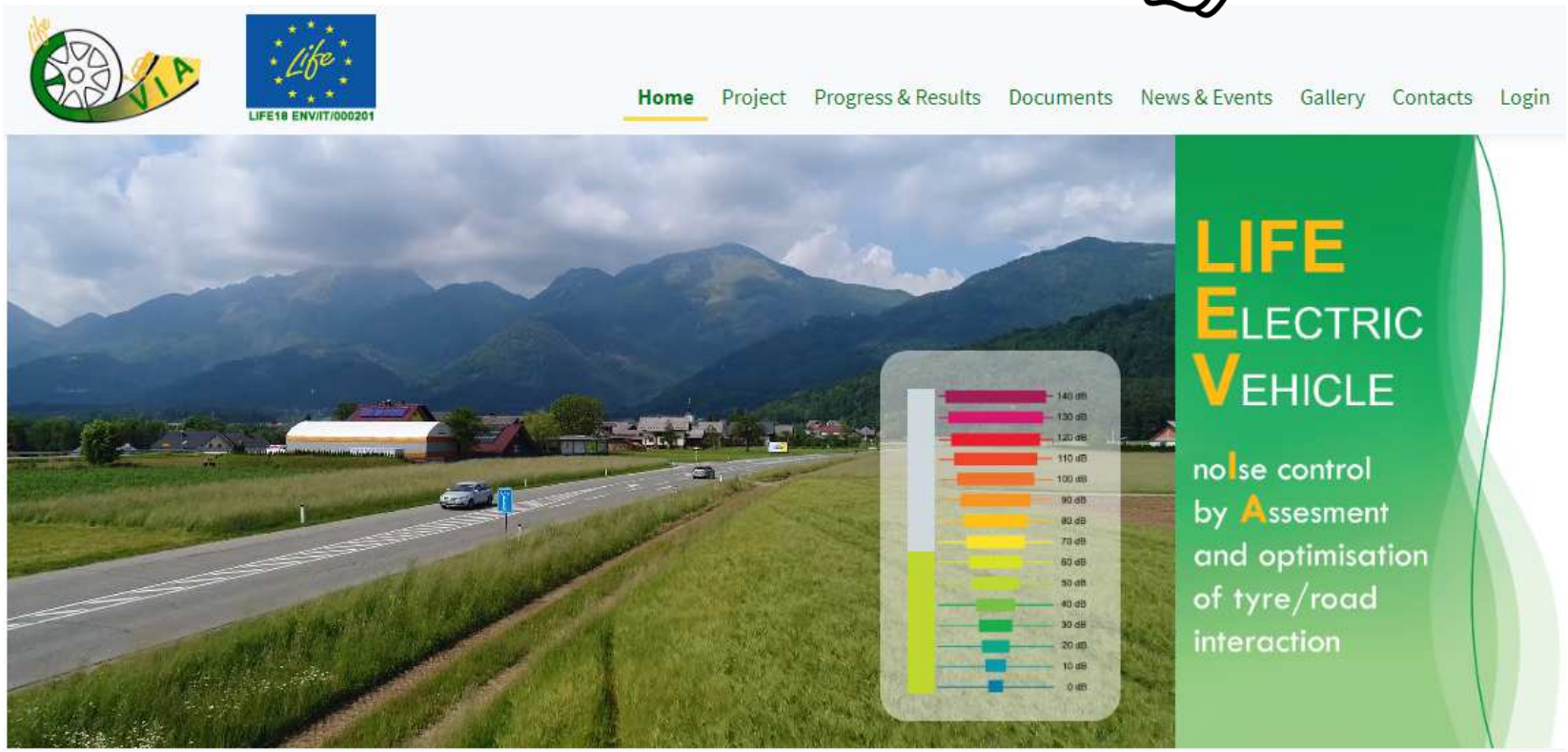
Website

The link

http://life-evia.eu/



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Website

The architecture

- **«Home page»**: LIFE/project/partners logos, project's description, news and events (the last three in evidence), related links to other projects or initiatives, links to social networks
- **«Project»**: description, objectives, foreseen actions, expected results, actions' description
- **«Progress and Results»**: Gantt chart, list of deliverables, list of milestones, progress of single actions (planned starting/ending date, actual starting/ending date, percentage of completion, …)
- **«Documents»**: publications, deliverables, reports, presentations
- **«News and events»**: last news in evidence and archive organized with monthly folders
- **«Gallery»**: photos and brief description of dissemination events
- **«Contacts»**: references of people involved in the project for each partner (email address, office phone number)
- **"Reserved area"** for partners

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Website

The management

The LIFE E-VIA website has been designed by Smarts S.r.l. (external contracting) with inputs and contents assistance provided by Vie en.ro.se Ingegneria and project's partners in order to respect specifications indicated in the project.

A back-end service is available, and online lessons have been organized between Smarts S.r.l. and Vie en.ro.se, so that Vie en.ro.se can be autonomous in:

- Managing website registrations and decide users' role (manager/simple user)
- Uploading documents/pictures
- Adding and editing news/events
- Updating project's results
- Changing logos, etc.

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Dissemination Plan

The structure

TYPE OF ACTION	DELIVERABLES	CODE
Dissemination products	Dissemination Plan	DP
	Life E-VIA Website	DP_W
	Noticeboard in English language	DP_NE
	Noticeboard in Italian language	DP_NI
	Noticeboard in French language	DP_NF
	Noticeboard in German language	DP_NG
	Scientific papers	DP_SP
	Articles for journal and magazine	DP_PA
	Report on yearly participation in INAD	DP_RI
	Layman's report	DP_RL
Promotion activities	Press conferences	PA_C
	Radio campaign	PA_RC
	Video of the prototype construction	PA_VP
	EV FESTIVAL video	PA_EV
Events	Final event	E_F
	Workshop	E_W
	Six-monthly meetings of the EUROCITIES	M_E

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Dissemination Plan

The timeline

LIFE E-VIA (LIFE18 ENV/IT/000201) DISSEMINATION PLAN

TYPE OF ACTION	DELIVERABLES	CODE	2019				2020												2021											
			9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Dissemination products	Dissemination Plan	DP																												
	Life E-VIA Website	DP_W				DP_W																								
	Noticeboard in English language	DP_NE						DP_NE_1 DP_NE_2																						
	Noticeboard in Italian language	DP_NI																												
	Noticeboard in French language	DP_NF																												
	Noticeboard in German language	DP_NG																												
	Scientific papers	DP_SP				DP_SP_1																								
	Articles for journal and magazine	DP_PA					DP_PA_1																							
	Report on yearly participation in INAD	DP_RI																												
	Layman's report	DP_RL																												
Promotion activities	Press conferences	PA_C																												
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	Video of the prototype construction	PA_VP																												
	EV FESTIVAL video	PA_EV																												
Events	Final event	E_F																												
	Workshop	E_W																												
	Six-monthly meetings of the EUROCITIES	M_E		M_E_1																										

TYPE OF ACTION	DELIVERABLES	CODE	2022												2023		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Dissemination products	Dissemination Plan	DP															
	Life E-VIA Website	DP_W															
	Noticeboard in English language	DP_NE															
	Noticeboard in Italian language	DP_NI															
	Noticeboard in French language	DP_NF															
	Noticeboard in German language	DP_NG															
	Scientific papers	DP_SP															
	Articles for journal and magazine	DP_PA															
	Report on yearly participation in INAD	DP_RI															
	Layman's report	DP_RL															
Promotion activities	Press conferences	PA_C															
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	Video of the prototype construction	PA_VP															
	EV FESTIVAL video	PA_EV															
Events	Final event	E_F															
	Workshop	E_W															
	Six-monthly meetings of the EUROCITIES	M_E															

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Dissemination Plan
Detailed activities

Dissemination Plan Ref.n.	Deadline	Code	Issued on	Description
1	01/09/2019			Dissemination plan
		DP_1	September 2019	Start of dissemination activities
2	01/12/2019			Life E-VIA Website
		DP_W	December 2019	Development and launch of LIFE E-VIA website www.life-evia.eu
3	01/12/2022			Noticeboard in English language printed in almost 100/300 copies each
		DP_NE_1	February 2020	LIFE E-VIA: objectives and actions
		DP_NE_2	February 2020	LIFE E-VIA: Roll-up
		DP_NE_3		
		DP_NE_4		
		DP_NE_5		
		DP_NE_6		
		DP_NE_7		
		DP_NE_8		
		DP_NE_9		
		DP_NE_10		
		DP_NE_11		
		DP_NE_12		
		DP_NE_13		
		DP_NE_14		
		DP_NE_15		
4	01/12/2022			Noticeboard in Italian language printed in almost 100/300 copies each
		DP_NI_1		
		DP_NI_2		
		DP_NI_3		
		DP_NI_4		
		DP_NI_5		
5	01/12/2022			Noticeboard in French language printed in almost 100/300 copies each
		DP_NF_1		
		DP_NF_2		
		DP_NF_3		
		DP_NF_4		
		DP_NF_5		

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Dissemination Plan
Detailed activities

Dissemination Plan Ref.n.	Deadline	Code	Issued on	Description
6	01/12/2022			Noticeboard in German language printed in almost 100/300 copies each
		DP_NG_1		
		DP_NG_2		
		DP_NG_3		
		DP_NG_4		
		DP_NG_5		
7	01/03/2023			Scientific papers to be presented in national'international congresses
		DP_SP_1	December 2019	Scientific contribution about the project in the EAI SmartCity 360° 2019 International Summit.
		DP_SP_2		
		DP_SP_3		
		DP_SP_4		
		DP_SP_5		
		DP_SP_6		
		DP_SP_7		
		DP_SP_8		
		DP_SP_9		
		DP_SP_10		
		DP_SP_11		
		DP_SP_12		
		DP_SP_13		
		DP_SP_14		
		DP_SP_15		
		DP_SP_16		
		DP_SP_17		
8	01/12/2022			Articles for journal and magazine
	open access journal	DP_PA_1	January 2020	Paper published on Open Access Sustainability 2020 about the sustainable pavement materials for the urban roads.
	open access journal	DP_PA_2		
	open access journal	DP_PA_3		
	international journal for dissemination of the obtained results	DP_PA_4		
	international journal for dissemination of the obtained results	DP_PA_5		
	top ranked journal	DP_PA_6		
	magazine EV festival	DP_PA_7		

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Dissemination Plan
Detailed activities

9	01/12/2022			Report on yearly participation in INAD
		DP_RI_1		
		DP_RI_2		
		DP_RI_3		
10	01/03/2023			Layman's report
		DP_RL		
11	01/07/2022			Press conferences
		PA_C_1		
		PA_C_2		
		PA_C_3		
12	01/12/2022			Radio campaign
		PA_RC		
13	01/12/2021			Video of the prototype construction
		PA_VP		
14	01/03/2023			EV FESTIVAL video
		PA_EV		
15	01/03/2023			Events in Florence
	International Congress in Florence	E_F_1		
	Electric vehicles festival	E_F_2		
16	01/12/2022			Workshop in Reggio Calabria
	Workshop in Reggio Calabria	E_W_1		
	Workshop in Brussels	E_W_2		
17	01/12/2022			Six-monthly meetings of the EUROCITIES Environmental Working Groups
		M_E_1	October 2019	EUROCITIES- Meeting in Oslo during the Environment Forum
		M_E_2		
		M_E_3		
		M_E_4		
		M_E_5		
		M_E_6		

Other activities		
Meeting	September 2019	First meeting among partners
Project kick off meeting	November 2019	LIFE 18 ENV and GIE Welcome meeting in Brussels

LIFE E-VIA

Electric **V**ehicle no**I**se control by **A**ssessment and optimisation of tyre/ road interaction

Dissemination and participation photo album

By Vie en.ro.se. Ingegneria

With the contribution of the LIFE programme of the European Union

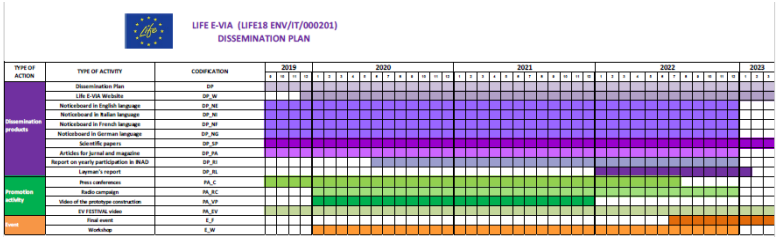
LIFE18 ENV/IT/000201

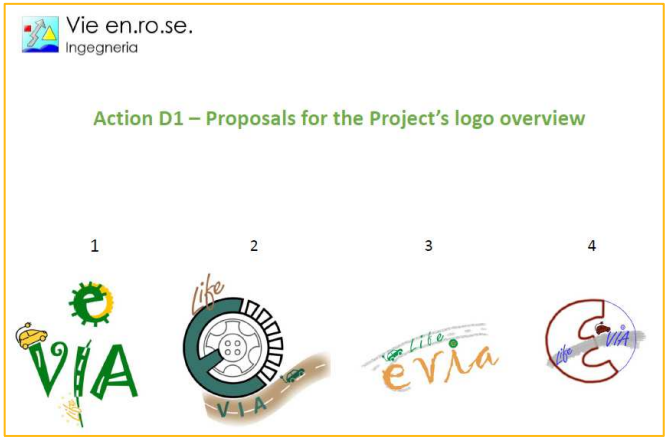
Kick off meeting of partners

Issued on: September 2019

By: All partners

MEETING





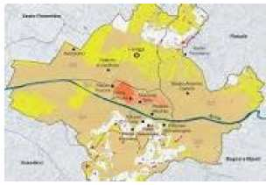
EUROCITIES- Meeting in Oslo during the Environment Forum

Issued on: October 2019

By: Comune di Firenze and Vie en.ro.se. Ingegneria

MEETINGS OF THE EUROCITIES
Code: M_E_1

« E-VIA » Electric Vehicle noise control by Assessment and optimisation of Tyre/road interaction



PROJECT LOCATION: Florence Italy

BUDGET INFO:

Total amount: 1.797,030 €

55% EC Co-funding: 933,295 €

DURATION: Start: 01/07/2019 - End: 31/01/2023

PROJECT'S IMPLEMENTORS:

Coordinating Beneficiary: Florence Municipality

Associated Beneficiary(ies):
Continental Reifen Deutschland
Ifsttar
Ipool S.r.l.
University of Reggio Calabria
Vie en.ro.se Ingegneria S.r.l

Eurocities Environment Forum
Oslo 23-25 Ottobre 2019

Arnaldo Melloni
Project Manager

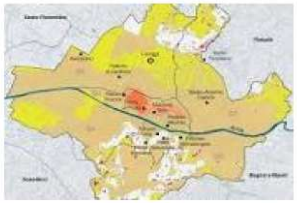
LIFE 18 ENV and GIE Welcome meeting in Brussels

Issued on: November 2019

By: Comune di Firenze

MEETING

« **E-VIA** » Electric Vehicle noise control by Assessment and optimisation of Tyre/road interaction



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University of Reggio Calabria
Vie en.ro.se Ingegneria S.r.l

LIFE18 ENV and GIE Welcome Meeting, Brussels, 7-8 November 2019

Arnaldo Melloni
Project Manager

Development and launch of LIFE E-VIA website

Issued on: December 2019

By: Vie en.ro.se. Ingegneria

Deadline: 01/12/2019

LIFE E-VIA WEBSITE
Code: DP_W

https://life-evia.eu/

SC4Life- SmartCity 360°
Scientific Contribution
Issued on: December 2019
By: UNIRC
Deadline: 01/03/2023

SCIENTIFIC PAPERS
Code: DP_SP_1

SC4Life

EAI COMMUNITY THAT BUILDS YOUR CAREER
Collaborative research. Objective evaluation. Fair recognition.

http://sc4life.org/full-program/

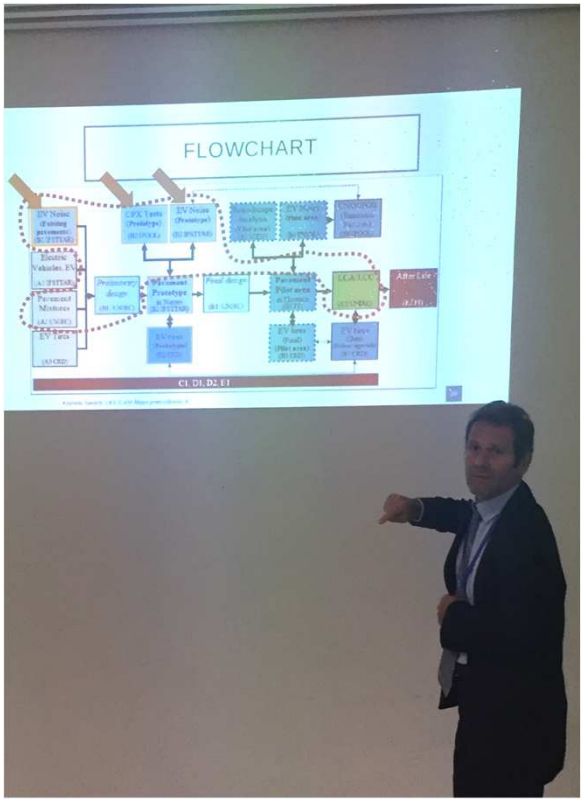
HOME REGISTRATION COMMITTEES PROGRAM FOR AUTHORS CALLS PRACTICAL INFO SPONSORSHIP SMARTCITY 360°

SESSION 1: Cities and Territory

Session Chair: Paulo Pereira

Keynote Speech: Fillipo Pràtico

Title: *LIFE E-VIA: Electric Vehicle noise control by assessment and optimisation of tyre/road interaction*



SC4Life conference will take place on the 5th December in the room #3
11:30 – 13:00 SESSION 1: Cities and Territory
Session Chair: Paulo Pereira

Keynote Speech
The LIFE E-VIA project

Electric Vehicle noise control by assessment and optimisation of tyre/road interaction
(LIFE18 ENV/IT/000201)
http://life-evia.eu http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=7210

Filippo Giammaria Praticò,
University Mediterranea of Reggio Calabria; Italy
filippo.pratico@unirc.it

SC4Life SmartCity360° THE GATEWAY TO INNOVATION UM CITIES

Paper published on Sustainability 2020 about the sustainable pavement materials for the urban roads.

Issued on: January 2020

By: UNIRC

Deadline: 01/12/2022

ARTICLES FOR OPEN ACCESS JOURNAL

Code: DP_PA_1

https://www.mdpi.com/2071-1050/12/2/704/htm/

sustainability

MDPI

Article

Energy and Environmental Life Cycle Assessment of Sustainable Pavement Materials and Technologies for Urban Roads

Filippo G. Praticò [1], Marinella Giunta [2,*], Marina Mistretta [3] and Teresa Maria Gulotta [4]

1 Department of Information, Infrastructure and Sustainable Energy (DIIES), Via Graziella, Feo di Vito, University Mediterranea of Reggio Calabria, 89214 Reggio Calabria, Italy; filippo.pratico@unirc.it
2 Department of Civil, Energy, Environmental and Material Engineering (DICEAM), via Graziella, Feo di Vito, University Mediterranea of Reggio Calabria, 89100 Reggio Calabria, Italy
3 Department of Heritage, Architecture, Urbanism (PAU), Via dell'Università, 25, University Mediterranea of Reggio Calabria, 89124 Reggio Calabria, Italy; marina.mistretta@unirc.it
4 Department of Engineering, Viale delle Scienze, University of Palermo, 90128 Palermo, Italy; teresa.gulotta@deim.unipa.it
* Correspondence: marinella.giunta@unirc.it; Tel.: +39-0965-169-2471

Received: 18 December 2019; Accepted: 16 January 2020; Published: 18 January 2020

check for updates

Abstract: Recycled and low-temperature materials are promising solutions to reduce the environmental burden deriving from hot mix asphalts. Despite this, there is lack of studies focusing on the assessment of the life-cycle impacts of these promising technologies. Consequently, this study deals with the life cycle assessment (LCA) of different classes of pavement technologies, based on the use of bituminous mixes (hot mix asphalt and warm mix asphalt) with recycled materials (reclaimed asphalt pavements, crumb rubber, and waste plastics), in the pursuit of assessing energy and environmental impacts. Analysis is developed based on the ISO 14040 series. Different scenarios of pavement production, construction, and maintenance are assessed and compared to a reference case involving the use of common paving materials. For all the considered scenarios, the influence of each life-cycle phase on the overall impacts is assessed to the purpose of identifying the phases and processes which produce the greatest impacts. Results show that material production involves the highest contribution (about 60–70%) in all the examined impact categories. Further, the combined use of warm mix asphalts and recycled materials in bituminous mixtures entails lower energy consumption and environmental impacts due to a reduction of virgin bitumen and aggregate consumption, which involves a decrease in the consumption of primary energy and raw materials, and reduced impacts for disposal. LCA results demonstrate that this methodology is able to help set up strategies for eco-design in the pavement sector.

all the scenarios. In detail, it accounts for more than 60% of the majority of environmental indicators, with the exception of EF_w, HT-ce, HT-nce, and ME.

The negative values of Ftox and HT-ce in Scenario 1 (addition of waste plastics in the bituminous mixture) are essentially due to the avoided impacts of virgin plastics.

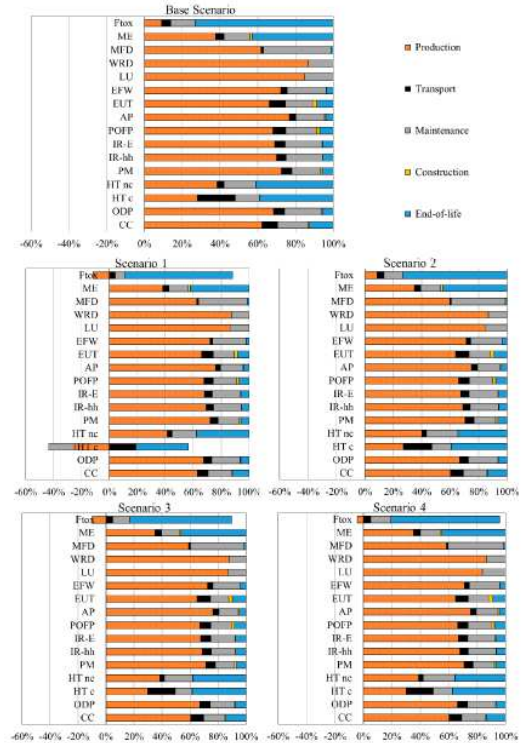


Figure 2. Contribution analysis of life-cycle environmental impacts.

LIFE E-VIA: objectives and actions

Issued on: February 2020

By: : Vie en.ro.se. Ingegneria

Deadline: 01/12/2022

NOTICEBOARD IN ENGLISH LANGUAGE

Code: DP_NE_1

With the contribution of the LIFE programme of the European Union
LIFE18 ENV/IT/000201

NOTICEBOARD IN ENGLISH LANGUAGE
Code: DP_NE_2

LIFE E-VIA

Electric Vehicle noIse control by
Assessment and optimisation
of tyre/road interaction

Coordinating beneficiary

COMUNE DI FIRENZE

Partners

Continental · Université Gustave Eiffel · iPOOL · Università degli Studi Mediterranea di Reggio Calabria · Vie en.ro.se. ingegneria

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Action D2

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Conferences

Event	Partner
Year 2020	
Beautiful sounds workshop (5 March, Florence)	A session will be dedicated to LIFE E-VIA project (Comune di Firenze, UNIRC, Vie en.ro.se, I-Pool will partecipate)
Eurocities meetings (17-20 March, Porto; Autumn, Torino)	Comune di Firenze and Vie en.ro.se will participate (a presentation about LIFE E-VIA project will take place)
Forum Acusticum 2020 (20-24 April, Lyon) https://fa2020.universite-lyon.fr/	Comune di Firenze and Vie en.ro.se will participate (Abstract sent)
27 International Congress on Sound and Vibration – ICSV27 (12-16 July, Prague) iiav.org	Comune di Firenze and Vie en.ro.se will participate (Abstract sent)
46th Annual Meeting of the German Acoustical Society (DAGA 2020), 16-19 March 2020	Continental Reifen Deutschland GmbH
French Technical Days in Acoustics and Vibrations (JTAV 2020)	Gustave Eiffel University (IFSTTAR)

LIFE E-VIA PROJECT
I MONITORING MEETING
21 February 2020

ACTION E1

- N. 6 General Meeting: 1 start up (21 september 2019), 4 mid term, 1 final;
- Steering Committee: to coordinate and monitor the overall progress of the actions;
- Monitoring Protocol

LIFE E-VIA PROJECT
I MONITORING MEETING
21 February 2020

ACTION E1

Monitoring Protocol

1. *Initial Monitoring*;
2. *Intermediate Monitorings*: performed at six momths interval following the initial to ensure that the Project is continuing appropriately and to identify any situations that need to be corrected. The six-month reports should contain three sections:

LIFE E-VIA PROJECT
I MONITORING MEETING
21 February 2020

ACTION E1

Monitoring Protocol

Intermediate Monitorings, sections:

a) evaluation of general results related to the Project's objectives;

b) evaluation in terms of efficiency of the working methods;

c) sheets regarding the punctual monitoring activities of each Action. A self-monitoring form (SMF) will be periodically filled in by each Beneficiary for each actions

LIFE E-VIA PROJECT
I MONITORING MEETING
21 February 2020

ACTION E1

Monitoring Protocol

- *3) Final Monitoring:* For each action completed, an indicator GO/NOGO will be calculated, based on the achievement of the percentages representing the indicators of progress of each sub action to which they relate