



#### **Gaetano Licitra**

ARPAT

## NEREIDE Noise Efficiently REduced by recycle pavements



#### WORKSHOP

#### INNOVATIVE MONITORING ACTIVITIES ON IMPLEMENTATION URBAN SITES

Firenze 11 Luglio 2017 I progetti LIFE svolti in Italia sul tema dell'inquinamento acustico ambientale: risultati conseguiti, esperienze in corso e sviluppi futuri















## **Project objectives**



- The project wants to investigate the use of new porous asphalt pavements and low noise surfaces composed by recycled asphalt pavements and crumb rubber from scrap tires.
- These materials will be mixed with binders at warm temperatures with specific benefits:
  - <sup>1</sup> to reduce the disposal of waste materials;
  - to achieve a significant reduction of noise in urban areas and health improvement;
  - to improve safety in urban areas;
  - <sup>1</sup> to reduce pollution due to asphalt laying.

## Main actions



- The project is expected to lay:
  - → a first site 2400 m long, with 6 different 400 m long stretches, and
  - → a second site 2800 m long made of 7 different mixtures including rubber from end-of-life tyres (including PERS technology) and recycled asphalts.
- The effectiveness of the new pavements will be evaluated by measurements of surface characteristics, acoustical and psychoacoustical properties and by surveys submitted to the exposed population, based on a before-after evaluation
- Guidelines on monitoring activities will be developed in order to upgrade and to improve the methods to assess the effectiveness in urban areas.



Standard and innovative monitoring techniques;



Ante vs Post approach;

Regione Toscana

## **Technical actions**

#### A. Preparatory actions

A1 State of the art Review

#### A2 Analysis of candidate sites and selection for experimental laying

#### B. Implementation actions

- B1 Mix design of new warm asphalt mixtures and Life Cycle Assessment
- B2 PERS mixture design
- B3 Selection of the acoustical and psychoacoustical parameters based on the measurements performed on site
- B4 Evaluation of structural properties of existing pavements
- B5 Noise monitoring of pre-existing road surface on the chosen locations
- B6 Psychoacoustical monitoring campaign and social survey in action planning sites (ante-operam)
- B7 Structural specifications of new pavement sections
- **B8 PERS laying in Belgium**



- As coordinator
- As contributor

## **Technical actions**



- B9 Surfaces laying tender and their implementation
- B10 Set up of the new methodology for urban Pass-By
- B11 Development and realization of an in situ acoustical absorbing measurement method on a mobile laboratory
- B12 Validation of the new methodologies for noise measurements
- B13 Field evaluation of structural properties and surface characteristics of new test sections
- B14 Noise monitoring of properties of the new realized surfaces
- B15 Psychoacoustical monitoring campaign and social survey on new experimental surfaces (post operam)
- B16 Analysis of all acquired parameters (structural, acoustical and psychoacoustical)
- B17 Drawing up of guidelines on the implementation of new mitigation actions: tenders, design and monitoring



- As coordinator
- As contributor







	2016		20	17			20	18			20	2019					
Action	IV	I	II	Ш	IV	I	Ш	Ш	IV	I	Ш	III	IV	I			
A.1	Х																
A.2	X																
B.1	X	Х						Х									
B.2	Х	Х															
B.3		X															
B.4		Х	Х			Х	Х										
B.5			X	X			X	X									
B.6			Х				Х										
B.7			Х					Х									
B.8				Х													
B.9			X	X	X				X								
B.10	X	X	X														
B.11	X	Х	Х	Х													
B.12			X	X													
B.13						Х	Х			Х	Х						
B.14						X	X			X	X						
B.15						Х	Х			Х	Х						
B.16								X				X					
B.17				X				X					X	X			

## Implementation context

 A preliminary analysis was necessary to drive Regione Toscana in the selection of the 2 sites within all available ones from its action plan, following the list of most prioritized sites according the Italian regulations.

The consequent list is sufficiently long to require a proper filtering procedure and on-site visits.

 Following candidate sites analysis, the implementation context is defined in the SR 439 for the first implementation site with 6 stretches (approved) and in SR 71 for the 7 stretches site (feasibility to be verified).





rovato con DCR n. 29 del 10 febbraio 2010. tiva delle priorità degli interventi di risanan

> sulle strade regionali ALLEGATO F



## **Implementation context**



• The selected areas characteristics:

Sites I SR439					AADT 2016	
	Inhabitants	Inhabitants exceeding limits	Sensitive buildings	2-wheelers	Light Vehicles	Heavy Vehicles
SR439	1587	1131	4	370	13889	124
SR71	5963	2172	6	112	10783	248









## **Implementation context**



• The first site is going to be layed with the following mixtures in September:







B3 Selection of the acoustical and psychoacoustical parameters



# Indicators and measurement protocols have been agreed, e.g. for acoustical:

Method	Ante- Operam	Post- Operam	Indicators
Noise levels at road side	X	X	L <sub>DEN</sub> , L <sub>night</sub> , L <sub>D</sub> , L <sub>N</sub> , Spectrum, L <sub>C</sub> -L <sub>A</sub> , other (NA)
Urban Pass By	X (test)	X	To be defined
СРХ	Х	Х	L <sub>CPX</sub>
Absorption ISO 13472-1*		Х	Absorption spectra
Running Absorption*		X	To be defined

\*Only on open pavements

	2016		2017 I II III IV X III				20	18			2020			
Action	IV	I.	Ш	Ш	IV	I.	Ш	Ш	IV	I.	Ш	Ш	IV	I.
B.3		Х												

#### B5 - Noise monitoring ante operam first site

- 6 continuous monitoring stations 1 week + 1 spot measurement
- CPX along 6 test stretches
- Analysis of CPX: report incoming















## **B9** Surfaces laying



- ARPAT will oversee laying and will learn laying techniques of PERS to understand best monitoring techniques.
- ARPAT will also assist Toscana to verify technical requirements included in tender and eventual efficiency monitoring requirements to be specified in tender.



	2016		20	17			20	18				2020		
Action	IV	I	Ш	III	IV	- I	Ш	Ш	IV	I	Ш	Ш	IV	I
B.9			Х	Х	Х				X					

## **Innovative techniques**



- **SPB method** is not viable in urban context:
  - So why? to evaluate efficiency in terms of noisiness of single vehicle category
  - So how? ARPAT is developping a procedure that allows this evaluation in urban context, measuring single vehicles passing by at night without a manned measurement.
- Absorption coefficient is measured with ISO 13472 at single points:
  - So why? It is not enaugh to establish laying accuracy
  - So how? A device for continuous measurements with PV sensors is under development by CNR.





### B10 – urban Pass-by



- Absence of free field conditions in urban context avoids the use of SPB standard approach.
- A new protocol is under development in order to obtain a SPB index in urban context taking data from night levels at continuous monitoring stations without manned measurements and gathering cathegories from traffic counter.

#### Steps forward:

- Test performed on available measurement data.
- New tests performed on 2 sites (in Pisa province).
- Analysis are ongoing to define protocol and indicators.





**Regione Toscana** 



## Urban pass-by (first test)



*First results show the need of analysis of these differences.* 



Measurements in this site where not exactly in the same place so speed and road shape might have affected the results.

	2016		20	17			20	18			2020			
Action	IV	1	Ш	Ш	IV	I.	Ш	III	IV	I	Ш	Ш	IV	I
B.10	X	X	Х											

# B12 Validation of the new methodologies

Action

B.12

IV

I

Ш

Χ

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Х

IV



- Pass By in urban context procedure (B10) and in situ absorption device developed by CNR (B11) will be tested on mitigation sites where standard procedure values are available;
- Validated procedures will be used in post operam monitoring.



Ш

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IV

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IV

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# B14 Post operam noise monitoring



- Indicators will be evaluated to represent post operam values of each special pavements.
- Measurements will be carried out at least 3 months after the laying, in winter 2018 (first site) and 2019 (second site).



	2016		20	17			20	18			2020			
Action	IV	I	П	Ш	IV	I	Π	Ш	IV	Ι	Ξ	Ξ	IV	I
B.14						Х	Х			Х	Х			

# B16 Analysis (structural, in the structural in the structural is acoustical and psychoacoustical)

 Structural, acoustical and psychoacoustical campaigns are carried out simultaneously. → Correlate the results of these analysis to identify common trends within indicators and to evaluate differences between experimental pavements.

reide

 In the 1st phase, ARPAT will verify if the lowering of noise levels acquired in noise monitoring will also correspond to a lowering of psychoacoustical indicators elaborated by CNR, and if requirements in terms of structural properties are still met.

	2016		20	17			20	18			2020
Action	IV	Ι	Ш	Ш	IV	I	Ш		IV	I	I
B.16						X					

## B16 Analysis (structural, acoustical and psychoacoustical)

The results will lead the guidelines for implementing the 2nd step of the laying especially regarding homogeneity evaluations.

A comparison between the expected ranking of surfaces' performance and the on-site ones will point out possible gaps between theoretical considerations and on-site implementation.

Strategies for implementing the developed surfaces and methods in different contexts in order to enhance transferability of the project actions will be detailed.

	2016		20	17			20	18			2020			
Action	IV	I	Ш	Ш	IV	1	Ш	III	IV	- I	Π	Ш	IV	I
B.16						X								

## B17 Drawing up of guidelines

- The Guidelines will be constituted by 3 documents developed coherently by 3 partners on:
- the definition of the tenders for the implementation of mitigation actions (edited by RegioneToscana)
- 2. the implementation of mitigation actions: design and construction of low noise pavement sections (edited by University of Pisa DICI)
- 3. the implementation of new mitigation actions: acoustics performances and monitoring methods (edited by ARPAT)

Acoustics perfo	rmances and	monito	ring me	thods (e	edited b	y ARPA	T)	methods (edited by ARPAT)											
B3 Definition of	oarameters		First rev	vision af	ter first	impleme	entation	and mor	nitoring	step									
BS-B6 Ante oper	am monitoring		B14 an analysi	d B15 Fii s step	rst mon	itoring a	nd	Finaliza	tion afte	er second	Imonito	oringster	°						
			B16 An	alysis fir	st step			B14 and analysis	B15 Sec step	gand									
	2016		20	)17			20	)18			20	19		2020					
Action	IV	I	Ш	Ш	IV	I	Ш	Ш	IV	I	П	III	IV	I					
B.17				X				X					X	X					





## **Dissemination:** general

#### ARPAT newsletter issues 3/11/16, 8/3/17

Ridurre il rumore del traffico con asfalti "silenziosi" realizzati con materiali riciclati

#### f Share 😏 Tweet G+1 🔊 Il progetto europeo Life-Nereide, cui partecipa anche AF **ARPAT** news riduzione del rumore possibile grazie ad asfalti realizzat Pneumatici Fuori Uso e asfalto "riciclato" Agenti Fisici ed Energia In Europa sono 125 milioni le persone esposte quotidianame livelli eccessivi di rumore da traffico e che per questo rischia conseguenze anche gravi per la salute, come sottolineato Se non leggi correttamente questa mail, clicca qu anche dall'Organizzazione Mondiale della Sanità. Una loved, 03 novembre 2016 08:30 venerd), 14 ottobre 2016 10:38 problematica che, anche se spesso sottovalutata, si fa "sen! Mitigare il rumore con Dati del controllo dei Tra le azioni di contrasto possibili c'è l'impiego di asfalti asfalti riciclati: il campi elettromagnetici progetto LIFE NEREIDE (CEM) ad alta frequenza "fonoassorbenti", realizzati grazie all'aggiunta di polverino di da Pneumatici Fuori Uso al bitume. Per testarne caratteristiche e vantaggi, a settembre 2016 ha finanziato dall'Unione Europea, che mira proprio ad ottimizz stradali realizzate con l'aggiunta di gomma riciclata e fresato recupero di vecchie pavimentazioni stradali e utilizzato in so Capofila del progetto è il Dipartimento di Ingegneria Civile affiancato da ARPAT, il centro di ricerca belga BRRC (Belgi consortile senza scopo di lucro Ecopneus, l'Istituto di acu: Al centro del progetto I dati rilevati in Toscana dalle pavimentazioni a basso impatto Corbino" e la Regione Toscana. misure effettuate nei pressi di acustico composte da polverino stazioni radio base (SRB antenne telefoniche) e impianti di gomma proveniente da II progett pneumatici esausti REduced efficacer nereide benefici non solo dal punto di vista dell'inquinamento acustico, ma anche negli impatti

ambientali complessivi e dell'inquinamento atmosferico nelle realizzazioni di nuove



 Speach at Radio Cusano Campus 27/2/17



Notice board installed





ASFALTO SILENZIOSO Strade urbane più sicure, meno rumorose e inquinanti, grazie a un nuovo asfalto, drenante e fonoassorbente, realizzato con il riciclo di oltre 24 mila kg di gomma da pneumatici A progettarlo è stato un team dell'Università di Pisa, con

6/5/17 article on "lo Donna", weekly magazine of newspaper



ARPAT fale all all 40 Agenzia regionale

08/03/2017 07:30

comunemente utilizzati.

per la protezione ambientale della Toscana



#### RUMORE - II secondo opuscolo della serie "Chi fa cosa in Toscana" spiega cosa fare e a

Toscana

ARPAT

della Toscani

enerd), 14 ottobre 2016 07:00

Rumore prodotto da

aziende - Chi fa cosa in

Agenzia regionale ental 1. fate off ath th

chi rivolgersi in caso di rumore derivante da attività produttive

## **Dissemination: technical**





 Paper at Convegno Nazionale Associazione Italiana di Acustica – Pavia June 2017



Associazione Italiana di Acustica 44° Convegno Nazionale Pavia, 7-9 giugno 2017

ICSV24

LONDON CALLING

**Regione Toscana** 

IL PROGETTO LIFE NEREIDE SULLO STUDIO DELL'EFFICIENZA DELLE PAVIMENTAZIONI A BASSA EMISSIONE. LE TECNICHE DI MISURA PREVISTE

23-27 July 2017, London

Mauro Cerchiai (1), Elena Ascari (2), Duccio Simonetti (3), Claudia Chiari (4), Gaetano Licitra (5)





Incoming



Elena Ascari

Istituto di Acustica e Sensoristica "O.M. Corbino", IDASC-CNR, Roma, IT,

24th INTERNATIONAL CONGRESS ON SOUND AND VIBRATION

 Special session and papers at International Congress of Sound and Vibration – London July 2017

Theme Area T15Policy, Education and European Projects T15 SS2 - Life Nereide - EU Project



Agenzia regionale



### **Dissemination: stakeholders**

ereide

- Speach at Ecomondo 9/11/16
- Speach at Asphaltica 24/2/17

- ecopneus
- Speach at Workshop Ancona 6/7/17



Today

Speach at Workshop - Firenze



Organizzato da



DEGLI STUDI FIRENZE ISPRA FIRENZI is en ro se la

#### WORKSHOP

I progetti LIFE svolti in Italia sul tema dell'inquinamento acustico ambientale: risultati conseguiti, esperienze in corso e sviluppi futuri





## Conclusions



NEREIDE project could be an opportunity to introduce a green economy example for an effective noise mitigation action in urban areas, using ELT.

About **3000 citizens** will benefit of new pavements with different performances, evaluated by structural, acoustical and psychoacoustical parameters that will permit to drive up other future actions.

**New methods** will be developped and performed for a better evaluation of acoustical parameters, also focusing on the safety of the road (*aquaplaning detection*).

For the first time citizens will directly partecipate in the evaluation of performances with more than **2400 questionnaires** before and after the pavement laying.









### Thanks









