LOWBRASYS OVERVIEW

Brussels, 10 March 2016

39th PMP Meeting

Speaker name: Mattia Alemani(Brembo)

LOWBRASYS: a LOW environment impact BRAke SYStem

GA 636592 - MG-3.1-2014: Technologies for low emission powertrains

(IT)

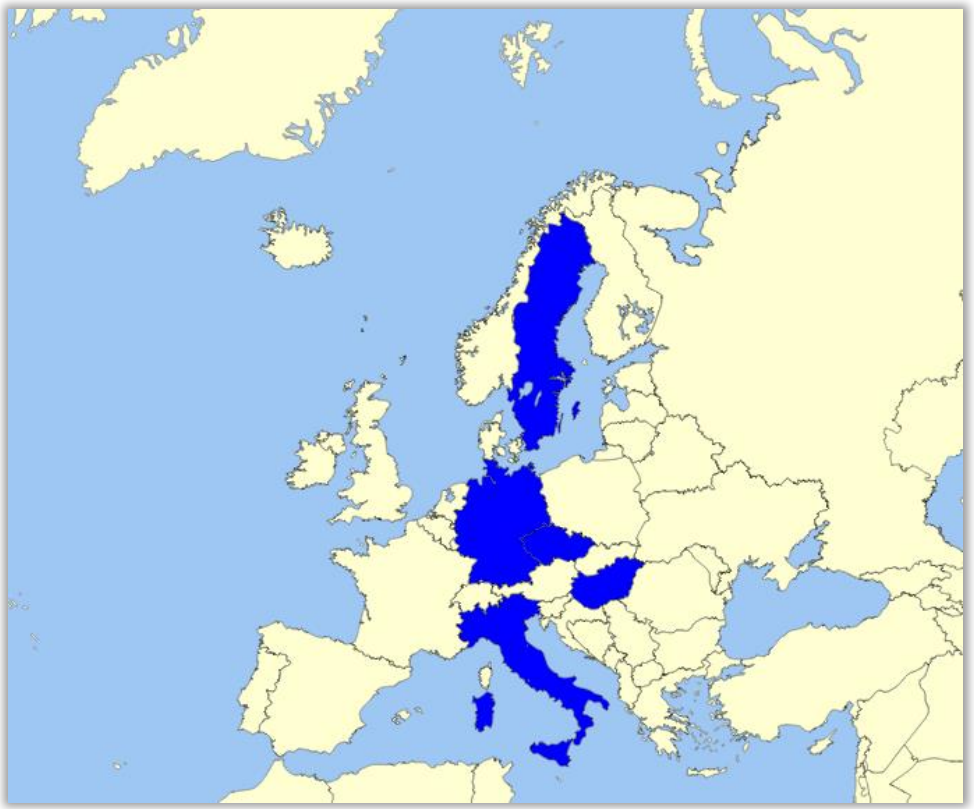
(DE)

(HU)

(SE)

(CZ)

(EU)



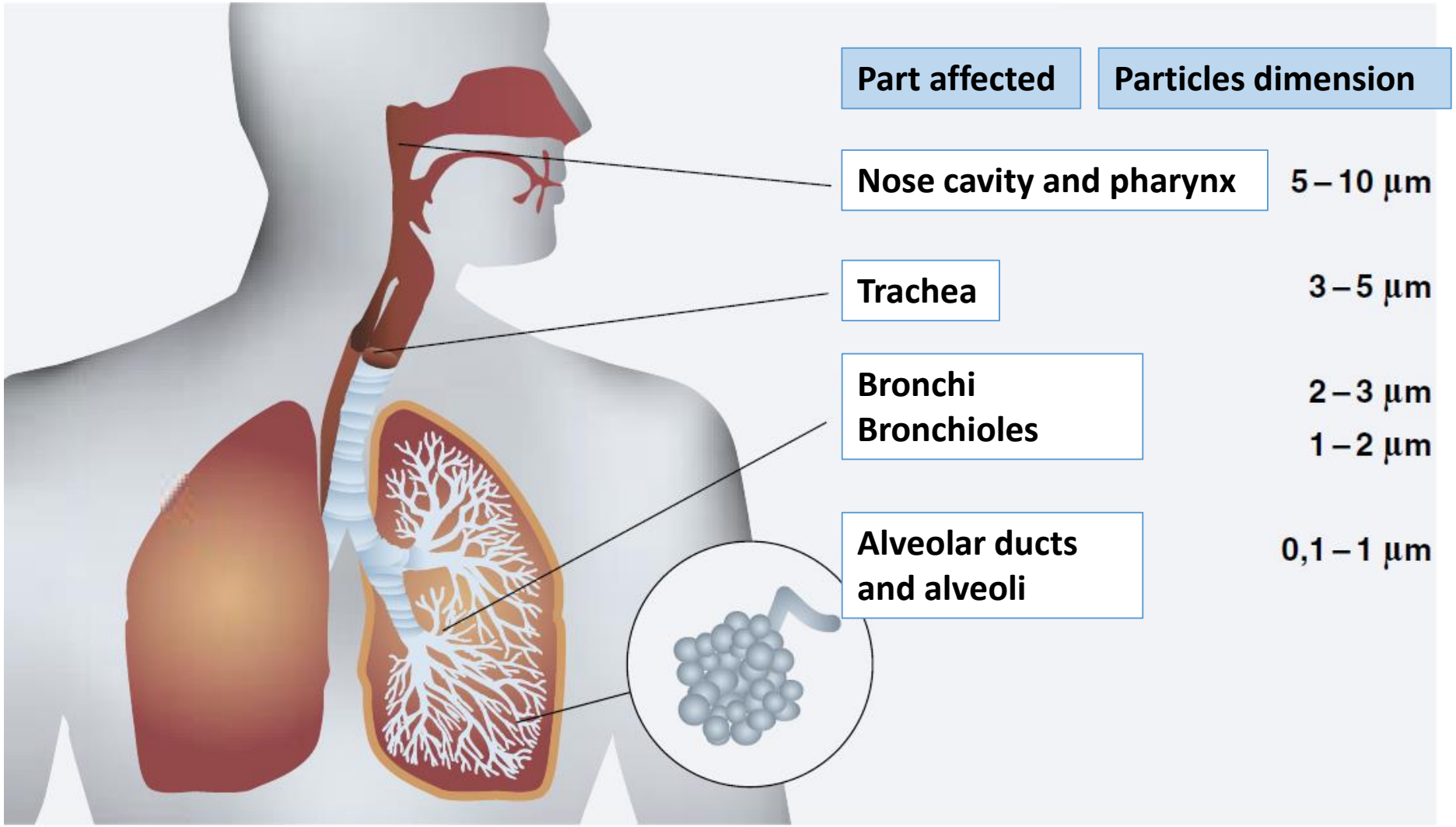
10 members from 6 European countries

Total costs: 9.5 million €

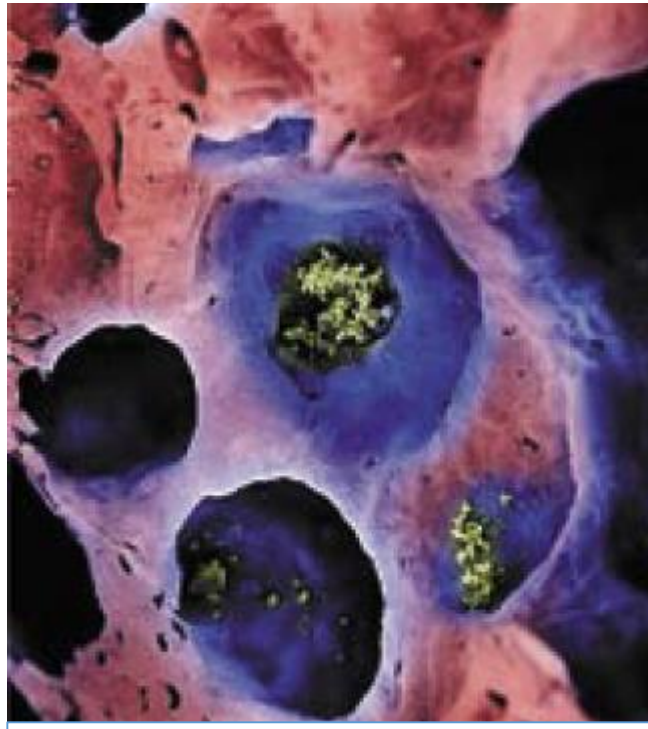
Project Start: 01. September, 2015

Project duration: 36 month

Background

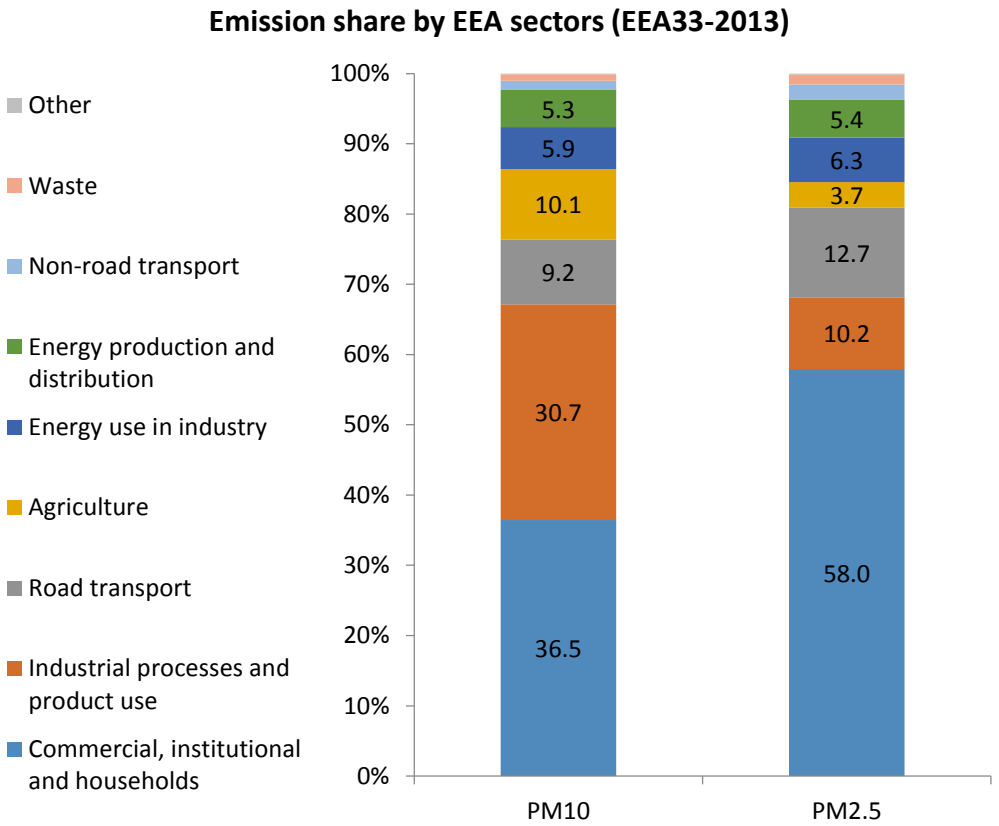


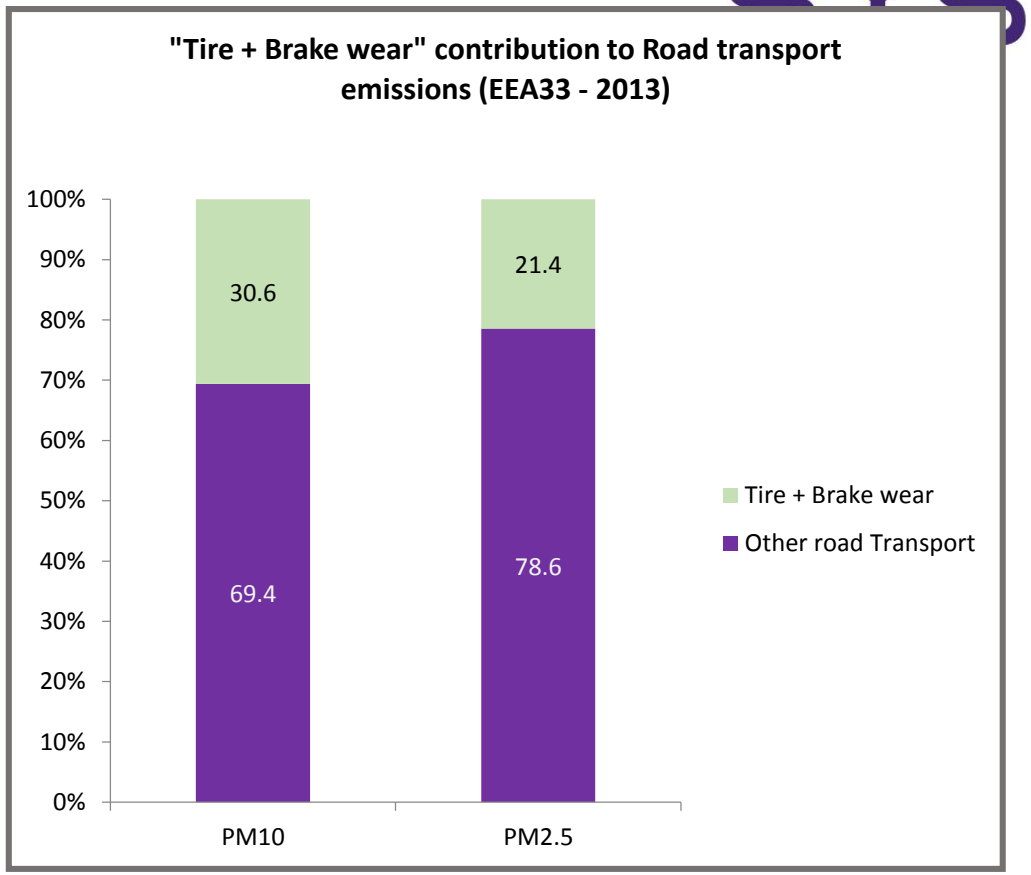
Part affected	Particles dimension
Nose cavity and pharynx	5 – 10 µm
Trachea	3 – 5 µm
Bronchi	2 – 3 µm
Bronchioles	1 – 2 µm
Alveolar ducts and alveoli	0,1 – 1 µm



Soot particles in human lung

Background

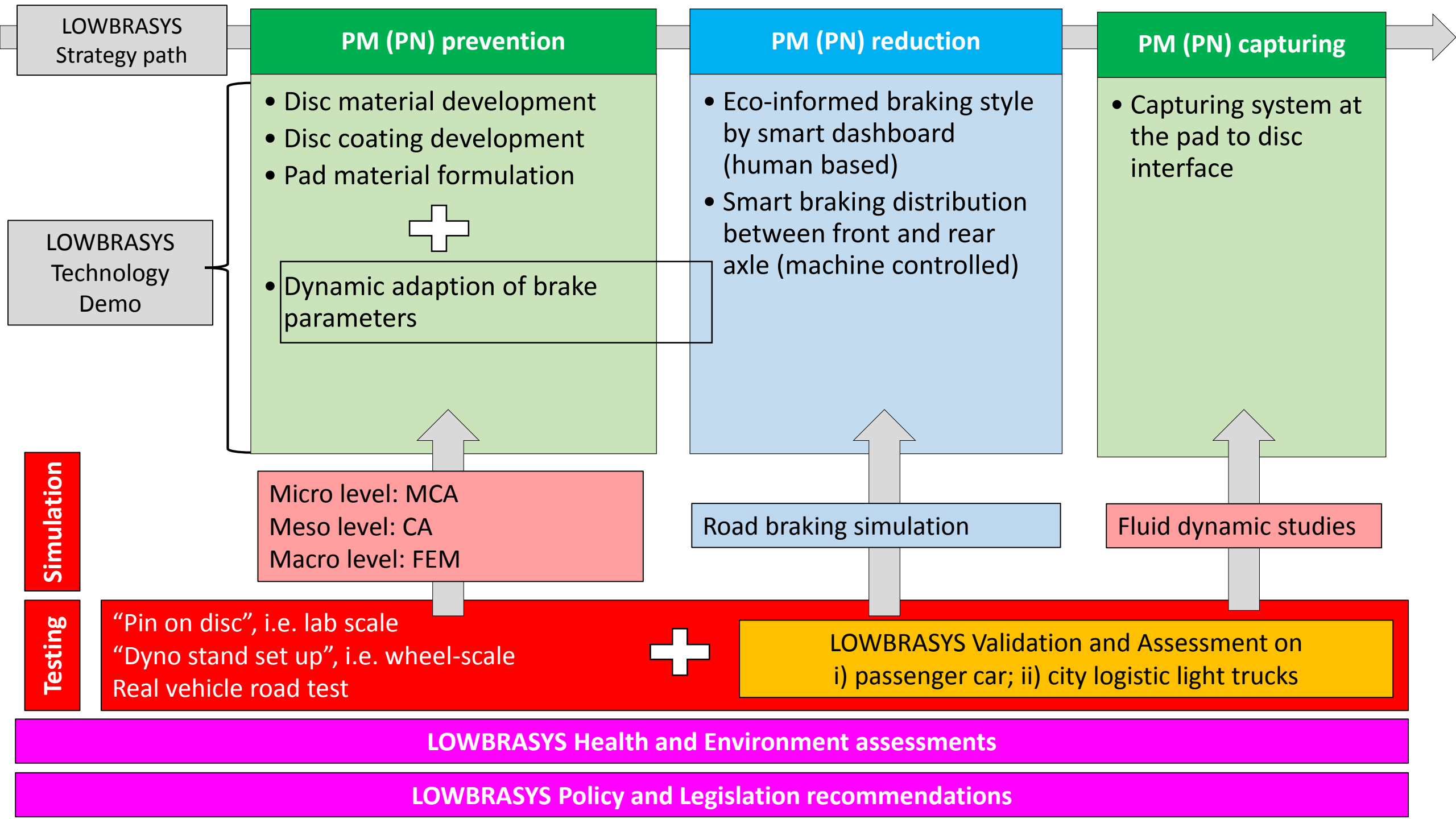




In 2013, tire and brake wear contributed approx. 20-30 % to the total road transport PM emissions (EEA33).
The relative contribution to the road transport of these unregulated emissions are expected to rise significantly due to declining exhaust emissions.

Goals of the project

1.	To demonstrate a novel and low environmental impact brake system that will reduce micro and nanoparticles emissions by at least 50%;
2.	To improve the measurement and understanding of micrometre-sized and ultrafine particles and their effects on health and the environment;
3.	Recommendations to policy makers.


LOWBRASYS Strategy path
PM (PN) prevention
PM (PN) reduction
PM (PN) capturing
• Disc material development
• Disc coating development
• Pad material formulation
+
• Dynamic adaption of brake parameters
• Eco-informed braking style by smart dashboard (human based)
• Smart braking distribution between front and rear axle (machine controlled)
• Capturing system at the pad to disc interface
LOWBRASYS Technology Demo
Simulation
Micro level: MCA
Meso level: CA
Macro level: FEM
Road braking simulation
Fluid dynamic studies
Testing
“Pin on disc”, i.e. lab scale
“Dyno stand set up”, i.e. wheel-scale
Real vehicle road test
+
LOWBRASYS Validation and Assessment on
i) passenger car; ii) city logistic light trucks
LOWBRASYS Health and Environment assessments
LOWBRASYS Policy and Legislation recommendations

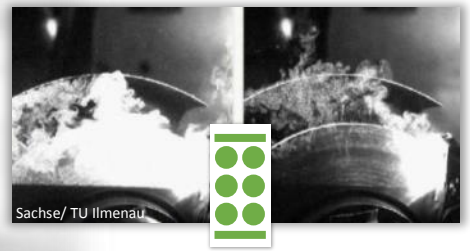
Technology overview

Smart Braking Dashboard

-Braking classifier
-Braking Manager
-Braking Coach (HMI)

Control strategy

- Brake by wire system
- New brake force sensors to optimize control loops for brake torque



Particle Capturing System

- Combination of technologies based on magnetic, electrostatic, active ventilation

Adv. Brake disc

- Ceramic coatings (WC-Co-Cr, Cr_2C_2-Ni-Cr and Al_2O_3-TiO_2) on cast iron and aluminum discs

- Increase of surface hardness through heat treatments, press hardening, nitriding and carbonitriding

Adv. Brake pad

- Goal: Innovative NAO-type friction materials with braking performance of Low-Met friction materials

- Modified formulation (remove Carbonaceous material and reduce Cu (to <0.5%))

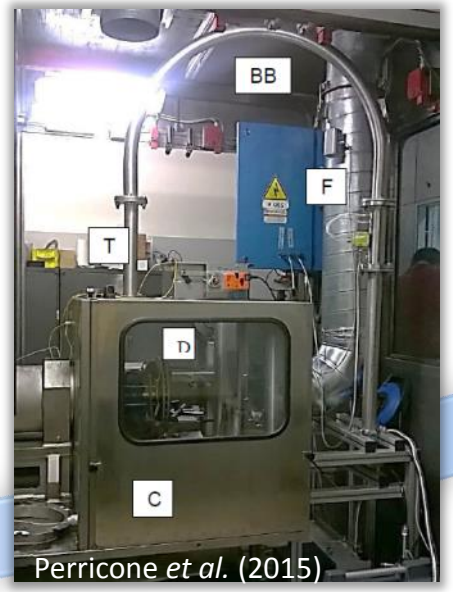
- Clay materials (vermiculite and kaolinite) with embedding of nanoparticles (ZnO and TiO2).

LOW BRA SYS

Testing overview

Tribometer testing

- Creation of wear maps
- Rank materials with respect to wear



Perricone *et al.* (2015)

Dyno Testing (up to roller dyno)

– To assess the impact of these technologies under close-to-real-world in-use conditions

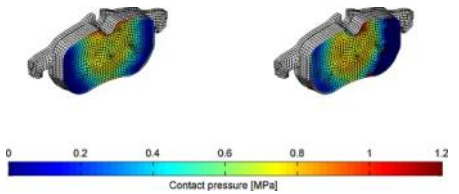
Test track

– Safety, Performance tests & validation

– Comparison to laboratory result

Real-World

- Real world driving tests in 2 EU cities
- 1000 km testing in each city under real conditions

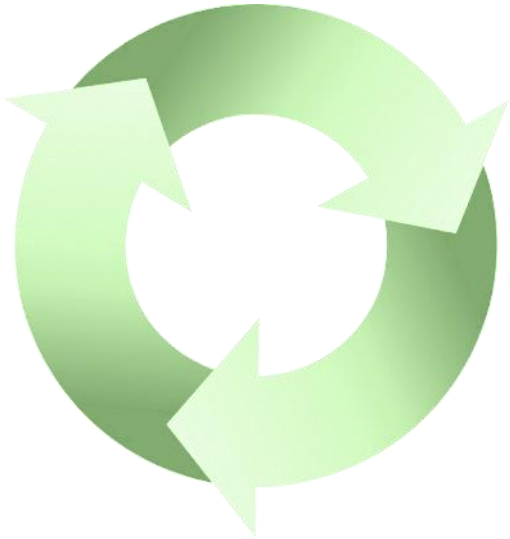


Söderberg et al. (2009)

Supported by Simulations

– On different scales to simulate wear and particle emissions

Health, Environment & Recommendations



Effects on Health and Environment

- PM analysis with state-of-the-art techniques to assess key factors of toxicity of inhalable particles

- Environmental assessment: Investigate impact on soils and aquatic communities including phytotoxicity tests

- Toxicity of PM will be investigated by exposure to selected human cell lines.

Life Cycle assessment

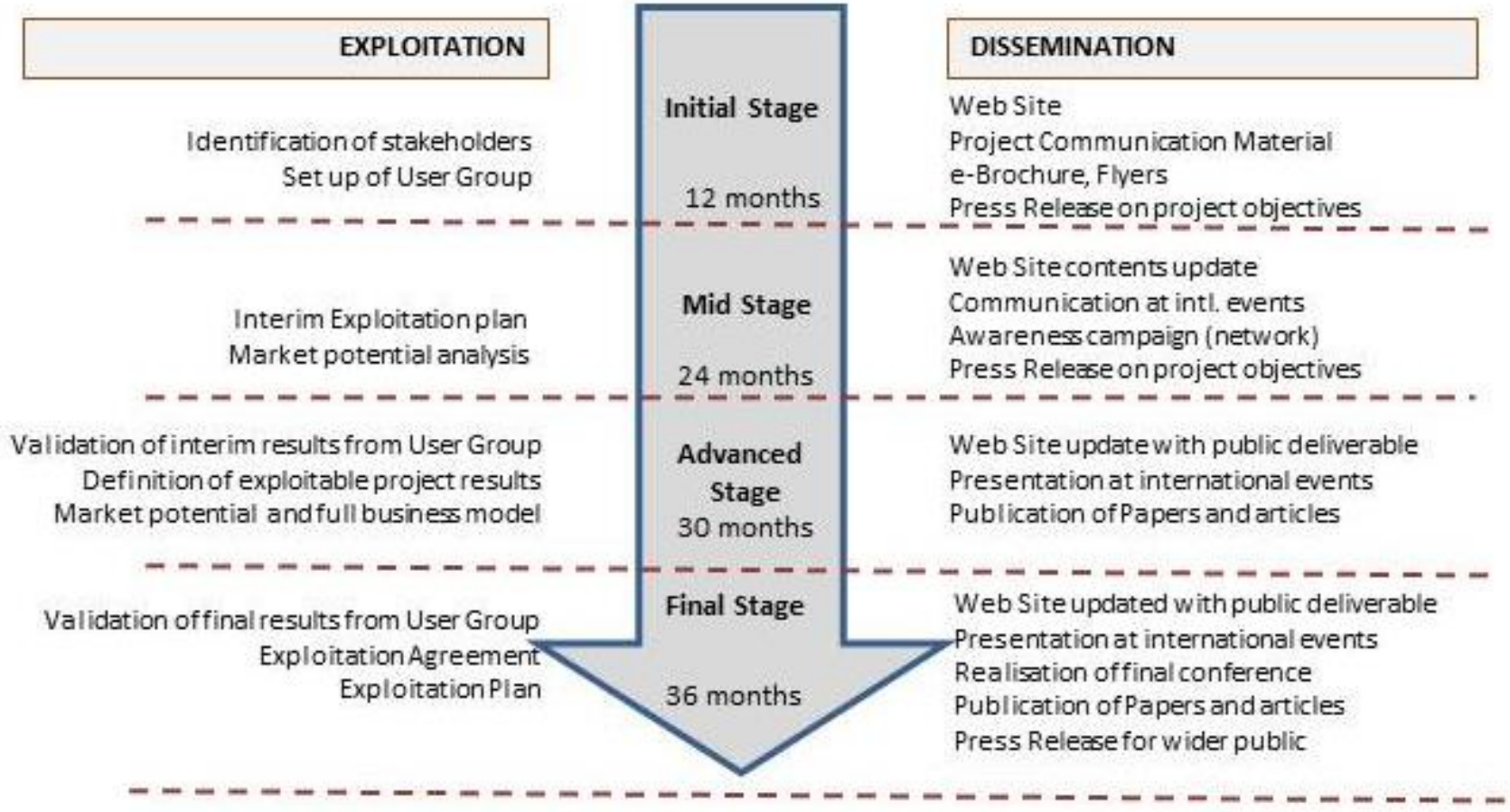
- To assess environmental impact
- Considers entire production chain from raw materials to product disposal
- Life Cycle Cost Analysis comparing new and traditional braking system
- According to ISO 14040:2009,14044:2006

Recommendations to policy makers

Defining the following recommendations

i) a solid, reproducible and repeatable measurement procedure for assessing PM emissions from brake wear
ii) Roadmap on the reduction of PM emissions from non-exhaust gases
iii) Results of socio-economic impact including cost-benefit assessment of monetary benefits associated to PM emissions reductions brought by the project.

Expected exploitation and dissemination



Expected impacts

1. Cleaner, more efficient road transport activities through advances in brake concept.
2. At least a 50% reduction of particle emissions demonstrated.
3. Contribution to improvements of urban air quality in the midterm and strengthening the competitiveness of the EU car industry.