MINUTES OF EXPERTS WORKSHOPS

Action E3

IMPROVE LIFE13 ENV/ES/000263

Coordinated by

CONTENT

Two meetings have been hold in Barcelona to discuss on air quality in the frame of the IMPROVE LIFE project. The first one was celebrated on the 7th of May 2015, when an **Open Forum on air quality in subway systems** was hold in the CSIC central offices in Barcelona City Centre. The event was open to researchers, stakeholders, public/private organisations and the public in general. The second event was an **Air Quality Platform Meeting** celebrated in Barcelona on 26-27th of September 2017, to which other LIFE projects were invited. The 2-days workshop with other European Projects was co-organised by IMPROVE LIFE and AIRUSE (LIFE11/ENV/ES/584). The minutes of both events are shown below.

COMMUTER AIR QUALITY IN RAIL SUBWAY SYSTEMS: CURRENT UNDERSTANDING AND FUTURE MITIGATION

07/05/2015

Commuting by underground rail is a transport mode used daily by over 100 million people worldwide. Published reviews of subway air quality worldwide reveal a wide range of PM concentrations present in underground platforms, and beg the question: why is there such diversity? The overall aim of the session is to motivate discussion to achieve real improvements in subway air quality, identifying main pollutant sources and prioritise cost-effective and energetically green air pollution mitigation strategies.

Millions of people worldwide commute using subway systems and are routinely exposed to levels of contaminated air that are illegal above ground. In Europe alone more than 60 cities utilize rail subways to facilitate commuter movement. With average return journey times lasting around one hour, underground commuters inhale particulate matter at concentration levels than can be higher than the 50 $\mu g/m^3$ mean PM10 (Particulate Matter <10 microns in size) limit legally imposed for outdoor European city air. In addition, inhalable particles on platforms are very different from those in the outdoor environment. Despite this one negative aspect, underground rail in general can be considered as "environmentally clean", facilitating commuter travel and reducing air pollution in the city above ground. Although there are currently no official regulations or recommendations with regards to air quality underground or indoors, several working groups are emphasizing the importance of including legislation for indoor air quality. Given this context, this special session aims to be part of a high-profile attempt to guide legislative frameworks towards more effective control of indoor air quality.

The session was chaired by **Teresa Moreno** (IDAEA, CSIC) and involved a far ranging discussion on the key issues relevant to subway air quality, within the frame of the IMPROVE LIFE project (http://improve-life.eu/en/), which aims to assess air quality in the subway facilities and propose measures to achieve cleaner public transportation, thus benefitting both users and employees. The session consisted of five platform presentations and five posters. Firstly, **Lidia**

Morawska (Queensland Univ., Brisbane, Australia), an expert in indoor air, outlined her work on infection spread in public transport, highlighting the importance of the proximity of passengers and the duration of each trip. Prof. Morawska sees a gulf of thinking between clinicians, engineers and scientists on this subject, and explained that ventilation is not the only mechanism to control infection spread in any transport systems, including our cars. **Caroline Duchaine** (Université Laval, Quebec, Canada) emphasized the need the develop surveillance methods of disease transmission in public vehicles, summarizing the results of a joint Laval/CSIC study on bioaerosols found in the Barcelona Metro. Bioaerosols in this unique environment are relatively unknown, and have humans as main sources unlike most situations outdoors. Teresa Moreno (IDAEA-CSIC) outlined the objectives of the IMPROVE LIFE project and stressed the importance of the main variables affecting air quality in the subway. Thus, the air quality of a given subway platform involves a complex interplay of the ventilation system, station depth and design, train speed, frequency, wheel materials and braking mechanisms, and number of passengers being transported. **Frank Kelly** (King's College, London) overviewed progress on a currently ongoing study of air quality in the London Underground system, the oldest in the world. In this systems it is clear that air quality largely depends on the number of kilometres underground of each line (45% of the London tube is underground), with PM levels being higher at deeper stations and dropping to ambient outdoor levels within 5 minutes when travelling above ground. Finally, **Alberto Giretti** (Polyt. Univ. Marche, Ancona, Italy) used his engineering expertise to demonstrate the need for intelligent control of subway ventilation systems using sensor networks. Prof. Giretti showed how simulation results can be used to estimate pollutants exposure levels for passengers, and how the dynamic of pollutants in a given station is dependent on both external (meteorological conditions) and internal (piston effect, passenger flow) factors.

The subsequent general discussion, led by the Chairwoman and involving both panel members and the audience, then ranged across a number of subjects, with the following key subjects:

- There is a need to compare the transient doses received when using different types of transport, and balance any negative health effects against positive effects such as the well documented cardiovascular benefits of exercise when walking or cycling.
- What is the health significance of short high exposures? What can be done to reduce exposure?
- There are technical solutions in the case of underground air quality, involving the adoption of new or improved systems of maintenance and energy use, such as regenerative braking and the use of intelligent sensors to allow monitoring and control in real time.
- Any suggested improvements must be cost effective and technically feasible. For example, can brake manufacturers be encouraged to change the metal content of their pads to produce more "ecologically sensitive" compositions and PM emissions?
- The IMPROVE LIFE project needs to identify good practice to improve air quality underground and share this information with other subway operators around the world.

LIFE-PLATFORM MEETING ON AIR QUALITY: ABATING URBAN EXPOSURE TO AIR POLLUTANTS

26/09/2017

Opening

Merce Rius, welcome. Air quality improvement is one of the most important challenges we face. We need co-operation form all stakeholders and citizens.

Janet Sanz. We are very aware of the air quality problem, and have much to learn. Scientific advice is fundamental. This is a health problem but also a social and environmental injustice. Our government is committed to tackle this issue. Summary of measures (LEZ from first December this year in Barcelona).

Mario Lionetti from EASME (European Association of Small and Medium Enterprises, one of the six executing agencies of the EC) manages the LIFE program (2014-2020) and other programs. He announces that the Second LIFE MAWP call 2018-2020 is in preparation. Next call will be in May (and will have a 4 months deadline). He focuses presenting the Environment and Resource efficiency (ENV-RE) priority area, which is divided in five thematic priorities (water, waste, environment/health, air quality/emissions and resources efficiency). Both "pilot" and "demonstration" projects are covered:

- ✓ "pilot projects": a technique or method that has not been applied or tested before, or elsewhere; offers potential environmental or climate advantages compared to current best practice; and applies on a larger scale to similar situations;
- ✓ "demonstration projects": put into practice, test, evaluate and disseminate actions, methodologies or approaches that are new or unknown in the specific context of the project, such as the geographical, ecological, socio-economic context, and that could be applied elsewhere in similar circumstances.

Economical sustainability, replicability and impact are the 3 main emphases. LIFE doesn't want projects that die at the end of the project or close in a shell (projects must achieve a EU dimension). A table of environmental impacts to be quantified is required. Note that > 4 years projects are also accepted with funding as high as 30 million euro. He shows the new emphasis on Close to Market projects (C2M) which include business perspective and pre-commercial activities.

AIR projects have effects also on other things (energy, health…). It is a cross-cutting Thematic priority. LIFE integrated projects (cover large territorial scale) to help implementation of EC directives on environment or climate. The applicant must not be a Member State entity which receives financing for a Capacity Building project which covers at least a part of the period to be

covered by the Technical Assistance project. EASME manages through all steps (evaluation, revision, monitoring, policy feedback). Since 2014 there are also Lawn facilities (PF4EE and NCFF).

Merce Rius explains how large cities share common problems, but this does not decrease its importance. For years the air quality problem has been minimized but now everybody is aware. 4 pollutants did not meet air quality standard in Catalonia in 2016: NO_2, O_3, PM and H2S. Trend analysis of NO_2 is too smooth, much less than for PM10, which however needs to go down to achieve WHO guidelines. NO_2 is mostly annual exceedance here (while in Madrid it is also a problem on an hourly level). The Emission Inventory of NOx has been updated to 2014. Road transport is responsible for 52% of NOx and PM10 emissions. Goals: -10% traffic emissions reduction in 5 years and 30% in the next 15 years for total emissions.

She presents the 48h-forecast model CALIOPE. The air quality plan will restrict access to LDV <EURO1 and passenger cars up to EURO1 for high pollution episodes since 2019. The plan includes also the reinforcement of public transport (extend rush hour and number of vehicles), which will be permanent in 2019. The plan promotes also to expand time flexibility in companies. 2 new public transport tickets are presented: *T-verde* and *T-aire* with no or low fare based on air quality criteria. She also highlights that the government of Catalonia needs support from central government of Spain for specific projects on mobility.

Alberto Gonzalez Ortiz from European Environmental Agency (EEA) talks about the MDIAK chain, which goal is the knowledge dissemination. He also presents another initiative: EEAcademy. He shows results of the upcoming report "Air Quality in Europe - 2017" where collected air quality and emissions data are reported for the year 2015. Emissions decrease from 2000s for all pollutants, except for BaP and NH_3 did not. For PM10 there is a clear impact of coal combustion in Eastern EU, and African dust in Canary Island but 90% of exceedance are either urban or suburban which clearly points also to road traffic.

He also shows results of the AEI (average exposure indicator) for PM2.5: Hungary and Poland did not meet it. Bulgaria and Croatia as well, but if considering all UB sites (not only the designated ones). For NO_2, 98% exceedances are at urban sites. Ozone is not presented since in cities is generally not a problem. The report also provides estimates of premature deaths are included in the report. The E-reporting helps a lot EEA compilation work.

Irene Olivares from Spanish Ministry of Environment informs that the 2016 report for Spain was published on 25th September. The year 2016 shows a new decrease of NO_2, O_3 and PM10 concentrations at a national level, while 2015 was increasing.

The Ministry is working on the new National Air Quality Plan (2017-2019, for which they are collecting comments from the public and administrations). It includes 36 measures grouped in 9 action areas:

1. Improving the information related to air
2. Environmental taxation
3. Improving movility
4. Research in relation to air quality

5. Improvements in agriculture and livestock to reduce NH3 emissions
6. Improvements in road transport
7. Improvements in air transport and airports
8. Improvements in railway transport
9. Improvements in seaports

It also works on the National Air Pollution Control Program (under NECD) to be published by April 2019 for NMVOCs, PM2.5, NH3 and NOx.

Joan Marc Craviotto from Barcelona City Council explains the view of the city of Barcelona to fight air pollution. He first gives an idea of the main statistics related to population and car density: 13 Million km are riven every working day in the city, but only 55% of vehicles are from Barcelona inhabitants. They also observed a slight reduction for NO2 in the city in 2016 compared to 2015 but in general there is significant decrease since 2000. 97% of Barcelona population above PM WHO guidelines (68% for NO2). He explains that Barcelona is immerse in an important transformation. A new paradigm is being established, replanning the principles from a city meant for the vehicles to a city meant for the people

New vision: new use of the streets, less private pollutant mobility and more public transport will bring better air quality and health A synergistic effort is urgently needed at municipal, metropolitan and regional level. He presents the upcoming Low Emission Zone, which will cover an area of 95 km2. Progressive implementation until permanent establishment in January 2020 (meanwhile only during episodes) based on DGT eco-labelling. He also presents the SUPERBLOCK concept, where macro blocks will have restricted inner circulation only for residents and services. The Superblocks will promote sustainable mobility, revitalize public space, promote the biodiversity and urban green infrastructure and facilitate citizenship involvement with city governance.

Xavier Querol from IDAEA CSIC introduces the main problems of air quality in Europe, emphasising critical parameters such as NO_2, BaP, O_3 and PM and the main goals of the AIRUSE Project. The structure of the project and description of the actions was described. AIRUSE started evaluating trends in air quality and emissions at a national level in Spain, and in AIRUSE cities (Barcelona, Porto, Milan, Florence and Athens), highlighting the effect of mitigation measures adopted at EU, national and metropolitan level. He then described the PM chemical speciation and source apportionment performed in AIRUSE, where >2000 sampled filters were analysed. The summarized results evidence the importance of secondary aerosols in PM concentrations, thus targeting a high number of measures at gaseous precursors (NO_x, SO_2, NH_3 and VOCs). Main sources of PM were identified as road traffic (at all sites) and biomass burning (at all sites, excluding Barcelona due to the good implementation of natural gas for domestic heating. Other important sources were local dust, industries and shipping. During pollution episodes at all cities the contribution of traffic and biomass burning increases, except in Athens, where African dust is the main cause of exceedances. The measures tested in AIRUSE were: street washing, Ca-Mg Acetate (CMA), $MgCl_2$. The tests were performed in typical urban roads, industrial roads and unpaved roads in order to have a comprehensive analysis. Street washing (combined with a preliminary sweeping) was found to be the most effective measure in all tested

roads. Reduction on mean PM10 levels was estimated at 7-10% (daily mean), 18% (daily mean) and >90% (in the first hour after washing) for urban paved, industrial paved and unpaved road respectively, as measured at kerbside monitoring sites. CMA and $MgCl_2$ were not found to reduce PM10 levels with statistically significance and, in any case, reduction was lower than that of water only (e.g. 8% for CMA versus 18% for water at the industrial paved road), this was attributed to the high solar radiation, rapid evaporation of road moisture and consequently to the lower capacity of CMA and $MgCl_2$ to keep a high road moisture and bind road dust particles. A side-effect of CMA spraying was found consisting in the stripping of NH3 from road surface due to the sensible (CMA induced) increase of pH.

AIRUSE recommends the use of a tandem operation, where the streets are first vacuumed-swept and then washed with water, since street sweeping alone resulted ineffective in reducing PM concentrations in the short term. The effectiveness of street washing is proportional to the magnitude of road dust contribution to total PM10. Street washing should be performed at the early morning (5-6h am), before the rush traffic hour. This is due to the fact that the effectiveness of street washing is related to the higher road humidity and being generally short-lived (few hours). Street washing should be prioritized at roads with medium-high vehicle intensity (>10,000 vehicles per day), during and after African dust intrusion events (or dry periods), when road dust emissions are sensibly higher. Non-drinking phreatic water (extracted from the subway system in most cities) should be preferred.

REDUST-LIFE+ project presented by **Outi Väkevä** from the city of Helsinki. She demonstrates that street dust is a significant problem in Nordic cities, mostly caused by the use of studded tyres and street sanding to improve safety in winter. The Project activities are based at 3 Finnish cities: Helsinki, Espoo and Vantaa.

A mobile monitoring van was used to measure particulate matter on street surfaces while driving, and 3 more mobile instrumented units to measure effect of studded tyres, sanding,…… They also evaluated maintenance methods, abatement measures for street dust, Ca Cl2, KCOOH, street sweeping, flushing,…. Dust binding tests were performed with $CaCl_2$ and potassium formate, with different application procedures. The initial emission reduction ranged from 40% to 90% the first day after application and decreased considerably the days after until no effect 3-4 days after. KA and CMA can be used to reduce emissions, Cl-bearing salt are not recommended to be used everywhere because, although they have an abatement effect, these have aside negative effects. Recommended to be applied in very dirty roads. If these have a low dust load effect is less evident. Improved maintenance actions might also reduce emissions and it is demonstrated that emissions can be reduced by 25% by street cleaning and dust binding. By applying these measures and additional ones on the use of studded tyres, on street dust PM10 daily exceedances have decreased dramatically. A tool for street dust mitigation measures was developed, including cost analysis. The cost analysis indicated that it is most feasible to: 1. prioritize additional measures on streets which have much traffic and high dust emissions, 2. increase the number of dust bindings, 3. perform street cleaning early in spring, however without risking traffic safety, and repeat cleaning if necessary 4. replace the traditional vacuum sweepers with modern street scrubbers or with other more efficient cleaning procedures.

Andres Bonfanti from BREMBO presents results from COBRE-LIFE+ on brake systems to reduce emissions of brake dust. He describes briefly the main layers of the brake pad manufacture and the typical pads categories available in the market (Semi-metallic, low metallic and NAO). The most common materials used for manufacturing.

They focus on the composition and structure of friction materials in brake pads to avoid using Cu. Binders and reinforcements, abrasives, fillers and lubricants. For each of the groups we can have different starting materials. Some are going to be forbidden in USA (Cu and Pb fibers). They studied the use of phenolic resin, Portland cement, fly ash, metakaolin, silica fume, sodium hydroxide, among others. He showed the general patterns of the break pad manufacturing process. They compared the performance with traditional pads. They compared the Cu free pad with an Alfa one on road. The outputs of testing were very positive. PM emissions show low mass and particle number emissions

They have now a PM measure system to evaluate emissions that reports on mass and number concentrations by defining a driving cycle. Cobra emit by 50% less than the organic binder pads. Also for ultrafine particles it seems that slightly lower emissions are also evidenced. The results obtained so far are regarded as particularly promising in view of further development of these new class of friction materials for the market. A fully automatic prototypal pilot line pressing station is currently available in Stezzano (Italy)

Pieter Looijestijn from E-MOBILITY Life+ from Metropolitan area of Amsterdam. In 2016 NL >100000 cars are electrics, especially hybrid. 43% of the e-vehicles in NL are in this zone. New project: 2,800 charge points in streets, growing by 80/month, with monthly 300 MW sustainable energy charged. 40,000 fully plug-in vehicles will be sold in 2018. There is not capacity to this demand without key measures for supplying charging. They favour smart charging, price transparency in EU roaming for charging. They launched a campaign for electrifying SMS cars for deliveries. They also installed charge points in the neighbourhoods. Studies on the timing of charging the vehicles, showing a window for low energy consumption between 0 and 5 h am. They also evidenced that cars are plugged long time, part of it without charging, so they suggest using and intelligent system to decide when the plugged car should charge, as a function of the energy demand. They consider electromobility is an effective way to improve air quality acting with local and regional authorities and combine restrictions with alternatives.

Tierry Sueguelong, AUTOLIFE12. There is an objective for CO2 reduction from transportation (26% of the EU CO2 emissions). There are strategies to reach it based on the energy mixt, vehicle technology, renewable fuels, and optimization of transportation, driving conditions, vehicle types, and durability and robustness of transportation. Concerning air quality pollutants, he states that EU is leading the standards on the emissions of these pollutants, EU is proposing real world driving emission testing. Diesel is requiring less fuel/km for most vehicles, the small vehicles should use gasoline. LIFE 12 is a LIFE project based in France by Solvay Solgefi. The project is based on improving fuel additives to diesel and gasoline engines to improve fuel quality and reduce CO_2 emissions/km maintaining the power of the vehicle. They added the additive in the fuel filter instead of in the fuel tank and it is replaced when the filter is changed

every 30000 km. EasyFlex additive is newly elaborated, reaching 4% increase on fuel efficiency. They are ready to move into series production. They suggest that is the process is used massively for existing and new vehicles they provide a reduction on emissions of around 7.11 Mt CO_2/year in France. They also demonstrated that the additive reduce NOx emissions in urban driving conditions.

Manuel Pujadas from CIEMAT shows results of MINOx street Life on using photo-catalysts in streets for NOx abatement. Using TiO_2 with UV light from insolation. Basically TiO_2 photo-catalyzes NO_2 in HNO_3 and this can be deposited in photo-catalyzed surfaces. This has been shown in laboratory scale but what is the real effect in outdoor ambient air. Life MINOx was a scientific approach to reply this question. Objectives: test the NOx sinks of the most promising photocatalytic materials, document in ambient conditions the effects, derive the effects in hypothetical future scenarios if applied massively in cities. They aimed to select 3 photocatalytic materials for applications and the application in 3 real scenarios on road, sidewalk and façade. He presented the methodology of application of the materials. They tested the photocatalytic potential at lab scale, later on they determined the vertical gradient and horizontal NO_2 gradients. They also monitored VOCs and resuspended TiO_2, as well as leaching of surfaces. They also modelled all the outdoor scenarios. The results showed that structural properties of the products were good, but they detected high variability of the NOx abatement potential at lab scale. The same product on a different substrate produced different effects. NOx dry deposition was estimated in 0.002 m/s. He presented the results on air quality. They could not detect effect on ambient NO_2 due to photocatalytics in the streets. In the case of the façade they observed gradients due to the effect of photocatalytic bricks, so it seems that there was photocatalytic effect but without influence on air quality. The durability of the effect is a pending issue. In the conclusions he highlighted that their tests demonstrated that effects on air quality by applying these materials are negligible.

Laura Krug from Deutsche Umwelthilfe presents Clean Heat Life based in Germany but measurements also in other countries. On domestic and residential emission (PM/BC) from wood burning. They aimed to obtain a significant reduction of wood burning emissions of PM and BC. NECD requires the largest reduction for 2030 for PM2.5, followed by NH_3. Currently and in 2030 emissions of PM2.5 are dominated by domestic heating (41%), BC in 2030 is expected to come by 69% from domestic heating. She shows the limit values for eco-design PM 40 µg/m^3, 20 µg /m^3 and 30 µg /m^3 for local space heaters (firewood stoves) in 2002, pellet stoves in 2022 and solid fuel boilers in 2020, respectively. The project is promoting policy recommendations: better information for consumers, recommending stricter emission limits, in highly polluted areas ban the installation and on use of solid biomass appliances, and recommend shifting to ambient WHO guidelines, harmonize the testing for approval tests of appliances. In the conclusions she remarks that installing new appliances is not the best solutions for air quality, sustainable alternatives of existing coal and wood burning facilities. The suggest use biomass burning in large facilities with control systems.

David Dajnak from King's College shows the London's strategy to improve air quality. He highlights the failure on attaining NO_2 limit values for air quality. Over 9000 Londoners died prematurely from long term exposure to air pollution in 2010. A high dieselization of the fleet is demanding for a stricter strategy on abating pollution from road traffic. He highlighted the measures until now: The Congestion Charge Zone, that is not efficient now on abating emissions. The LEZ has failed due to the increase of emissions due to dieselization and the failure of the diesel NOx abatement strategy. London is devising an Ultra LEZ for 2020. All vehicles reaching centre of London will have to be EURO4 for gasoline and EURO6 for diesel vehicles in 2020. But unfortunately, he said, the area of application is very reduced in size. They also devised a scenario for 2025. They propose to reduce diesel cars by 2.5%/year until 2025. In 2025 they forecast to meet the NO_2 limit value in London with measures of the 2025 scenario, with the exception of a neighbourhood in the western London where specific local measures will be required for attainment. He finally elaborates on the impact of climate change on air quality. They used a modelling tool to evaluate energy use 3 scenarios depending on the nuclear power generation share. They show both for NOx and PM2.5 a massive decline from road traffic in 2035, but the climate incentives to biomass burning in domestic heating will increase the PM2.5 levels that might counterbalance the PM2.5 decrease from traffic. In any case the new London administration has targeted meeting WHO guidelines by 2030 and the zero carbon city in 2050.

Ángeles Cristóbal from the Madrid City Council shows the current situation of air quality in Madrid and plans. Madrid has 24 automatic stations and they exceed NO2 annual and hourly limit values from the EU, they exceed PM10 and PM2.5 WHO guidelines and they exceed the O3 targets. In 2016 9 sites exceeded the annual limit value (13 in 2015 and 6 in 2014). In a few of them they also exceeded the hourly limit value. Trends for PM and NO2 are decreasing but not in the case of O_3. In the town O3 levels tend to increase. She evidenced that road transportation is the first source contributing to emission inventories of NOx (51.4%), PM10 (61.3%) and PM2.5. Concerning source contribution to ambient air levels of NO_2, road traffic accounts for 74%, 36% for PM2.5. She presents main patterns of the new Madrid City Plan. They started with a Decree in January 2016 to tackle short term episodes to reduce number of hourly NO_2 exceedances, with parking bans, speed limits reductions and vehicle restrictions based on plate limitations. She showed the example of the implementation of the protocol on December 29, 2017 when restrictions of the third level (plate, parking and seed restrictions). They received a positive answer from the society. Then she reported on the New Air Quality Plan or 'A' Plan. This is an approach with 2020 and 2030 targets. It contains 30 measures on mobility (21), urban regeneration, nature based solutions and information and public awareness. They devised park and rides around the city, speed control, increased biking systems, a large central area with outdoor parking for residents only, parking prices based on eco-efficiency of vehicles (free for plug-in vehicles, renewal of public transport fleets and municipal fleets, sustainable mobility plans for the administrations and companies, measures on urban freight distribution, increase of charging network as well as CNG and GLP; are the main measures on mobility. Also renewal energy in the city, measures for greening. Action focusing of the most vulnerable population and cooperation with other administration. They plan to reduce ambient air concentrations by 25% in the centre of Madrid in 2020, and an important reduction in PM10 and PM2.5 (8 and 6%).

Nick Molden and **Massimo Fedeli** from Air Alliance on vehicle eco-labelling for new and old vehicles. Air quality is illegally high in many cities, diesel is blamed for it, the solution should be delivered fast, the confidence on official data on emissions is low, electrification cannot solve the problem quickly enough, and consumer confusion is increasing. The cities have to deliver the solution to the problem. Emission Analytics is using the portable emission monitoring systems in the last 6 years and they measured 1500 vehicles. Cars are selected randomly, not from the manufacturers. They preserve the independency from manufacturers in this way. The emission testing is very similar to the RDE tests from the new approval test, but the RDE will be applied only to new EURO6c cars, while their database includes EURO5 and EURO6 vehicles and can be expanded to older ones. Using all diesel models measured there was a 5 ratio between the PEMS and the approval test emissions in 2015 these ratios decreased down to 3 or 4 with the new EURO6, but in the last part of 2016 and beginning of 2017 the ratio increased to 7 because manufacturers adapted again their emission testing to optimal outdoor ambient temperatures and not for colder ones when ERG is less effective in abating NOx. The good news is that some of the diesel vehicles are very clean. If we focus on the 10 % cleaner the NOx emissions is around 150 mgNOx/km and the 5% cleaner is <80mg/km. Any vehicle before EURO5 is emitting high levels of NOx, in EURO5 and especially EURO6 a clean proportion of diesel is present. A new eco-labelling showing these emissions will drive manufacturers to minimize as much as possible, even below legal limits, because they know the data will be public. Anything we can do to remove all pre-E5 diesel vehicles, discriminate E5 and E6 and get ripped off of only the dirty ones, incentivize going beyond regulatory minimums, turnover fleet or supporting retrofitting will be an excellent tool for air quality. Air is proposing a new vehicle eco-labelling system independent from regulators and from manufacturers, based on EQUA index. On the 17th October London will show the EQUA index on the official website. UK government is requiring a minimum EQUA labelling in tenders for new cars for the administration. The Air Alliance is created. They presented the Air Alliance. Emission Analytics give all the dataset to the Alliance to make it public and open to everybody and promote the use as an air quality tool.

DEBATE

Xavier Querol (XQ) to Mario Lionetti (ML): can he say more on the new LIFE projects?

ML: this will be presented tomorrow in the PREPAIR project

CHALLENGES AND PROBLEMS TO OVERCOME AT FOUR SCALES

XQ to Alberto Gonzalez (AG): what is the view at the EC about actions being motivated mostly by the NO2 exceedances rather than PM? This is affecting 10% of the population of the EU28 whereas on the other hand most of the premature deaths in Europe are due to PM values. EU standards are not working as they are too focused on NO2 and PM levels are too permissive compared to WHO guidelines.

AG: there is no limit value below which there is no effect for PM levels, but there is one for NO2. There is more evidence to calculate NO2 health effects. It is true that limits have to decrease, EU as a whole needs to have a political agreement, not only the EC.

XQ: comments on the fact that the EU legislation keeps postponing the implementation of the WHO guideline.

AG: the EU legislation has the lower average exposure indicator in addition to the limit value. We have more standards apart from the limit value. And Member States decide before the EC.

Ignacio Fernández (IF) asks about the new ceiling directive. The reference value for PM2.5 does not include the primary emissions, maybe fugitive emissions neither. Do we have the real emission values?

Irene Olivares (IO) says that the reductions will be calculated with the emissions inventory according to the EU rules. It is true that this is a calculation, it is not a measurement. But this is what we have, and the same rules apply to everybody.

XQ: point 13 of Goteborg protocol says that the Member State can apply for an adjustment of the emissions every year.

Outi Vakeva (OV) asks about the reduction targets presented for each country. What does that mean? Do countries have to implement any measures?

AG: He has presented the obligation for all countries with a reduction target, the reduction depends on each country. This value is calculated by each country annually and they have to apply measures to be below in the limit values.

XQ: following IX we have to be prepared to use policies that were not good in the past. The effect has been very positive for some contaminants. 75% reduction of As, Mn, Cd after industrial measures were done in Barcelona. So we cannot take only criticism. The effect has been so good that some things that before were not important are important now. For example, non-exhaust emissions, shipping are now important after bigger sources have been controlled. Improving air quality has to look at these new sources.

EFFECTIVENESS OF URBAN AIR QUALITY MEASURES (PROJECTS)

OV: regarding brake pads, what about the heavy metals? Is there any information on how they will be affected?

Andrea Bonfanti (AB): brake-disks will have metals for sure. 20-50% of PM from brakes is elemental Fe in PM10, Fe oxide is present as well but they need higher temperature. They are working on the brake disks now, not pads. They want to reduce Fe oxide from the brake emissions.

XQ: they have analysed all brake pads in Barcelona and found 12% Cu in moto brake pads. Also stibnite (Sb oxide) is carcinogenic

AB: this is different in cars with less than 5% Cu. They have not look at Sb concentrations and in any case Sb is less and less used in brakes.

Thierry Seguelong (TS): Transportation. WE are bringing lots of `pieces from China or India without regulations, not only brake but also other materials, catalysts. We need the EC to be stronger in the market.

XQ: the brake pads they analysed were European.

ML to AB: are you ready to commercialize?

ML to all other projects: when you solve the problem you have to see the side effects, so what about water consumption if you use water for road wash?

XQ: in Barcelona we have to extract water from the subway system so this is not a problem. The best practice is to avoid the emission better than remediation. We have to reduce the number of cars, no reduce the speed (that can produce higher NO2 emissions). So we say wash the roads if you have had 15 days without rain or a NAF episode. Use not drinking water.

OV: In Helsinki they use drinking water for road washing but only in special roads with high traffic.

AB: they found asbestos, Pb, Cd and other pollutants in brake pieces from India and China. Regarding the "afterlife" they have to show good quality of barked. By 2018 they will have the answer for high standard cars.

EFFECTIVENESS OF URBAN AIR QUALIY MEASURES (PROJECTS)

XQ: In AIRUSE they look at the Netherlands and Norway as success stories for mobility. The % of electric vehicles in both countries is large and increasing. When do they think can achieve 15% of the fleet?

Pieter Looijestijn (PL): As % increases prices will go down. They expect by 2025 in Holland the e-car will be dominant.

Sophie Moukhtar (SM): on the MINOX project. TiO2 is used in many things, food cosmetics, but may have a health effect problem?

Manuel Pujadas (MP): TiO_2 is not ingested, the problem could be breathing nanoparticles of this composition. In any case the amount of TiO_2 in the resuspended dust is not significant and it is not a matter of concern if not used massively.

XQ: A Russian paper in Nature this year says that gasoline cars produce potentially double secondary aerosols than E6 diesel vehicles. When E6 diesel cars are equipped with technology to reduce NOx the diesel will be much cleaner than now. So future can be different, the bad effects of diesel cars are related to the old vehicles.

TS: E6 emits more PM than E5.

EFFECTIVENESS OF URBAN AIR QUALITY MEASURES (THE CITIES)

Teresa Pay (TP): on the exceedances of O_3 n Madrid. Are you aware of the sources? Reducing NOx will affect? What are the effects on the Plan A?

Angeles Cristobal (AC): We still have not seen the effect of Plan A in O_3, not yet. O_3 is very complicated, so it is difficult to see the effects of NOx reduction. Lower NOx relates to higher O_3 and maybe that is why ozone increases on weekends when traffic is low.

Jose Manuel Felisi (JMF): when will we have healthy cities?

David Dajnak (DD): in 2050 London will have much better air but for best health we need zero pollution. 75% of PM comes from outside London but measures should not focus only outside the city, people in megacities like blaming outside sources but they also produce local pollution.

AC: W op city air will be better in 10 years, but it is a long way so we should apply technological and no technological measures.

THE AIR ALLIANCE

DD: The London emission inventory has lots of problems as there are sources missing.

Nick Molden (NM): Although data is available, the data they use needs private information too. It is an improvement but it is not standardized. Still you cannot compare the RDE test.

XQ: The Air alliance is excellent because they are objective and not related to companies. The official test is run with cars using 25º for the exhaust gas recirculation making easy to pass the test. This is legally permitted but they are real conditions. What does it happen in winter when we have NOx high levs? Or in summer when we have Ozone episodes? Manufactures are taking advantage of the legal vacuum

Massimo Fedeli (MF): It is not illegal, it is immoral.

27/09/2017

Ramona Ocak is an EC officer, and presents the European Investment Project Portal as the meeting place for promoters and investors. It is a portal to Boost investments by pointing in contact Promoter (public/private) and investors community. Translation is free of charge. Different issues are covered. 192 projects are published. Not only for looking for fund, also for publicizing. She shows some statistics on project beneficiaries (country, field..) and some indicators of the Portal (visits, by country, by project..)

Eligibility criteria:

- Have a minimum size of EUR 1 million (project total cost)

- Fall within the geographical scope of Article 8 and the sectors/objectives of Article 9(2) of the EFSI Regulation – (EU) 2015/1017 (MS plus cross-border projects with neighbouring countries)
- Be compatible with EU and MS law and shall not entail any legal, reputational or national security risks
- Have started or be expected to start within three years from submission to the Portal
- Only legal entities (in good standing) established in a Member State (not individuals) can submit projects
- Be clearly described as investment projects with accurate information provided Start within the next 3 years
- Complement funding already received, give visibility

The Portal will diversify their sources of financing, complement EU funding received (i.e. grants), offer visibility to project promoters for investors worldwide – particularly on the early phase of project development (e.g. start-ups, angel investment) and help in finding new collaborators and business partners. The Portal offers to investors direct easy access to a broad range of investment projects covering various economic sectors in all EU Member States, a transparent and forward-looking pipeline of projects coming from EU-based project promoters and tailored alerts and notifications, based on investors preferences and interests (country, sector, project size, etc.)

Teresa Moreno presents results from the IMPROVE LIFE+ project: Implementing methodologies and practices to reduce air pollution of the subway environment. The objective of the project is to provide to the local and national transport authorities of European countries the appropriate measures and strategies to reduce concentrations of inhalable particulate matter (PM1, PM2.5 and PM10) and identify distinctive chemical components in underground rail air.

Measurements are performed in the subway system of Barcelona, both in platforms and trains. Several variables taken into account are: i) Station design: single/double track, access points, depth, ventilation systems, platform door systems; ii) Train frequency and piston effect; iii) Passenger numbers; iv) Train design: braking systems, wheels, air conditioning, etc.; v) Contamination by outside city air; vi) Ferruginous environment influenced by brake pad chemistry.

Several mitigation tests have been carried out including emissions for specific components (brakes, rails, catenary), activities in the tunnel, effect and practicability of applying antiresuspension product to the ballast before placement and changes in ventilation protocols. The chemical characterization in fact includes not only subway PM but also several materials such as ballast, catenary, brushes, brakes, pantograph, rails and wheels.

Some preliminary conclusions are drawn:

- Ventilation is a key factor influencing air quality in both platforms and inside trains. Summer platform ventilation and air conditioning inside trains both improve air quality. Driving air into the tunnel system from outside produces better air quality than the reverse.

- Protocols regarding regular replacement of AC filters in trains should be re-examined.
- Platform screen door systems, in addition to improving safety, produce much better air quality than traditional open subway platforms.
- Extreme transient peaks in PM concentrations produced by night tunnel maintenance have a detectable, but much lower, short-term impact on daytime platform air quality. The most polluting activity is identified as that of ballast removal and replacement, producing abundant granitic rock dust.
- The treatment of ballast with anti-resuspension polymer has a detectable influence on daytime platform air quality, and is to be encouraged.

Barend Van Drooge explains the results obtained on organic chemical PM components within the IMPROVE project. 10% - 20% of metro-PM2.5 is organic carbon which consists of thousands of organic compounds. The IDAEA laboratory is able to Detect very low concentrated organic pollutants, some from inside some tracing infiltration:

- Polycyclic aromatic hydrocarbons (PAH)
- hopanes (lumbricant oils)
- Saccharides (anhydro-, primary-, alcohol-)
- Dicarboxylic acids
- Carboxylic acid

But also nicotine, n-alkanes, MDH-jasmonate (perfume), phthalate esters (plasticizers), organophospourus FR. PM2.5 and carbonaceous particles (TC) are correlated to hopanes (lubricant oils from vehicle-traffic) and sum of organic tracer compounds. Plasticizers (flame retardants<) only in the new stations (organic phosphorous compounds) 30 times higher than outdoor.

Some flame-retardants are prohibited, but some are there with very high concentrations. Tobacco smoke & fragrances are related to stations. Organic dust higher in winter. n-alkanes correlate with hopanes (vehicle-traffic). Large variety of organic compounds are detected in PM2.5 of subway stations. Outdoor (combustion) sources influence air quality of metro stations...more in winter. Benzo[a]pyrene concentrations are similar to outdoor air concentrations.

Newer subway station (Collblanc) with independent ventilation system / separation from railway show lowest concentrations of organics, PM2.5 and TC...except for newest station that showed highest levels of new plasticizer/flame retardant TCP.

Short commuting times and moderate air pollutant concentrations probably do not cause adverse effects in passengers….nevertheless, an evaluation on the endocrine disrupting potential of the organic fraction is recommended due to elevated phthalate ester concentrations.

Jesus Miguel Santamaria presents the LIFE RESPIRA project in Pamplona. They study Exposure of cyclists and pedestrians. Electrochemical sensors. Volunteers around the city. >150 million measurements. Also PM and ozone, beside NOx. CO from residential heating in the northern area of Pamplona. Negative effect of vegetation sometimes. Big effort to sensor calibration and validation.

Statistics from the beginning: May 2015 (2 years): 200 volunteers (persistent: 113), 20,000 trips, 44,000 km cycled, 10,000 km driven, 15,000 bike-hours, 1,500 trips with heart rate meters, 77,000 data-recording hours, 150 million measurements, 817,000 total segments, 3 million data points.

BC decrease faster without trees, but better with hedges. Ground level efficiency of photocatalytic for NO2 (40%). They developed the "healthy route" planner:

- Web portal: selection of healthy routes
- Viewing active sensors and pollution levels
- Contamination level the user is exposed to
- Displaying the optional routes, choosing the most convenient
- Representation of routes and mileage made by users
- Android Application (identical functionality)
- iOS application for Apple devices (identical

Face masks (up to 60% of BC). Mobility plan. Social perception of air pollution. Didactic guide for school. Modelling activities included:

- Application of Computational Fluids Dynamics (CFD) Models
- Simulations of air quality with very high resolution (< 5m)
- Estimation of population exposure to urban pollutants
- Prediction of pollution episodes
- Simulation of pollution reduction scenarios

Cristina Vasconcelos presents the AIRUSE webpage.

Luc Int Panis introduces the Pasta Project. Cities with different mode distribution. The more km of cycling path, the more the users. Big health gain for cyclers. Cross sectional analysis. Risk of false associations. Look at the effect on changes of exposures. 2 open access papers published. 2 years of questionnaires. High education was a bias. NO_2 correlates with the perception. Exposures different for people living in the same house. (BC). The dose is always much higher for cycler and walker (the inhalation is 4 times higher). Measure physical activity level to know the dose. But physical activity is healthier anyway (in spite of higher dosage)? People forget easily about moderate activities.

BC above 1.5 extra physical activity yield to lower lung function, below this umbral, it is good to cycle. Mortality risk studies say that is always good to cycle. But lung function studies suggest the existence of this threshold. 4 kg in 2 years gained by car drivers, lost by cyclers. Building

cycling highways is worth economically (at least y a factor of 2). HEAT helps calculation euro gaining walking or cycling.

Sophie Mouktar gives a presentation on AIRPARIF. LINK TO climate actions. Same size as Barcelona, double people. Problem of radial public transportation, as in Barcelona.

In vehicle exposure, concentration doubled the sidewalk. Bike lane distance from the curb decrease rapidly by a factor of 2. Bus fleet will be electric by 2020. Subway in 25 stations monitoring. Data available online. During 2 years. So far very high concentrations of PM10, higher than outdoor traffic sites. Working people in subway is on strike because of air pollution. *En voiture*, tool to calculate your daily dose

Josep Armengol from TMB presents the recent and future activities of TMB for renovating the bus fleet. Urban policies are beyond our control, in 2030 half of the fleet will be electric. Commercial speed. Things we can do regard: network, fleet, number of new vehicles. The orthogonal network is aimed to have a network, as in the metro. Emission studies changing fleet and/or network.

ZeEUS project. China has 170.000 electric buses, in Europe there are around 200. Overnight busses (they charge the battery 5 hours during night). 15 h work in winter and 12 h in summer.

Opportunity charging buses (less autonomy). Need to be charged in stations, stressing the whole schedule. Very high cost of purchase and maintenance. Highest energy consumption in summer (A/C). In summer the two options do not wok to fulfil the service.

Patrick Reiden from Lund University. Transportation was increasing oil consumption year by year, the only sector to do that. Internal combustion losses 65% energy. Electric loss only 8%. Batteries are however heavy, expensive and last to charge. Slide vehicle and charging while moving.

Small batteries (60 KW/h only). 170 km totally; 100 with battery, 70 km recharging on the top. Winter consumption peaks (heating inside bus). Recharging often the batteries is good. Slide-in infrastructure (from the bottom) could be used also by private vehicles. 100 cities with trolley bus infrastructure. Swedish German cooperation in 2017 from bottom charging for trucks (only 10% need electrification, the rest with batteries)

M. Dolores Hidalgo presents the Gystra LIFE project. Global system for Sustainable TRAffic management. The CORETRA project, demonstrated, using technology RSD, that 6,4% of the most polluting vehicles are responsible for more than 35% of total emissions of CO, NOx, HC and PM (Madrid, 2014-2015). NO_2, key traffic pollutant, was not measured because current RSD did not include this possibility. Pollutant emissions from motor vehicles are initially controlled from their manufacture before bring them onto the market. However, the reality is that these tests are performed on "bench" without circuit tests and within specific driving cycles. Therefore, real driving emissions from vehicles in urban areas differ from the official data. High Emitters are heterogeneous and include modern vehicles (e.g. Euro V), and vehicles that passed a Periodic Technical Inspection (PTI). 6% of vehicle in Madrid are responsible for 35% of emissions.

The main objective of GYSTRA project is to establish a real and effective policy for sustainable mobility, both for city traffic as for public transport fleets, and to implement actions that achieve the reparation of the vehicles that are polluting beyond the defined thresholds (High Emitters). The goal will be achieved with the creation of a global emission management system using a newly developed RSD adapted to the EU requirements by including NO_2. The RSD+ will measure CO, HC, CO_2, NO and NO_2 via nondispersive infrared spectroscopy (for the carbon species) and dispersive ultraviolet spectroscopy (for nitrogen species) in less than 0.5 seconds via the exhaust of vehicles. RSD+ software determines the ratios of CO/CO_2, HC/CO_2, NO/CO_2 and NO_2/CO_2 in the diluted and dispersed exhaust plumes and applies the mathematics of chemical mass balance of internal combustion to calculate tailpipe concentrations that are corrected for water and excess air. RSD+ also calculates a total obscuration factor (termed a "smoke factor") that is a fuel specific exhaust opacity measurement. RSD+ technology is prepared to measure in the European roads in fixed locations, similar to speed radars.

Expected results:

- Sustainable mobility policy based on a legal frame to identify high emitter vehicles (HE) and reduce traffic emissions.
- Develop RSD+ prototypes which complies with EU standards, small and versatile, able to be installed in fixed locations, with uncertainty less than 15% applied to all the emissions.
- Model replicable
- Dissemination of the results to more than 50,000 people from all sectors.
- Public model:
    - In the Spanish pilot (Madrid), 700,000 vehicles per year will be monitored (30% of fleet in Madrid).
    - Circa 5% will be identified as HE.
    - With the repair of HE it is expected to achieve reductions of CO, HC and NOx emissions of 617 t/y, 89 t/y and 518 t/y, respectively, in Madrid.
    - The projection for all the country would be 17,779 t/y, 2,463 t/y and 15,320 t/y, respectively.

Lisa Blyth from Vito talks about PM and BaP being an issue in Poland. NO2 as well. Benzo(a)pyrene: All 182 municipalities in the Małopolska Region exceed the target level of 1 ng/m³. Key objective is to accelerate the implementation of the "Air Quality Plan for the Małopolska Region" & improve air quality in the region. Planned actions: from grassroots (municipalities) to the regional level. Budget: €16.8M. Duration: Oct 2015 – Dec 2023

Anti-smog regulation:

- Kraków: solid fuel ban in (Coal is mostly used currently) - adopted 15 Jan 2016, effective from 1 Sept 2019.
- Małopolska: Eco-design standards for all boilers, stoves & fireplaces - adopted 23 Jan 2017, effective from 1 June 2017 (new devices) and from 2023 (existing).
- Silesian Region: similar regulation adopted on 7 April 2017
- 6 other regions: regulation being discussed

60 eco-managers are recruited in order to accelerate actions at local level and increase public awareness. Traffic restriction in Krakow city. Main tasks are creating a harmonized residential emission inventory, a trans-boundary emission database, the creation of an inter-regional AQ modelling tool and a sustainable service. She also presents the EISSA project. In this project, each region will receive its own EISSA framework filled with their residential inventory for the pollutants that will be included in the regional model. Finally, she presents the ATMOSYS planning: user friendly web based modelling tool to assess effectiveness of local management plans: traffic, but also point (industry) and area.

David Dajnak from Kings College presents on the London Hybrid exposure model. This is a dynamic model to compare with static exposure methods for NO_2 and PM2.5. Thy have measure AQ in the London subway showing that all lines are different, with very high BC values. Also AQ inside trains s better when train doors open. For city air they are producing x20m maps with hourly concentrations, using indoor/outdoor ratio to calculate exposure to outdoor pollutants. Their hybrid exposure model shows lower concentrations for NO_2 and PM2.5 than real data, they think this is because they are not considering indoor values. They are now trying to improve the indoor sources considerations.

Laura Pretto introduces the Brenner Lower Emissions Corridor LIFE project. It aims to develop a LEC to manage traffic on the basis of a proactive logic, maximising the environmental benefits and minimising inconvenience for people. They have installed 3 monitoring AQ stations in the side of the motorway, with 3 policies to test: 1. Reduction of speed limit to 110 km/h when traffic is very intense (this is the speed limit that results in less pollutants), 2. Reduction to 110 km/h under conditions of high atmospheric pollution. 3. In urban areas with high traffic conditions optimising the use of the motorway by choosing a corridor in the city instead. They have recently started the measurements and therefore don't have results yet.

Lavinia Laiti on the LIFE IP PREPAIR LIFE project. The Po basin is densely populated and heavy industrialised farmed areas, with a morphology and meteorological conditions that help stagnation of air pollutants. This is an integrated project helping to implement at the AQPs at larger territorial scale, establishing a data sharing infrastructure for monitoring and allowing the reduction of pollutant transport across the north Adriatic Sea. The project will last for 7 years with a budget of 17 million euros and 36 actions. The project is organised in 7 pillars including: emissions evaluation actions (to set up common databases and tool for emission evaluation), air quality evaluating actions, agriculture emissions, biomass burning, transport actions (to promote sustainable mobility), energy efficiency and communication actions.

DEBATE

Question from David Dajnak (DD): If we close the tunnel with the screen doors we increase the PM levels into the train?

Teresa Moreno (TM): We did not see this, the screen door and the train door coincide when stopping and train takes air from the platform. Furthermore, tunnel has his own independent system of ventilation

Xavier Querol (XQ): How the trends of PM10 are in the last years and what proportion of PM10 is external to Paris Metropolitan Area.

Sophie Moukhtar (SM): trends decrease clearly but we are still on exceedance. From 60 to 70% of the annual mean seems to be external. XQ asked also about the relevance of the PM episodes caused by agricultural emissions around Paris. She replied in spring 2015 and 2014 intensive PM episodes were caused by NH3 emissions from agriculture but also by NOx.

TM to DD: How can you measure BC in the metro with so high Fe concentrations that interfere the absorbance measure for BC. Details will be provided on their methods used.

XQ to Laura Pretto (LP): What is the actual effect of speed reduction on ambient NO2 levels in your project? We did also studies in Barcelona and we saw limited effect but there was an important effect on reducing congestion in the city if you allow flowing smoothly to the first traffic light by reducing speed. They replied they are starting the project and definitive data is not available. They will evaluate both effects.

DD to LP: how do you know 80 km/h results in the lowest emissions if the emission factors do not work?

LP: there is a curve path that shows this, and we are only talking about passengers' cars, not heavy vehicles.

TM to Lavinia Laiti (LL): Questions on how reducing biomass burning emissions in the Po valley project. SM argues that they should ban wood burning in these areas (LL says this is difficult as this is a traditional problem and there is no political will). Also XQ requested how they plan to reduce NH_3.

LL: we are trying to get better practices from the use of fertilizers training the agricultures.

TM thanks on behalf of XQ and herself all attendants and speakers for their contribution to a very productive workshop.