LIFE Project Number

LIFE09 ENV/IT/000082

FINAL Report

Covering the project activities from 01/10/2010 to 30/06/2014

Reporting Date

30/09/2014

LIFE+ PROJECT NAME or Acronym

population EXposure to PAH (EXPAH)

Project Data

Project location	Rome
Project start date:	01/10/2010
Project end date:	31/12/2013 **Extension date:** 30/06/2014
Total Project duration (in months)	45 months (including **Extension of** 6 **months**)
Total budget	€ 2,037,749
Total eligible budget	€ 1,957,149
EU contribution:	€ 978,202
(%) of total costs	49.98%
(%) of eligible costs	96.04%

Beneficiary Data

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2. Executive Summary

2.1. The Final Report

The present report is structured in five parts: Summary, Introduction, Administrative part, Technical part and comment on the Financial report. The Summary presents the EXPAH project, describing the objectives, key deliverables and outputs. The introduction describes the background, the problem addressed and the objectives, outlining the results achieved, the methodological solution adopted. The administrative part reports the management process, the coordination and the organization of the project team, with details about actions carried out to accomplish these tasks. The management system is also evaluated according to the problems encountered and the solutions adopted thanks to a joint effort from the partnership. The technical part provides details on the status, the activities carried out, the progress and materials annexed for each action of the project. The actions are divided into technical, management and dissemination actions. At the end of the paragraph, a detailed evaluation of the project implementation is proposed. The financial part is a comment on the financial report, including an overview of costs incurred, information on the accounting system, and allocation of costs per action.

The following abbreviations will be used throughout the report:

PAH	Polycyclic Aromatic Hydrocarbon
EXPAH	population EXposure to PAH
PM	Particulate Matter
EC/OC	Elemental Carbon/Organic Carbon
REN	Regional Environmental Network
VOC	Volatile Organic Compound
BTEX	Benzene/Toluene/Xylene compounds
I/O	Indoor/Outdoor
SODAR	SOnic Detection And Ranging
RASS	Radio Acoustic Sounding System
MB	Management Board
ECMWF	European Center for Meteorological Weather Forecasting
CTM	Chemical Transport Model
FARM	Flexible Air quality Regional Model
SVM	Support Vector Machine
GIS	Geographic Information System

2.2. Project Objectives

The overall goal of the EXPAH project was to identify and to quantify population exposure among children and elderly people to Polycyclic Aromatic Hydrocarbons PAHs content in particulate matter in highly urbanized areas and to assess the impact on human health, in order to support environmental policy and regulation in this field. An integrated approach, based on

measurements and modelling techniques, had be used to estimate the spatial distribution of population exposure to PAHs, to identify key determinants of high exposures including time-activity and locations in relation to the sources and to estimate potential health effects on the target population. The urban area of Rome was chosen as test area.
More specifically the EXPAH objectives were:

Objective 1: To develop a state-of-the-art PAHs emission inventories for the test city and to upgrade related speciation profiles for specific sources.

Objective 2: To improve and integrate air pollution models from the regional down to the local scale to describe the emissions, diffusion, atmospheric transformations, and removal of transport-related pollutants with particular relevance to PAHs.

Objective 3: To estimate the actual concentration of particulate matter and PAHs in different areas of the city, using existing monitoring network and field studies, to assess the actual human exposure in different living places (microenvironments).

Objective 4: To develop an outdoor-indoor infiltration model able to estimate the amount of both particles and PAHs of ambient origin present in each predefined indoor microenvironment.

Objective 5: To estimate the mean exposure of the target populations (children and elderly) to particles and of PAHs using data from the air pollution model, infiltration models and population time-activity patterns through an exposure model.

Objective 6: To estimate the short-term and long-term health impact of particles of different sizes and PAHs on mortality and morbidity using actual and model estimated exposures levels and taking into account the effect of several potential confounding factors.

Objective 7: To improve our understanding of the human health effects and the corresponding exposure-response relationships of PAHs in order to evaluate the impact of different threshold values of air pollutants concentration, with special attention on organic compounds.

Objective 8: To evaluate the health impact in view of existing, planned as well as alternative future EU policies in order to provide recommendations for adaption and mitigation strategies.

Some objectives (objectives 1, 2) were achieved as originally planned according to the project proposal, while others were obtained with a few months of delay due to delay in carrying out a key action (action 3.3) which postponed all the remaining linked actions. This delay was overcome though thanks to project prolongation by 6 months, approved in 29/04/2013. The associated deliverables and outputs produced are described in technical annexes (Chapter 7.2) and dissemination annexes (Chapter 7.3).
To achieve all the above mentioned objectives, a number of targeted actions have been undertaken. In particular, **objective 1** has been achieved by means of actions 4.1, 4.2, 4.3 and 4.4 who collected raw emission data for the test area and carried out their spatial, temporal and chemical disaggregation for both sources emission assessment and for feeding a CTM system. **Objective 2** was implemented by action 4.5. The CTM model FARM was upgraded to deal with PAHs emission, dispersion and transformation processes and then applied in the test area to obtain ambient PAHs concentrations during a year (June 2011-May 2012). The actions 3.2, 3.3 and 3.4 allow to reach **objective 3**. They carried out seasonal PAHs monitoring activities in 20 living environments (homes, schools, cars, buses, offices) located around the city, as well as personal monitoring of PAHs exposure in nine individuals among children and elderly people. Such data have then been used by actions 5.1 and 5.2 to achieve **objective 4** which develop an infiltration model able to estimate the amount of indoor PAHs concentrations of ambient origin in different living environments. The **objective 5** was achieved by actions 5.3 and 5.4 using data provided by action 3.1, 4.5, 5.1 and 5.2. A

microenvironments based exposure model was developed and applied to provide seasonal and annual PAHs and $PM_{2.5}$ exposure maps, with population exposure profiles, for both children and elderly people living in the test area. The actions 6.1, 6.2 and 6.3 allow to reach the **objectives 6 and 7**. Both short-term and long-term health effects were found and assessed for population exposure to PAHs. Evidence of an association of all the exposures with short-term natural and respiratory mortality, both at delayed and prolonged latencies was found, as well as an association between long-term exposure and non-accidental and cardiovascular mortality. Finally, the **objective 8** was achieved by three actions (7.1, 7.2 and 7.3). Two future emission scenarios at the year 2020 were identified and impacts on ambient air, population exposure and health effects assessed.

2.3. Key deliverables

The complete list of deliverables and the correspondent actions and annexes are provided in Table 1. Compared to the project proposal, all the expected deliverables have been produced as planned and their full version is provided in the corresponding annexes (see last column in Table 1).

Table 1: Full list of project deliverables, by action

Name of Deliverable	Associated action	Due date	Status	Annex
Data set from intensive field campaigns of indoor-outdoor PM2.5 and speciated PAHs as well as EC/OC PM contents in living places for the summer and winter seasons	3.3	31/3/2013	Completed on time	7.2.1
Data set of personal exposure to PM2.5 and PAHs	3.3	31/3/2013	Completed on time	7.2.2
Report on infiltration and exposure model with software prototypes.	5.2; 5.3	30/9/2013	Completed on time	7.2.3
Report on model capability to simulate PM2.5 and PAHs in the base case	4.5	30/3/2013	Completed 2 months ahead of time	7.2.4
Report on Annual and seasonal exposure maps to PM2.5 and speciated PAHs for children and elderly people in the base case	5.4	31/3/2014	Completed on time	7.2.5
data-base for health assessment with software prototype	6.1; 6.3	31/12/2013	Completed 1 months ahead of time	7.2.6
Report on evaluation of policy and mitigation scenarios	7.1	31/6/2013	Completed 3 months ahead of time	7.2.7
Report on impact to PAHs outdoor concentrations and population exposure in the policy and mitigation scenarios	7.2	31/3/2014	Completed on time	7.2.8
Report on health impact of PAHs in the base case and policy and mitigation scenarios	6.1; 6.2; 6.3; 7.3	31/5/2014	Completed 2 months ahead of time	7.2.9
Report on the PAHs environmental and health effects analysis methodology employed and its level of portability in other EU areas.	2.2	30/6/2014	Completed 1 months ahead of time	7.2.65
Report on recommendations for adaptation and mitigation strategies.	2.2	30/6/2014	Completed 1 months ahead of time	7.2.64
Layman's report	2.5	30/6/2014	Completed 1 months ahead of time	7.3.1
GIS application with data and results	8.1	30/6/2014	Completed on time	7.2.12

After LIFE communication plan	9.1	30/6/2014	Completed 1 months ahead of time	7.3.16

2.4. Output

The main outputs of the project are summarized below. The main results and annexes are provided as a demonstration of the feasibility to integrate environmental and health data to address the problem of population exposure to PAHs. The outputs were divided into technical, administrative, financial and dissemination activities.
The list of indicators of outputs and the associated costs is provided in Annex 7.4.1.

Table 2. List of project's technical output by objective and action.

Name of technical output	Type of tech. output: Report (R); Dataset (D); Methodology (M)	Objective	action	status	annex
Compilation of a full emission inventory of air pollutants with PAHs for the target city and for the reference year (base case scenario)	D	1	4.1, 4.2, 4.3	achieved	7.2.13, 7.2.14, 7.2.15
Hourly resolved concentration fields of both ambient gaseous and size resolved aerosol pollutants with speciated PAHs and PM aerosol components with EC/OC in the urban area of Rome for one year in the base case scenario	D	2	4.5	achieved	7.2.16
Collection of long-term air quality monitoring data for the city of Rome	D	3	3.3	achieved	7.2.17
Concentration data of indoor-outdoor PM2.5 and its EC, OC and PAHs contents in some living places (e.g. homes; schools; cars) collected during intensive field campaigns in the summer and winter seasons	D	3	3.3	achieved	7.2.18
Field data of personal exposure to PM2.5 and PAHs contents	D	3	3.3	achieved	7.2.19
Infiltration modelling system applied to the City of Rome	M	4	5.1, 5.2	achieved	7.2.3
Exposure modelling system validated and applied to the City of Rome with software prototype	M	5	5.3	achieved	7.2.20
Annual and seasonal exposure maps to PM2.5 and speciated PAHs for children and elderly people in the base case scenario	D	5	5.4	achieved	7.2.21, 7.2.5
Annual and seasonal cumulative distribution of exposure to PM2.5 and PAHs compounds for children and elderly people in the base case	D	5	5.4	achieved	7.2.5
Evaluation of short-term health effects for acute mortality and coronary, cerebrovascular and respiratory morbidity: data-base, exposure-response, threshold evaluation	R	6, 7	6.1, 6.2, 6.3	achieved	7.2.9
Evaluation of long-term effects for mortality, lung cancer and other cancers and cardiovascular and respiratory morbidity: data-base, exposure-response, threshold	R	6, 7	6.1, 6.2, 6.3	achieved	7.2.9

evaluation					
PAHs emissions inventory for future scenarios	D	8	7.1	achieved	7.2.7
Hourly concentration fields of both ambient gaseous and size resolved aerosol speciated PAHs in the urban area of Rome in the policy and mitigation scenarios	D	8	7.2	achieved	7.2.22, 7.2.8
Annual and seasonal exposure maps and cumulative distribution of exposure to PM2.5 and speciated PAHs for children and elderly people in the policy and mitigation scenarios	D	8	7.2	achieved	7.2.23, 7.2.8
Health effects of the policy and mitigation scenarios	R	8	7.3	achieved	7.2.9
GIS application containing all data and results produced by the project	D		8.1	Achieved	7.2.24

Table 3. List of project's dissemination outputs by action.

Name of dissemination output	action	annex
Mailing list of stakeholders	2.2	7.3.2
Layman's report for dissemination of results (IT/EN)	2.5	7.3.1
Project logo	2.2	7.3.3
Project leaflet EN	2.2	7.3.4
Project leaflet IT	2.2	7.3.5
EXPAH newsletters issues 1-4 (in English)	2.2	7.3.6.1-4
On site chemical monitoring panel (in Italian)	2.2	7.3.7
On site meteorology monitoring panel (in Italian)	2.2	7.3.8
Summary report (in Italian)	2.2	7.3.9
List of published papers	2.2	7.3.10.x
EXPAH final conference	2.4	7.3.11.x
EXPAH mid term conference	2.4	7.3.12.x
EXPAH kick-off conference	2.4	7.3.13.x
News about EXPAH on Italian Environment Ministry web page	2.2	7.3.14
Press release - Inquinamento, l'impegno della ricerca Inail per l'anno europeo dell'aria	2.2	7.3.15
After LIFE Communication Plan	9.1	7.3.16
Pictures of project's implementation		7.3.17

Table 4. List of project's Management output.

Name of management output	annex
Minutes of technical meetings and MB	7.1.1.x
Monitoring forms for actions progress	7.1.2.x

Table 5. List of project's financial output.

Name of Financial output	annex
Standard Payment Request and Beneficiary's Certificate	8.1
Consolidated Cost Statement for the Project	8.2
Financial statement ASL-RME	8.2b
Financial statement INAIL	8.3
Financial statement CNR- Inquinamento Atmosferico	8.4
Financial statement ARIANET	8.5
Financial statement Agenzia Regionale Protezione Ambientale – Lazio	8.6
Financial statement CNR –Istituto di Scienze dell'Atmosfera e del Clima	8.7
Financial statement THL – National Institute for Health and Welfare	8.8
Financial notes	8.9

2. Introduction

Polycyclic Aromatic Hydrocarbons (PAHs) are a class of complex organic chemicals of increasing concern for their occurrence in the environment. They are ubiquitous in ambient air and some of them have been identified as suspected carcinogens. PAHs can be found in the atmosphere in both gaseous and particulate forms (PM2.5 and PM10) depending on their volatility which is governed by their chemical structure. The best known PAH is the benzo[a]pyrene (B[a]P). The United States Agency for Toxic Substances and Disease Registry has considered 17 priority PAHs based on their toxicological profile. There is strong evidence for the relationship between PAH exposure and lung, skin, and bladder cancer in humans. DNA damage induced by PAHs exposure was demonstrated by different authors and increase of genotoxic risk in people working in ambient urban air was also detected. Long-term exposure to PAHs has also been associated with gene mutation cell damaging and increased risks of cardiopulmonary mortality. Short term exposure has been reported to cause impaired lung function in asthmatic people and thrombotic effect in people affected by coronary heart disease.

PAHs and their derivatives are produced by the incomplete combustion of organic material: mainly from anthropogenic combustion and biomass burning. In general there are five major emission sources of PAHs: domestic, mobile, industrial (including power generation and waste processing), agricultural and natural. In highly urbanized areas domestic heating and mobile sources, and specifically vehicles, are the largest contributors of PAHs, with diesel fuelled cars releasing higher particulate emissions than gasoline fuelled ones. As a consequence populations living in these areas are exposed to pollutants which have potential health effects. The European Directive 2004/107/EC proposed a target value of 1 ng/m3 B[a]P for the total content in the PM10 fraction averaged over a calendar year. Furthermore this directive also suggests to assess the contribution of B[a]P in ambient air, as well as the indication for each Member State to monitor other relevant PAHs. However PAHs are not continuously monitored as the other regulated air pollutants. Consequently the time and spatial characteristics of the population exposure to PAHs is not well known.

The LIFE+ EXPAH project has filled this gap of knowledge producing useful information to assess the PAHs exposure of urban population and its related health effects. The EXPAH project addressed the environmental and health problems induced by emission, dispersion and transformation of PAHs compounds. The overall goal of the project was to identify and to quantify population exposure among children and elderly people to PAHs content in particulate matter in the area of Rome, chosen as demonstration area, and to assess the impact on human health, in order to support environmental policy and regulation in this field.

The EXPAH methodology consists in an integrated approach which involves field campaigns measurements for assessment of actual PAHs exposure, modelling for PAHs ambient concentrations, and epidemiologic investigations to estimate potential health effects of PAHs on the target population. The strategy to assess the impacts of PAHs on urban areas is based on a modelling approach where starting from an emission inventory of the studied area, the emission, dispersion and transformation processes are simulated by a computer model to obtain the impact of PAHs on air quality. PAHs exposure results are then used to assess the related health impacts. The potential effects on air quality induced by new EU and local policies are evaluated by means of the above mentioned modelling chain using a "What-If" scheme. Based on the new air quality impacts the corresponding effects on human health are

then evaluated. In the EXPAH project the health effects are evaluated by considering all involved processes. Starting from the emissions of the main sources identified, the ambient PAHs concentrations are estimated by means of modelling techniques, properly validated by dedicated measurements. As population spend most of the time in indoor environments, a proper assessment of exposure has to consider the indoor infiltration of outdoor (ambient) pollutants. Then breathing air man intakes doses of toxic compounds which cumulate in the human bodies to produce short and long term health effects are considered. In order to take into account the involved exposure processes, the EXPAH project applies a methodology based on both an indoor/outdoor infiltration model to estimate indoor concentrations in the main living environments, and on a microenvironments approach where daily PAHs exposure is estimated by summing all single exposures experienced in the visited living environments weighted for the time spent in each of them.
EXPAH project built a prototype assessment method capable to provide basic knowledge on PAHs concentrations and health impact over urbanized regions and to perform scenarios analyses to evaluate the effectiveness of possible reduction measures. It can contribute to development, assessment, monitoring and evaluation of environmental policies at both local and national levels. The obtained results can also provide a valuable support to EC legislation concerning PAHs.

The EXPAH project obtained remarkable results summarized below:

- A PAHs emission inventory has been built for Lazio Region and for the urban area of Rome. It emerges the greatest relevance of emissions from domestic heating sector and from biomass combustion in particular (Objective 1).
- An advanced air quality model (FARM), was upgraded to include PAHs chemistry, and then used to estimate spatial and temporal variability of outdoor concentrations at 1 km resolution over the city of Rome (Objective 2). Yearly averaged $PM_{2.5}$ concentration field shows that the European limit value of 20 µg m-3 is exceeded over a large fraction of Rome conurbation, while annual average B[a]P concentration does not exceed the 1 ng/m^3 limit value. However, daily concentrations during the winter exceeded the limit value demanding for intervention.
- PAHs exposure levels were measured in the main indoors and traffic environments (cars and buses) of school children and the elderly (Objective 3). Results show a strong seasonality of exposure to PAHs which is higher during colder seasons. This occurrence is attributed to high emissions coming from domestic heatings. Living environments do not seem to be protected by infiltration of outdoor pollutants.
- Indoor PAHs concentrations were found to be related with correspondent outdoor ones. Infiltration was estimated to be about 60-90% depending of PAHs compound and living environment. A model was developed to estimate indoor concentrations from outdoor ones (Objective 4).
- Spatial distribution of exposures were calculated by combining microenvironment data and ambient air quality models results (Objective 5). Most important microenvironments were homes for the elderly and homes and schools for the children. These living environments dominate the overall exposure due to the not negligible PAHs infiltration and the longer time spent in these environments. Seasonal exposure was confirmed although on a yearly bases the legal limit of BaP is not exceeded. Due to the strong seasonality of PAHs exposure, the latter does not seem to represent a safe health protection limit. A significant portion of population was found to be exposed to $PM_{2.5}$ concentrations higher than WHO guideline limit demanding for intervention.

- Both short-term and long-term health effects were identified as a consequence of PAHs exposure (Objective 6). An increasing of mortality for a variation in PAHs exposure within 2-5 days was found with evidence of linearity in the dose-response association (Objective 7). At longer term an increase of risk of mortality for non-accidental and cardiovascular causes was identified.
- The environmental and health effects consequent to the foreseen emissions at the year 2020 were estimated as well as those with additional mitigation measures (full conversion from biomass heating to natural gas fuelled systems) (Objective 8). Without mitigation measures the PAHs impacts is estimated to increase with consequent higher health impact. Conversely the transformation of biomass combustion in cleaner heating system seems to be effective in reducing environmental/health impact.

Expected longer term results

The outcomes of the project are believed to have the following impacts:

- Implementation, updating and development of European Union environmental policy and legislation on air quality:
  Modification of EU regulation on BaP limits and PAHs monitoring: The observed PAHs levels in urban areas have been found to be characterized by high seasonality with large difference between heating and non heating seasons. During cold seasons, high concentration of PAHs were both observed and modelled. The current EC air quality standard for B[a]P, based on annual mean value, seems to be unable to represent a safe health protection limit, as high winter PAHs concentrations are compensated by the one order of magnitude lower values occurring during the summer time. Consequently a shorter time average period would better represent the actual exposure level of population. A monthly value of B[a}P concentration is recommended for this reason. Furthermore, the prescribed minimum temporal coverage of PAHs sampling and analysis adopted by environmental authorities (33%) seems to be unable to monitor the high temporal variability observed in PAHs levels. High peak of PAHs concentrations can be lost by this sampling frequency, underestimating the actual exposure of population. Consequently, an extended time coverage of PAHs sampling is recommended for PAHs monitoring. Local and National Authorities were invited at the final conference to keep them informed about the above issues. Contacts were also established with representative of important WHO project (REVIHAAP) to keep them informed about the latest results.

  Emission policy and biomass regulation at national and regional level: Evidences from the EXPAH project, address the biomass combustion as the most important PAHs emission sources in the metropolitan area of Rome. When used as domestic heating system, wood produces large PM2.5 and PAHs emissions with a low heat production efficiency, especially if traditional stoves are employed. The increase of selling of domestic heating systems based on pellets, together with the use of traditional stoves and fireplaces as secondary heating systems has acerbated the problem. Consequently, the use of biomass for domestic heating should be regulated and possibly reduced at regional and National levels. In principle, for environmental and efficiency reasons, it should be substituted with natural gas. Alternative, low emission high quality biomass burning system should be used in addition to recommendations on their proper use and maintenance. Research in the field of ultra low dust technologies, high efficiency and clean combustion system is

needed. The above issues have been presented to the Rome's Municipal Assessor for Environment during the final conference.

Short term and long term plans, transport and heating system plans at local level: The major air quality problem affecting Rome conurbation is connected to particulate matter concentration in both its fine and coarse components. It is therefore advisable to address local measures to the possible reduction of PM emissions. Transport and residential heating are the sectors accounted for the larger contribution to PM emissions in Rome. An effort to improve Rome public transport system and possible regulation on diesel vehicle circulation can be identified as the most promising measures on the transport sector. A discussion about this topic has been held during the final conference with the participation of the Rome's Municipal Assessor for Environment. In addition, the EXPAH WEB-GIS has been linked to a web portal about air quality and health in Rome (www.romariasalute.it) to keep population informed about the latest results.
Improvements are possible for residential heating emissions. A large number of public and private building are heated by gasoil fired boilers that could be substituted by more efficient and less polluting gas fired heating systems. The increase of use of biomass for house heating should be investigated to estimate its penetration and to individuate the areas more affected by those emissions. Information campaigns concerning the environmental problems caused by biomass burning in urban areas should be promoted, regulations could be introduced concerning the use of this fuel inside Rome metropolitan area. The promotion of economic incentives to substitute biomass greener fuels could be considered.
Measures concerning residential heating are expected to be the most effective to reduce PAHs concentrations in Rome.

Measures for reduction of indoor concentrations and exposure: findings of the EXPAH project highlight the presence of PAHs in the normal living environments. They are mainly caused by infiltration from outdoor air. Main risk reduction should therefore target improvement of outdoor air quality, especially consideration for cleaner biomass combustion technologies and use of alternative energy sources. Northern Europe experiences highlight the possible use of filtered ventilation systems to reduce the impact of infiltration from outdoor air. Interventions on building structures to reduce the penetration efficiency and increase the air exchange and deposition rates might produce improvements in indoor air quality.

- Integration of the environment into other policies: the results of the project have clearly indicated that choices at environmental level have health consequences. A future environmental policy could have clear impact on various economic sectors, including car industry for design and production of low polluting vehicles, producers of heating systems employing less fossil fuels and biomasses, heavy industry with control of emissions and targeted energy use.

- Future EU and Global applicability and reproducibility of demonstrated technology: the EXPAH project created an unforeseen compilation of standard methodologies for the assessment of population exposures to PAH compounds including air quality monitoring, modeling, population time activity, assessment of infiltration, and source identification. As far as the monitoring, modeling and health effects methodologies are concerned, it has to be considered that their application requires very high multidiscipline skills, normally available in specific research groups. Out of this scientific context, it would be difficult to find the required know

how to implement the proposed methodologies. So, in order to export them in a different context without sufficient skills, support would be necessary to gather the needed data and to apply the EXPAH methodologies. To improve the level of portability, the PAHs monitoring activities were carried out by using standard and consolidated methods for sampling and chemical analysis. The employed techniques are easily replicable at the scientific or technical departments of environmental agencies.
Some of EXPAH's results and deliverables can be reutilized in a different geographic area, as they can be considered representative of a general urban Mediterranean context. In this way some of the expensive and time consuming surveys and sampling activities do not need to be replicated, improving the level of portability. Among them we can find:

- Time activity data of children and elderly people living in Rome;
- PAHs infiltration factors for home, school, office, car, bus;
- 2020 PAHs National emissions in the 2020CLE and 2020AME scenarios.

- Further improvement of EXPAH methodology: Although the EXPAH project adopted the most updated methodologies for the evaluation of PAHs exposure in the urban population, a number of possible improvements in both data and employed methodologies can be identified.

  As for monitoring of PAHs exposure the following improvements can be adopted:
  - Better coverage of PAHs temporal profiles by means of more time resolved monitoring or optimized sampling approaches;
  - Better technical chemical analysis to increase accuracy and the number of identified PAHs compounds for toxicity and source fingerprint studies.
  - More detailed studies on PM2.5 composition and their indoor infiltration.
  - Assessment of PAHs exposure in living environments with specific indoor sources (kitchen; fireplace; candles; smokers)
  - Measurements of micro-climate(eg. temperature, humidity, wind, pressure) parameters;
  - Detailed description of particle size distributions including PAHs related to particle infiltration and respiratory tract deposition;
  - Seasonal and source specific variation of PAH compounds particle size distribution;
  - Assessment of air exchange rates and deposition surfaces in living environment for a better determination of infiltration.

  As for modelling techniques the following improvements might be required:
  - Better assessment of PAHs emissions with particular attention to biomass combustion sources used as domestic heating;
  - Better information on spatial and temporal characteristics of biomass combustion and domestic heating sources;
  - Extension of the number of PAHs compounds modeled including their atmospheric transformation processes;
  - Extension of PAHs degradation processes in addition to the ozone driven B[a]P reduction.
  - Assessment of PAHs exposure for working age population by including information on mobility, commuting and preferred working time locations to account for time variability of population density.

  As for health effect assessment a number of enhancements can be considered:

  - Longer time series of PAHs exposure to support both short and long term analysis;
  - Better accuracy in the determination of PAHs exposure;
  - Higher space resolution of PAHs exposure to account for street level effects and urban hotspots.

- Level of portability of EXPAH methodology in other urban areas: the EXPAH project was implemented in the city of Rome, as it was considered as representative of a large Mediterranean urban area. Its methodologies to assess PAHs population exposure can be exported in other metropolitan areas or medium size cities eventually with a mixed industrial/urban context, provided the expertise is available. The mixed context is of particular interest due to the complains about health effects produced by large industrial facilities, such as steel plants, which are often located close to urban and harbour areas. In such a context, it might be important to assess PAHs exposure, source contributions and to identify mitigation scenarios. The EXPAH project has provided methodologies that are able to answer to the main questions existing in such contexts. Unfortunately, they are not completely portable out of the area where they have been implemented. A number of adaptations to the specific situation have to be planned. Among them we find:
  - Seasonal PAHs monitoring at outdoor level to provide actual PAHs exposure of population and data for testing of model performance;
  - identification of main sources and evaluation of the contribution from biomass combustion;
  - Development of PAHs, PM2.5 and gaseous pollutants emission inventory for the studied region;
  - Cartographic data of the studied region;
  - Population density data for the studied region;
  - Health outcomes for the studied region.

  It has to be considered that a large fraction of the local information mentioned is usually available in the European countries.

  As mentioned above, other important data-bases, such as population time activity and PAHs infiltration factors, can be either exported from EXPAH results or derived by the application of the EXPAH methodologies in the area of study.

  As far as the above data are available and skilled or supported expertise in AQ modelling and epidemiology are accessible, the application of methodologies should provide results on PAHs population exposure for the studied region.

- Potential stakeholders for portability: Municipality of large urban area with mixed urban/industrial/harbour context or Region addressing air quality and emission reductions in atmospheric particulate matter (PM) hotspots in areas with continued high use of coal and biomass burning heating applications.

- Key messages for policy makers: the following key messages can be issue for policy makers:
  - A reduced time averaged evaluation (e.g. monthly) is recommended for B[a]P concentrations.
  - An intervention on $PM_{2.5}$ emission sources is needed with particular attention on diesel vehicles and domestic heating.

  - The use of biomass for domestic heating should be regulated and possibly reduced and substituted with natural gas or alternative low emission systems.
  - The large uncertainty affecting the estimation of PAHs emissions, particularly for biomass combustion used in domestic heating, should be reduced.
- Potential interest in portability: Potential interest on portability of the EXPAH methodology was found in some Regional Environmental Authorities. In particular the Friuli Venezia Giulia Environmental Authorities manifested its interest in EXPAH methodologies and results, inviting EXPAH partners for making presentations about them. Other Regional Authorities were invited at the final conference. Contacts have also been established with the environmental authority of Veneto Region to present EXPAH results in view of a possible collaboration. Contacts were established with head of Environment Authority of Puglia Region and his staff. He was also invited at the final conference to give a presentation about the PAHs environmental problems in the city of Taranto where the largest European steel plant is located which is producing a big environmental/health problems in the living population. There is great potential portability of the EXPAH methodologies in this area and a great interest in doing it, but financial and local problems do not allow at the moment to make it. As for European level contacts were early established with a Poland environmental authorities to get them informed about EXPAH methodologies, but the initial relationships were not continued for unknown reasons.

3. Administrative part

3.1 Description of the management system

The project management system has been structured in the following actions:

- Co-ordination and management (Action 1.1)
- Monitoring of the project (Action 1.2)
- Administration of budget and financial audits (Action 2.1)

Co-ordination and management.

The project was designed to be composed by three interconnected main technical phases:

- Monitoring tasks (actions 3.x)
- Modelling tasks (actions 4.x, 5.x, 7.1, 7.2)
- Health impact tasks (actions 6.x, 7.3)

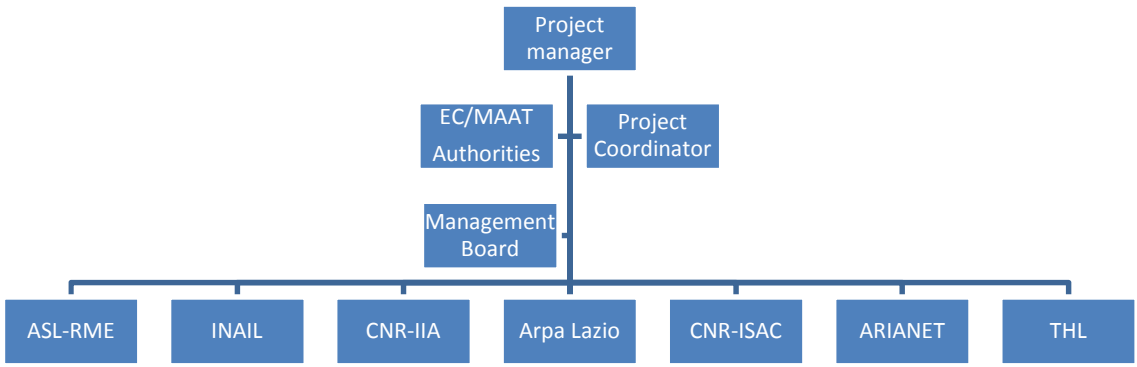
Overall management (actions 1.1, 1.2, 2.1) and dissemination tasks (actions 2.2, 2.3, 2.4, 2.5, 8.1) completed the project's structure. As the three technical phases were interconnected for delivery of data, they were scheduled to be accomplished one after the other, while management and dissemination tasks run for the entire project.

The project beneficiaries, according to the formal partnership agreements, were the following:

- Department of Epidemiology of the Lazio Region, ASL-RME (Coordinating Beneficiary);
- Departments of Occupational Hygiene and Production Plants and Human Settlements, Italian Workers' Compensation Authority (INAIL), Research Certification and Verification.

- CNR, Air Quality Institute
- Arianet S.r.l.
- ARPA-Lazio
- CNR- Istitituto di Scienze dell'Atmosfera e del Clima
- THL – National Institute for Health and Welfare

The project team was structured according to the organigramme shown below.



Both the Project Manager (F. Forastiere) and Project Coordinator (C. Gariazzo) had one or two people of administration staff for helping and supporting all project organization activities. The operative organization and management of the project was conducted by the Project Coordinator with the help of his own staff. In addition to all administrative and financial matters concerning the project, the Project Manager maintained the contacts with the Commission and stakeholders. At partners level, a Task Manager was identified to be responsible for the implementation of actions. The following persons were identified for each partner:

ASL-RME	G. Cesaroni; M. Stafoggia
INAIL	M. Gherardi; A. Pelliccioni
CNR-IIA	A, Cecinato; C. Perrino
Arpa-Lazio	F. Sacco
CNR-ISAC	S, Argentini
Arianet	S, Finardi; C. Silibello
THL	O. Hanninen

In addition, administrative staff persons dealing with all financial and administration issues of the project were endorsed.
Each project action was pre-assigned to a partner at the stage of proposal. However, for their complexity and interconnected nature, some tasks (eg. monitoring) needed intensive coordination and management to be implemented. In order to organise the project, a communication system based on both email and phone was used. It was used as the main way to share opinions and preliminary documents and results among the partners. Data were also

exchanged by means of a ftp server (ftp\\: 95.228.102.188) with restricted access to project participants. As for important technical issues, either action or Management Board meetings was used to discuss project arguments. Action meetings were organized for discussing the implementation of specific aspects of the scheduled tasks with rather low impact on other project actions. The Management Board (MB) was instead organized to discuss about the implementation of the project and to solve problems with a relative high impact on key actions and on the overall project. The MB was composed by representative persons for each partners chosen among those included in Task Managers listed above. A MB meeting was supposed to be organized every six months. The following MB meetings were held:

- 09/12/2010 (annex 7.1.1.10)
- 19/12/2011 (annex 7.1.1.11)
- 13/09/2012 (annex 7.1.1.12)
- 16/04/2013 (annex 7.1.1.13)

Timing of MB was not implemented as strictly scheduled, being related with management of project actions. Sometimes MB meetings were organized as Action meetings being more related to implementation of specific actions rather than the whole project.

The Project Coordinator organized the following meetings to coordinate the project:

- 6 Action 3.2 meetings (annexes 7.1.1.1-6);
- 3 Action 3.3 meetings (annexes 7.1.1.7-9);
- 1 Action 5.1 meeting (annex 7.1.1.14)
- 4 Action 6.x meetings (annexes 7.1.1.13, 7.1.1.15-17)
- 3 Actions meetings (annexes 7.1.1.18-20)
- 4 Management Board (annexes 7.1.1.10-13)

For each meeting agenda and minutes were prepared to focus the discussion and summarize decisions and then distributed to the participants. The actions undertaken were then followed up by the Project Coordinator to guarantee their implementation.
Three public conference were also organized (kick-off; mid-term and final) to share results and feedbacks with stakeholders.

Coordination with the European Commission

The coordination with the Commission has been handled by e-mail and correspondence letters. Information about the progress of the planned activities, monitoring their compliance with the project milestones and deliverables, reporting financial statements and related certification to the European Commission were collected, reviewed, and distributed.
We had frequent contacts with the external monitor Ms. Yael Meroz of ASTRALE GEIE-TIMESIS, who monitored the activities and the compliance of the project deliverables and milestones with what declared in the proposal.
The monitoring team visited the Project Coordinator/Manager and Task Managers on the dates 31/05/2011, 23/03/2012, 18/12/2012 and 2/4/2014 and reported the progresses and problems encountered by the project to the European Commission.
Nine official letters were received from the European Commission after the monitoring team visits, the evaluation of the Inception, Mid-term, Progress reports, the supplementary agreement and the request of postponement. The letters reported the main strengths and weaknesses of the project. Concerning the latter, some delays in the implementation of technical actions, as well as non-compliance in some of the reporting of financial documents were underlined by the EC. Such issues have been carefully considered afterwards, and are extensively detailed in the present Final Report. As for technical issues, the EC addressed a

few requests of modifications emerging from the periodical visits of the external monitor team. Requests and solutions undertaken are summarized below:

EU reference letter	Request	Solution undertaken
Mid term report	Portability: Please explain the efforts undertaken so far in order to promote the model to other highly urbanized areas in Italy and in EU. Please explain the tangible results achieved so far and provide letters.	A letter of interest was received from Environment Agency of Friuli V. Giulia region (annex 7.3.18) and a seminar on EXPAH was held. Other Agencies were invited at the final conference; The Environment Agency of Veneto region has manifested its interest in EXPAH modelling methodologies. A seminar will be organized.
Mid term report	Support to EC legislation concerning PAHs: Please indicate what has been/will be done in this respect (contact with EU Institutions, with EU level working groups etc.)	Contacts have been established with participants of WHO REVIHAAP project (annex 7.3.25) to provide EXPAH results which could support future legislation revision
Mid term report	Add a new page "Results" on the website where you should include a summary description of the results achieved	A page 'Results' has been added on the main page containing the achieved results
Mid term report	picture of equipment purchased under the project not bearing the LIFE logo	The LIFE logo has been added to the equipments shown in the pictures (annex PIC.2, annex PIC.12
Progress report	adding a link to the GIS feature on the home page	done
Progress report	ensuring that the "last date of update" is correct on the website.	done
Progress report	please provide material from both the mid-term and the final conferences (such as presentations, list of participants and photos) with the Final Report	done (see annexes 7.3.11.x; 7.3.12.x; PICs)
Progress report	please clarify within the Final Report whether the GIS platform created by the project is compliant with the INSPIRE Directive	in compliance with INSPIRE Directive
Progress report	to include a link to the platform in a portal of ARPA on air quality in the city of Rome.	A link to air quality and health website (www.romariasalute.it) has been added to access to PAHs maps delivered by EXPAH

During the project two requests of modifications of the Grant Agreement were submitted to the Commission and accepted by it. The first was due to the incorporation of the former Associated beneficiary ISPESL into INAIL Institute and, according to article 15.2 of the

Common Provision, the need to update the original project documents (annex 7.1.3). The second modification was consequent to a request of prolongation of project duration by 6 months (annex 7.1.4).

Partnership agreements status and key content

Formal agreements between the coordinating beneficiary and the partners have been established following the Life+ guidelines. The dates of the agreements, for each specific partner, were illustrated and sent to European Commission with the Inception Report.

Monitoring of the project

Monitoring activities were carried out by the Project Coordinator and consisted in evaluating the efficacy of planned actions and verifying that the project's objectives had been achieved.
The actions of the project were monitored every six months by means of Action Monitoring Forms. The forms have been implemented and compiled by the Project Coordinator and by the associated beneficiaries for the specific actions. The form is composed by a section on the general status of the implementation of the action, and by three points checking: 1-Tasks, Milestones achieved in the period; 2-Output foreseen and delivered in the period; 3-Tasks, Milestones foreseen in the next period. Also, sections about summary results of the monitoring, major problems encountered, and recommendations and requests for actions and support complete the form. The form has been filled in and signed by the beneficiary responsible for the action and sent back to the Project Coordinator (the latest monitoring forms compiled for each action is attached in Annexes 7.1.2.1-32).
In addition four meetings were held with the tutor Ms. Yael Meroz of ASTRALE GEIE-TIMESIS external monitoring team, in order to monitor the state of advancement of the project and its compliance with what declared in the proposal.

Administration of budget and financial audits

The Project Coordinator dealt with all administrative and financial matters concerning the coordination of the project. According to what contained in the approved partner's agreement, copies of the financial documents and the time-sheets produced by the associated beneficiaries were collected and archived by the coordinating beneficiary every three months. In order to monitor the expenses of the project, each partner updated its financial statement every three months, and sent it to the Coordinating Beneficiary, which also predisposed an overall project MS-Excel file aimed at registering all project costs. Contacts with the monitoring team of the Commission were necessary to fix errors in compiling these excel forms. These accounting systems have been operative with costs updated at June 2014.

3.2 Evaluation of the management system

Project management process

The management system adopted has been generally successful. Each action was assigned to a beneficiary, responsible for the fulfilment of deliverables and milestones in the time scheduled, and the Coordinating beneficiary checked and supported the progress of the action. Whenever the Project Coordinator or any of the partners recognized delays or deviations from the expected milestones, all the possible measures to be undertaken were evaluated by the Project Coordinator. The management process has been facilitated by solid collaborative relationships among partners. All the partners participated to technical meetings and other

joint events organized during the project, and they were all involved in the dissemination activities to share their competence and experience.
The project coordinator was in charge for keeping the contacts with the EC external monitor, informing partners about problems and specific requests as well as for their fixing.
Periodical contacts/meetings with the external monitor were useful to monitor the status of the technical activities, check the adequacy of the financial documentation provided and solve problems. The project took advantages in subdividing different management tasks between the Project manager and the Project Coordinator. While the former was main involved in project's promotion and dissemination, the latter took care about the project handling and implementation.
Finally, all the partners contributed to the creation of a mailing list of stakeholders and involved important representatives of ministries, environmental officers and policy makers to the project events and dissemination activities.

Problems encountered

There have been a number of problems encountered and discussed with the monitor and the members of the EC.
The project faced the following problems which were managed and solved:

- **Delay in the transfer of the funds from the beneficiary to the partners**. New national regulations regarding transfer of funds (Decreto Legge 187/2010), that entered into force at the beginning of the project, caused a significant delay in the transfer of the relative share of the first pre-financing payment from the beneficiary to the partners since 01/10/2010 (these transfers were eventually made on April, 2011) .
- **Change in legal status of ISPESL associated beneficiary**. The former associated beneficiary Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro (ISPESL) was suppressed by a national law (law of 30 July 2010 n. 122, converted with modifications in Decreto Legge 31 maggio 2010 n. 78). Its functions were transferred to Istituto Nazionale Assicurazioni Infortuni sul Lavoro (INAIL), causing the submission of a request of modification of the Grant Agreement to the Commission on 14/02/2011 which was approved (EC letter of 21st June 2011, annex 7.1.3)
- **Internal delay in the real availability of funds for the partners**. Missing of the payment by the end of 2010 caused a further administrative delay of the internal availability of the funds for two institutions (CNR and INAIL) that had to acquire the technical instruments to conduct the field surveys (action 3). In particular, the postponement of the funds implied a request of financial balance variation to handle the project budget and a formal document of the commitment of money which allows spending. In particular INAIL completed this procedure by December 2011.
- **Administrative procedures to purchase equipments for INAIL**. The internal administrative procedures to purchase the equipments and consumables needed by INAIL to conduct the field survey lasted longer than expected. They started on January 2012, after the availability of all letters of formal authorizations in spending money, and finished on April 2012 with the delivery of goods. The effect was mainly on the implementation of action 3.3.
- **Financial and technical problems in implementing chemical field campaigns.** The lack of availability of funds in the associated beneficiaries organizations and the internal administrative delay in some partners, has made it impossible to purchase the equipments at the scheduled time (IV 2010) to be used in the chemical field campaigns (December 2010 for action 3.2 and January/June 2011 for action 3.3). The lack of funds has also made impossible the hiring of new technical and administrative

Personnel to be used in the implementation of these actions. The implementation of these actions was then postponed by nine months and consequently also the linked actions were postponed (5.x, 6.x, 7.x), causing a request of prolongation of the project duration by 6 months to the Commission (annex 7.1.4). Actions undertaken to overcome the problems are better described in the Inception and Mid-term reports. However, it is worth noting that thanks to the prolongation of project duration, all problems encountered were overcome successfully.

- **Web-GIS server unavailability.** The publication on the internet of the updated version of the web-GIS application, to be carried out by action 8.1, was delayed due to unavailability of the public web server for INAIL administrative reasons.

The financial issues were:

- Financial documents: the transmission of financial documents from partners has been irregular. Repeated reminds have been sent to financial officers to receive documents.
- Timesheets: timesheets were not regularly sent by the partners. Repeated reminds have been sent to financial officers to receive documents. Estimation of annual costs was a matter of several discussions among the partner and with the Commission. Problems were fixed according to the EC external monitor suggestions.
- Some unforeseen costs were incurred particularly for maintenance of equipment. We provided the related invoices and proofs of payments and provided the due justifications in the financial part of the report.

Partnerships and their added values

The project fulfilled all the expected results and deliverables and this is an outcome of the strong collaboration among partners. This was due to the capability of creating a heterogeneous and very specialized group of experts in different fields. The involvement of each partner in the communication with national and international scientists and policy makers has been crucial for the dissemination of the project in order to provide evidences and support to public decisions. More specifically, the partnership had been selected for their own specific expertise and areas of influence at the local, national and EU-levels:

- ASL-RME had a long history of coordination and management of projects at international, national and regional level, with strong skills in the exposure assessment and epidemiological design.
- INAIL had a strong expertise in chemical and meteorological monitoring as well as in AQ modelling.
- ARIANET is a National leader company in the field of air pollution modelling and environmental impacts.
- CNR-IIA was one of the most experienced Italian institutions in the field of atmospheric chemistry and physics, with dozens of publications on international and national journals, and influence at the regional and municipality levels on the issues of air quality policies;
- ARPA-Lazio is in charge for the Lazio region to monitor and control the environment.
- CNR-ISAC is the Italian reference Institute for boundary layer meteorology and climate research.

- THL is the Finnish reference Institute for exposure modelling, health and welfare research.

Each partner disseminated the project and their own results in specific thematic conference and journals. This provided a large spread of the dissemination activities in different disciplines and scientific/stakeholder contexts, which represent a great added value.

The strong complementarities among such diverse professional figures made available the large amount of outputs provided by EXPAH, and represented an example of multi-disciplinary approach to be exported in the future.

4. Technical part

In this section, a description of the activities carried out for each action is provided, with reference to the deliverables and outputs produced, indicators of progress and the time requested for the completion of the action. The list of the actions is shown in Table 6, with actual and foreseen start and end dates, while the complete list of deliverables with updated time and annexes is provided in Table 1.
An updated list of the status for each action was already provided with a new timetable in the Inception report.
Specific details on each action, along with the associated timetable and annexes are provided in the task-by-task description in paragraph 5.1. For expenditures for each action, please refer to section 6.1.

Table 6: Timetable of project actions

Actions	Foreseen start date	Actual start date	Foreseen end date	Actual end date
1.1 co-ordination and management	October 2010	October 2010	June 2014	June 2014
1.2 monitoring of project	January 2011	January 2011	March 2014	March 2014
2.1Administration of budget and financial audit	January 2011	January 2011	June 2014	June 2014
2.2 Dissemination to policy and decision makers and to the public	October 2010	October 2010	March 2014	March 2014
2.3 web design, development and results displaying	October 2010	October 2010	June 2014	June 2014
2.4 conference spanning the topics of the project	July 2012	November 2010	June 2014	June 2014
2.5 Layman's report developing for dissemination	January 2014	January 2014	June 2014	June 2014
3.1 Estimation of population time activity data and analysis	October 2010	December 2010	October 2012	November 2012
3.2 Intercomparison (intra- and inter-laboratory PAH measurements and intra-laboratory particulate sampling).	October 2010	May 2011	December 2011	March 2012
3.3 Field campaigns of particulate PAH (indoor, outdoor and personal exposure evaluations and data analysis), and ancillary measurements concerning gaseous toxicants and the PM2.5 chemical components including EC/OC.	January 2011	November 2011	March 2013	March 2013
3.4 collection of meteorological data in the studied region	January 2011	January 2011	September 2012	September 2012
4.1 Collection of raw emission inventories and their upgrading	October 2010	October 2010	March 2011	June 2011
4.2 Definition of simulated areas, collection of cartographic data and traffic data for Rome	October 2010	October 2010	June 2011	June 2011
4.3 Traffic emission calculation	April 2011	April 2011	September 2011	November 2011

4.4 Upgrading of particulate PAHs speciation profiles and integration of all emission inventories and spatially, temporally and chemically disaggregation	July 2011	July 2011	March 2012	May 2012
4.5 Upgrading of model PAHs transformation processes and simulation of meteorology, emission, dispersion, transformation and deposition of outdoor pollutants	October 2011	October 2011	March 2013	April 2013
5.1 Statistical analysis of indoor and outdoor PM2.5, PAHs, EC/OC and corresponding i/o ratios.	September 2012	September 2012	March 2013	March 2013
5.2 developing of a microenvironment infiltration model	January 2013	January 2013	June 2013	June 2013
5.3 developing of an exposure model	April 2013	January 2013	September 2013	September 2013
5.4 simulation of population exposure	July 2013	June 2013	March 2014	March 2014
5.5 optimization of model results with actual population exposure	April 2013	July 2013	March 2014	May 2014
6.1 Evaluation of the short-term impact of PAHs and other pollutants on natural and cause specific mortality	January 2013	January 2013	December 2013	February 2014
6.2 Evaluation of short-term impact of PAHs and other pollutants on emergency hospital admissions.	January 2013	January 2013	December 2013	February 2014
6.3 Evaluation of the impact long term exposure in the occurrence of lung cancer, coronary and cerebrovascular events.	January 2013	January 2013	December 2013	February 2014
7.1 Definition of possible emission scenarios from planned alternative future EU policies for PAHs and mitigation scenarios	January 2013	January 2013	June 2013	August 2013
7.2 Calculation of outdoor PAHs and exposure maps in the selected scenarios	April 2013	April 2013	March 2014	March 2014
7.3 Calculation of health effects for the selected scenarios	January 2014	March 2014	June 2014	June 2014
8.1 Integration of data and results by means of GIS techniques	April 2012	April 2011	June 2014	June 2014
9.1 After LIFE Communication plan	June 2014	July 2014	September 2014	September 2014

4.1. Technical progress, per task

Action 3.1 Estimation of population time activity data and analysis

Status: Completed

Beneficiary responsible for implementation: Department of Epidemiology- SSR Lazio ASL RME

Activities carried out

The action 3.1 (Estimation of time activity data and analysis) of the EXPAH project aimed to collect and analyze time activity data of population groups to get information of which kind of environment (home, school, car bus, outdoor, etc) are attended during a weekday and a public holiday. Such data have be used to estimate the PAH exposure experienced by population during its typical day, evaluated as a weighted exposure of the different pollutants levels of the most visited micro-environments. The city of Rome was selected of this study and both children and elderly people were interviewed by questionnaire to collect time activity data on a seasonal basis. The activities carried out were:

- Developing of questionnaires for children and elderly people living in Rome to collected data about time activities during season/day of week (annex 7.2.25).
- Distribution and collection of filled in questionnaires for 483 children and 707 elderly;
- Statistical analysis of data
- Identification of most visited living environments
- Estimation of hourly and daily visiting time of the identified living environments stratified for season/day of week/population classes

Indicators of progress

- Number of questionnaire distributed: 700 (children); 998 (elderly)
- Number of questionnaire filled in collected: 483 (children); 707 (elderly)
- Number of technical reports: 1
- Contributions to EXPAH newsletters: 2

Problems encountered

The main problem was the delay in the implementation of the action. This was due to the choice to conduct seasonal interviews instead of a single shot one. It produced much more detailed results able to represent the seasonality of such information.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
3.1 Estimation of time activity data and analysis	Proposed																
	Actual																

Output achieved

- Data set of time activity data for children and elderly people living in Rome.

Annexes

- Time activity diary (Annex 7.2.25)
- Technical Report (Annex 7.2.26)

Action 3.2 Intercomparison (intra- and inter-laboratory PAH measurements and intra-laboratory particulate sampling).

Status: Completed

Beneficiary responsible for implementation:

- Action 3.2.1 Inter-comparison (inter-laboratory PAH measurements and intra-laboratory particulate sampling): INAIL
- Action 3.2.2 Inter-comparison (inter-laboratory PAH measurements and intra-laboratory particulate sampling; intra-laboratory EC/OC and particulate measurements): CNR-IIA.
- Action 3.2.3 Inter-comparison (intra-laboratory PAH measurement): CNR-IIA.

Activities carried out

The aim of action 3.2 was to develop sampling and chemical analysis methods among the partners able to allow the reliability, the homogeneity and comparability of PAHs data collected by each partners. Schools and offices were sampled both indoor and outdoor, as well as Metro, for PM2.5 with low and medium volume samplers to test the best equipment to be

used in the regular campaigns. Information of PAHs content in the different size fractions of PM2.5 ware also gathered. The activities carried out were:

- Inter-intra comparison of sampling and chemical PAHs analysis among the partners;
- Set up of common methods for sampling and analysis of PAHs compounds in indoor living environments;
- Collection of preliminary data of PAHs in indoor living environments to test the feasibility of identified methodologies;
- Collection of preliminary data of gaseous toxicant in indoor living environments
- Technical reports and recommendations for regular field campaigns;

Indicators of progress

- Sampled and chemical analyzed 332 filters;
- Technical report on inter/intra comparison study, set up of methodologies and preliminary PAHs and gaseous toxicant data (annex 7.2.27)
- Technical report on $PM_{2.5}$ composition analysis (annex 7.2.28).
- Technical report with instructions/information/suggestions/remarks for regular field campaigns (annex 7.2.29)
- Contributions to EXPAH newsletters: 1

Problems encountered

The main problem was the delay in the implementation of the action. This was due to the delay in transfer of the funds from the beneficiary to the partners and in the availability of funds to purchase equipment. It produced a significant delay in the implementation of the actions which involve the entire project. Details about problems can be found in the Inception Report.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
3.2 Intercomparison (intra- and inter-laboratory PAH measurements and intra-laboratory particulate sampling).	Proposed																
	Actual																

Output achieved

- Methodologies for sampling of PM2.5 and chemical analysis for PAHs content in living environments
- Recommendations for regular field campaigns

Annexes

- Annex 7.2.27 Report on preliminary PAHs field campaign
- Annex 7.2.28 Technical Report-Comparison study of PM2,5 chemical composition by using MV and LV samplers-action 3.2.2
- Annex 7.2.29 Report on recommendations for regular field campaigns
- Annex pics 1 personal sampling in Metro
- Annex pics 2 personal samplers
- Annex pics 3 indoor sampling at school with three samplers
- Annex pics 4 indoor sampling at school with three samplers

3.3 Field campaigns of particulate PAH (indoor, outdoor and personal exposure evaluations and data analysis), and ancillary measurements concerning gaseous toxicants and the PM2.5 chemical components including EC/OC.

Status: Completed

Beneficiary responsible for implementation:

- Action 3.3.1. Field campaigns of indoor/outdoor PM2.5, chemical processing for PAH determination and data analysis: INAIL
- Action 3.3.2. Field campaigns of particulate PAH (indoor, outdoor) and data analysis: CNR-IIA
- Action 3.3.3. Ancillary measurements concerning gaseous toxicants and the PM2.5 chemical components including EC/OC: CNR-IIA
- Action 3.3.4. Collection of outdoor PM10/PM2.5 and of criteria pollutants in the Regional Environmental Network stations: ARPA-Lazio
- Action 3.3.5. Personal exposure measurements of PAHs: INAIL

Activities carried out

The aim of action 3.3 was to collect PAHs, $PM_{2.5}$, additional $PM_{2.5}$ chemical composition, and ancillary gaseous toxicants data, in different living/working microenvironments in Rome. The work provides data of population exposure and supports modeling studies for a wide estimate of urban population exposure. Personal exposure measurements on children and elderly people were also included in the study. Three Institutes (CNR-IIA, INAIL, ARPALazio) carried out the field campaigns and collected the data. The methodology was based on active sampling at low volume condition on PTFE filters and gas chromatography/mass spectrometry determination of $PM_{2,5}$-bound PAH's non-volatile congeners, characterized by higher carcinogenic and mutagenic potencies. According to the experimental design, two seasonal in-field campaigns (summer and winter-spring) have been performed by sampling both indoor and outdoor living/working microenvironments. In each seasonal campaign, 20 living environments have been monitored. In all, six schools, two offices, and nine houses were investigated as EXPAH stationary sites. In addition, we have considered three mobile sites (two cars and an electricity powered bus). The main focus was on the carcinogenic PAHs, namely benz(a)anthracene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene and the mutagenic benzo(ghi)perilene. The EXPAH PAHs and $PM_{2.5}$ monitoring study has provided important data about the air quality within living/working environments. It demonstrated that significant concentrations of $PM_{2.5}$ and aerosol embedded PAHs can be found in schools, houses and offices as well as in-vehicle transport systems. The main origin of these pollutants is from ambient air. It penetrates within these micro-environments

being often resuspended. The infiltration factors depends on the pollutants, the environment and the season. Episodes of indoor concentrations higher than the legal limit (1 ng/m^3) have been observed for the most cancerogeneous PAH (BaP), although in the monitored periods its average value was below this limit.

The activities carried out were:

- Indoor/outdoor sampling on PTFE filters of PM2.5 in 20 living environments in two seasonal campaigns (winter/spring and summer) for a total of 1930 filters;
- Outdoor sampling of $PM_{2.5}$ in three REN stations of Rome.
- Chemical analysis of collected filters for PAHs content, VOCs (BTEX), ozone and nitrogen dioxide, organic and elemental carbon by means of gas chromatography/mass spectrometry;
- Chemical analysis for PM2.5 components (organic and inorganic) in three schools and one office;
- Personal monitoring of 5 children and 4 elderly people for PM2.5 with PAHs content on seasonal basis (winter and summer) with a total of 255 filters sampled and chemical analyzed;
- Analysis of collected concentration results;
- Formatting of data for its delivery and use
- Setup of a data set of indoor/outdoor concentrations of $PM_{2.5}$, PAHs, VOCs, gaseous toxicant and $PM_{2.5}$ components;
- Uploading of data set on the project ftp server

Indicators of progress

- Short Technical Report on Indoor/Outdoor monitoring of PAHs, PM2.5 and its chemical components with ancillary measurements of gaseous toxicants (annex 7.2.30)
- Report on Indoor Outdoor monitoring of PAHs PM2.5 in living environments (annex 7.2.31).
- Contributions to EXPAH newsletters: 4

Problems encountered

The main problem was the delay in the implementation of the action. This was due to the delay in transfer of the funds from the beneficiary to the partners and in the availability of funds to purchase equipment. It produced a significant delay in the implementation of the actions which involve the entire project. Details about problems can be found in the Inception and Mid-term reports. A number of management strategies were undertaken to solve the problems. First, in order to optimize the management of the field campaigns, we considered to adopt a different sampling strategy from that mentioned in the proposal, which required a reduced number of samplers and supporting persons to conduct them at the costs of a longer time span (5 weeks instead of 2). It was approved by the Commission with letter of August 18th 2011 (annex 7.1.5). Second, to avoid the stop of field activities consequent to the lack of samplers, we decided to carry out the planned work by sharing the CNR-IIA equipments and to lend consumables. Then we decided to adopt a sampling strategy where the 20 sites to be monitored were carried out in different periods of time due to the limited number of available samplers. Another problem was the noise produced by the purchased samplers, which made it

impossible to be used for indoor measurements at homes. To overcome the problem new samplers with low noise impact were selected and ordered by CNR-IIA.

Timetable

Action		2010		2011				2012				2013				2014	
Number/name of action		Sept.	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II
3.3 Field campaigns of particulate PAH (indoor, outdoor and personal exposure evaluations and data analysis), and ancillary measurements concerning gaseous toxicants and the $PM_{2.5}$ chemical components including EC/OC	Proposed																
	Actual																

Perspectives for continuing the action after the end of the project

The field of indoor pollution studies would benefit of further additional study on infiltration of pollutants and related parameters, as well as to enlarge the number of pollutants monitored and the living environments.

Output achieved

- Data set from intensive field campaigns of indoor-outdoor $PM_{2.5}$ and speciated PAHs as well as EC/OC PM contents in living places for the summer and winter seasons
- Data set of personal exposure to $PM_{2.5}$ and PAHs

Annexes

- Annex 7.2.1 Data set from intensive field campaigns of indoor-outdoor PM2.5 and speciated PAHs as well as EC/OC PM contents in living places for the summer and winter seasons (Deliverable)
- Annex 7.2.2 Data set of personal exposure to $PM_{2.5}$ and PAHs. (Deliverable)
- Annex 7.2.30 Short report on Indoor/Outdoor monitoring of PAHs, $PM_{2.5}$ in living environments.
- Annex 7.2.31 Report on Indoor Outdoor monitoring of PAHs $PM_{2.5}$ in living environments.
- Annex 7.2.32 Time schedule of summer field campaign
- Annex 7.2.33 Authorization letter for personal sampling
- Annex pics 5 Outdoor sampling and information panel at XXV aprile school
- Annex pics.06 indoor car monitoring
- Annex pics.07 indoor bus monitoring
- Annex pics.08 indoor home monitoring
- Annex pics.09 indoor school monitoring
- Annex pics.10 indoor office monitoring
- Annex pics.11 outdoor school monitoring
- Annex pics.12 PM sampler low noise impact
- Annex pics.personal.01 children monitoring
- Annex pics.personal.02 elderly monitoring

3.4 Collection of meteorological data in the studied region

Status: Completed

Beneficiary responsible for implementation:

- Action 3.4.1 Collection of upper air meteorological data in the study region: CNR-ISAC
- Action 3.4.2. Collection of upper air and surface meteorological data in the study region: INAIL

Activities carried out

The action 3.4 of EXPAH project carried out a field campaign to collect meteorological data in the urban area of Rome and its surroundings. The aims of the field experiment was to detect the main local circulation patterns and provide data to action 4.5 to reconstruct the meteorological fields by means of a modelling system. Four measurements sites equipped with in situ and ground based remote sensing systems were used. The field campaign started on December 2010 and ended on June 2012. The data were preprocessed for validation and averaged on a hourly base.
The activities carried out were:

- Installation of three meteorological stations with ground base equipments and remote sensing techniques for upper air meteorological profiles.
- Calibration and maintenance of equipments.
- Field meteorological campaign from December 2010 up to June 2012 in four stations located within and around the area of Rome.
- Validation, analysis and post-processing of collected data
- Formatting of data for its delivery and use
- Development of a data set for surface and upper air meteorological data
- Uploading of data set on the project ftp server

Indicators of progress

- Technical report on meteorological measurements (annex 7.2.34)
- More than 35000 meteorological measurements (4 x 365 x 24) were produced, each of them composed by multi-parameters (Annex 7.2.35)
- Contributions to EXPAH newsletters: 2

Problems encountered

Some parts of the CNR-ISAC SODAR (card, cables, acoustic shelter, etc) have been replaced during the year in order to keep the signal/noise ratio constant. The thermal profiles (MTP-5P) data set has an interruption due to a problem in a controller board which needed to be replaced with a new one. At one station (Villa Pamphili) a few interruptions on data collection came up, due to malfunctioning in some components of the equipment, missing of power supply and periodic maintenance of the equipments. The average raw data production was above the 90%.

Timetable

Action	**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action	**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**

3.4 Collection of meteorological data in the studied region	Proposed																
	Actual																

With respect to the original foreseen time schedule, the collection of meteorological data was extended up to June 2012 to support both the chemical field campaigns, which were postponed of nine months, and the modeling activities that were rescheduled to a different simulation period (June 2011-June 2012) due to delay in implementing the field campaigns.

Output achieved

- Data set of hourly surface and upper air meteorological parameters at four stations with additional available territory data

Annexes

- Annex 7.2.34 Technical report on meteorological measurements
- Annex 7.2.35 Data set of hourly surface and upper air meteorological parameters at four stations with additional available territory data
- Annex pics.13 Meteorological monitoring at Tor Vergata station
- Annex pics.14 Meteorological mobile laboratory at Pamphili station
- Annex pics.15 Locations of expah meteorological stations
- Annex pics.16 Monteporzio meteorological station
- Annex pics.17 Montelibretti meteorological station

4.1 Collection of raw emission inventories and their upgrading

Status: Completed

Beneficiary responsible for implementation: ARIANET

Activities carried out

A reference PAHs emission data set has been constructed on the basis of emission inventories available at national and international level. In order to develop a complete emission inventory for the city of Rome and its surrounding area, it has been necessary to integrate different source of information characterized by diverse scales and space resolution, identify inconsistencies and integrate them to cover the space areas covered by air quality model simulations. The following inventories were acquired and compared: TNO2000, EMEP 2005 e ISPRA 2005. Differences in terms of both PAHs total and macro-sector emissions were quantified at national level. The different datasets emission inter-comparison set in evidence the large degree of uncertainty that affects PAHs emissions and that can generally be considered larger than that associated to other pollutants.
The activities carried out were:

- Collection of available European, National and Provincial air pollution emission inventory
- Comparison among the collected inventories
- Identification and fixing of missing data
- Compilation of a reference emission inventory for the studied area
- Spatialization at municipal level of the reference emission inventory

- Chemical speciation of the reference emission inventory

Indicators of progress

- Identification and collection of three emission inventories
- Presentation at MB of December 2010 (annex 7.2.36)
- Contributions to EXPAH newsletters: 2
- Technical report on collection of raw emission inventories.

Problems encountered

No problem was identified in the implementation of this action.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
4.1Collection of raw emission inventories and their upgrading	Proposed																
	Actual																

Output achieved

- Raw reference emission inventory of , PM2.5, PAH and gaseous pollutants

Annexes

Annex 7.2.36 Presentation on collection of raw emission inventories at MB.
Annex 7.2.13 Technical report on collection of raw emission inventories.

Perspectives for continuing the action after the end of the project

The different datasets emission intercomparison set in evidence the large degree of uncertainty that affects PAHs emissions and the great relevance of PAHs emissions from biomass combustions. Consequently a revision of PAHs reference emission profiles used to develop emission inventories is needed particularly for the biomass combustion sector. Efforts in collecting updated raw proxy and emission data should be made in this field to fix missed information.

4.2 Definition of simulated areas, collection of cartographic data and traffic data for Rome

Status: Completed

Beneficiary responsible for implementation: ARIANET

Activities carried out

The action 4.2 defines the extension of the computation domains used in the action 4.5 to simulate PAH dispersion and transformation. The activities carried out were:

- Collection of cartographic data of Lazio region.

- Collection of land use data for the Lazio region
- Collection of traffic data for the urban road network of Rome
- Collection of cartographic data to be provided to emission estimation models
- Definition of extension of the simulation domains based on project MINNI results.

Indicators of progress

- Cartographic data

Problems encountered

No problem was identified in the implementation of this action.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
4.2 Definition of simulated areas, collection of cartographic data and traffic data for Rome	Proposed																
	Actual																

Output achieved

- Delivery of cartographic data for the study area
- Definition of extension of area to be simulated

Annexes

Annex 7.2.38 Cartographic data for the studied area
Annex 7.2.14 Presentation on computation domain and MINNI2005 results

4.3 Traffic emission calculation

Status: Completed

Beneficiary responsible for implementation: ARIANET

Activities carried out

The aim of this action was to calculate pollutants traffic emissions in the study area usinfg a bottom-up approach, with particular attention to those derived by the traffic flows over the road network of the city Rome. The activities carried out were:

- Updating of TREFIC code to include the estimation of PAHs emission and the lamping scheme needed by FARM model.
- Reconstruction of vehicular flows over the main road network of the city of Rome provided by action 4.2.
- Reconstruction of traffic flow over the Provincial road network starting from vehicles passages (AISCAT, ASTRAL and ATAC data for year 2009) and the application of a traffic assignment model (CARUSO).

- Application of the TREFIC code to estimate vehicles PAHs and gaseous pollutants emission over the identified road networks.
- Development of a cartographic data set of traffic emissions.
- Uploading of data set on the project ftp server

Indicators of progress

- Cartographic data

Problems encountered

No problem was identified in the implementation of this action.

Timetable

Action		2010		2011				2012				2013				2014	
Number/name of action		Sept.	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II
4.3 Traffic emission calculation	Proposed																
	Actual																

Output achieved

- Data set of traffic emissions over the Lazio region and the city of Rome.

Annexes

Annex 7.2.40 Presentation on emissions from road network
Annex 7.2.41 Cartographic data of road emission (available at EXPAH ftp web site (ftp://95.228.102.188).

4.4 Upgrading of particulate PAHs speciation profiles and integration of all emission inventories and spatially, temporally and chemically disaggregation

Status: Completed

Beneficiary responsible for implementation: ARIANET

Activities carried out

The aim of this action was to deliver a model ready PAHs emission inventory, integrating all data from actions 4.1, 4.2 and 4.3 and applying a spatial, temporal and chemical disaggregation. The activities carried out were:

- Integration of raw emission inventories.
- Temporal updating of raw emission inventories at the year 2009
- Preparation of input files for emission manager code (EMMA)
- Temporal, spatial and chemical disaggregation of emissions
- Development of a model ready emission data set
- Post-processing of emissions for GIS import
- Uploading of data set on the project ftp server

Indicators of progress

- Presentation on action 4.4 progress at MB2011
- Presentation on action 4.4 progress at MB2012
- Data set of model ready emissions
- Technical report on integration of emission inventories

Problems encountered

No problems were identified in the implementation of this action.

Timetable

Action		2010		2011				2012				2013				2014	
Number/name of action		Sept.	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II
4.4 Upgrading of particulate PAHs speciation profiles and integration of all emission inventories and spatially, temporally and chemically disaggregation	Proposed																
	Actual																

Output achieved

- A model ready PM2.5, PAHs and gaseous pollutants reference emission inventory spatially, temporally and chemically disaggregated.

Annexes

Annex 7.2.42 Presentation at MB2011 on emissions.
Annex 7.2.43 Presentation at MB2012 on emissions Expah_4.1-4.3-4.4
Annex 7.2.15 Technical report on calculation and integration of traffic emissions with the updated Lazio Region inventory. Spatial, temporal and chemical disaggregation of the emission inventory

4.5 Upgrading of model PAHs transformation processes and simulation of meteorology, emission, dispersion, transformation and deposition of outdoor pollutants

Status: Completed

Beneficiary responsible for implementation: ARIANET

Activities carried out

The aim of this action was to model the PAH emission, dispersion, transformation and deposition over the study area. It used emission data provided by action 4.5. The activities carried out were:

- Updating of FARM code to simulate PAHs processes
- Download and formatting of ECMWF meteorological analysis data at European scale

- Meteorological simulation for one year (June 2011-May 2012) over the selected target domains (Italy, Lazio, Rome).
- Air Quality simulation for one year (June 2011-May 2012) over the Lazio region and the city of Rome
- Post processing and daily averaging of air quality simulations
- Development of a data set of air quality concentrations over the city of Rome
- Upload of the data set on the project ftp site.

Indicators of progress

- Presentation of modeling activities at MB 2011
- Presentation of modeling activities and early results at MB 2012
- Presentation of modeling activities and PM2.5, gaseous results at MB 2013
- Presentation of modeling activities and PAHs results at MB 2013
- Technical report on model capability to simulate PM2.5 and PAHs in the base case.

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the simulation period was moved from year 2011 to June 2011-May 2012 to optimize the number of observations useful for validation of model results. This shift made one quarter of delay in the end of action.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
4.5 Upgrading of model PAHs transformation processes and simulation of meteorology, emission, dispersion, transformation and deposition of outdoor pollutants	Proposed																
	Actual																

Output achieved

- PM2.5, PAHs and gaseous pollutants modeled concentrations in the base case scenario during the modeled simulation period over the Lazio region and the city of Rome.

Annexes

Annex 7.2.44 Presentation of modeling activities at MB 2011
Annex 7.2.45 Presentation of modeling activities and early results at MB 2012
Annex 7.2.46 Presentation of modeling activities and PM2.5, gaseous results at MB 2013
Annex 7.2.47 Presentation of modeling activities and PAHs results at MB 2013
Annex 7.2.4 Technical report on model capability to simulate $PM_{2.5}$ and PAHs in the base case. (Deliverable)
Annex 7.2.16 Hourly and daily concentration fields of both ambient gaseous and size resolved aerosol pollutants with speciated PAHs and PM aerosol components with EC/OC in the urban area of Rome for one year in the base case scenario.

5.1 Statistical analysis of indoor and outdoor PM2.5, PAHs, EC/OC and corresponding i/o ratios

Status: Completed

Beneficiary responsible for implementation: THL

Activities carried out

The action 5.1 statistically analyzed the Indoor/Outdoor (I/O) PAHs and PM2.5 concentrations in different living environments collected by action 3.3 to estimate relations and related parameters. The activities carried out were:

- Collection of basic data of the environments monitored during EXPAH field campaign.
- Collection of I/O PM2.5, PAHs, EC/OC EXPAH data and quality assurance
- Analysis of I/O PM2.5, PAHs, EC/OC EXPAH data for I/O ratios determination

Indicators of progress

- Presentation of infiltration and exposure modelling at MB2012
- Presentation on statistical analysis of PAHs results at actions meeting sept. 2013
- Technical report on infiltration and exposure modelling

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the implementation of this action was shifted. The relatively limited data set size did not allow for reaching statistical significance in the current study, although the results are in compliance with those foreseen in the original proposal. In particular the seasonal analysis was affected by the relative low number of data for some microenvironments (eg. offices and transport). Consequently the analysis of the overall data was considered. This is not a critical aspects for the reaching of the specific objectives of the project.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
5.1 Statistical analysis of indoor and outdoor PM2.5, PAHs, EC/OC and corresponding i/o ratios	Proposed																
	Actual																

Output achieved

- A set of infiltration factor for PAHs and PM2.5 in living environments.

Annexes

Annex 7.2.48 Presentation on infiltration and exposure modeling at MB2012

Annex 7.2.49 Presentation statistical I/O analysis at actions meeting 2013

Annex 7.2.3 Report on infiltration and exposure model with software prototypes.

5.2 Developing of a microenvironment infiltration model

Status: Completed

Beneficiary responsible for implementation: THL

Activities carried out

Action 5.2 uses literature methods to estimate the main driving factors affecting infiltration of pollutants in indoor microenvironments to develop an infiltration model for PAH compounds using the data and statistical analysis from Action 5.1. The activities carried out were:

- Developing of an infiltration model for different microenvironments taking into account the particle size distribution
- Application of Liu.Nazaroff method to estimate particle penetration
- Application of Lai-Nazaroff method to estimate particle deposition
- Delivery of a quantitative model for PAH, PM2.5 infiltration
- Exposure analysis
- Developing of a lung deposition model.

Indicators of progress

- Presentation of infiltration and exposure modelling at MB2012
- Presentation on statistical analysis of PAHs results at actions meeting sept. 2013
- Technical report on infiltration and exposure modelling

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the implementation of this action was shifted.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
5.2 Developing of a microenvironment infiltration model	Proposed																
	Actual																

Output achieved

- An infiltration model for PAHs and PM2.5.

Annexes

Annex 7.2.48 Presentation on infiltration and exposure modeling at MB2012

Annex 7.2.49 Presentation statistical I/O analysis at actions meeting 2013

Annex 7.2.3 Report on infiltration and exposure model with software prototypes. (Deliverable)

5.3 Developing of an exposure model

Status: Completed

Beneficiary responsible for implementation:

- ACTION 5.3.1 Developing of an exposure model: THL
- ACTION 5.3.2 Implementation of the exposure model: INAIL

Activities carried out

The aim of action 5.3 was to develop an exposure model which integrates the outdoor PAHs concentrations and PAHs infiltration indoors with population time-activity, including time spent indoors and in traffic to estimate the actual exposure levels generated by the emissions and atmospheric dispersion processes. The model relies on analysis results from Actions 5.1 and 5.2 and therefore also on field campaign data collected in Action 3.3. The activities carried out were:

- Analysis of literature about exposure modelling studies and employed methodologies
- Study of software platform where to implement exposure model
- Collection of data and results provided by actions 5.1, 5.2 and 3.3 to be used for implementation of exposure model
- Integration of infiltration coefficient for PAH and Pm2.5 with time activity data.
- Implementation of preliminary program for exposure modelling
- Developing of the final programs for exposure modelling working with PAHs concentration data provided by action 4.5
- Developing of a statistical exposure model to take into account of uncertenties on model parameters.
- Developing of post-processing programs for averaging results at different time scales.

Indicators of progress

- Presentation on statistical exposure modeling at actions meeting sept. 2013
- Presentation on deterministic exposure modeling at actions meeting sept. 2013
- Technical report on exposure modelling

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the implementation of this action was shifted.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
5.3 Developing of an exposure model	Proposed																
	Actual																

Output achieved

- A deterministic and statistic exposure model for PAHs and PM2.5.

Annexes

Annex 7.2.50 Presentation on statistical exposure modeling at actions meeting sept. 2013
Annex 7.2.51 Presentation on deterministic exposure modeling at actions meeting sept. 2013
Annex 7.2.5 Technical report on exposure modelling

5.4 Simulations of population exposure

Status: Completed

Beneficiary responsible for implementation: INAIL

Activities carried out

The aim of action 5.4 was to apply the exposure model developed in action 5.3, by using PAHs and PM2.5 ambient concentration data provided by action 4.5. The activities carried out were:

- Elaboration of daily PAHs and PM2.5 exposure maps for children and elderly people living in the city of Rome during the simulated period (June 2011-May 2012) in the base case scenario.
- Calculation of seasonal and annual PAHs and PM2.5 exposure maps for children and elderly people living in the city of Rome during the simulated period (June 2011-May 2012) in the base case scenario.
- Calculation of cumulative PAHs and PM2.5 exposure profiles for children and elderly people living in the city of Rome
- Determination of the uncertainties in the exposure assessment by means of the statistical exposure model.

Results showed that both children and elderly are exposed to PAHs concentrations up to 2 ng/m^3 on yearly bases with a possible uncertainty of about 1 ng/m^3. As for B[a]P the average annual exposure is predicted to be about 0.6 ng/m^3 with an uncertainty of 0.2 ng/m^3. So the legal limit of B[a]P (1 ng/m^3) is not exceeded. As for children, mean exposures up to 4.0 and 1.1 ng/m^3 are estimated for PAHs and B[a]P respectively during the heating season. Conversely during the non-heating season, much lower exposures are predicted (up to 0.6 and 0.15 ng/m^3 for PAHs and B[a]P respectively). Downtown area are found to be more exposed than outskirts ones. The most contributing microenvironment was found to be home followed by school, due to the predominant time spent in these two indoor rooms respect to the time spent at outdoor or in other activities. Model results were validated with personal exposure measurements carried out within action 3.3.5. The model is found to reproduce the observed exposures with some limitation in predicting the day by day variations.

Indicators of progress

- Presentation on statistical exposure modeling at actions meeting sept. 2013
- Presentation on deterministic exposure modeling at actions meeting sept. 2013
- Technical report on exposure modelling

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the implementation of this action was shifted.

Timetable

Action	2010	2011	2012	2013	2014

Number/name of action		Sept.	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II
5.4 Simulations of population exposure	Proposed																
	Actual																

Output achieved

- Daily and seasonal exposure maps for PAHs and PM2.5 in the city of Rome in the base case scenario.
- Cumulative exposure profiles for children and elderly people in the base case scenario.

Annexes

Annex 7.2.50 Presentation on statistical exposure modeling at actions meeting sept. 2013
Annex 7.2.51 Presentation on deterministic exposure modeling at actions meeting sept. 2013
Annex 7.2.5 Technical report on exposure modelling (Deliverable)

5.5 optimization of model results with actual population exposure

Status: Completed

Beneficiary responsible for implementation: INAIL

Activities carried out

The aim of action 5.5 was to apply statistical methodologies to improve agreement between observed and CTM modelled PAHs ambient concentrations. The activities carried out were:

- Collection, management and pre-processing of data.
- Application of a Supporting Vector Machine (SVM) methodologies and optimization of results.
- Cost-benefit analysis of SVM results depending on input data provided
- Optimization of SVM model and its ability to reproduce spatial characteristics of the studied phenomena
- Elaboration of optimized PAHs and BaP SVM maps for the city of Rome.

The first part of foreseen tasks allowed to identify the best architecture of SVM and input data to better reproduce the observed concentrations. The following input variables have been finally selected for the SVM model: the date, wind direction, wind speed, precipitations, total cloud cover and PAH/BaP estimates by CTM FARM. The SVMs have been trained and tested and the results have been compared with those obtained in action 4.5 by CTM FARM. The SVM models show the best values on each index of performance both for PAH and for BaP. In particular, while CTM FARM show a tendency to overestimate and underestimate the actual measurements, respectively, the SVM models fit the data better and with a higher correlation. The same SVMs have been applied to all the daily samples to build daily exposure maps. Moreover, these models have been applied for building maps considering two different scenarios for year 2020 developed in Action 7.1.

Indicators of progress

- Presentation of progress activities of action 5.5 - actions meeting Sept. 2013
- Presentation of progress activities of action 5.5 - actions meeting Jan. 2014

- Technical Report on Application of SVMs to estimate PAHs maps in the urban area of Rome

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the implementation of this action was shifted.

Timetable

Action		2010		2011				2012				2013				2014	
Number/name of action		Sept.	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II
5.5 optimization of model results with actual population exposure	Proposed																
	Actual																

Output achieved

- Optimized daily concentration maps for PAHs and BaP in the city of Rome.

Annexes

Annex 7.2.52 Presentation of progress activities of action 5.5 - actions meeting Sept. 2013
Annex 7.2.53 Presentation of progress activities of action 5.5 - actions meeting Jan. 2014
Annex 7.2.54 Technical Report on Application of SVMs to estimate PAHs maps in the urban area of Rome

6.1 Evaluation of the short-term impact of PAHs and other pollutants on natural and cause specific mortality

Status: Completed

Beneficiary responsible for implementation: ASL-RME

Activities carried out

This action aimed to evaluate the short-term relationship between PAHs concentrations and natural and cause-specific mortality. The study has built an extensive platform of environmental, population and clinical data to evaluate the effects of air pollution on health. The activities carried out were:

- Collection of deaths data
- Geo-coding of deaths data
- Assessment of the exposure based on results of actions 4.5 and 5.4
- Definition of a protocol to analyze data
- Analysis of literature
- Assessment of estimated effects on mortality
- Data analysis

The results showed an association of all the PAHs exposures with natural and respiratory mortality, especially at delayed and prolonged latencies, whereas the effects on cardiovascular mortality were somewhat weaker. Despite the short time-series, and the limited power for the

statistical analyses, the associations between PAH/BaP and natural mortality were statistically significant, with a clear evidence of a linear relationship, and no evidence of lack of effect at low concentrations. Elderly and subjects dying on colder months were vulnerable to the effects of PAH, while there were no differences according to gender and place of death.

Indicators of progress

- Presentation action 6.x meeting Feb. 2013
- Presentation actions meeting Sep. 2013
- Data base for health assessment
- Technical report on health impact of PAHs.

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the implementation of this action was shifted.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
6.1 Evaluation of the short-term impact of PAHs and other pollutants on natural and cause specific mortality	Proposed																
	Actual																

Output achieved

- Data base for health assessment.
- Values of Increment of Risk of mortality due to fixed increment of short-term PAHs exposure.
- Concentration-response functions for mortality due to short-term PAHs exposure.

Annexes

Annex 7.2.55 Presentation action 6.x meeting Feb. 2013
Annex 7.2.56 Presentation actions meeting Sep. 2013
Annex 7.2.6 Data base for health assessment (Deliverable)
Annex 7.2.9 Technical report on health impact of PAHs. (Deliverable)

6.2 Evaluation of the short-term impact of PAHs and other pollutants on emergency hospital admissions

Status: Completed

Beneficiary responsible for implementation: ASL-RME

Activities carried out

This action aims to evaluate the short-term relationship between PAHs concentrations and emergency hospital admissions for different causes. The study has built an extensive platform

of environmental, population and clinical data to evaluate the effects of air pollution on health. The activities carried out were:

- Collection of hospital admissions data
- Geo-coding of hospital admissions data
- Assessment of the exposure based on results of actions 4.5 and 5.4
- Definition of a protocol to analyze data
- Analysis of literature
- Assessment of estimated effects on hospital admissions
- Data analysis

Results indicated a little evidence of an association of any of the PAHs exposures with cardio-respiratory emergency hospitalizations. There was a weak suggestion of immediate association of $PM_{2.5}$ with cardiovascular morbidity, and prolonged effect on respiratory morbidity. No association was found for PAH and BaP with any of the studied outcomes, however it is worth to underline that COPD admissions increased with PAH levels.

Indicators of progress

- Presentation action 6.x meeting Feb. 2013
- Presentation actions meeting Sep. 2013
- Data base for health assessment
- Technical report on health impact of PAHs.

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the implementation of this action was shifted.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
6.2 Evaluation of the short-term impact of PAHs and other pollutants on emergency hospital admissions	Proposed																
	Actual																

Output achieved

- Data base for health assessment.
- Values of Increment of Risk of hospital admissions due to fixed increment of short-term PAHs exposure.
- Concentration-response functions for hospital admissions due to short-term PAHs exposure.

Annexes

Annex 7.2.55 Presentation action 6.x meeting Feb. 2013
Annex 7.2.56 Presentation actions meeting Sep. 2013
Annex 7.2.6 Data base for health assessment (Deliverable)
Annex 7.2.9 Technical report on health impact of PAHs. (Deliverable)

6.3 Evaluation of the impact of long-term exposure in the occurrence of lung cancer, coronary and cerebrovascular events.

Status: Completed

Beneficiary responsible for implementation: ASL-RME

Activities carried out

This action aimed to evaluate the long-term relationship between PAHs concentrations and lung cancer and cardiovascular mortality and morbidity. The activities carried out were:

- Selection of events
- Assessment of the exposure based on results of actions 4.5 and 5.4
- Analysis of literature
- Assessment of estimated effects on mortality and morbidity
- Data analysis

Results showed an evidence of an association of all the exposures with non-accidental mortality, cardiovascular mortality, and incidence of lung cancer and stroke. The results on the association between air pollution and mortality or lung cancer incidence are comparable with previous studies on the topic.

Indicators of progress

- Presentation action 6.x meeting Feb. 2013
- Presentation actions meeting Sep. 2013
- Presentation of results of action 6.3 at actions meeting Jan 2014
- Data base for health assessment
- Technical report on health impact of PAHs.

Problems encountered

Due to delay on the availability of PAHs concentration data provided by action 3.3, the implementation of this action was shifted.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
6.3 Evaluation of the impact of long-term exposure in the occurrence of lung cancer, coronary and cerebrovascular events.	Proposed																
	Actual																

Output achieved

- Data base for health assessment.
- Values of Increment of Risk of cause specific mortality due to fixed increment of PAHs exposure.
- Values of Increment of Risk of incidence of lung cancer and cardiovascular events due to fixed increment of PAHs exposure.

Annexes

Annex 7.2.55 Presentation action 6.x meeting Feb. 2013
Annex 7.2.56 Presentation actions meeting Sep. 2013
Annex 7.2.57 Presentation of results of action 6.3 at actions meeting Jan 2014
Annex 7.2.6 Data base for health assessment (Deliverable)
Annex 7.2.9 Technical report on health impact of PAHs. (Deliverable)

7.1 Definition of possible emission scenarios from planned alternative future EU policies for PAHs and mitigation scenarios

Status: Completed

Beneficiary responsible for implementation: ARIANET

Activities carried out

The action 7.1 aims in identifying possible future emission and PAHs mitigation scenarios at local, National and European levels. The activities carried out were:

- Collection of information about future scenarios at local, National and European scales.
- Definition of 2020 “current legislation” scenario.
- Definition of 2020 “additional reduction measures” scenario
- Identification and quantification of emission scenarios to be modelled

Indicators of progress

- Presentation on progress action 7.1 at the actions meeting Sept. 2013
- Presentation on progress action 7.1 at the actions meeting Jan. 2014
- Technical report on policy and mitigation scenarios.

Problems encountered

Difficulties in accessing detailed information about the national emission trend for PAHs and in general about data concerning emissions from biomass combustion. The implementation of this action was shifted due to delay in the project itself.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
7.1 Definition of possible emission scenarios from planned alternative future EU policies for PAHs and mitigation scenarios	Proposed																
	Actual																

Output achieved

- Delivery of two 2020 emission scenarios with evaluation of differences with respect to the base case scenario.

Annexes

Annex 7.2.58 Presentation on progress action 7.1 at the actions meeting Sept. 2013
Annex 7.2.59 Presentation on progress action 7.1 at the actions meeting Jan. 2014
Annex 7.2.7 Technical report on policy and mitigation scenarios. (Deliverable)

7.2 Calculation of outdoor PAHs and exposure maps in the selected scenarios

Status: Completed

Beneficiary responsible for implementation:

Action 7.2.1 Calculation of outdoor PAHs in the selected scenarios: ARIANET

Action 7.2.2 Calculation of PAHs exposure maps in the selected scenarios: INAIL

Activities carried out

The action 7.2 has the aim to recalculate both outdoor PAH and exposure maps of target population in the selected scenario identified in action 7.1. The activities carried out were:

- Implementation of a model ready emission scenario for 2020 “current legislation”
- Implementation of a model ready emission scenario for 2020 “additional reduction measures”
- Air Quality simulation for one year (June 2011-May 2012) over the Lazio region and the city of Rome using the 2020 “current legislation” scenario
- Air Quality simulation for one year (June 2011-May 2012) over the Lazio region and the city of Rome using the 2020 “additional reduction measures” scenario
- Daily averaging of air quality simulations for the two future scenarios
- Post processing of results for comparison with base case results
- Application of the PAHs and PM2.5 exposure model for two future scenarios
- Calculation of seasonal and annual PAHs and PM2.5 exposure maps for children and elderly people living in the city of Rome during the simulated period (June 2011-May 2012) in the two future scenario.
- Calculation of cumulative PAHs and PM2.5 exposure profiles for children and elderly people living in the city of Rome
- Development of a data set of air quality concentrations and exposure results over the city of Rome for the two future scenarios
- Upload of the data set on the project ftp site.

The analysis of simulation results evidenced an average reduction of NO_2 concentrations of about 26% for both future scenarios; a mean decrease of $PM_{2.5}$ concentrations of 7 and 17% respectively for 2020 CLe and 2020 with additional measures emission scenarios. As for B[a]P, an average increase of concentrations of about 24% is expected for the 2020 CLe scenario while a reductions of 66% is predicted for the 2020 with additional measures scenario.

Based on the above new ambient impacts scenarios results, the correspondent PAHs and PM2.5 population exposures have been calculated using the methodology developed under action 5.3-5.4. Mean variation of exposure to PAHs in 2020CLe scenario shows an increase of exposure which especially involves the central part of the city. Increments of 26% and 17% are estimated respectively for heating season and non heating seasons. The 2020CLe scenario also shows an increase of B[a]P exposure which is more evident during heating season (observed mean increment is 24%). On the other hand, $PM_{2.5}$ exposure behavior in 2020CLe

scenario shows a mean decrement during all seasons, in particular warmer seasons (spring and summer) register an higher exposure decrement (-5% and -12%) than colder seasons (winter -4% and fall -5%).

The second analyzed scenario 2020Cle plus measures, which adds supplementary measures of mitigation emissions to the pervious scenario, shows lower emission and concentration levels. PAHs and B[a]P exposure of children population show an evident decrement and reaches -69% and -68% for PAHs and B[a]P compounds respectively.

Indicators of progress

- Technical report on impact to PAHs and PM2.5 outdoor concentrations and population exposure in the policy and mitigation scenarios

Problems encountered

The implementation of this action was shifted due to delay in the project itself.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
7.2 Calculation of outdoor PAHs and exposure maps in the selected scenarios	Proposed																
	Actual																

Output achieved

- PM2.5, PAHs and gaseous pollutants modeled concentrations in the two future scenarios over the Lazio region and the city of Rome.
- Daily and seasonal exposure maps for PAHs and PM2.5 in the city of Rome in the two future scenarios.
- Cumulative exposure profiles for children and elderly people in the two future scenarios.

Annexes

Annex 7.2.8 Technical report on impact to PAHs and PM2.5 outdoor concentrations and population exposure in the policy and mitigation scenarios (Deliverable)

7.3 Calculation of health effects for the selected scenarios

Status: Completed

Beneficiary responsible for implementation: ASL-RME

Activities carried out

This action aimed in estimating the variations in health effects due to the implementation of the two future scenarios using exposure results provided by action 7.2. The activities carried out were:

- Collection of PM2.5 exposure at the two future scenarios
- Application of a human health impact function based on a baseline mortality rate, a PM2.5 concentration-response function and the total population with an age of ≥30 years exposed.
- Determination of global annual mortality due to variations in PM2.5 concentration.

Results showed that in Rome, the number of deaths per year attributable to $PM_{2.5}$ exposure is projected to slightly decrease in the scenario of the current legislation, and it is likely to substantially decrease in the scenario with additional measures (i.e. substituting the biomass with natural gas for non-industrial combustion). These estimates confirm previous results from the literature according to which $PM_{2.5}$ is the pollutant associated with considerable effect on premature mortality. Mitigation processes are possible and they would lead to a substantial decrease in premature deaths attributable to air pollution.

Indicators of progress

- Technical report on health impact of PAHs.

Problems encountered

The implementation of this action was shifted due to delay in the project itself.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
7.3 Calculation of health effects for the selected scenarios	Proposed																
	Actual																

Output achieved

- Number of deaths attributable to PM2.5 in the base case and the two future scenarios

Annexes

Annex 7.2.9 Technical report on health impact of PAHs (Deliverable)

8.1 Integration of data and results by means of GIS techniques

Status: Completed

Beneficiary responsible for implementation: INAIL

Activities carried out

The action aims in integrating in a Geographic Information System (GIS) all data and results produced by actions 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 4.5, 5.4 and 7.2 to provide a comprehensive tool to manage project's data in an integrated way. The activities carried out were:

- Preliminary design of data base of geographic data
- Preliminary design and insert of the geographic reference information layers
- Preliminary report containing a user guide for spatial data handling and interchange under EXPAH GIS.
- Preprocessing and input on GIS of some available territorial data
- Inclusion of EXPAH data and results on GIS
- Developing of a WEB-GIS application
- Inclusion of EXPAH data and results on WEB-GIS

Indicators of progress

- Presentation of design of action 8.1 at MB 2010
- Presentation of progress action 8.1 at actions meeting Sept. 2013.
- WB-GIS application (available at EXPAH web site)

Problems encountered

The action suffered of a few administration problems related with personnel contract and with availability and accessibility of the server to run the web-GIS application.

Timetable

Action		**2010**		**2011**				**2012**				**2013**				**2014**	
Number/name of action		**Sept.**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**
8.1 Integration of data and results by means of GIS techniques	Proposed																
	Actual																

The duration of action was longer than planned in the original proposal. This was due to a few reasons: wrong planning of time needed for the implementation; migration of the software architecture from commercial to open source tools with longer developing time; design and implementation of the web-GIS application originally not foreseen; delay for administration problems.

Output achieved

- Delivery of GIS and Web-GIS applications containing all project data in a territorial geographic context in compliance with INSPIRE Directive.

Annexes

Annex 7.2.24 GIS application containing all data and results produced by the project. Available at http://www.ispesl.it/expah/expahwebgis.asp. (Deliverable)
Annex 7.2.61 Presentation of design of action 8.1 at MB 2010
Annex 7.2.60 Presentation of progress action 8.1 at actions meeting Sept. 2013.
Annex 7.2.62 Technical report on geographic data handling

4.2 Dissemination actions

4.2.1 Objectives

The Dissemination actions were aimed at diffusing knowledge, methodologies, know-how and results of the project at different levels to stakeholders. The dissemination required the activation of several communication channels and the collaboration of all the partners of the project. The activities were organized and supported by the Project Manager and Project Coordinator.

The objectives of the dissemination actions were:

- basic project information at the monitoring sites by panels
- lessons at primary school about air pollution
- producing at least three scientific papers
- organizing a mid-term and a final dissemination conference
- applications for presentation at national and international conferences
- involvement of stakeholders in the project's meetings and progress activities
- contacts with environmental officers and policy makers
- web site implementation and updating

The above objectives were reached by the project. Details about dissemination activities carried out are presented below.

4.2.2 Dissemination: overview per activity

The Coordinating beneficiary ASL-RME, in cooperation with the Associated beneficiary INAIL have been responsible for the dissemination activities and events during the project. The dissemination actions carried out throughout the project are the following:

- Dissemination to policy and decision makers and to the public (Action 2.2)
- Web design, development and results displaying (Action 2.3)
- Conference spanning the topics of the project (Action 2.4)
- Layman's report developing for dissemination (Action 2.5)
- After-LIFE communication plan (Action 9.1)

Most of the people involved in these dissemination activities were from Regional and Municipal Environment Authorities, Scientific Community and representatives of National Ministries. Spots participation were from local authorities, public (mainly through the web) and colleagues.

Dissemination to policy and decision makers and to the public

The aim of this action was to disseminate the project objectives, methodologies and results to the stakeholders and to make them accessible to the public. To this purpose a stakeholders list

with 190 contacts has been created (Annex 7.3.2). It was used to organize a kick-off meeting (annex 7.3.13) to inform stakeholders about the project and its objectives. Furthermore, the same stakeholders list has been used for invitation to the mid-term and final Conferences, and also for other dissemination activities.
Three conferences (kick-off, mid-term and final) were organized (annexes 7.3.13, 7.3.12, 7.3.11) to illustrate project's progress and available results as well as to get feedbacks from the stakeholders. About 250 Project's leaflets (annexes 7.3.4, 7.3.5) were distributed as well as other available project materials (eg. newsletters (annex 7.3.6) and summary report (annex 7.3.9)).

In order to facilitate the communication with stakeholders and to illustrate the progress of the project, newsletters were developed and disseminated using the above stakeholders list. Four issues were created (annex 7.3.6.1-4). They were also distributed at the project conferences.

The project has been also illustrated in several (19) conferences and seminars (see Table 7). A list of contributions is also shown in annex 7.3.10.

Table 7. list of contributions to scientific conferences.

conference name/place/date	paper title	type of contribution	annex
EUROtox 2011 – Paris, France, 28-31 August 2011	LIFE + Project: Population Exposure to PAHs (EXPAH)	poster	7.3.10.1.1 poster
8th International Conference Air Quality - Science and Application, Athens 19-23 March 2012, Greece.	The LIFE+ Population Exposure to PAH (EXPAH) Project: indoor/outdoor monitoring and emissions estimation in Rome.	oral	7.3.10.2 abstract 7.3.10.2.1 presentation
	PAH distribution in the size segregated aerosol of a work office	poster	7.3.10.5 abstract 7.3.10.5.1 poster
V convegno nazionale Il Controllo degli Agenti Fisici: Ambiente, Salute e Qualità della Vita. Novara 6-8 June 2012, Italy	Il Progetto LIFE+ Population Exposure to PAH (EXPAH): esposizione Indoor/outdoor in ambienti di vita e stima delle emissioni nella città di Roma	oral	7.3.10.3 abstract 7.3.10.3.1 presentation
PM2012 V convegno nazionale sul particolato atmosferico, Perugia 16-18 maggio 2012	Progetto EXPAH: IPA cancerogeni in ambiente indoor	poster	7.3.10.6 abstract 7.3.10.6.1 poster
International Symposium for the Advancement of Boundary Layer Remote Sensing- 5-8 june 2012 boulder, Colorado USA.	Remote sensing measurements of the urban boundary layer of Rome under the EU LIFE+ EXPAH project	poster	7.3.10.4 abstract 7.3.10.4.1 poster
12th Sigma Aldrich Young Chemists Symposium S.A.Y.C.S., Riccione, October 1-3, 2012	Idrocarburi aromatici volatili in ambienti indoor e outdoor a Roma	poster	7.3.10.7 abstract 7.3.10.7.1 poster
ECOMONDO, Rimini,	Idrocarburi policiclici	oral	7.3.10.9.1 presentation

November 8, 2012.	aromatici nell'aria delle scuole e nelle case di Roma: similitudini e peculiarità		
Environmental Health 2013, Boston, March 3-6, 2013.	Indoor and outdoor VOCs and PAHs in schools and houses of Rome, Italy	poster	7.3.10.28 poster
XIV Congresso Nazionale della Divisione di Chimica dell'Ambiente e dei Beni Culturali, Rimini 2-5 giugno 2013	Studio dell'esposizione di bambini e anziani a Idrocarburi Policiclici Aromatici (IPA) presenti nel particolato sottile della città di Roma	oral	7.3.10.8 abstract 7.3.10.8.1 presentation
Environment and Health – Bridging South, North, East and West. Conference of ISEE, ISES and ISIAQ, Basel, Switzerland, 19-23 August 2013	PAH indoor-to-outdoor relationship and exposure levels in Rome	poster	7.3.10.10 abstract 7.3.10.10.1 poster
ITM 2013 NATO/SPS International Technical Meeting on Air Pollution Modeling and its Application. Miami, FL, 27-31 August 2013, USA	PAHs modeling over urban area of Rome: integration of models results with experimental data	oral	7.3.10.22 abstract 7.3.10.22.1 presentation
EUROtox 2013. Interlaken, 1-4 September 2013, Switzerland	Exposure to $PM_{2.5}$-bound PAHs in Rome: the contribution of transportation microenvironments	poster	7.3.10.13.1 poster
	Urban air pollution in Rome: children and elderly exposure to polycyclic aromatic hydrocarbons in fine particulate matter (PM2.5)	poster	7.3.10.14.1 poster
European Aerosol Conference (EAC), Prague, 1-6 September, 2013	Aerosol Processes in PAH Infiltration and Population Exposure in Rome (EXPAH).	oral	7.3.10.11 abstract 7.3.10.11.1 presentation
	Seasonal behavior of indoor and outdoor PAHs in different microenvironments of Rome, Italy	oral	7.3.10.12 abstract 7.3.10.12.1 presentation
9th International Conference Air Quality - Science and Application, 24-28 March 2014, Garmish Parternkirchen, Germany	An integrated BaP (PAHs) approach to estimate children and elderly exposure in the city of Rome, Italy	oral	7.3.10.17 abstract 7.3.10.17.1 presentation
	Modelling exposure and lung deposition of particle-bound polycyclic aromatic hydrocarbons (PAHS).	oral	7.3.10.18 abstract 7.3.10.18.1 poster
	Seasonal variation of PAHs concentration in Rome metropolitan area and source attribution through diagnostic ratios analysis	oral	7.3.10.19 abstract 7.3.10.19.1 presentation
Workshop del Gruppo di Studio Inquinamento Indoor dell'Istituto Superiore di Sanità,	IPA indoor a Roma: scuole, case, uffici, veicoli: il Progetto LIFE+ EXPAH	poster	7.3.10.29 abstract 7.3.10.30 poster
	EXPAH Project: Idrocarburi	poster	7.3.10.31 poster

Roma, 28 maggio 2014	policiclici aromatici indoor e outdoor nelle scuole e in un ufficio a Roma		
GI_FORUM 2014 – Geospatial Innovation for Society - GI for Public Health. Salzburg, Austria, July 1 – 4, 2014	A geospatial time-aware Web interface to inform about air pollution and population exposure in a big city and its surroundings	oral	7.3.10.23 abstract 7.3.10.23.1 presentation
International Congress on Environmental Modeling and Software (iEMSs). San Diego, CA, USA 15th-19th June, 2014.	Estimation of PAHs concentration fields in an urban area by means of Support Vector Machines	oral	7.3.10.25 abstract 7.3.10.25.1 presentation
26th Annual International Society for Environmental Epidemiology Conference, Seattle, Washington, USA, 24th-28th August 2014	Long-term exposure to polycyclic aromatic hydrocarbons (PAH), mortality and incidence of lung cancer in the Rome Longitudinal Study, 2008-2012 - the EXPAH (Population Exposure to PAHs) project	oral	7.3.10.26 abstract 7.3.10.26.1 presentation
	Spatio-temporal exposure to fine particles and polycyclic aromatic hydrocarbons, short term effects on mortality in Rome, 2011-2012 - the EXPAH project	poster	7.3.10.27 abstract 7.3.10.27.1 poster
16th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes 8-11 September 2014, Varna, Bulgaria.	PAHs Urban Concentrations Maps using Support Vector Machine	poster	7.3.10.24 abstract 7.3.10.24.1 poster

Eight Papers were submitted to scientific journals. A list of published papers is shown in table 8.

Table 8. list of paper published in scientific journals.

Journal	paper title	issue	annex
Toxicology letters	LIFE + Project: Population Exposure to PAHs (EXPAH)	S205, (2011) S124	7.3.10.1
Toxicology letters	Exposure to $PM_{2.5}$-bound PAHs in Rome: the contribution of transportation microenvironments	S251, (2013) 221S	7.3.10.13
Toxicology letters	Urban air pollution in Rome: children and elderly exposure to polycyclic aromatic hydrocarbons in fine particulate matter (PM2.5)	S251, (2013) 221S	7.3.10.14
Environ. Science and Pollution Research	Children and elders exposure assessment to particle-bound polycyclic aromatic hydrocarbons (PAHs) in the city of Rome, Italy	DOI 10.1007/s11356-013-2442-y, 2013	7.3.10.15
Air Quality,	Application of a chemical transport	DOI	7.3.10.16

Atmosphere & Health	model and optimized data assimilation methods to improve air quality assessment	10.1007/s11869-014-0235-1, 2014	
Air Pollution Modeling and its Application XXIII, Springer Proceedings in Complexity, Springer International Publishing Switzerland 2014	PAHs modeling over urban area of Rome: integration of models results with experimental data	DOI 10.1007/978-3-319-04379-1__56	7.3.10.22
Atmospheric Environment	Indoor PAHs at schools, homes and offices in Rome, Italy	Volume 92, July 2014, Pages 51-59	7.3.10.20
Atmospheric Environment	Assessment of population exposure to Polycyclic Aromatic Hydrocarbons (PAHs) using integrated models and evaluation of uncertainties	submitted	7.3.10.21

A few (six) interventions in seminars and workshop have been undertaken to promote and illustrate the EXPAH project and its results to stakeholders. Table 9 shows a list of seminars given.

Table 9. List of seminars and presentations at workshop undertaken.

Institute	Place	Title	Annex
Arpa Frili	Palmanova (UD), July 2013	workshop progetto EU EXPAH	7.3.18 Program 7.3.18.1-4 Presentations
LIFE DAY	Brescia 2012	Progetto EXPAH (population EXposure to PAH): risultati del monitoraggio indoor/outdoor e stima delle emissioni di IPA a Roma	7.3.19 Presentation 7.3.19.1 Poster
Workshop project FP7 TRANSPHORM	Helsinki June 2012	The LIFE+ EXPAH (population EXposure to PAH) project: indoor/outdoor monitoring and emissions estimation in Rome	7.3.20 Presentation
CNR-ISAC	Rome May 2012	THE LIFE+ POPULATION EXPOSURE TO PAH (EXPAH) PROJECT: INDOOR/OUTDOOR MONITORING AND EMISSIONS ESTIMATION IN ROME	7.3.21 Presentation
Final conference LIFE project MEDPARTICLES	Rome June 2013	The LIFE+ EXPAH (population EXposure to PAH) project	7.3.22 Presentation
15th Task Force on Measurement and Modelling Meeting (TFMM)	Bologna (Italy), 8 - 10 April 2014	Yearly Simulation of PAHs concentrations over Rome urban area. Comparison of modelling results with experimental data collected during EXPAH campaigns	7.3.24 Presentation

As for dissemination to public, about twelve information panels (annexes 7.3.7, 7.3.8) were installed in all places where chemical and meteorological monitoring were carried out. Examples of installed information panels are shown in pictures annexes (pics 3, 4, 5, 7, 13, 14, 16, 17, 18, 19, 20). In addition a lesson about air pollution was held in a primary school (annex pics. 21), where project material (project leaflet in Italian) were distributed, Although we foreseen to publish general articles in national and local press, the project could not achieved this task for an insufficient connection with journalists and press agencies.

Dissemination of project's aims and results has also been carried out by web. The project was presented in "Project of the Month" web-page of the Italian Environment Ministry (annex 7.3.14). Also the INAIL web page issued a press release about the ongoing research activity on air pollution at the INAIL Institute (annex 7.3.15) during the celebrations of the European year of Air.

Table 10: List of other dissemination materials produced during the project

Type	Description	Reference
Project logo	Created at the beginning of the project and used in all communication documents	Annex 7.3.3
Panel	chemical and meteorological monitoring panels erected at all locations where the project was implemented and made visible to the public	Annex 7.3.7; 7.3.8
Leaflet	It reports a brief introduction of the project background, the environmental problem addressed, the methodology used to study it and the main expected results. Can be downloaded from the website of the project. 400 copies (200 IT, 200 EN) were printed, 250 were delivered. 43 and 30 (IT, EN) visitors were registered for downloading.	Annex 7.3.4; 7.3.5
Summary report	Document summarizing the project in Italian, that can be downloaded and printed by the stakeholders, partners and public for a more detailed description of the project activity and results.	Annex 7.3.9
Newsletters	Document summarizing the project's progress and ongoing activities – 200 copies of each issues were printed, about 250 were delivered at the conferences. About 200 were also delivered by email using the stakeholder list The issues 1, 2 and 3 were downloaded from the web by 63, 47 and 52 visitors respectively.	annex 7.3.6.1-4
Layman's report	Layman's report for final results of the project, 200 copies were printed. About 200 were also delivered by email using the stakeholder list. Its web downloading has not been registered yet.	Annex 7.3.1 (Deliverable)
AFTER LIFE	AFTER-Life Communication Plan . It has not been disseminated yet. A copy will be published on the web.	Annex 7.3.16 (Deliverable)

Networking activities

The EXPAH project, being implemented by partners involved also in other LIFE+ project (eg. MEDPARTICLES, DIAPASON), undertook firstly network activities with these projects. Presentations were given in common conferences to highlight latest results and share experiences. A strict collaboration was established with the MEDPARTICLES LIFE+ project, due to the use of common methodologies to assess health impacts. A presentation has also been given in a workshop organized by the EU FP7 TRANSPHORM.

Web design, development and results displaying

The website was published on internet in January 2011 on a web base application, regularly updated, reporting the project objectives, actions, progress and results.

It is structured in 12 sections corresponding to different internet pages: 1-Home page, 2- The project, 3-Publications, 4-Dissemination, 5-Events, 6-Results, 7-Latest news, 8-Press release, 9-Gallery, 10-Contacts, 11-Useful links, Web-GIS.
The web address is the following: www.ispesl.it/expah.
It is accessible also from the websites of the partners. In the future it might be possible that due to the overall migration of the former ISPESL web site, which actually hosts the EXPAH web site, the latter will be transferred under the new INAIL web site. According to the web manager an automatic readdressing of the current web access name will be implemented to guarantee the access using the current web site nomenclature.

In particular the project website contains:

- background, objectives, methodologies, actions, expected results and partners of the project
- List and link of publications as technical report, conference contributions and published papers
- Deliverables and results from the actions
- Dissemination materials
- Events and related materials
- Link to Web-GIS applications for display of results in a geographic context
- Photos of the implementation of actions and of main events

The website contents are written in English and Italian and an indicator counts the number of visits on the website. From January 2011 up to July 2014 510,442 people visited the website with 394 average visitors per day (annex 7.3.23). The website has been frequently updated with new materials, documents and images, and it will be available also for the After-Life Communication plan.

Conference spanning the topics of the project

In order to disseminate the project's results and to involve stakeholders three conferences (Kick-off, Mid-term and Final) were organized in Rome on December 10th 2010, December 18th 2012 and June 11st 2014 respectively. Programs are available in annexes (7.3.13, 7.3.12, 7.3.11). Representative of local Authorities, involved Ministry and stakeholders were invited. About 50, 63 and 102 people attended the kick-off, med-term and final conferences respectively (annexes pics.Final_conference; pics.Mid_term conference; pics.Kick_off conference)
The programs were structured with a first session concerning the state of air quality in Rome, the evidences and health effects, followed by a session dealing with the EXPAH contributions in this field. Both stakeholders and project participants gave presentations during the above conferences (annexes 7.3.11.1-10; 7.3.12.1-11; 7.3.13.1-9) to illustrate air pollution local and general aspects and how EXPAH has contributed to solve them. Discussions on the main topics addressed by the project were undertaken. In the final conference an additional international session was added, which hosted invited speakers from IARC, Lyon and Cal EPA, USA. At the National context, with invited speakers from Environment Ministry and ARPA Puglia, hosting the most PAHs exposed industrial area in Italy, complete the morning session. After the presentation of the final results of the EXPAH project, the final conference hosted a discussion with the participation of representative of health and Environment Ministry as well as the head of the Municipal environment council.

Layman's report developing for dissemination

The Layman's report has been produced in both paper and electronic format in two languages (English and Italian).
The Layman's report includes a brief description of the project and its objectives, challenges and final results. The report presents the main steps of the project and a special focus has been devoted to the policy implications.
100 copies have been printed. Some of them have been distributed to local and national stake-holders/peers in the scientific community. The rest of them will be distributed in the next weeks after delivery of the final report. Furthermore, a wider dissemination has been done via e-mail sending of the electronic version of the Layman's report to the mailing list. A copy has also been published on the web site.

After-LIFE Communication plan

The post-project communication plan is a key element to disseminate and communicate the results of the project. The actions to be implemented are:

1. Presentations at conferences, seminars and meetings: as already explained earlier, most of the results of EXPAH have been presented at conferences and workshops organized during the duration of the project itself. These have been very important opportunities to disseminate the findings of the projects among the scientific community and different stake-holders at national and EU level. These activities will continue for the next two years by giving presentations at the most important scientific conferences at National and EU levels. Final results and their policy implications with recommendations will be the preferred arguments. At the moment at least five conferences have been identified where to send contributions.
2. Papers on scientific journal. At least three papers related with the latest results will be published on scientific journal.
3. Contacts with stakeholders and policy makers: the collaboration and update with stakeholders and policy makers has been not only carried on, but also increased after the completion of the project, with frequent contacts and informal meetings. In general, technical roundtables will be organized to discuss the main findings of the project, and how to exploit them at the local and national level to improve air quality.
4. Diffusion of the methodologies: the methods developed within EXPAH have been widely spread over the scientific community and will be the basis for future technology transfers. Documents will be sent to Regional Environment Agencies and seminars will be held to disseminate methodologies and results.

The report on the After-LIFE Communication plan is provided in Annex 7.3.16, in both English and Italian version.

4.3 Evaluation of Project Implemention

In the following section, a summary of the methodology applied is presented, together with the results attained within each Action and their evaluation. In terms of cost efficiency, it will be described more in detail in the financial section. However, it is important to note that the expenditures for all actions were generally consistent with those reported in the original

proposal, and that we managed to achieve all the outputs and milestones keeping the costs in line with the original project.

Table 11: Evaluation of foreseen against achieved results

Task	Foreseen in the revised proposal	Achieved	Success Indicator	Evaluation
1.1	Coordination between EXPAH and Commission; Interaction with policy makers and environmental authorities; Successfully coordination of all project actions; Smooth and efficient information flow between actions; Operative tasks met in compliance with agreed time schedules and resource allocations;	Ten letters from the EC + four monitoring visits of the tutor; 1 kick-off meeting, 1 Mid-term workshop and 1 final conference were organized; Mailing list of stakeholders; 17 action meetings and 4 MB were organized; up to July 2014 2566 and 2069 emails were respectively received and sent by the coordinator; With respect to the revised proposal almost all the actions were completed on time of with a short delay.	See besides the number of meetings organized	Technical issues were addressed during project management and the action was successfully completed.
1.2	Operative tasks met in compliance with agreed time schedules; Milestones met in compliance with time schedule; Efficient work-flow among actions;	All the deliverables and Milestones were completed on time or with a short delay; Every six months all active actions were monitored for compliance with time schedule by means of Action Monitoring Forms.	27/27 actions accomplished within time schedule or close to it; 11/11 Milestones achieved within time schedule or close to it	The action successfully completed its tasks.
2.1	Formal approval of financial reports	The Financial Reports in the Inception and Mid-term reports have been accepted by the EC with a few recommendations. Copies of the financial documents and the time-sheets produced were collected and archived by the coordinating beneficiary every three months.	2/2 financial reports approved by EC;	The EC notified some inconsistencies in the reporting of some financial and administrative forms, which were promptly addressed and solved.
2.2	Participation of representatives of each invited institution to the meeting; Conferences participations Publications in scientific journals..	Dissemination activities conducted during the entire duration of the project and summarized in Tables 3,7-9.	50, 63 and 102 participants at the three conference organized; 19 participations at conferences; 7 papers in peer-reviewed journals; 6 presentations at seminars	The dissemination activities were successful and there was a wide participation to the official meetings of the project. The methodologies, the materials, the results and the future perspectives were shared during conferences, seminars, and available on the website.
2.3	Project web site published under INAIL web site and its updating	Website published on internet in December 2010 and updated whenever materials were available.	510,442 visitors (jan 2011- july 2014); 394 average visitors per day	The action successfully completed its tasks. A few recommendations were issued by the EC which were promptly addressed and solved.
2.4	Two conferences organized and held.	A kick-off, Mid-Term and Final conferences were organized and held in Rome on December 10th 2010, December 18th 2012 and June 11st 2014 respectively.	3/2 conferences organized	The action successfully completed its tasks.
2.5	Layman's report in electronic format; Paper copies of Layman's report; Publishing of Layman's report on the project web site.	The Layman's report produced in paper and electronic form	200 copies printed/ about 100 distributed.	The action successfully completed its tasks.
3.1	The survey will provide important information on time activity patterns; Identification of the main microenvironments significant for PAH exposures; Characterization of population time activity in these	Survey of time activity data of children and elderly people were achieved by questionnaires. The main living microenvironments identified and their time activity assessed and quantified.	1700 questionnaires distributed /1290 received	With respect to the original proposal the work was extended to obtain information on seasonality of the time activity data. This takes a longer time to

	microenvironments; time-activity modelling for integration in exposure assessment			accomplish the task but better results were obtained.
3.2	Reliable procedures for determining carcinogenic PAHs including benzo(a)pyrene associated to particulate collected at low-volume conditions; Equivalence comparisons between the applied method and the Italian standard method for atmospheric benzo(a)pyrene; Homogeneity assessment for PAH data bases obtained by the Partners with the same methods and/or with the different methods processed. Reliable procedures for determining EC/OC associated to particulate collected at low-volume conditions; Preliminary data on BaP, PAH, EC/OC and gaseous pollutants in indoor and outdoor environments in Rome; Preliminary comparison between selected location and "reference" (REN) site concentrations of air pollutants; Databases from the comparison between the PM2.5 chemical composition data obtained by using two low-volume samplers and one dual channel medium-volume sampler; Technical reports, documents and informative material to be transmitted to Project partners or discussed in workshops and seminars (dissemination); Training and education of young researchers.	Procedures for determining PAHs and EC/OC with PM2.5 components at low volume conditions were delivered. Inter and intra calibration among the Partners were undertaken. Comparison between PM2.5 composition at low and medium sampling volume was carried out. Preliminary I/O data of BaP, PAHs and EC/OC were obtained for schools and offices with information on PAHs content in different aerosol size fractions. Three technical reports were produced.	332 filters sampled and chemical analyzed; three technical reports; 1 contribution to expah newsletters	The action accomplished its tasks. Administration problems produced significant delay in its implementation which affected the whole project. Purchase equipments at the right time, in compliance with the planned project time schedule, is a risky task and should be solved by renting them or using available ones.
3.3	Summer and winter I/O carcinogenic PAHs associated to PM2.5, measured in 20 microenvironments lying in the urban Rome area; Percent distribution of seasonal I/O PAH congeners; Summer and winter I/O EC/OC, measured in 3 environments lying in the urban Rome area; Summer and winter airborne I/O PM2.5 mass concentration, measured in 20 locations lying in the urban Rome area; Summer and winter airborne I/O PM2.5 chemical composition, measured in 3 locations lying in the urban Rome area; Gaseous toxicants (O3, NO2, monoaromatic hydrocarbons), measured as average contents during the summer and winter campaigns at all sites studied; Daily collected filters of PM10 and PM2.5 for PAHs determination and air quality data in the REN stations during the seasonal field campaigns for PAHs campaigns; Summer and winter carcinogenic PAH associated to PM2.5, monitored for 5 to 7 exposed volunteers by means of personal measurements; Processed data-bases, suitable for further modelling aimed at drawing information about outdoor/input infiltration of PAHs and PM2.5; Technical reports about the concentration data analysis; Scientific reports (journal articles, congress communications).	Seasonal field campaigns for monitoring and analysis of PAHs, PM2.5, EC/OC components and gaseous toxicant were carried out in 20 living environments collecting more than 2000 filters. Personal exposure measurements for PAHs were undertaken for 9 individuals (5 children and 4 elderly). Three REN stations were monitored for PAHs and PM2.5. A technical report was produced as well as 2 papers in scientific journal and several communications at scientific conferences. A data set was produced and delivered.	2000 filters sampled and analyzed; 255 filters sampled and analyzed for personal exposure measurements; two technical reports produced; two papers in peer-reviewed journals; 14 contributions at conferences.	The action accomplished its tasks. Administration problems produced significant delay in its implementation which affected the whole project. Purchase equipments at the right time, in compliance with the planned project time schedule, is a risky task and should be solved by renting them or using available ones. Participants have undertaken several solution to solve unavailability of equipments adopting different sampling and management strategies described in former reports.
3.4	Collection of hourly surface and upper air meteorological data for one year at four stations	Hourly meteorological data were collected and analyzed at four meteorological stations located in Rome and its surroundings.	35000 meteorological measurements; one technical report	The action accomplished its tasks. The field campaign was extended to cover the postponed period

		Post processing was carried out for derived parameters (turbulence) and for identification of main circulation weather conditions.	produced; one contribution to a conference; one contribution to expah newsletters	of the chemical field campaign.
4.1	Construction of a reference PAHs emission data set	A reference PAHs emission data set for the year 2011 has been constructed for the Lazio region and the municipality of Rome starting from the National emission inventory. Comparison with other available European emission inventory was carried out for consistency.	one report produced; one contribution to expah newsletter	The action successfully reached its results. The task highlighted several problems about the uncertainties related with estimation of PAHs emissions which should be addressed.
4.2	Definition of the air quality modelling computational domains which identify EXPAH target areas; Construction of cartographic and traffic data bases to support EXPAH modelling and later analysis activities.	Computational domains were identified and defined based on National scale simulations. Cartographic and traffic data for the identified domains were collected, processed and formatted.	construction of a dataset of cartographic data and traffic flow data for the main traffic road network of Rome.	The action successfully reached its results.
4.3	Reconstruction of hourly emissions of all the pollutants, including PAHs, on every link of Rome city traffic model network to be provided to action 4.4.	Hourly emission data were reconstructed over the main road network of the city of Rome. Traffic emissions were also reconstructed for the Provincial and Regional highways	data-set of traffic emissions over the main traffic road network of Rome.	The action successfully reached its results.
4.4	Production of hourly gridded emissions of PAHs and all the other pollutants covered by European legislation and needed by air quality model to be provided to action 4.5.	Hourly gridded emissions of PAHs and of other air pollutants were produced for the Lazio region and the city of Rome	dataset of gridded hourly PAhs emissions over two model's domains; one technical report produced	The action successfully reached its results.
4.5	Assessment of the PAHs atmospheric reactions processes implemented within the chemical transport model FARM; Evaluation of outdoor hourly average concentrations and deposition of PAHs and of all the other pollutants considered by the atmospheric chemistry simulations, over a time period of one year.	The FARM model was updated to include PAHs atmospheric reactions. Hourly outdoor PAHs, aerosol and gaseous pollutants concentrations were simulated over the period June 2011-May 2012.	dataset of modelled air quality concentrations over Rome; one technical report produced; one contribution to a conference; one paper in peer-reviewed book; on presentation at a seminar	The action successfully reached its results.
5.1	Quantitative characterization of PAH I/O relationships (including i/o ratios and infiltration rates for selected microenvironment categories; analysis of the seasonal variability and determining factors like building types, ventilation systems and indoor sources); Principal component analysis is used for source characterization	PAHs I/O relationships were identified and quantified for selected microenvironments. Seasonality was searched but not found. Principal component analysis was carried out using Positive Matrix Factorization (PMF) method without finding significant results.	one technical report produced; three contributions to conferences; one contribution to expah newsletter.	The action successfully reached its main results. However it outlined different problems in the applied methodology: the limited number of data does not allow for determination of seasonality and differences among infiltration of PAHs compounds with sufficient statistical significance.
5.2	quantitative model for PAH infiltration, accounting for particle size distribution and different types of microenvironments. The model describes the expected indoor concentration of PAH compounds when the type of the building and microenvironment and the outdoor concentrations are known	An infiltration model for PAHs was developed and tested for different microevironments (home, school and traffic)	see 5.1	The action was successfully implemented. However it suggested different improvements such as: More detailed description particle size distributions related to particle infiltration and lung deposition modelling; Seasonal variation of PAH compounds particle size distribution is worth of studying; Air exchange rates and deposition surfaces needs further study.
5.3	A quantitative exposure model presented as equations and algorithms	An exposure model based on microenvironment approach,	Unix Bash script programs developed	The action was successfully implemented.

	that can be implemented as part of a computer model and applied both as a stand alone probabilistic model as well as a deterministic model component in integration with the city of Rome population and air quality model; Bash script program to calculate gridded hourly PAHs exposure for the target population; Bash script program to calculate gridded mean PAHs population exposure;	using time activity data, PAHs infiltration model results and outdoor gridded PAHs concentrations provided by the FARM model, has been developed and implemented in a computer code written in Bash script language; Bash script programs to calculate gridded mean PAHs children and elderly exposure have been developed.	and applied; one technical report written	
5.4	Hourly PAHs and PM2.5 exposure maps for the target population during the reference year; Annual and seasonal averaged PAHs and PM2.5 exposure maps for the target population; Seasonal and annual PAHs and PM2.5 exposure cumulative distribution of target population	Daily PAHs and PM2.5 exposure maps for the target population during the reference year were calculated; Annual and seasonal averaged exposure maps were derived; Seasonal and annual cumulative exposure profiles for the target population were calculated.	dataset of population exposure results; one technical report written; one contribution to a conference; one contribution to expah newsletter	The action was successfully implemented. As daily outdoor PAHs and PM2.5 concentrations were considered more reliable than hourly results, daily exposure maps were calculated.
5.5	New PAH outdoor maps more related to the measured PAH concentrations; A new mathematical model to filter deterministic models	A new mathematical model, based on SVM methodology, was developed to improve the agreement between modelled FARM and observed PAHs concentrations. New PAHs concentration maps were calculated and delivered.	one program developed in MatLab software; one technical report written; two contributions to conference; one contribution to expah newsletetr	The action was successfully implemented.
6.1	At least four (natural, cardiac, cerebrovascular, respiratory mortality) concentration (exposure)- response functions will be available.	Four PAHs concentration-response functions were derived.	Dataset for health assessment; 4 PAHs concentration-response function derived; one technical report developed; two contributions to conferences	The action was successfully implemented.
6.2	At least five (ischemic heart disease, including myocardial infarction, heart failure, stroke, aggravation of asthma and chronic obstructive pulmonary disease) concentration (exposure)-response functions will be available.	Six PAHs concentration-response function (cardiovascular, ischemic, heart failure, cerebrovacular, respiratory and COPD) were derived.	see 6.1	The action was successfully implemented.
6.3	At least three (Lung cancer, coronary and cerebrovascular events) concentration (exposure)- response functions will be available.	six PAHs concentration-response function (non accidental mortality, cardiovascular mortality, respiratory mortality, incidence of lung cancer incidence of acute coronary events, incidence of stroke) were derived.	see 6.1	The action was successfully implemented.
7.1	Definition of PAHs and particle matter emission reduction scenarios.	Two emission scenarios at the year 2020 were identified and quantified.	2 emission scenarios identified	The action was successfully implemented.
7.2	Assessment of impact on PAHs atmospheric concentrations of emission reduction scenarios; Evaluation of outdoor hourly average concentrations and deposition of PAHs for all the considered emission scenarios; PAHs and PM2.5 exposure maps for the target population in test city in the selected scenarios; PAHs and PM2.5 exposure cumulative distribution of target population in the selected scenarios.	Impacts of PAHs atmospheric concentrations in the two future scenarios assessed. Daily PAHs concentrations in the two future scenarios; PAHs and PM2.5 exposure maps for the target population in the two future scenarios; PAHs and PM2.5 exposure cumulative distribution of target population in the two future scenarios.	dataset of air pollution concentrations in two scenarios; dataset of population PAHs exposure in two scenarios; exposure profiles for population in two scenarios; one technical report produced	The action was successfully implemented. As pointed out in action 5.4 daily concentrations were considered more reliable than hourly one.
7.3	At least 4 different scenarios will be developed and health effects from the short term and the long term view point will be assessed.	The number of deaths for non-accidental causes attributable to long-term exposure to PM2.5 in the two selected scenarios were assessed. The two scenarios identified in action 7.1 were considered. It was not feasible to	health impact of PM2.5 in two scenarios; one technical report produced in conjunction with action 6.x	The action was successfully implemented.

		analyze scenarios other than those two considered for consistency reasons.		
8.1	Mapping of intermediate and final project results; Development of a Geographic data model to support analysis of population exposure to atmospheric pollutants and to represent, show and disseminate results; Procedures to increase compatibility between GIS and environmental models.	Project results were mapped using a GIS system. A web GIS was developed to improve accessibility and dissemination Cartographic and other ancillary data were integrated to support analysis of population exposure to pollutants. Procedures were developed to import model and observed data into the GIS system	one web-gis application developed and published on internet; one technical report produced; one contribution to a conference.	The action was successfully implemented.
9.1	A report containing an after LIFE communication plan.	An AFTER-Life plan has been finalized, with details on the actions to be implemented after the end of the Project, the stakeholders involved, the means to be used, and their cost sustainability	one report produced.	The action was successfully completed.

According to the above achieved results, we can consider that those provided by actions 3.2, 3.3, 4.5, 5.4, 6.1, 6.2, 6.3, 7.2, 7.3 and 8.1 are immediately visible and accessible for the stakeholders.
As far as the effectiveness of the dissemination activity is concerned, according to the amount of attendances at the three organized conferences (50, 63 and 102 respectively) and the number of total hits and visitors at the web site (more than 1 Million and 50 K respectively) we could argue the high interest in EXPAH results and documents. Presentations and reports were mostly downloaded from the web site with more than 50 downloading each. For these reasons we can conclude that dissemination activity was effective.

4.4 Analysis of long-term benefits

Environmental benefits

According to the evidences provided by EXPAH project, the observed PAHs levels in urban areas have been found to be characterized by high seasonality with large difference between heating and non heating seasons. During cold seasons, high concentration of PAHs were both observed and modeled. The current EC air quality standard for B[a]P, based on annual mean value, seems to be unable to represent a safe health protection limit, as high winter PAHs concentrations are compensated by the one order of magnitude lower values occurring during the summer time. Consequently a shorter time average period would better represent the actual exposure level of population. A monthly value of B[a}P concentration is recommended for this reason.
Furthermore, the prescribed minimum temporal coverage of PAHs sampling and analysis adopted by environmental authorities (33%) seems to be unable to monitor the high temporal variability observed in PAHs levels. High peak of PAHs concentrations can be lost by this sampling frequency, underestimating the actual exposure of population. Consequently, an extended time coverage of PAHs sampling is recommended for PAHs monitoring.

EXPAH took advantages from the participation of some of its partners components to a few working groups at International (WHO-REVIHAPP), National and local (Air Quality committee of Rome) levels. Results produced by EXPAH were brought to the attention to these working groups to support of the review of EU air quality legislation due in 2013 (eg. communication to REVIHAPP WHO project (annex 7.3.25). WHO-REVIHAPP was one of main scientific activity during the implementation of EXPAH with the aim to provide the

European Commission and its stakeholders with scientific evidence-based advice on health aspects of air pollution. A large discussion came up in international working groups about the current lifetime cumulative risk for benzo[a]pyrene causing cancer (1E-04) that is associated with the current guideline (1 ng/m3). Representative of EPA and International Agency for Research on Cancer (IARC) were invited at the final EXPAH conference to present their point of view and to get informed about the latest EXPAH results.

Findings of the EXPAH project highlight the presence of PAHs in the normal living environments. They are mainly caused by infiltration from outdoor air. Main risk reduction should therefore target improvement of outdoor air quality, especially consideration for cleaner biomass combustion technologies and use of alternative energy sources.
Substantial indoor sources were not identified in the study, although it is well known that perfumed candle and wood ovens (cooking), fireplace are possible indoor sources. Re-suspension of indoor particles with a likely outdoor origin represents another possible indoor source.
Northern Europe experiences highlight the possible use of filtered ventilation systems to reduce the impact of infiltration from outdoor air. Interventions on building structures to reduce the penetration efficiency and increase the air exchange and deposition rates might produce improvements in indoor air quality. Furthermore, the use of domestic facilities able to produce indoor emissions (eg. fireplace, candles) should be limited or properly used.

Another important aspect outlined by the EXPAH project is the emission policy and biomass regulation at National and regional level. It addressed the biomass combustion as the most important PAHs emission sources in the metropolitan area of Rome. When used as domestic heating system, wood produces large PM2.5 and PAHs emissions with a low heat production efficiency, especially if traditional stoves are employed. The increase of selling of domestic heating systems based on pellets, together with the use of traditional stoves and fireplaces as secondary heating systems has acerbated the problem. Consequently, the use of biomass for domestic heating should be regulated and possibly reduced at regional and National levels. In principle, for environments and efficiency reasons, it should be substituted with natural gas. Alternative, low emission high quality biomass burning system should be used in addition to recommendations on their proper use and maintenance. Research in the field of ultra low dust technologies, high efficiency and clean combustion system is needed.
An important aspect to be highlighted is the large uncertainty affecting the estimation of PAHs emissions, particularly for biomass combustion used in domestic heating. An effort is needed to reduce this uncertainty. National, Regional or local environmental Agencies should improve this estimation by collecting raw data or identifying proper proxy variables.

At local level and particularly for the city of Rome, a number of regulations should be undertaken. The major air quality problem affecting Rome conurbation is connected to particulate matter concentration in both its fine and coarse component. It is therefore advisable to address local measures to the possible reduction of PM emissions. Transport and residential heating are the sectors accounted for the larger contribution to PM emissions in Rome. An effort to improve Rome public transport system and possible regulation on diesel vehicle circulation can be identified as the most promising measures on the transport sector. The knowledge of the transport system and of its pollutant emissions in Rome is up to date, being based on traffic modelling and bottom-up emission estimate.
Improvements are possible for residential heating emissions. A large number of public and private building are heated by gasoil fired boilers that could be substituted by more efficient and less polluting gas fired heating systems. The increase of use of biomass for house heating

should be investigated to estimate its penetration and to individuate the areas more affected by those emissions. Information campaigns concerning the environmental problems caused by biomass burning in urban areas should be promoted, regulations could be introduced concerning the use of this fuel inside Rome metropolitan area. The promotion of economic incentives to substitute biomass greener fuels could be considered.
Measures concerning residential heating are expected to be the most effective to reduce PAHs concentrations in Rome area.

The above issues were disseminated by the EXPAH's partners using their business network. In particular The representatives of two key Ministry (Environment and Health) were invited at the final conference where results about policy implications were given. The head of Environment Municipal Office of Rome was also kept informed about the EXPAH results and its suggestion about the need of emission reduction from biomass burning sources. The participation of some EXPAH partners at the Air Quality committee of Rome, gave the opportunity the disseminate the local policy issues related to the EXPAH results. The PAHs WEB-GIS application component has been linked to a portal dedicated to Air Quality and Health Effects on population of Rome (www.romariasalute.it). This has guaranteed visibility and dissemination.

Long-term benefits and sustainability

The reduction of both PM2.5 emissions and the consequent effects on PAHs concentration, as demonstrated by the EXPAH project, represent a direct benefit in term of environment and health effects (about 50% of reduction in the number of deaths in the 2020 scenarios with banning of biomass combustion), which has potential for high visibility, effectiveness and social benefits.
The introduction of low emission high quality biomass burning system for domestic heating should be business opportunities for new technology. Research in the field of ultra low dust technologies, high efficiency and clean combustion system is recommended.

Partners are motivated to continue the reaserch in the field of biomass combustion and indoor exposure, as well as in developing a mobile information system to disseminate the EXPAH results and its high resolution environmental information at individual level.

Partners will continue to participate to the ECOWEB project (annex 7.3.26) to transfer the methodology employed. According to an invitation for collaboration (annex 7.3.27), the data set of PAHs measurements will be transferred to a developing Information Platform for Chemical Monitoring (IpCheM, http://ipchem.jrc.ec.europa.eu/). It is an European project, coordinating by the Institute for Environment and Sustainability of EC-JRC aimed in constructing a data portal and information system about chemical data. This will represent a good opportunity to further disseminate results.
The web-GIS application will be the bases for new proposals under the LIFE calls for integrating new features and functionalities.
Presentations will continue to be given at Regional Environment Agencies to disseminate results and methodologies and to support their transferability.
Proposals under new LIFE calls will be also addressed in the fields of indoor air quality, aerosol exposure and biomass combustion characterization.

Replicability, demonstration, transferability, cooperation

The EXPAH project created an unforeseen compilation of standard methodologies for the assessment of population exposures to PAH compounds including air quality monitoring, modeling, population time activity, assessment of infiltration, and source identification. As a result the annual and spatial patterns of PAH exposures of children and the elderly were characterized in detail, allowing for development of efficient risk reduction policies.
As far as the monitoring, modeling and health effects methodologies are concerned, it has to be considered that their application requires very high multidiscipline skills, normally available in specific research groups. Out of this scientific context, it would be difficult to find the required know how to implement the proposed methodologies. So, in order to export them in a different urban context without sufficient skills, support would be necessary to gather the needed data and to apply the EXPAH methodologies. To improve the level of portability, the PAHs monitoring activities were carried out by using standard and consolidated methods for sampling and chemical analysis. The employed techniques are easily replicable at the scientific or technical departments of environmental agencies.
The EXPAH project was implemented in the city of Rome, as it was considered as representative of a large Mediterranean urban area. Some of EXPAH's results and deliverables can be reutilized in a different geographic area, as they can be considered representative of a general urban Mediterranean context. In this way some of the expensive and time consuming surveys and sampling activities do not need to be replicated, improving the level of portability. Among them we can find:

- Time activity data of children and elderly people living in Rome;
- PAHs infiltration factors for home, school, office, car, bus;
- 2020 PAHs National emissions in the 2020CLE and 2020AME scenarios.

Conversely, raw data have to be collected to get specific information about the above needs.

Of particular interest would be the application of EXPAH methodologies in mixed industrial/urban context due to the complains about health effects produced by large industrial facilities, such as steel plants, which are often located close to urban and harbor areas. In such a context, it might be important to assess PAHs exposure, source contributions and to identify mitigation scenarios.
The EXPAH project has provided methodologies that are able to answer to the main questions existing in such contexts. Unfortunately, they are not completely portable out of the area where they have been implemented. A number of adaptations to the specific situation have to be planned. Among them we find:

- Seasonal PAHs monitoring at outdoor level to provide actual PAHs exposure of population and data for testing of model performance;
- identification of main sources and evaluation of the contribution from biomass combustion;
- Development of PAHs, $PM_{2.5}$ and gaseous pollutants emission inventory for the studied region;
- Cartographic data of the studied region;
- Population density data for the studied region;
- Health outcomes for the studied region.

It has to be considered that a large fraction of the local information mentioned is usually available in the European countries.
As mentioned above, other important data-bases , such as population time activity and PAHs infiltration factors, can be either exported from EXPAH results or derived by the application of the EXPAH methodologies in the area of study.
As far as the above data are available and skilled or supported expertise in AQ modeling and epidemiology are accessible, the application of methodologies described in several technical reports (annexes 7.2.13-15, 7.2.4 and 7.2.9), should provide results on PAHs population exposure for the studied region.

Innovation and demonstration value

The EXPAH project provided a set of methodologies to get information on PAHs exposure of population living in large metropolitan areas. It was possible to assess the actual PAHs exposure in the most visited living environments in different seasons using specific protocols for sampling and analysis of PAHs, to identify the most responsible emitting sources at urban level, to estimate daily PAHs exposure at urban level with a spatial resolution of 1 Km^2 and to evaluate health outcomes due to PAHs exposure as well as the future impacts on exposure and health consequent to the 2020 emissions predictions. A few recommendations to better monitor PAHs and limit its exposure were issued as well as suggestions for National and EU policy implications and local regulations concerning biomass combustion (annex 7.2.64).
Stakeholders at national and local levels have been involved from the first steps of the project, and multiple dissemination events have been organized, aiming to inform the widest public on the PAHs phenomenon and effects as well as addressing for which possible mitigation measures policy makers could design in order to reduce its impact.
The results and methodologies provided by EXPAH are innovative for a number of reasons:

- PAHs infiltration factors in different living environments have been assessed and are new especially for building located in a city of the Mediterranean area;
- Information at high spatial resolution on which part of a city (eg. Rome) is more exposed to PAHs were not available. Larger scales (regional) impact assessment studies were carried out up now;
- The correspondent PAHs exposure to a city's population with information on contributions from different living environments (eg. home, school, traffic) is rather new with respect to the current state of knowledge; Evaluation of uncertainties of the evaluated exposures by statistical approaches is also new and it is going to be published in a scientific journal;
- The evaluation of short and long term health effects by using modelling techniques to assess PAHs exposure is also a significant advancement in the current methodologies, which takes advantages by the better accuracy in the evaluation of PAHs exposure, allowing to obtain better assessment of health impacts;
- Limits and needs of the foreseen emission scenarios at the year 2020 for PAHs and PM2.5 are identified at urban level both in terms of environment and health perspectives, providing new information for environment policies and mitigation strategies.

Long-term indicators of the project success

The results of the EXPAH may have long term results on the following areas:

- *Environment*. Regulation in PAHs emissions from biomass combustion will produce a significant benefit in the environment.
- *Health*. According to EXPAH results, a reduction in PAHs emissions consequent to a regulation, will have a direct consequence and impact in both short term and long term health effects.
- *Social*. The effects of air pollution tend to be higher for people of lower socioeconomic position. This is due to greater exposure level as well as higher susceptibility due to more frequent lifestyle (smoking, physical activity, obesity) in people of lower social class. Any improvement in environmental pollution will provide a larger benefit to less advantaged people thus providing more environmental justice.
- *Economic*. Any effort to reduce air pollution and the consequent health impact will produce economic gain. In addition, business from several sectors, like vehicle industry, producers of heating systems, heavy industry will be forced to innovation and larger investment with future more advanced business.
- *Occupational*. Increase in the occupational level will result from more environmental control, especially at industry level but also for inspection and control personnel.

Quantitative long-term indicators of the expected project success are reported below, with reference to the three years after the project end:

- Number of publications achieved after the end of the project:
- Number of times the EXPAH publications are cited:
- Number of times the project results are taken into consideration in policy on EU/National/local levels
- Number of times the project representatives are invited at conferences, seminars, other events
- Number of visits of the web site
- Number of requests for clarifications, update, dissemination and scientific material (publications, Layman’s report, etc.)

5. Comments on the financial report

The standard statement of expenditure (available in the 'toolkit' on the LIFE web page) must be used and presented in a separate document, as described below – see section 8 on financial reporting. This part of the technical report must include the following points:

- overview of costs incurred,
- information about the accounting system and relevant issues from the partnership agreements
- an allocation of the costs per action

This information should include sufficient detail to establish a clear link between technical activities on the one hand and costs declared in the financial forms on the other. Please note that – as set out in the Common Provisions on the eligibility of costs – only costs that

are necessary for and clearly linked to the activities carried out, are eligible. This section should justify and explain extraordinary cases, e.g. necessary costs not foreseen in the budget, persons changing status during the project from external consultants to employed staff (or vice versa), etc.

5.1. Summary of Costs Incurred

–Complete the following table concerning the incurred project costs and comment on each of the cost categories focussing particularly on discrepancies compared to the allowed flexibility of 30,000€ and 10% (cf. Article 15.2 of the Common Provisions)

PROJECT COSTS INCURRED				
	Cost category	Budget according to the grant agreement*	Costs incurred within the project duration	%**
1.	Personnel	1.502.783	1.590.793,53	106
2.	Travel	47.010	18.229,03	39
3.	External assistance	18.600	31.580,75	170
4.	Durables: total non-depreciated cost			0
	- *Infrastructure sub-tot.*			0
	- *Equipment sub-tot.*	136.000	74.405,99 (15.292,67 eligible)	55
	- *Prototypes sub-tot.*			0
5.	Consumables	198.800	212.004,16	107
6.	Other costs	20.700	9.849,03	48
7.	Overheads	**113.856**	**130.826,54**	115
	TOTAL	**2.037.749**	**2.067.689,03**	101

According to the overall costs shown in the table above, a good balance between budget and actual total costs has been reached. The personnel cost, as foreseen, had the highest weight over these total costs, followed by the consumable costs. The external assistance costs, which weight for about 1.5%, had the largest overspending (+ 13,000 €; >170%) with respect to the foresee budget. This is mainly due to extra costs in both the external financial audit and an unforeseen repairing of equipments in action 3.4.2 (5,600 €) needed to guarantee the proper functioning of systems. The latter was authorized by the financial desk of the Commission by email. The lower expenditure of equipments and the little increase of consumable costs, with respect to the foreseen budget, was, as outlined in previous reports, due to a minor budget revision approved by Commission with the letter of 18/10/2011 (ENV/E-4/SB Ares (2011)) as answer to the Inception Report. In this request of budget revision, we essentially moved costs from equipment to consumable, to better manage the monitoring activities in Action 3.3 and fix an erroneous inclusion of consumable materials in the equipments elements. The costs incurred from the start date for these two cost elements, reflects this budget revision. Consequently the consumables budget category registers a slight overspending (7%) than

foreseen, mainly caused by the high number of consumable material needed for the monitoring activities, while only 55% of the original budget was used for equipment.

5.2. Accounting system

Each beneficiary used an analytical accounting system, with a specific code assigned to the project account. This allowed an easy traceability of expenditures and incomes. The LIFE Excel template has been adopted by all partners, where all the costs were inserted by hand, and transmitted to the Associated Beneficiary every three months.
The invoices for all incurred expenses have been identified by:

- Name or Acronym of the project (EXPAH);
- The project code (LIFE09 ENV/IT/000082);

Whenever these could not be applied, a dedicated stamp was used.
The timesheets used to register the working time of personnel comply with the template suggested by the EU (Annex 8.13), reporting on a monthly basis the number of hours spent daily by each employee on the present project, on other Life projects and on other activities, with a summary of the total numbers of hours worked for each day of a given month. For the personnel subjected to an automatic time recording system, the total number of hours worked was derived from the official monthly database; for the personnel subjected to different rules of working time accounting, the total number of hours worked was certified by the Project Manager or other responsible at a higher hierarchical level.
The monthly timesheets were signed by each employee usually within a few weeks after the end of each month, and countersigned within a timespan of a few additional days by the Project Manager or other responsible at a higher hierarchical level.

5.3. Partnership arrangements (if relevant)

The agreements between the coordinating beneficiary, namely ASL-RME, and the associated beneficiaries were signed between 27th October 2010 and 31st March 2011, and were sent to the European Commission with the Inception Report the 30th of June 2011. Details on the contents of the partnership agreements are reported in the Inception Report.

The financial reports have been delivered by the associate beneficiaries to the coordinating beneficiary on a three-monthly basis, using the template statement of expenditure (contained in the LIFE Toolkit). Each associate beneficiary has entered into the template statement of expenditure the information regarding the expenses incurred. The financial reports have been verified consistently by the coordinating beneficiary, to guarantee the eligibility of the costs of the participants, as well as the coherence with the budget approved in the presentation stage.

5.4. Auditor's report/declaration

See annex 8.12.

5.5 Summary of costs per action

Action no.	Short name of action	1. Personnel	2. Travel and subsistence	3. External assistance	4.a Infra-structure	4.b Equip-ment	4.c Prototype	5. Purchase or lease of land	6. Consumables	7. Other costs	TOTAL

1.1	Co-ordination and management	78165.5	973.37	0	0	0	0	0	0	0	79138.87
1.2	Monitoring of the project	46363.94	0	0	0	0	0	0	0	0	46363.94
2.1	Administration of budget and financial audits	64465.47	0	10040	0	0	0	0	0	0	74505.47
2.2	Dissemination to policy and decision makers and to the public	11539.45	0	0	0	0	0	0	0	0	11539.45
2.3	Web design, development and results displaying	4453.75	0	6000	0	0	0	0	0	0	10453.75
2.4	Conference spanning the topics of the project	7212.19	0	0	0	0	0	0	7522.56	0	14734.75
2.5	Layman's report developing for dissemination	4653.46	0	0	0	0	0	0	0	5399.72	10053.18
3.1	Estimation of population time activity data and analysis	28474.14	0	0	0	0	0	0	0	0	28474.14
3.2.1	Intercomparison of PAH measurements	65420.16	0	0	0	0	0	0	0	0	65420.16
3.2.2	Intercomparison of PAH, PM, EC/OC	59314.97	0	0	0	390	0	0	15404.06	0	75109.03
3.2.3	Intercomparison PM ultrafine and PAHs	30385.71	0	0	0	1170	0	0	9593.57	0	41149.28
3.3.1	Field campaigns of indoor/outdoor PM2.5, chemical processing for PAH	38792.83	0	0	0	678.81	0	0	12585.94	0	52057.58
3.3.2	Field campaigns of particulate PAH (indoor, outdoor)	179483.47	293.7	0	0	3510	0	0	73990.7	0	257277.87
3.3.3	Ancillary measurements of gaseous toxicants, PM2.5 chemical components, EC/OC	112068.91	662.91	0	0	2259	0	0	62077.29	2543.3	179611.41
3.3.4	collection of outdoor PM10 and PM2.5, and of criteria pollutants	40331.23	0	0	0	0	0	0	10002.52	0	50333.75
3.3.5	personal exposure measurements of PAHs	38245.88	0	0	0	1098.34	0	0	17545.93	529.51	57419.66
3.4.1	collection of upper air meteorological data in the studied region	68856.09	3870.57	9927.75	0	0	0	0	3160.75	0	85815.16
3.4.2	collection of meteorological data in the studied region	8294.32	0	5613	0	0	0	0	0	786.5	14693.82
4.1	Emissions.collection	19218.37	0	0	0	0	0	0	0	0	19218.37
4.2	Domain.definition	17144.99	667.70	0	0	0	0	0	0	0	17812.69
4.3	Traffic.emissions	16930.49	0	0	0	707.03	0	0	0	0	17637.52
4.4	Emissions computation	32309.18	961.28	0	0	821.69	0	0	0	0	34092.15
4.5	Meteorology PAH dispersion	82002.96	1658.79	0	0	2448.33	0	0	0	0	86110.08
5.1	Statistical analyses indoor/outdoor data	17625.51	0	0	0	0	0	0	0	0	17625.51

5.2	Development of µE infiltration model	39714.59	1925.3	0	0	0	0	0	0	0	41639.89
5.3.1	Development of the exposure model	54926.76	5344.31	0	0	0	0	0	120.6	0	60391.67
5.3.2	implementation of the exposure model	7282.22	0	0	0	0	0	0	0	0	7282.22
5.4	simulation of population exposure	26581.36	0	0	0	0	0	0	0	590	27171.36
5.5	optimization of model results with actual population exposure	37441.73	0	0	0	0	0	0	0	0	37441.73
6.1	short-term impact of PAHs on natural and cause specific mortality	70030.02	0	0	0	0	0	0	0	0	70030.02
6.2	short-term impact of PAHs on emergency hospital admissions	66628.32	0	0	0	0	0	0	0	0	66628.32
6.3	impact of long-term exposure in the occurrence of lung cancer, coronary and cerebrovascular events.	38428.92	0	0	0	0	0	0	0	0	38428.92
7.1	Scenarios definition	10885.69	398.3	0	0	0	0	0	0	0	11283.99
7.2.1	PAH Scenarios analysis	63174.38	1472.8	0	0	2209.47	0	0	0	0	66856.65
7.2.2	Calculation of exposure maps in the selected scenarios	17486.72	0	0	0	0	0	0	0	0	17486.72
7.3	Calculation of health effects for the selected scenarios	24975.8	0	0	0	0	0	0	0	0	24975.8
8.1	Integration of data and results by means of GIS techniques	61484.07	0	0	0	0	0	0	0	0	61484.07
Over-heads											130826.54
	TOTAL	1590793.6	18229.03	31580.75	0	15292.67	0	0	212003.92	9849.03	2008575.49

By comparing the above action costs with those foreseen at the time of proposal, we see on average a very good overall agreement. A very close value to the overall budget is reached by the actual expenditures. However, by looking in more details it can be seen some actions showing over expenditure, which are compensated by others exhibiting lower costs than original budget. This effect allows to obtain an overall agreement with the total foreseen costs. In particular the table below compares the total incurred costs with the original budget. Comments are given for those actions having over expenditure greater than ±20 %. It should be considered that most of the macro-actions (3. monitoring; 4. air pollution modelling; 5. exposure modelling; 6. health effects; 7. evaluation of scenarios) are on balance, although within them some sub-actions exhibit a few discrepancies in the incurred costs which are compensated by costs of other sub-actions. This was in some way expected, as a strong inter-operability occurred among actions.

Action no.	Short name of action	Original Budget	Total costs incurred	Total cost incurred	Comments

				%	
1.1	**Co-ordination and management**	80,310	**79,138.87**	**98.5**	
1.2	**Monitoring of the project**	38,360	**46,363.94**	**120.9**	**The monitoring activities by means of monitoring forms produced higher personal costs.**
2.1	**Administration of budget and financial audits**	70,700	**74,505.47**	**105.4**	
2.2	**Dissemination to policy and decision makers and to the public**	11,500	**11,539.45**	**100.3**	
2.3	**Web design, development and results displaying**	8,660	**10,453.75**	**120.7**	**The web GIS design produced higher costs than foreseen**
2.4	**Conference spanning the topics of the project**	15,390	**14,734.75**	**95.7**	
2.5	**Layman's report developing for dissemination**	8,195	**10,053.18**	**122.7**	**Higher costs of design and production increased the costs**
3.1	**Estimation of population time activity data and analysis**	26,000	**28,474.14**	**109.5**	
3.2.1	Intercomparison of PAH measurements	51,400	65,420.16	127.3	**Although discrepancies in costs of sub-actions are detected, the overall costs are on balance. Interoperability occurred among actions**
3.2.2	Intercomparison of PAH, PM, EC/OC	96,421	75,109.03	77.9	
3.2.3	Intercomparison PM ultrafine and PAHs	22,359	41,149.28	184.0	
3.2	**Preliminary itercomparison**	**170,180**	**181,678**	**106.8**	
3.3.1	Field campaigns of indoor/outdoor PM2.5, chemical processing for PAH	71,750	52,057.58	72.6	**Although discrepancies in costs of some sub-actions are detected, the overall costs are on balance. Interoperability occurred among actions**
3.3.2	Field campaigns of particulate PAH (indoor, outdoor)	286,744	257,277.87	89.7	
3.3.3	Ancillary measurements of gaseous toxicants, PM2.5 chemical components, EC/OC	184,904	179,611.41	97.1	
3.3.4	collection of outdoor PM10 and PM2.5, and of criteria pollutants	50,200	50,333.75	100.3	
3.3.5	personal exposure measurements of PAHs	100,450	57,419.66	57.2	
3.3	**Field campaigns of I/O PM , PAHs**	**694,048**	**596,700**	**86.0**	

3.4.1	collection of upper air meteorological data in the studied region	92,230	85,815.16	93.0	
3.4.2	collection of meteorological data in the studied region	6,325	14,693.82	**232.3**	**Unpredicted costs for repair of damaged equipments occurred. This increased the costs**
3.4	**collection of meteorological data in the studied region**	**98,555**	**100,509**	**102.0**	
4.1	Emissions.collection	19,916	19,218.37	96.5	
4.2	Domain.definition	21,199	17,812.69	84.0	
4.3	Traffic.emissions	19,888	17,637.52	88.7	
4.4	Emissions computation	29,786	34,092.15	114.5	
4.5	Meteorology PAH dispersion	82,310	86,110.08	104.6	
4	**Air pollution Modeling**	**370,209**	**375,889**	**101.5**	
5.1	Statistical analyses indoor/outdoor data	17,240	17,625.51	102.2	
5.2	Development of μE infiltration model	37,523	41,639.89	111.0	
5.3.1	Development of the exposure model	66,899	60,391.67	90.3	
5.3.2	implementation of the exposure model	7,200	7,282.22	101.1	
5.4	simulation of population exposure	24,600	27,171.36	110.5	
5.5	optimization of model results with actual population exposure	33,120	37,441.73	113.0	
5	**Exposure modeling**	**186,582**	**191,552**	**102.7**	
6.1	short-term impact of PAHs on natural and cause specific mortality	70,620	70,030.02	99.2	
6.2	short-term impact of PAHs on emergency hospital admissions	66,620	66,628.32	100.0	
6.3	impact of long-term exposure in the occurrence of lung cancer, coronary and cerebrovascular events.	38,400	38,428.92	100.1	
6	Health effects	**175,640**	**175,087**	**99.7**	
7.1	Scenarios definition	11,241	11,283.99	100.4	
7.2.1	PAH Scenarios analysis	70,773	66,856.65	94.5	

7.2.2	Calculation of exposure maps in the selected scenarios	14,400	17,486.72	121.4	**Higher personal costs increased expenditures. The design and implementation of the statistical exposure model, not originally foreseen , produced these larger working activities**
7.3	Calculation of health effects for the selected scenarios	24,960	24,975.8	100.1	
7	**Evaluation of scenarios**	**121,374**	**120,603**	**99.4**	
8.1	**Integration of data and results by means of GIS techniques**	45,300	61,484.07	135.7	**This action produced much more results than originally foreseen. This needed larger working efforts which produced higher personal costs.**

7. Annexes

7.1 Administrative annexes

Partnership agreements are available as annexes of the Inception report.

Annex 7.1.1.1 minute implementation action 3.2 -1st meeting
Annex 7.1.1.2 minute implementation action 3.2 -2nd meeting
Annex 7.1.1.3 minute implementation action 3.2 -3rd meeting
Annex 7.1.1.4 minute implementation action 3.2 -4th meeting
Annex 7.1.1.5 minute implementation action 3.2 -5th meeting
Annex 7.1.1.6 minute implementation action 3.2 -6th meeting
Annex 7.1.1.7 minute implementation action 3.3 -1st meeting
Annex 7.1.1.8 minute implementation action 3.3 -2nd meeting
Annex 7.1.1.9 minute implementation action 3.3 -3rd meeting
Annex 7.1.1.10 minute MB meeting dec 2010
Annex 7.1.1.11 minute MB meeting dec 2011
Annex 7.1.1.12 minute MB meeting sep 2012
Annex 7.1.1.13 minute implementation action 6.x and MB meeting apr 2013
Annex 7.1.1.14 minute implementation action 5.1- 1 meeting
Annex 7.1.1.15 minute implementation action 6.x -1st meeting
Annex 7.1.1.16 minute implementation action 6.x -2nd meeting
Annex 7.1.1.17 minute implementation action 6.x -3rd meeting
Annex 7.1.1.18 minute of actions meeting sep 2013
Annex 7.1.1.19 minute of actions meeting Jan 2014
Annex 7.1.1.20 minute of actions meeting May 2014
Annex 7.1.1.21 minute of meeting for organization of Mid-term Conference
Annex 7.1.2.1 action 1.1 monitoring Form marzo2014
Annex 7.1.2.2 action 1.2 monitoring Form marzo2014
Annex 7.1.2.3 action 2.1 monitoring Form marzo2014
Annex 7.1.2.4 action 2.2 monitoring Form marzo2014
Annex 7.1.2.5 action 2.3 monitoring Form marzo2014
Annex 7.1.2.6 action 2.4 monitoring Form marzo 2014
Annex 7.1.2.7 action 2.5 monitoring Form marzo 2014
Annex 7.1.2.8 action 3.1 monitoring Form oct 2012
Annex 7.1.2.9 action 3.2.1 monitoring Form dic2011
Annex 7.1.2.10 action 3.2.2 monitoring Form dic2011
Annex 7.1.2.11 action 3.2.3 monitoring Form dic2011
Annex 7.1.2.12 action 3.3 monitoring Form aprile2013
Annex 7.1.2.13 action 3.4.1 monitoring Form set2012
Annex 7.1.2.14 action 3.4.2 monitoring Form set2012
Annex 7.1.2.15 action 4.1 monitoring Form dic2011
Annex 7.1.2.16 action 4.2 monitoring Form dic 2011
Annex 7.1.2.17 action 4.3 monitoring Form dic 2011
Annex 7.1.2.18 action 4.4 monitoring Form set 2012
Annex 7.1.2.19 action 4.5 monitoring Form aprile 2013
Annex 7.1.2.20 action_5.1_monitoring_Form_march2014
Annex 7.1.2.21 action_5.2_monitoring_Form_march2014
Annex 7.1.2.22 action 5.3 monitoring form marzo 2014
Annex 7.1.2.23 action 5.4 monitoring form marzo 2014
Annex 7.1.2.24 action 5.5 monitoring form marzo 2014
Annex 7.1.2.25 action 6.1 monitoring Form marzo2014

Annex 7.1.2.26 action 6.2 monitoring Form marzo2014
Annex 7.1.2.27 action 6.3 monitoring Form marzo2014
Annex 7.1.2.28 action 7.1 monitoring Form marzo 2014
Annex 7.1.2.29 action 7.2.1 monitoring Form marzo2014
Annex 7.1.2.30 action 7.2.2 monitoring Form marzo2014
Annex 7.1.2.31 action 7.3 monitoring Form marzo2014
Annex 7.1.2.32 action 8.1 monitoring Form marzo2014
Annex 7.1.3 EC letter for Supplementary Agreement
Annex 7.1.4 EC letter for request of Postponement
Annex 7.1.5 EC letter as answer to Inception report.
Annex 7.1.6 EC letter as answer to first monitoring visit
Annex 7.1.7 EC letter as answer to second monitoring visit
Annex 7.1.8 EC letter as answer to Mid term report
Annex 7.1.9 EC letter as answer to third monitoring visit
Annex 7.1.10 EC letter as answer to progress report
Annex 7.1.11 EC letter as answer to fourth monitoring visit
Annex 7.1.12 EC transmission letter for prolongation request
Annex 7.1.13 EC 2nd Amendment

7.2 Technical annexes

Annex 7.2.1	Action 3.3. Data set from intensive field campaigns of indoor-outdoor $PM_{2.5}$ and speciated PAHs as well as EC/OC PM contents in living places for the summer and winter seasons. (available at EXPAH ftp web site (ftp://95.228.102.188).
Annex 7.2.2	Action 3.3. Data set of personal exposure to PM2.5 and PAHs. (available at EXPAH ftp web site (ftp://95.228.102.188).
Annex 7.2.3	Actions 5.1, 5.2 Report on infiltration and exposure model with software prototypes.
Annex 7.2.4	Action 4.5 Report on model capability to simulate PM2.5 and PAHs in the base case.
Annex 7.2.5	Action 5.3-5.4 Report on Annual and seasonal exposure maps to PM2.5 and speciated PAHs for children and elderly people in the base case.
Annex 7.2.6	data-base for health assessment with software prototype (available at EXPAH ftp web site (ftp://95.228.102.188).
Annex 7.2.7	Action 7.1 Report on evaluation of policy and mitigation scenarios
Annex 7.2.8	Action 7.2 Report on impact to PAHs outdoor concentrations and population exposure in the policy and mitigation scenarios
Annex 7.2.9	Actions 6.1, 6.2, 6.3, 7.3. Report on health impact of PAHs in the base case and policy and mitigation scenarios
Annex 7.2.12	Action 8.1 GIS application with data and results (available at www.ispesl.it/expah)
Annex 7.2.13	Action 4.1 Technical report on collection of raw emission inventories and their upgrading
Annex 7.2.14	Action 4.2 presentation on definition of simulated areas and MINNi results.

Annex 7.2.15 Actions 4.3, 4.4. Technical report on calculation and integration of traffic emissions with the updated Lazio Region inventory. Spatial, temporal and chemical disaggregation of the emission inventory.

Annex 7.2.16 Action 4.5 Hourly resolved concentration fields of both ambient gaseous and size resolved aerosol pollutants with speciated PAHs and PM aerosol components with EC/OC in the urban area of Rome for one year in the base case scenario (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.17 Action 3.3 Collection of long-term air quality monitoring data for the city of Rome (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.18 Action 3.3 Concentration data of indoor-outdoor PM2.5 and its EC, OC and PAHs contents in some living places (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.19 Action 3.3 Field data of personal exposure to PM2.5 and PAHs contents (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.20 Action 5.3 Exposure modelling system validated and applied to the City of Rome with software prototype (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.21 Action 5.4 Annual and seasonal exposure maps to PM2.5 and speciated PAHs for children and elderly people in the base case scenario (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.22 Action 7.2 Hourly concentration fields of both ambient gaseous and size resolved aerosol speciated PAHs in the urban area of Rome in the policy and mitigation scenarios (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.23 Action 7.2 Annual and seasonal exposure maps and cumulative distribution of exposure to PM2.5 and speciated PAHs for children and elderly people in the policy and mitigation scenarios (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.24 Action 8.1 GIS application containing all data and results produced by the project (available at www.ispesl.it/expah)

Annex 7.2.25 Action 3.1 Time activity diary form for children.

Annex 7.2.26 Action 3.1 Report on survey on children and elderly people time activity in Rome-action 3.1

Annex 7.2.27 Action 3.2 Report on preliminary PAHs field campaign

Annex 7.2.28 Action 3.2 Technical Report-Comparison study of PM2,5 chemical composition by using MV and LV samplers-action 3.2.2

Annex 7.2.29 Action 3.2 Report on recommendations for regular field campaigns.

Annex 7.2.30 Action 3.2 Short report on Indoor/Outdoor monitoring of PAHs, $PM_{2.5}$ in living environments.

Annex 7.2.31 Action 3.3 Report on Indoor Outdoor monitoring of PAHs $PM_{2.5}$ in living environments.

Annex 7.2.32 Action 3.3 Time schedule of summer field campaign

Annex 7.2.33 Action 3.3.5 Authorization letter for personal sampling

Annex 7.2.34 Action 3.4 Technical report on meteorological measurements

Annex 7.2.35 Action 3.4 Data set of hourly surface and upper air meteorological parameters at four stations with additional available territory data (available at EXPAH ftp web site (ftp://95.228.102.188).

Annex 7.2.36	Action 4.1	Presentation on collection of raw emission inventories at MB.
Annex 7.2.38	Action 4.2	Cartographic data of the studied area (available at EXPAH ftp web site (ftp://95.228.102.188).
Annex 7.2.40	Action 4.3	Presentation on emissions from road network
Annex 7.2.41	Action 4.3	Cartographic data of road emission (available at EXPAH ftp web site (ftp://95.228.102.188).
Annex 7.2.42	Action 4.4	Presentation at MB2011 on emissions.
Annex 7.2.43	Action 4.4	Presentation at MB2012 on emissions Expah_4.1-4.3-4.4
Annex 7.2.44	Action 4.5	Presentation of modeling activities at MB 2011
Annex 7.2.45	Action 4.5	Presentation of modeling activities and early results at MB 2012
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Annex 7.3.16 Action 9.1 After LIFE Communication Plan

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8. Financial report and annexes

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