



Summary review

April 2016

IMPROVE LIFE13 ENV/ES/000263



Coordinated by
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1. ACTIVITIES FOLLOW-UP

The following summary report covers IMPROVE LIFE13 ENV/ES/000263 activities from **01/01/2016 to 31/03/2016**.

Activities were launched on time and the project progresses according to the proposed timetable. The main tasks initiated or accomplished at each action in progress were as follows:

- **Actions B1 and B2** “Determination of the impact of selected parameters and Testing mitigation measures and development of mitigation strategies”. In order to further characterise the impact of emissions from different brake pads in the air quality of the stations, air quality measurements were performed in line 5 where all trains use the same type of brake pads. The station selected, according to the protocol followed in all measurements in IMPROVE, was Sant Ildefons (a station with two railtracks). The sampling campaign started on the 3rd of February and lasted the whole month. During this period, renewal works were not carried out in order to obtain measurements under representative and standard conditions. The percentage of data coverage is lower than in the previous campaigns (73% vs >90%), due to frequent power cut-offs during the first two weeks.

Sampling equipments were moved to the station of Tarragona (L3) on the 29th of February, where they will be measuring until the 25th of April. During this time a repetition of the campaign carried out in this station in 2015 will be done, aiming to compare the results on air quality conditions in the platform when the ventilation regime is changed from the normal conditions introducing outdoor air into the tunnel and/or platform (impulsion) to a different experimental condition removing indoor air towards the outdoor environment (extraction). In addition during this campaign air purifying equipments will be used to see their efficiency on reducing PM concentrations in the platform. The effect of air purifiers manufactured by 2 different companies (PureAir and GINSA) will be compared against the air quality in the platform under normal conditions. Periods with different sampling conditions will last for a week, followed always for a week under normal conditions to observe differences before and after the implementation of each ventilation as shown below:

Date	Normal ventilation	Air purifier PUREAIR	Change in ventilation	Air purifier GINSA
29-13 March				
14-20 March				
21-27 March				
28-3 April				
4-10 April				
11-17 April				
18-24 April				



(PUREAIR) in Tarragona station.

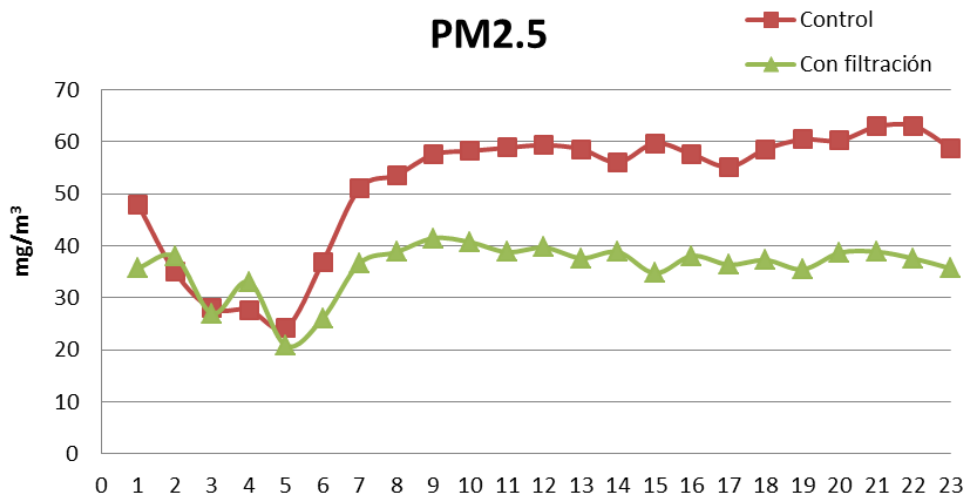
The campaigns involve the deployment of several equipments at one end of the platform of the selected station fulfilling all the necessary safety conditions. The monitoring equipment includes a high volume PM_{2.5} sampler (for daily sampling particulate matter below 2.5 microns), passive samplers for NO₂ monitoring, and automatic equipments registering continuously concentration levels of i) PM in 3 sizes (1, 2.5 and 10 microns); ii) particle number concentrations in 16 size ranges; and iii) CO, CO₂, temperature and relative humidity every 5 minutes.

Action B2. Testing air purifier equipment

A third report showing all measuring campaigns carried out from January 2015 until March 2016 was prepared. In this report is concluded that:

i) The temporal variations of PM_{2.5}, N_{0.3-10} and CO₂ concentrations recorded at Sant Ildefons station (L5) during the whole sampling campaign, indicate that as typically observed in previous campaigns, average concentrations at nights were generally lower than those corresponding to the operation hours, which indicates the importance of sources related to the subway operation activities. However, during weekends, with extended metro service times, PM_{2.5} and N_{0.3-10} concentrations frequently attained their minimum at midday, probably associated with lower trains' frequency together with higher ventilation rates. The sharp decreases of CO₂ concentrations observed during weekends are consistent with a lower number of metro users.

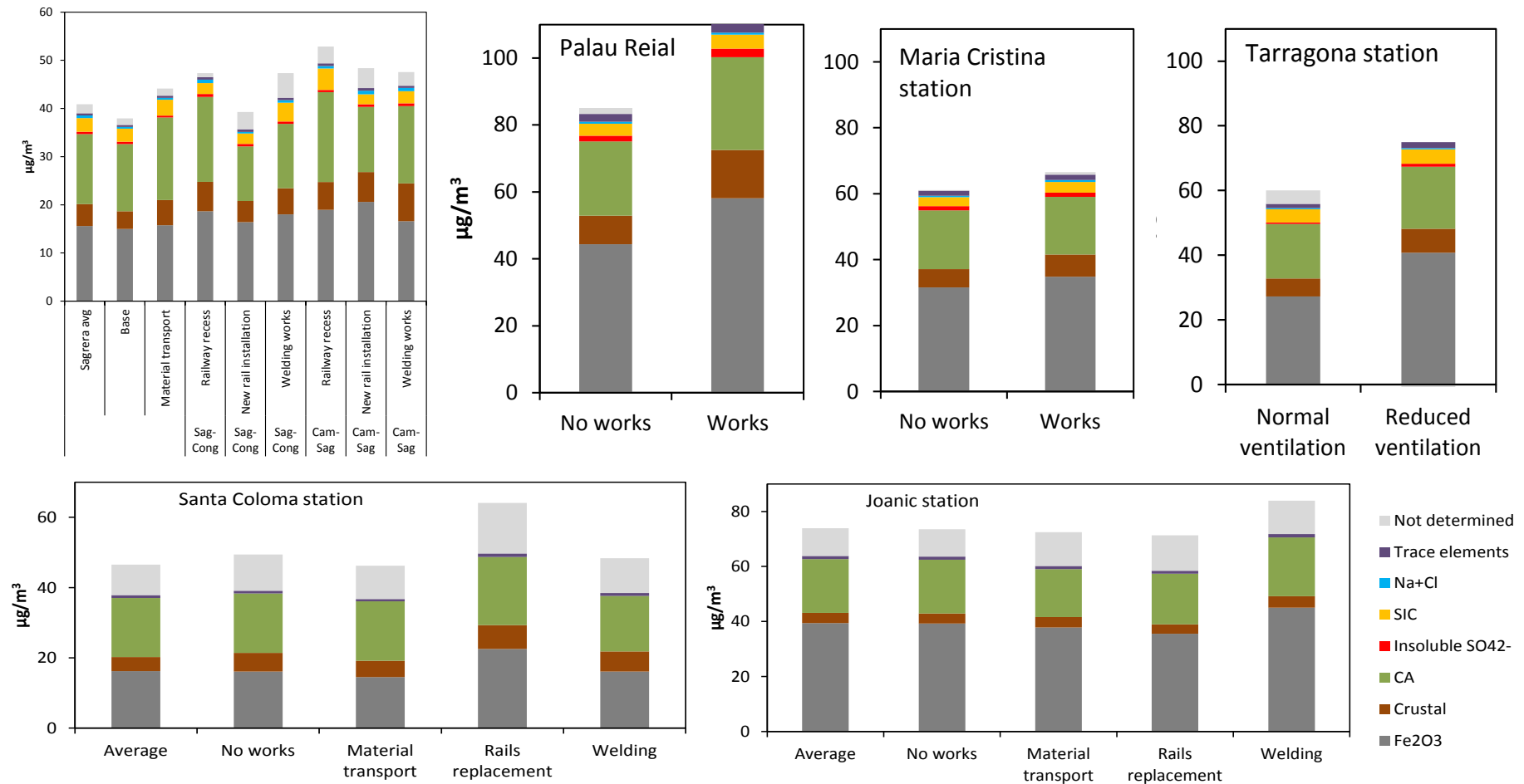
Regarding the measurements done during the installation of the PureAir purifier (not included in the third report as its results are still under study), preliminary results indicate an average reduction on PM_{2.5} of 30% while functioning. These measurements will be repeated during April to check reproducibility of the results.



Action B2. PM_{2.5} concentrations while air purifier equipment (PUREAIR) was operational in Tarragona station (green line) compared to normal measurements (red line).

ii) Complete chemical analyses of all the PM_{2.5} samples collected by the high volume sampler were planned in order to determine the variations in chemical composition driven by the influence of the different activities performed. Up to March 2016, a total of 242 samples had been completely analysed (71 samples from Sagrera station, 44 samples from Palau Reial station, 27 from Maria Cristina station and 21 from Tarragona station). During this period (January to March 2016), 33 samples from Santa Coloma and 46 samples from Joanic station have been carried out completely except for the ion chromatography analyses. Average results comparing normal conditions and periods with experimental and maintenance activities are shown in the figure below. These results are shown in detail in the third report where all measuring campaigns carried out from January 2015 until March 2016 are discussed.

Additionally, 63 samples, from Sagrera, Palau Reial, Maria Cristina and Tarragona stations, have been analysed so far for organic species analysis, based on the activities carried out at the stations and the PM_{2.5} concentrations. The analysis consists on: extraction in a solvent mixture of methanol and dichloromethane, and subsequent analysis of the extracts on a gas-chromatograph coupled to a mass-spectrometer (GC-MS). A total of 35 organic species are determined with this methodology.



Action B1. Average chemical composition in $\mu\text{g m}^{-3}$ (major components grouped according to similar origin/properties) for the entire sampling period so far, comparing the base situation (no works, or normal ventilation in the case of Tarragona station), and during the different renewal works carried out at Sagrera, Palau Reial, Maria Cristina, Tarragona, Santa Coloma and Joanic stations. These results are discussed in detail in the third sampling report. CA: Carbonaceous Aerosol, SIC: Secondary Inorganic Compounds (nitrate, sulphate and ammonium).

- **Action C1** “Effectiveness of the project actions”. The impact of the implementation actions of IMPROVE will be evaluated once they have been completed (December 2016). The data obtained during PM sampling and chemical characterization conducted before and after the implementation of the measures scheduled in Action B1 will allow the CSIC partner to quantify how much emission estimates will change as a result of the adoption of the strategies. The estimate of the impact of each air particles source before and after the application of remediation measures will permit the evaluation of the effectiveness and air quality benefit in terms of PM_{2.5}, PM₁₀ and several PM chemical components related to indoor metro emissions.
- **Action C2** “Assessment of the socio-economic impact of the project”. This action will officially start on July 2016.
- **Action D1** “A Project website designed as a tool to raise the profile of the project and improve the dissemination of its activities”. The web site of IMPROVE LIFE (<http://improve-life.eu>) was launched in December 2014 and is updated in a 2-week basis. Main updates during this period have been on reports, scientific publications and conference presentations of the project, activities and results. A visitor’s counter has been added to have a more detailed knowledge of the web views.
- **Action D2** “LIFE+ Information board will be on displayed describing the project at the locations where it is implemented, at strategic places accessible and visible to the public”. LIFE+ Information boards are on display since January 2015 describing the project at the locations where it is implemented, at strategic places accessible and visible to the public. By April 2016 hard information boards on the project have been placed at Sagrera, Palau Reial, Maria Cristina, Tarragona, Santa Coloma, Joanic and Saint Ildefons stations where measurements have been performed. Panels are also permanently displayed in IDAEA-CSIC (Palau Reial) and TMB (Santa Eulalia) main offices. No vandalism problems have occurred during the January-March period.



Action D2. IMPROVE LIFE panel displayed in the lobby of Saint Ildefons station.

- **Action D3** “Dissemination of project results”. During this period the following activities to disseminate IMPROVE LIFE results have been carried out:
 - ✓ An update on the IMPROVE results was presented by T. Moreno to the managers of all the different subway lines in TMB (25 January, TMB Zona Franca office) and to the Committee of Work Security (9 March, Santa Eulalia TMB office).
 - ✓ **Technical publications** on the project results in international scientific journals and presentations in scientific conferences acknowledging the LIFE+ financial support during this period:
 - V. Martins, T. Moreno, M.C. Minguillón, B.L. van Drooge, F. Amato, E. de Miguel, M. Capdevila, S. Centelles, X. Querol. Origin of inorganic and organic components of PM_{2.5} in subway stations of Barcelona, Spain. *Environ. Pollut.*, 208 (January 2016), pp. 125–136 (IF. 4.373)
 - V. Martins. Subway stations with platform sliding doors and good ventilation reduce passengers’ exposure to PM_{2.5}. : "Science for Environment Policy": European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol. 17 March 2016, Issue 451
- The following manuscript is in press:
 - V. Martins, T. Moreno, L. Mendes, K. Eleftheriadis, E. Diapouli, C. Alves, M. Duarte, E. de Miguel, M. Capdevila, X. Querol, MC Minguillón. Factors controlling air quality in different European subway systems. *Environmental Research*
- **Action E1** “Project Management and Audit”. The next report to be delivered is the Midterm report that will be submitted by December 2016.
- **Action E2** “Monitoring of the project progress according to indicators defined by the managing team”. Three-month summary reviews, as the present one, are being prepared since the beginning of the project and published in the web page. Regular meetings every month of all partners to discuss developments, problems and progress of the project have been hold (more frequently than initially programmed), including:
 - ✓ Discussion on final structure of the sampling calendar for 2016. 14 January 2016. TMB offices. CSIC: Teresa Moreno, Cristina Reche; TMB: Eladio de Miguel, Sonia Centelles.
 - ✓ Selection of station to measure in L5. 26 January 2016. Visit to Cornellà station. CSIC: Teresa Moreno; TMB: Ferran Gracia, Josep Sousa.
 - ✓ Selection of location in Tarragona station to install air purifiers in subway platforms. 23 March 2016. CSIC: T. Moreno; TMB: E. de Miguel; GINSA: J. Cusí, J. M. Felisi.
 - ✓ Discussion on activities carried out in Joanic tunnel during the measurements done in December 2015. 23 March 2016. TMB offices. CSIC: Teresa Moreno, Cristina Reche; TMB: Eladio de Miguel, Sonia Centelles, Pascual Cano.
- **Action E3** “Networking with other European projects (including LIFE+)”. A list of related projects is continuously updated in the project web page.



2. LIST OF THE PROJECT'S OUTCOMES DURING THE PERIOD

ACTION	DATE	TITLE
2.1. IMPROVE LIFE publications		
D3	01/2016	V. Martins, T. Moreno, M.C. Minguillón, B.L. van Drooge, F. Amato, E. de Miguel, M. Capdevila, S. Centelles, X. Querol. Origin of inorganic and organic components of PM2.5 in subway stations of Barcelona, Spain. Environ. Pollut., 208 (January 2016), pp. 125–136 (IF. 4.373)
2.2. IMPROVE LIFE reports		
B1&B2	31/03/2016	Third summary report on the <i>Sampling campaigns: Progress and results so far</i>
E2	31/03/2016	Summary review
2.3. IMPROVE LIFE other dissemination materials		
D1	31/03/2016	Project website (updated)
D3	31/03/2016	Articles general/trade press



3. DISSEMINATION ACTIVITIES

ACTION	DATE	TITLE
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3.1. IMPROVE LIFE events

3.2. IMPROVE LIFE presentations in other events

D3	01/2016	An update on the IMPROVE results was presented by T. Moreno to the managers of all the different subway lines in TMB (25 January, TMB Zona Franca office).
D3	03/2016	An update on the IMPROVE results was presented by T. Moreno to the Committee of Work Security (9 March, Santa Eulalia TMB office).

3.3. IMPROVE LIFE networking with other projects



4. DELIVERABLES AND MILESTONES CHECK-UP (31/03/2016)

(Shown in green those already completed, and in yellow those in progress)

START	ACTIVITIES FOLLOW-UP	OUTCOMES available on-line at:	DEADLINE
A. PREPARATORY ACTIONS			
A1 Documentation of current status and selection of critical parameters to be tested			31-march-15
1-oct-14	Construction of 1 historical database of studies examining the methods used to identify and resolve the contribution of aerosol emission sources and their major results	Deliverable 2 Historical source contribution	31-jan-15
	Elaboration of 1 list of the main parameters identified to be considered in all studies	Deliverable 4 Parameters to test	31-march-15
	Prioritisation of air pollution sources in subway systems	Milestone D Main Air Pollution sources	31-jan-15
B. IMPLEMENTATION ACTIONS			
B1 Determination of the impact of selected parameters			30-jun-16
1-jan-15	Organisation and coordination of a campaign program	Campaigns calendar	15-dic-14
	Presentation of Technical reports on the advance of:	Report 1 Campaigns	30-apr-15
	- sampling campaigns		
	works		
	air conditioning in trains (series 2 & 3K)	Report 2 Campaigns	31-oct-15
	ventilation		
	air conditioning (series 5K)		
	rail change		
	brake pads		
	ventilation	Report 3 Campaigns	31-mar-16
	graphite pantograph		
	- chemical analysis		
	inorganic	Milestone G Impact of main air pollution source	31-dic-15
	PAH in PM filters		
	NO2 samples		
	- results of the chemical analyses	Milestone H Main pollution tracers	31-dic-15
	- statistical analysis,		
	- results of source apportionment		
	Determination of the impact of main air pollution sources	Database 2 Chemical tracers concentration	31-mar-16
	Identification of the main pollutant tracers	Milestone K Characterisation emission sources	30-jun-16
	Construction of 1 database with concentrations of chemical tracers for pollutant sources in subway systems and the impact of each of them on air quality	Deliverable 8 Report sources contribution	30-jun-16
	Characterisation of the emission sources		
	Report on the overviewing and comparing the full impacts on air quality of each of the selected parameters		

START	ACTIVITIES FOLLOW-UP	OUTCOMES available on-line at:	DEADLINE
B2. Testing mitigation measures and Development of mitigation strategies			30-sep-16
1-abr-15	Organisation and coordination of a campaign program	Campaigns calendar	1-dic-14
	Presentation of Technical reports on the advance of:	Report 1 Campaigns	30-apr-15
	- testing mitigation measures and estimated benefit in metro ambient air quality		
	ballast with water	Report 2 Campaigns	31-oct-15
	air conditioning in trains (series 2 & 3K)		
	ballast with dust suppressant		
	ventilation		
	air conditioning (series 5K)	Report 3 Campaigns	31-mar-16
	brake pads		
	ventilation		
	graphite pantograph		
	Proposal of measures for air pollution emission reduction	Milestone I Propose mitigation measures	31-may-16
	Testing of mitigation measures for emission sources	Milestone J Test mitigation measures	31-may-16
	Evaluation of mitigation measures	Milestone L Evaluate mitigation measures	30-sep-16
	Report on the results of mitigation measures in subway systems	Deliverable 9 Report Mitigation measures	30-sep-16
	Preparation of 1Technical Guidance documentation, identifying and comparing effective strategies for reducing the impact of each selected emission source.	Deliverable 10 Technical guide mitigation measures	30-sep-16
C. MONITORING ACTIONS			
C1 Effectiveness of the project actions.			31-mar-18
1-abr-15	Definition of (Management Team) a list of parameters/ indicators to assess the impact of the project including:	List 2 Impact indicators	31-dic-16
	- initial situation regarding PM levels and sources (Action A1)		
	- identification of air pollution sources during the campaigns (Action B1)	Commitment of members	30-jun-15
	- contribution of each of the emission sources identified		
	Nomination of an external committee to evaluate the progress of the project after 2 years		
	Elaboration of 1 Quality plan for the political effectiveness of the project	Deliverable 12 Report policy effectiveness	31-dic-17
	Monitor of the impact of the project	Milestone P Monitor the impact of the project	31-mar-18

START	ACTIVITIES FOLLOW-UP	OUTCOMES available on-line at:	DEADLINE
C2 Assessment of the socio-economic impact of the project.			31-mar-18
1-jul-16	Monitor of the awareness of the problem (annually <i>not every 6 months</i>) with a questionnaire to public:	Deliverable 11 Questionnaires for public	31-dic-17
	- Number of people participating.		
	Incentive other metro systems, or local authorities to apply measures proposed by IMPROVE	List 3 Replicated measures	31-mar-18
	Assessment of the socio-economic effect	Milestone M Assess Socio-economic effect	31-dic-17
	Report on the socio-economic impact of the project	Deliverable 18 Report Socio-economic Impact	31-mar-18
D. COMMUNICATION AND DISSEMINATION ACTIONS			
D1 A Project website.			31-mar-18
1-oct-14	Design and maintenance of the project website	Deliverable 1 Project website	31-dic-14
	Monitor of the number of visitors.	6 Summary reviews	31-mar-18
D2 LIFE+ Information boards.			31-mar-18
1-oct-14	Preparation and placing of 10-15 information boards	Deliverable 3 Information boards	31-jan-15
	Maintenance of boards in the metro facilities	13 Summary reviews	31-mar-18
D3 Dissemination of project results			31-mar-18
1-oct-14	Design and elaboration of 300 leaflets.	Deliverable 7 Informative leaflets	30-jun-16
	Publication of articles (4-6) in local/national press (quantification of their readership), during actions B1 & B2 and at beginning/end of project	Deliverable 15 Articles in general/trade press	31-mar-18
	Submission of 6 technical papers/presentations in international journals/conferences	Deliverable 13 Publications journals/conferences	31-mar-18
	Organisation of 1 open-forum Stakeholders (around 80 people) private and public sector	Milestone E Organize open-forum	30-jun-15
	Publication of the forum's outcomes on the project's web site.	Deliverable 5 Minutes of the open Forum	30-sep-15
	Organisation of 1 international conference (200 people) with researchers, governmental institutions, public transport assoc. and public.	Deliverable 17 Proceedings of the conference	31-mar-18
D4 Production of Layman's Report.			31-mar-18
1-jul-16	Production and dissemination of 2.000 copies to the stakeholders	Deliverable 16 Layman's Report	31-mar-18



START	ACTIVITIES FOLLOW-UP	OUTCOMES available on-line at:	DEADLINE
E. MANAGEMENT ACTIONS			
E1 Project Management and Audit.			31-mar-18
1-oct-14	Nomination of the Project Management Team	Milestone A Project management team	31-oct-14
	Elaboration of the Quality assurance plan	Milestone C Quality assurance plan	30-nov-14
	Submission of the Inception Report	Inception Report	30-jun-15
	Submission of the Mid-term Report	Mid-term Report	31-dic-16
	Submission of the Final Report	Final Report	30-jun-18
E2 Monitoring of the project progress.			31-mar-18
1-oct-14	Revision the progress of the project, according to its indicators.	Milestone B Indicators of Progress	30-nov-14
	Meeting between partners	Deliverable 19 Summary reviews	31-mar-18
	Implementation of corrective recommendations after each meeting if necessary		
E3 Networking with other European projects (including LIFE+).			31-mar-18
1-oct-14	Organisation of 1 expert group workshop	Deliverable 6 Minutes of the expert's workshop	30-sep-15
	Organisation of 1 workshop with other European projects	Milestone F Workshop with LIFE+ projects	30-jun-17
	Participation in other LIFE+ project's meetings	Presentations of IMPROVE	31-mar-18
E4 After-LIFE+ Communication Plan.			31-mar-18
1-jul-16	Preparation of the After-Life communication plan	Deliverable 14 After-Life communication plan	31-mar-18