



LIFE 08 ENV/F/000487

Midterm Report
Covering the project activities from **01/01/2010** to **31/12/2012**

Reporting Date
31/03/2013

LIFE+ PROJECT PHOTOPAQ
**Demonstration of Photocatalytic Remediation Processes
on Air Quality**

Data Project

Project location	Lyon - France
Project start date:	01/01/2010
Project end date:	31/12/2013 (Extension date proposed: 30/06/2014 see modification request)31/12/2013 Extension date: 30/06/2014
Total budget	4 018 190 €
EC contribution:	1 984 573 €
(%) of eligible costs	49.88

Data Beneficiary

Name Beneficiary	CNRS
Contact person	Dr Christian GEORGE
Postal address	IRCELYON Institut de Recherches sur la Catalyse et l'Environnement de Lyon 2, avenue Albert Einstein, F-69629 Villeurbanne Cedex
Telephone	(33) (0)4 72 43 14 89
Fax:	(33) (0)4 72 44 84 38
E-mail	Christian.George@ircelyon.univ-lyon1.fr
Project Website	http://photopaq.ircelyon.univ-lyon1.fr/

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List of abbreviations

CA	Consortium agreement
NO	Nitrogen monoxide
NO ₂	Nitrogen dioxide
HONO	Nitrous acid
HNO ₃	Nitric acid
O ₃	Ozone
VOC	Volatile Organic Compound
HCHO	Formaldehyde
PM10,	Particulate matter with particles diameters measuring 10µm or less
PM2.5	Particulate matter with particles diameters measuring 2.5µm or less
CO ₂	Carbon dioxide
NO _y	Nitrogen oxides
THC	Total hydrocarbons
TiO ₂	Titanium dioxide
NO _x	Nitrogen Oxides
MoT	Monitoring Team
PI	Principal Investigator

2. Executive summary

In this project, the aim is to demonstrate the usefulness of photocatalytic materials for air pollution reduction in the urban environment. Hereby, levels of air quality that do not give rise to significant negative impacts should be reached, a concept whose aim is to progress beyond the emission reductions and their technical limitations of the currently available standard techniques. In the very recent years, photocatalytic self-cleaning and “de-polluting” materials have been suggested as a remediation technology mainly for NO_x and aromatic VOCs in the polluted urban environment. The associated technologies have been launched on the European market with the aim to have a positive impact on urban air quality and the corresponding effects of the health of the urban population. These commercial products are based on the photo-catalytic properties of a thin layer of TiO₂ deposited at the surface of the material (such as glass, pavement ...) or contained in bulk in paints or coating mortar. The use of TiO₂ photocatalysts as an emerging air pollution reduction technology has been reported in many European areas. However, it seems that both the effectiveness and the real impact on air quality of these relatively new technologies up to now have been demonstrated only in a very limited manner in real scale applications before going into the European market. Assessing and demonstrating the effectiveness of these depolluting techniques have a real EU added value both in terms of policy making (and implementing the EU air quality strategy) and economics (by providing a demonstration of the actual performance of a new technique).

This report states the current progress of the project and comes along with three main requests:

- **a six months no-cost extension;**
- **a modification in the budget cost categories;**
- **a modification of the partners' budget.**

The budget modification and extension request will be send by mid-April 2013.

3. General progress.

3.1 Summary of the general progress

The project's official starting date is January, 1st 2010. The project has been launched by the Kick of Meeting in Lyon on the 13 and 14th January 2010. This project aims at evaluating the feasibility of using TiO₂ based products to alleviate the air pollution under real atmospheric conditions. Most of the actions have started earlier than initially scheduled to match the currently active discussions.

On **December 31st 2012**, the actions implemented by the consortium are:

Preparatory actions:

- Investigate the influence of photocatalytic surface films on atmospheric relevant reactions by flow tube experiments (species investigated NO, NO₂, HONO, HNO₃, VOC, tracers): **all the objectives are fulfilled, the tracer studies for coating mortar are still ongoing**, here particulate tracers compounds for photocatalytic reactions in the gas phase under atmospheric conditions have to be identified in the laboratory and in the field measurements, identify the low volatile photocatalytic reaction products in the aqueous runoff of coated model surfaces (new runoff reactor constructed and measurements done), screening of photoactive materials used in the field site (CTG's old, new samples **and boosted sample**, Brussels tunnel samples analyzed): **all the objectives are filled, the analysis of the boosted sample are ongoing**.

- Provide the protocols and techniques for the evaluation of photocatalytic materials (pollutants investigated NO, NO₂, O₃, HONO, VOCs, e.g. toluene, propene, pyrrole), identify the impact of the selected materials on the loss of air pollutants (pollutants investigated NO, NO₂, O₃, HONO, VOCs, e.g. toluene), identify and characterize the gas tracers and particles. *All the objectives for P2 actions are fulfilled, some additional test on the “boosted sample” need to be conducted.*
- Provide a general protocol for the field studies by the definition of the field requirements for I1 and I2, by the definition of the parameters to be measured (gaseous species : ozone, NO, NO₂, nitrous acid, major hydrocarbons and oxygenated volatile organic compounds , PM₁₀, PM_{2.5}, aerosol’s organic fraction, nitrate fraction of the fine aerosol, sulphate fraction of the fine aerosol and irradiation light spectrum), by the definition of the spatial and temporal distribution of the measurement (2 weather stations have been implemented for I2 : wind speed and direction, temperature, relative humidity, rainfall), and by the definition of the parameters to be transferred to P4 actions. *The objectives related to P3/I2 action are achieved. Similar actions for the preparation of the outdoor campaign (I1) will be conducted.*
- All instruments which were used in the preparatory actions (P1, P2) and in the tunnel campaign (I2) were defined and carefully checked for the analytical performance by the different groups. In addition, most instruments were intercompared in the first tunnel campaign. There was a successful intercomparison for NO, NO₂, HONO and CO₂ (accuracy better 10 %, precision better 2 %), while instruments for HCHO, carbonyls, particle number, particle mass, particle composition) showed higher deviations. These instruments were again carefully checked and problems identified, which will be solved in the next implementation actions. In addition, the CO instruments failed during the first tunnel campaign and are now replaced by other instruments. *The objectives related to P4/I2 action are achieved. Similar actions for the preparation of the outdoor campaign (I1) will be conducted.*

Implementation actions:

- As stated and agreed by the commission, the first campaign has been shifted toward the end of PhotoPAQ. *Nevertheless, the site selection process is finalized; an industrial site owned by Italcementi Group in Petosino, near Bergamo shall host the next implementation site, “outdoor campaign”. An active canyon street and a parallel non-active reference site will be built during first months of 2013. The latter is scheduled from April 9th to May 10th 2013.*
- The implementation action “indoor campaign” (I2) has been conducted in September 2011 in Brussels. The Leopold II tunnel was taken as field site. The protocol to carry out the monitoring campaign has been implemented, the realization of the field trial has been done (application of photocatalytic materials, installation of the lighting system...) and the data collection during the pre and main campaign has been conducted.

Caused by too small artificial UV-light intensity and a too short tunnel section prepared, the photocatalytic reduction of major pollutants was below the precision errors of the used instruments of ca. 2 %, In addition, surface passivation of the used photocatalytic coating mortar was identified under the tunnel conditions. The collected data have shown that the commercial product is rapidly passivated, due to the high pollution in the tunnel and the high roughness of the coating surface, leading to no measurable depolluting action. Based on these negative results, a second campaign was performed in January 2013, where a two times longer tunnel section is prepared with higher activity photocatalytic material and a more intense light irradiation system. Laboratory results indicate that surface passivation is a minor problem under the new

planned conditions in the tunnel. Using the knowledge gained in the P actions, it was possible to suggest a formulation to the products which will be tested in a second phase of I2 in January 2013. In order to optimize all parameters for the second phase of I2 it has been decided to increase the length of the test section and to intensify the lighting as well as to use a product which can be activated more intensely.

- A preliminary assessment of the current state of the air quality and the geometry of the field site has been done in order to optimize the measuring campaign. First a review of the air quality of the greater area surrounding the tunnel field testing site was conducted, detailed drawings and blueprints from the Leopold II road tunnel were provided, detailed data for the direct road traffic emissions inside the road tunnel, schematics for the tunnel's ventilation system,...were put at disposal to assess the depolluting effectiveness and evaluate the numerical modelling results.

Dissemination actions:

- The web site has been implemented in April 2010 and monthly updates are done. Moreover, the PhotoPAQ consortium publishes a newsletter twice a year, subscriptions are done online.
- A press conference has been organized to launch the field campaign in Brussels on September the 8th, 2011 (the press releases are available on the website).
- PhotoPAQ participated to the JEP as sponsor in September 2011. A short documentary of the field campaign in Brussels has been produced and broadcast.
- 200 brochures have been distributed and 5 posters has been realized and used for all events.
- PhotoPAQ Symposium has been organized in May 2012: Photocatalysis: Science and Application for Urban Air Quality the LIFE+ PhotoPAQ conference 2012. All information about the programme and all lectures are available on the PhotoPAQ website.
- Several TV documentaries have been made on PhotoPAQ.

All these points are subject to a precise description in the technical part of this report.

3.2 Assessment as to whether the project objectives and work plan are still viable.

This project aims at evaluating the feasibility of using TiO₂ based products to alleviate the air pollution problem under real atmospheric conditions.

It advertised following main objectives:

- developing the testing methodology for photocatalytic removal/production of NO_x, HONO, large number of VOCs and particles, with all tests being performed under atmospherically relevant conditions.
- testing the photocatalytic activities of the commercially available TiO₂ based products in order to examine the pollutant removal effectiveness, (assessing if these depolluting surfaces are sinks or sources of pollutants)
- designing better environmental indicators and methods to assess the impact of this new technology in European cities,
- providing recommendation to the European authorities on the practical application for air treatment, (including a numerical "demonstration tool" for the depolluting action).

All these objectives are still viable. At the time of writing, no risk of major failure has been identified for the rest of the project. The main difficulties encountered so far were found in organising the outdoor campaign – but this has been fixed as I1 will take place in April-

May 2013. The phase 1 of I2 showed that commercial products were not suited for the heavy pollution found in tunnel, but using the knowledge gained in the P actions a new product formulation has been suggested and will be tested in phase 2 of I2 in January 2013. We first underline that the structure of PhotoPAQ allowed overcoming these difficulties without endangering the project. However, some delays were introduced in the workplan. While all experimental/implementation actions will be done by mid May 2013, **we still request a six months extension of the project without an increment of the budget, in order to allow fully treating the data, providing all deliverables and performing high level dissemination actions. The budget modification and extension request will be send by mid-April 2013.**

The following states current status and viability (including changes) in the original work plan and action design.

Preparatory actions:

The interplay between the P and I actions is a strong backbone of the structure of PhotoPAQ and it allowed to overcome the major difficulties found in the low activity of the commercial product tested. While most of the P actions are now well advanced we do want to keep them active up to the end of 2013.

P1 should still address (i) tracers and organics degradation and (ii) operate the newly designed runoff reactor and (iii) to study the new boosted material used in the second tunnel campaign. These laboratory results will be very valuable for the interpretation of the tunnel and field campaign (I1 and I2) results. The P1 actions already permitted to investigate species: NO, NO₂, HONO, some VOCs but some complementary research is still necessary to do: HNO₃, oxygenated VOC. In addition the development of the tracer method for the implementation actions (I1 & I2) is still under investigation. Moreover, in order to identify the low volatile photocatalytic reaction products in the aqueous runoff of coated model surfaces, new measurements need to be done with the new runoff reactor constructed. The laboratory experiments are relevant to be maintained up to 31/12/13 but with no budget impact. The extension of the P1 action will enhance the results quality. P1 and P2 should have limited activities up to the end of 2013. P3 and P4 are deeply associated to implementation actions which are going to be very important in 2013 (phase 2 in the tunnel in I2 and outdoor campaign of I1).

During the implementation action (I2), it has been shown that all the preparatory actions are clearly deeply linked with the field actions. The possibility for the PhotoPAQ team to go back to the laboratory tests during the both implementation campaign is essential to achieve satisfactory results even above the initial targets and to obtain relevant objectives. The extension of the period for the preparatory actions won't involved any delay in the implementation actions or all others actions of the project as the main labs actions to conduct the field campaign has been done. It is now more efficient to continue together preparatory and implementation if requested.

- The results obtained for the P2 actions in all facilities showed a decrease of NO_x in the presence of the photoactive surfaces, which may indicate an effect of TiO₂ on the atmosphere containing this pollutant. The planned tests were all conducted; however, more tests are requested depending on the reformulation of the materials that is used in the implementation actions I1 and I2. **Therefore, P2 should be extended up to the 31st December 2013, with no extra cost and no objectives changes.**
- The experience gained so far has shown that adjustments of the field strategy have to be carried out until the very last days before the campaign to take advantages from local opportunities. **Considering that the agenda for field actions has been extended, an**

extension of P3 action until 31/12/2013 is required, with no extra cost and no objectives changes.

- All instruments to be used in action I1 in Bergamo will be defined, a continuous quality check of the instruments used in P1, P2, I1, I2 will be done. The finalization of the intercomparison data from the first I2 tunnel campaign for HCHO, carbonlys, particle number, particle mass, particle composition will be made. The intercomparison for CO and VOCs will be repeated in the next I2 tunnel campaign, in addition to the intercomparison of the other instruments. All instruments used in the I1 action in Bergamo will be intercompared again at the I1 field site. The results will be published on workshops, conferences and in international journals. **Therefore, P4 should be extended up to the 31/12/2013, with no extra costs and no objectives changes.**

Implementation actions:

Action I1 is now planned and its core activities will take place at Bergamo during April/May 2013. Of course, this intensive observation period will be associated with the campaign preparation period (before) and data treatment period (after). The action is planned to ending the 30th June 2014.

The partners CTG would reallocate ca; 40K€ from its “equipment” budget category and 20K€ from “personnel cost budget category to I1/prototype budget category. Thus 60K€ will be reallocated to the prototype budget category/ I1 within the CTG budget in order to achieve the I1 objectives. The foreseen cost for the prototype for the I1 action is estimated to 85K€, with 2 streets canyon. Moreover CTG accepted to cover accommodation costs during the Outdoor campaign.

Action I2: A second measuring campaign has been carried out in the tunnel at Brussels in January 2013 in order to overcome the difficulties met during the first measuring campaign. In this second campaign, the test site will be enlarged and the light intensity increased and more efficient product used. This second phase has been delayed slightly due to stricter safety rules imposed by the Brussels’ authorities. These stricter rules found their origin in the larger light intensity used. I2 was therefore redesigned to avoid any impact on the driver’s safety and driving conditions, implying some reviews of our plans by external experts mandated by the local authorities. At the time of writing, this second campaign was performed. Prior to the measuring campaign a test has been performed to see the activation capacity of the new product under the planned conditions of the tunnel.

During the Thessaloniki management meeting, we agreed that the budget available for the phase 2 of I2 was ca. 80 K€, based on the costs of the first campaign. However, the power and the number of the lamps for the 2nd campaign has been reviewed and increased to match our scientific constraints and the cost estimated is now 60 K€ (instead of 18K€ in the previous campaign), increasing the corresponding expenditure. A transition zone after the test section has been imposed by the Brussels’ authorities in order to avoid any impact on the driving conditions within the tunnel. This transition allows a smooth transition in the lightning conditions in the tunnel.

In order to finance the second campaign, we will request an amendment on this budget category: the partners BUW, IFT, Lisa, ICARE and IRCELYON accepted to reallocate ca; 20 K€ from their consumable or other cost budget category to I2/prototype budget category. **Thus 100K€ will be reallocated to the prototype budget category/ I2.** The financial statement described in the part 6 includes the global cost of the first campaign but also the skim coat and the prototype of the new lighting design for the second campaign. Thus the balance of the prototype budget category will be used for the payment of the implementation of the indoor campaign (I2: 100 K€).

This decision taken during the last management meeting (Bergamo: 7th -9th November 2012) has contractual implications and the Consortium decided to implement those by all adapted means, including the transfer of a part of the budget to the budget category prototype. Thus a budget amendment to the contract is required and hereby requested.

Thanks to the budget modification requested (increment the prototype budget category for the 2 implementation actions); PhotoPAQ project will be able to reach its objectives in satisfactory manner:

- The second indoor campaign gives the opportunity to fill all our scientific requirements and analysis. The cost of the both indoor campaign (first in September 2011 and the second in January 2013) is evaluated to 270 €, 170K€ has been reported in PhotoPAQ financial statement. And 100 K€ are still pending.
- The implementation (or prototyping) of the outdoor campaign with all necessary requirements is estimated to 85 K€; the quotation is available upon request. The consortium PhotoPaq decided to conduct the outdoor campaign with the implementation of 2 streets canyon instead of one planned in order to guarantee the scientific requirements. The prototype budget available for the outdoor campaign (I1) is 85 K€, which is the budget required for the implementation with the 2 streets canyon (optimum design).

The reallocation of the use of the prototype budget category per actions won't change the objectives of the I1 and I2 actions.

In section 4.3 of the report, relevant parameters to achieve these objectives are measured which to evaluate progress in achieving each objective listed.

In the section 6, more details on the foreseen expenses are listed.

3.3 Problems encountered.

The actions planned are confirmed and were implemented. However some problems in the preparatory actions and implementation actions which do not alter the overall project have been met.

Preparatory actions:

P1 and P2: First samples (delivered as coated glass plates, labeled here as 'old samples') arrived in the laboratories 9 months after the project (due to the time needed for the development of an active coating dedicated to the specific application in a tunnel and to the complex preparation of samples) start and were successfully tested. In addition, caused by problems with the mechanical stability of the first P1 sample, raw material for own sample preparation was provided to the laboratory partners by CTG only in July 2011, which introduced another 6 month delay. However, during the I2 preparation phase, it appeared that partner CTG delivered different samples to be used in the tunnel in May 2011 (addressed as 'new samples'). After the Brussels tunnel campaign, these new samples either prepared during the tunnel application or with the raw material were tested in the P1-2 actions. The results revealed that more experimental studies are needed to ensure the quality of the tests done and therefore, the action P1 should be indeed extended. In addition, caused by the deactivation problems of the 'new samples' under the tunnel conditions of action I2, a new photocatalytical material will be used in the second tunnel campaign (addressed as 'boosted samples').

For the implementation of the second tunnel campaign, some constraints were overcome:

- validity, stability and resistance to passivation of the ‘boosted’ samples provided by CTG at 8 W/m² irradiance
- estimation of the photocatalytic remediation for the tunnel campaign based on the P1 results (max. 4% for the extended tunnel section and 5 W/m² irradiance)
- re-activation conditions identified from the laboratory to be transferred to the final experimental tunnel conditions (measured irradiance, pollution level during the second tunnel campaign)
- lower activity against VOC (due to the slower degradation rate)
- since VOCs are not efficiently removed on the used coating mortar samples, the development of the tracer method also still needs more laboratory studies.

Due to the initial problem with sample delivery and then with the need to reformulate them in order to enhance their resistance to passivation in the tunnel (due the high level of pollution) an extension of the P1-P2 actions was requested already in the last report.

P4: The intercomparison for HCHO, other oxygenated VOCs and particles was not successful caused by experimental problems of some instruments, which were recently identified and which will be solved in the next tunnel campaign. In addition, the CO and THC were not working in the first tunnel campaign and will be replaced by other. The intercomparison exercise will be repeated in the next tunnel campaign.

Implementation actions:

I1: The main difficulty in identifying the outdoor site was associated with the need to find a real urban place where a large surface could be treated with the active material and especially covering the facades. Several proposals were received from some European Municipalities (Madrid, Metz, and Strasbourg) for the renovation of the pavement with photocatalytic cement-based materials, without the possibility to coat the facades of surrounding buildings. Anticipating those difficulties, we put forward this task. At the end, after two first hypothesis of an industrial site in France (near the Gargenville cement plant) and an urban site in Italy (Bergamo), as the owners did not agree to have this done, a suitable industrial site near Bergamo has been found where an artificial street canyon (at the 1:1 scale) will be set-up on one factory site by Italcementi Group in Bergamo. This will give us the opportunity to also cover the walls of the canyon and to have a parallel reference site with similar geometry to consider also the variable atmospheric condition. This solution was also chosen with respect to the remaining budget to be used for the preparation of the site, for the monitoring campaign previewed. Now the I1 plan is settled and will be active in 2013, with some delay to the initial plan.

I2: During the implementation of the “indoor or tunnel campaign”, some difficulties came up: the tunnel section was not coated entirely, but only about 70m of the planned 90m, no ‘burn-free’ period was foreseen for the photocatalytic material: due to the tight schedule of placement of the material and the lighting, the material could not be activated by the UV-light prior to the measuring campaign, misaligned lamps at the beginning of the main campaign, change of lamps placement, light intensity was lower than expected, and finally one CO₂-sensor, THC-sensors (both) and CO (one) failed, the large volume of air to be treated as to the number of square meters of active surface. Thus, a second measuring campaign has been carried out in January 2013 in order to overcome these difficulties and met the objectives of the project and its deliverables: evaluate the improvement in the efficiency of coating applied, by increasing the length of coated surface (up to about 160 meters) and the UV irradiation level, aiming at verifying the efficiency in occasion of the new campaign. The implementation of the

second campaign (the tunnel of Brussels) has been delayed by 6 months in order to obtain the approval of the Brussels Region. Indeed, the technical requirements for optimizing scientific experience (empowered UV lamps installed in the tunnel) were subjected to an evaluation by the Ministry for Mobility and Transport of the city of Brussels in order to ensure the safety of motorists. The implementation of the 2nd campaign has been conducted in January 2013. However the implementation requires a financial effort of all partners and a shift of budgets from different cost categories and actions to specifically cover the new need of I2. These resources are available in the budgets of partners (in the budget category consumables and other costs), and we would transfer the responsibility to PI of I2. The extra cost will be cover by the PhotoPAQ budget. The results on this 2nd tunnel campaign will be available by mid 2013 (with 12 months delay). The delay on the dissemination on the results won't have any impact on the implementation on the outdoor campaign", the preparatory phases for the indoor campaign have been conducted and the know-how is present.

I3: One of the difficulties in the implementation of I3 was: gathering a complete set of data for the review of the air quality from urban background stations. The local hosts however, managed to gather the data required through their local contacts. The delay in the selection of the outdoor field trial site results in a delay in the submissions of deliverables vii and viii. However, as a solution it was suggested to submit initial versions for these deliverables containing information only on the Leopold II trial and submit the final versions upon completion of the outdoor experiment in Bergamo, Italy. A delay in the initial version of deliverable viii was also observed due to the fact that the 1st phase of the Leopold II trial was also delayed. The data measured during the campaign were used as input boundary conditions for the 3rd set of numerical simulation that are currently under way and scheduled to finish by the end of April 2012, when the deliverable is expected to be submitted.

4. Administrative part

4.1. Description of project management

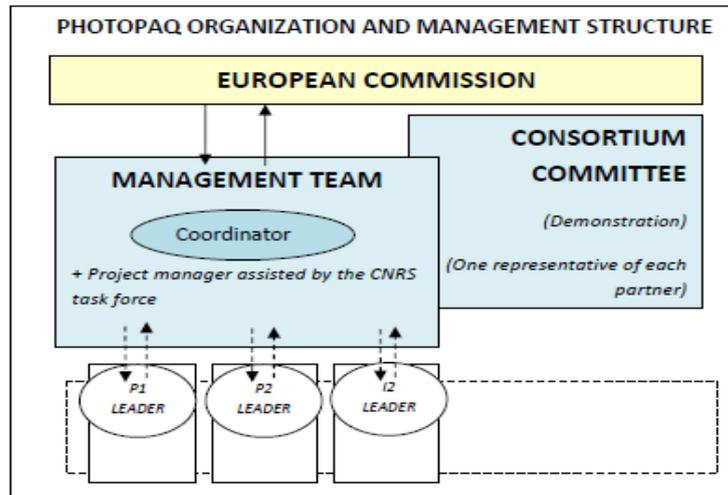
The coordination is lead by the partner 1a, the CNRS-IRCELYON. In the initial proposition, the management was organized around 3 main structures:

- (i) a **Consortium Committee**, which is empowered to make high-level decisions on every aspect of the project together with the crucial duty of ensuring the integration of the various activities across PhotoPAQ.
- (ii) the **Research Activity Leaders** in charge of the technical management.
- (iii) **Management Team** dealing with the day-to-day management.

A consortium Agreement, signed the 27th September 2010 describes in details the organizational structure and the rights and duties of the operational bodies responsible for the decision-making. This agreement can be found in Appendix N°3

During the implementation of the PhotoPAQ project, we realized that it was more appropriate to merge the consortium committee meetings with the management team meetings. Indeed, the action leaders are also the representative partners for the consortium meeting and both meetings have been scheduled in the same period.

Thus, the PhotoPAQ consortium has held a series of meetings since January 2010, with its various structures, guaranteeing the implementation of all actions at European level. The respective roles of the various structures involved in the project organization are summarized below:



a. Consortium Committee

The **Consortium Committee** is the decision-making body of the Consortium. It is composed of one representative from each partner organization, together with associated partners, and chaired by the Project Coordinator. Its role is to make high-level decisions concerning every aspect of the PhotoPAQ network life: technical, financial, schedule, partnership, dissemination and exploitation.

The Consortium Committee met and will continue to meet on yearly basis, and specifically, annual review meetings and a final review meeting will be held. Extraordinary meetings could be called for, should the need arise.

Date of the meeting: KoM the 13th and 14th January 2010 in Lyon, the 31st January and 1st February 2011 in Brussels, the 24th-26th January 2012 in Thessaloniki, [the 16th May 2012 in Corsica](#) and [the 7th-9th November 2012 in Bergamo](#).

Minutes of these meetings can be found in [Appendix N°1](#).

b. Management Team

The technical and demonstration aspects of the project are the responsibility of the management team, chaired by the coordinator, who is finally sharing the overall scientific managerial responsibility of the project. The management team is the link between the consortium and the responsible scientific officer and administrative services at the EC and shall perform all tasks assigned. This management group (constituted by the coordinator and the action leaders) meet on six months basis in order to ensure an on-going flow of information and data between partners.

Date of the meeting : KoM the 13th and 14th January 2010, the first management meeting on the 15th and 16th July 2010, the second management meeting on the 31st January and 1st February 2011, the third management meeting on the 4th July 2011, the fourth management meeting on the 24th -26th January 2012, [the 16th May 2012](#) and [the fifth management meeting on the 7th-9th November 2012](#).

Minutes of these meetings can be found in [Appendix N°1](#)

c. Research Activity Leaders

The Action leaders coordinate the actions in all work-packages; inform the coordinator of the progress project status, results obtained and problems encountered, work scheduled, decision and questions and to implement decision.

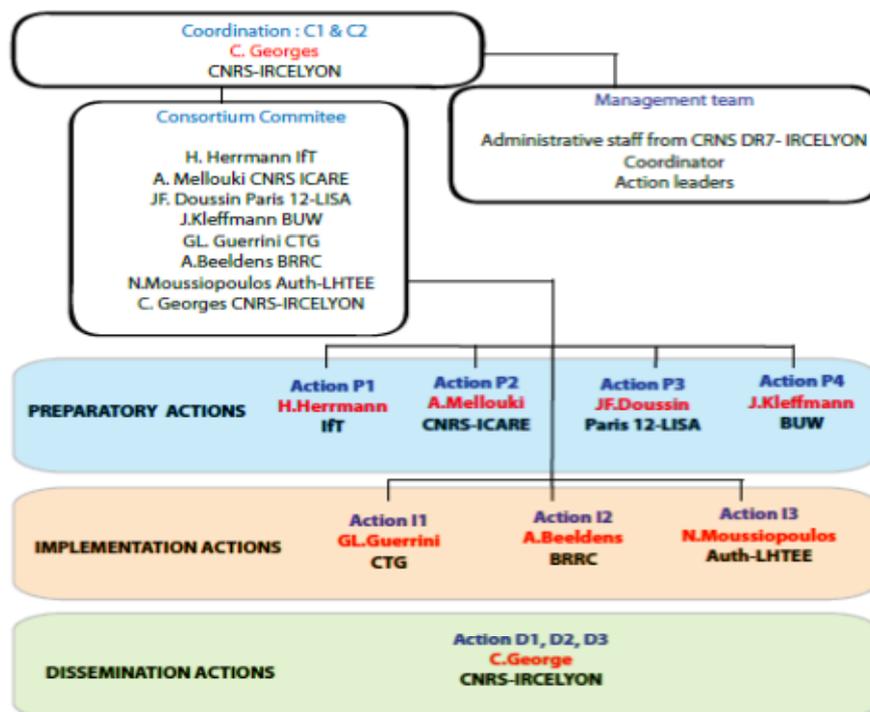
The Actions Leaders are listed in the organisational chart below.

d. Project Coordinator

The project coordinator *Dr. Christian GEORGE* is managing the project. The coordinator's main tasks are the monitoring compliance by the parties with their obligations, the collecting, reviewing and submitting information on the progress of the project and the preparation of the after-Life+ dissemination plan, the preparation of the meetings, proposing decisions and preparing the agenda of General assembly meetings, chairing the meetings, preparing the minutes and monitoring the implementation of the decisions, the transmission of documents and information connected with the project and the administration of the community financial contributions. The project coordinator is assisted by a project manager who is part-time dedicated to the management of the project and is responsible for monitoring the day to day and overall progress of the project. The Project manager, *Mrs Audrey PHILIPPE-SABOUL* has been hired the 1st February 2011 with part-time contract at 70% for the first four months and with a part-time contract at 50%. The Job description can be found in Appendix N°2. The description of the management and coordination actions of the consortium, the project coordinator and the management team will be described in the technical part under the results of the action named C1 and C2.

4.2. Organization chart of the project

The coordination is lead by partner 1a i.e., the CNRS-IRCELYON. However each action is lead by the PIs listed below:



5. Technical part

5.1. Actions.

5.1.1. Action C1 – Successful implementation of the 10 actions by the 7 beneficiaries

Beneficiary responsible for implementation: CNRS-IRCELYON

Contributors: CNRS-IRCELYON

Main Objective: the successful implementation of the 10 actions by the 7 beneficiaries

Indicators: monitoring of the effectiveness of the actions

Expected results:

1 /-Effective and constant workflows & Dissemination of information within the project

Indicators: Number of meetings, implementation and monthly update of the monitoring tools

2 /-Regular submission, validation, storage and dissemination data (including deliverables).

Indicators: availability of the information anytime

In order to ensure the implementation of the 10 actions by the 7 beneficiaries, the role of the project coordinator Dr *Christian GEORGE* and the project management is:

- *The monitoring compliance by the parties with their obligations:* Following the signature of the consortium agreement in September 2010, all the parties respect their obligations. The consortium agreement is available in the appendix N°3.
- *The collecting, reviewing and submitting information on the progress of the project:* The management team has implemented in June 2011 several monitoring tools. This template has been elaborated in order to follow the action with regard to the objective defined in the initial proposal. This template is available in the appendix N°4 or on the intranet (website). Furthermore, the action leaders report on their preparatory or implementation phases during each management team meetings.
- *The preparation of the meetings: the agenda of General assembly meetings, chairing the meetings, preparing the minutes and monitoring the implementation:* the coordinator organized all the meetings, defined the dates and locations. He also defined the agenda and spread the minutes, via the PhotoPAQ mailing list created and via the intranet website. During the management team meeting, a detailed description of the activities of the last six month per action is done. The minutes are available on the appendix N°1.

Please find below the table of the PhotoPAQ meetings and the main decisions:

		Planned		Actual		Main decisions
		Where	Duration	Where	Duration	
Management	Kick-off meeting	Lyon	2	LYON	13/14 Jan 2010	Decisions on the creation of the photoPAQ website Interchange the schedule for the field campaign
	Management meeting 1	Leipzig	1	Brussels	15/16 July 2010	Elaboration Consortium agreement Definition of the tunnel campaign site (I2) Due to a delay of reception of the cement sample, the Preparatory action faced delays of 6 months
	Management meeting 2 & Annual meeting 1	Paris	1	Brussels	31 Jan -02 Feb 011	Distribution of PhotoPAQ brochures Definition of the first PhotoPAQ workshop (JEP: Bordeaux) Date of the tunnel campaign has been validated

	Management meeting 3	Wuppertal	1	Brussels	04 July 2011	Decision of the organization of the PhotoPAQ workshop in Corsica in 2012 Decision to do a film on the tunnel campaign Decision of the date of the press conference Organization of the tunnel campaign and decision of the deadlines
	Management meeting 4 & Annual meeting 2	Orléans	1	Thessaloniki	24-26 Jan 2012	Decision to proceed to 2nd campaign in Brussels Decision for the outdoor site
	Management team discussion			Porticcio, Corsica	14-17 May 2012	Discussion about the localization of the outdoor campaign
	Management Meeting 5	Bergamo		Bergamo	7-9th Nov 2012	Decision to go ahead with the 2 nd campaign despite the over cost Sharing the over cost between all partners Decision on the outdoor Site Petisino, Bergamo / Date
	Astrale meeting			Lyon	20 April 2010	
	Launched Life + rogramme Day			Paris	04 March 2010	
	Life + day			Paris	10 May 2010	
	Astrale Meeting			Lyon	21 Feb 2011	
	Astrale Meeting			Brussels	21 Sept 2011	
	Life + training day			Paris	11avril 2011	
Preparatory phase	P1 - done during annual meeting					
	Coordinator visit			Paris	01 June 2010	
	Visit			Leipzig	15/16 April 2010	
	Visit Hartmut Herrmann + Christian ICARE			Orléans	Sept 2011	
Implementation	I2 - Field campaign	Brussels	15	Brussels	7-23 Sept 2011	
Dissemination	D3 – PhotoPAQ conferences 1, 2 and 3	Not decided yet	Not decided yet	Bordeaux JEP	29-30 Sept 2011	
				Corsica, France	14-17 May 2012	Brochures distributed (200) Movie on the indoor campaign broadcast Dissemination products widely distributed

Name of the Deliverable	Code of the associated action	Deadline	Actual Deadline
Investigations on the influence of photo-catalytic surface films on atmospheric relevant reactions by flow-tube experiments	action P1	30/06/2011	30/06/2011
Identification of gas phase and particulate “tracer” compounds for photo-catalytic heterogeneous reactions to be searched for in the field measurements	action P1	30/06/2011	30/06/2011
Identification of low volatile photo-catalytic reaction products in the aqueous runoff of coated model surfaces by bench-top reactor experiments identify “tracers” to be searched for in the field	action P1	30/06/2011	30/06/2011
protocols and techniques for evaluation of the use and efficiency of photo-catalytic depolluting materials on air quality	action P2	31/12/2011	31/12/2011
basis for authorities to adopt a more integrated approach to urban management by informing stakeholders to use the techniques and methods successfully tested in the project.	action P2	31/12/2011	31/12/2011
scientific strategy of the field experiments	action P3	29/02/2012	29/02/2012
Review of air quality measurements and studies for the selected regions of the field sites	action I3	30/06/2010	30/06/2010
Numerical modelling results for the optimisation of the field sites and the expected achievable de-pollution	action I3	30/06/13 (final)	31/12/2013
Field measurements data analysis and geographic classification	action I3	30/06/2013	31/12/2013
Evaluation and validation of the numerical modelling technique	action I3	30/06/2013	31/12/2013
Integrated assessment and cost benefit analysis	action I3	30/06/2013	31/12/2013
Prepare annual reports including: a recommendation report about the approach in order to apply in an urban environment the photocatalytic materials; a report concerning the monitoring methodology to be adopted in relevant project (e.g. an "intelligent management of a tunnel" by using specific sensors for pollutants); a "demonstration tool" for the depolluting action, which can be obtained from the numerical modelling actions.	action D2	On going	On going

(xvii) International dissemination of results based on a number of modules: Brochure published, Press releases published, Workshops implementation Reviewed publications.	action D3	On going 31/12/2012 31/12/2012 31/12/2011 31/12/2012 31/12/2013 31/12/2013 31/12/2013	 31/12/2012 31/12/2012 31/12/2011 31/12/2012 30/06/2014 30/06/2014 30/06/2014
(xvii) After-LIFE Communication Plan	action D3	31/03/2014	30/09/2014

DELIVERABLE PRODUCTS OF THE PROJECT

- *The transmission of documents and information connected with the project:* internal and external communication about the project, regular meetings have been implemented, and various electronic tools (emails, teleconference,) have been used to exchange information with the consortium beneficiaries.

The main communication and dissemination activities connected to the project have been implemented mainly during the tunnel campaign (I2). We organized a press conference on September 8th, 2011 at 10:00pm within the tunnel. The press conference started by an introductory talk of the Ministry of Transport and Mobility of the Brussels Region, by a presentation of PhotoPAQ by its coordinator, and ended by a visit of the demonstration site within the tunnel. The announcement of the press conference (English, French and Dutch) is available in appendix N°5. The press release is available in Appendix N°6 and on the website (<http://photopaq.ircelyon.univ-lyon1.fr/Press-review>)

Several TV documentaries were made during the tunnel campaigns and broadcasted on BBC, France2, M6, RTBF, ZDF, etc...

In the meanwhile, the PhotoPAQ team decided to hire a company in order to elaborate a short documentary based on the PhotoPAQ demonstration site in Brussels, as the power of images is an efficient way of dissemination. This video is available on the PhotoPAQ website (<http://photopaq.ircelyon.univ-lyon1.fr/PhotoPAQ-campaigns/Indoor-campaign>). This documentary has been largely broadcast by all the partners. It has been also widely used for the first PhotoPAQ workshop in Bordeaux (the details of the cost and the diffusion impact will be detailed in the action D3).

During the field campaign, a notice board presenting the PhotoPAQ project has been set-up at the entry of the tunnel. A picture of the notice board is available in appendix n°7 and on the website (<http://photopaq.ircelyon.univ-lyon1.fr/Images>). The PhotoPAQ management team decided also to make PhotoPAQ T-shirts; pictures are available in appendix N°7 and on the website

As soon as the result of the field site campaign in Brussels are ready for dissemination, we will post them and share this information via the website (<http://photopaq.ircelyon.univ-lyon1.fr/PhotoPAQ-campaigns/Indoor-campaign>). The corresponding section on the website has already been created. In addition peer-review publications on the tunnel results are planned for 2013.

Furthermore, preliminary numerical modelling results for the field trial campaign in Leopold II road were presented on two highly prestigious international conferences:

- the 14th International Conference on Harmonisation within Atmospheric Dispersion Modelling (HARMO 14th, <http://www.harmo14.gr/>)
- the 4th International Symposium on Transparent Conductive Materials (former TCOs - <http://www.tcm2012.org/>)

- *The administration of the community financial contribution:* regarding the consortium agreement, the beneficiaries shall send on a six month basis the financial statement and the

- Organization and coordination of the second tunnel campaign
- Storage of the measurement data for the second tunnel campaign
- Organization and coordination of the outdoor campaign
- Storage of the Field data for the outdoor campaign
- **January 2013 and August 2013: Collecting the financial statement on six months basis and consolidation of the consortium's financial data.**
- **June-September 2014: collection of the financial statement for the final financial report.**
- **The next meeting will be organized during the outdoor campaign in Bergamo planned for the first semester of 2013.**

Please find below the planning of the next PhotoPAQ meeting:

		Planned		Actual	
Management	Management meeting 6	Paris	1	Bergamo	
	Management meeting 7	Lyon	1	Paris	
	Management meeting 8	Wuppertal	1	Wuppertal	
	Annual meeting 3	Leipzig	2		
Preparatory phase	P1 - done during annual meeting				
	P2 - done during annual meeting				
	P3	Paris	2		
	P4	Wuppertal	5		
Implementation	I1 – Field campaign	Italy or France	15		
	I2 – Second Field campaign	Belgium	15		
Dissemination	D1 – done during management meeting				
	D2 - done during management meeting				
	D3 – PhotoPAQ conference 3	Not decided yet	Not decided yet		First semester 2014

5.1.2. Action C2 – Monitoring the effectiveness of the actions

Beneficiary responsible for implementation: CNRS-IRCELYON

Contributors: CNRS-IRCELYON

Main Objective: Monitoring the effectiveness of the actions: possibility to verify the progress and status of the project any time

Expected results:

1/ -The financial, technical report sent on a six months basis

Indicators: Milestones, Number of reports collected

In September 2010, the consortium agreement (CA) has been signed by all partners; the CA defines all the obligations and duties of the beneficiaries. The consortium agreement is available in [appendix N°3](#). The management team proceeds to a permanent comparison between the actual progress of the actions and the project plan and signal either verification or a deviation from the plan. Thus the management team, chaired by the coordinator, elaborates monitoring and evaluation tools, in order to compare at anytime the progress of the action. This template is available in [appendix N°4](#) or on the intranet website. The reports are sent on a six months basis.

The main indicators for the C2 actions, described in the initial project, are the Milestones. The Milestones table allows us to follow the progress of the project's actions. However due to the delay of the delivery of the sample, due to the interchange of the implementation actions, the milestones table needs to be updated.

Name of the Milestone	Code of the associated action	Deadline	Deadline Progress report	Actual Deadline (Midterm report)
Laboratory testing of photocatalytic material	Action P1	30/12/2011	31/12/2013	31/12/2013
Built a depolluting site, by applying photocatalytic cement-based materials	actions I1 + I2	30/06/2011	30/09/2013	31/12/2013 (I2) 30/06/2014 (I1)
Collected data based on the defined monitoring campaign methodology	actions I1 + I2	30/06/2012	30/09/2013	31/12/2013 (I2) 30/06/2014 (I1)
Collected data based on the defined monitoring campaign protocol	actions I1 + I2	31/12/2012	30/09/2013	31/12/2013 (I2) 30/06/2014 (I1)
Tests under controlled atmospheric conditions	Action P2	31/12/2011	31/12/2013	31/12/2013
Field studies scientific strategy and implementation	Action P3	31/12/2011	30/09/2013	31/12/2013
Instrumentation Quality Insurance	Action P4	30/06/2013	30/09/2013	31/12/2013
In situ monitoring campaign – 1	Action I1	31/12/2012	31/12/2013	30/06/2014
In situ monitoring campaign – 2	Action I2	31/12/2012	30/09/2013	31/12/2013
Field site optimization and design	Action I3	30/04/2011	31/12/2013	30/06/2014
Integrated assessment and cost benefit analysis	Action I3	30/06/2013	31/12/2013	30/06/2014
Geographic classification of expected de-pollution performance	Action I3	31/12/2012	31/12/2013	30/06/2014
Operational website	Action D1	30/06/2010	31/09/2010	30/06/2014
Reporting	Action D2	31/09/2010 31/03/2013 31/03/2014	Done 31/03/2012 31/03/2013 31/03/2014	31/03/2012 31/03/2013 30/09/2014
International dissemination of results	Action D3	31/12/2013	31/12/2013	30/09/2014
Website communication	action D1	On going	31/12/2013	30/09/2014

Laboratory testing of photocatalytic material:

The project is currently facing some delays due to the 9/14 months delayed production, delivery and testing of the samples for the preparatory phases and more recently by the fact that the samples effectively produced for industrial purposes were different from those prepared for laboratory testing. In addition, for the second tunnel campaign a third ‘boosted sample’ is used, which also has to be tested in the laboratory. **Therefore, this action requests a period extension in order to continue the testing on the samples effectively deployed in the tunnel and during the outdoor campaign. The preparatory phase should therefore continue and shall now end on 31/12/13 instead of 31/12/11. Indeed, some complementary tests are required. However there won't be any extra cost for this action. The P1 deliverables are anyway available in [appendix N°9.1](#).**

Built a depolluting site, by applying photocatalytic cement-based materials

The first implementation site has been planned in 2011 and has been conducted in September 2011. **Caused by the negative results this campaign is repeated under optimized conditions (length of the tunnel, UV-light intensity, material) in January 2013. The second campaign (outdoor campaign: I2) has been delayed in order to define the most suitable site and is planned for the first semester 2013. That is why we request an extension of this action up 30/06/2014 (end of the project).**

Collected data based on the defined monitoring campaign methodology and protocol

These actions must be done with the same schedule as the implementation actions and are therefore requiring an extension to collect and organize the data.

Instrumentation Quality Insurance

This action must be done with the same schedule as the implementation actions.

In situ monitoring campaign – 1 & In situ monitoring campaign – 2

During the kick-off-meeting, the consortium concluded that compared to Action I1 (outdoor campaign), action I2 (tunnel campaign) was more straight forward to be implemented mainly due to delays in selecting an appropriate site for the outdoor campaign and to the immediate availability of Leopold II tunnel given by the Municipality of Brussels. To counter balance these observations and facts, it was decided that in the initial work programme action I2 should replace action I1 and vice versa. As a result, Action I1 is now scheduled to take place in 2013.

The action I2 has been implemented in September 2011; however a second monitoring campaign will be performed during the first semester of 2012, see action I2 about the encountered problems. The action I1 will be conducted on spring/summer 2013. For this reason we request an extension of the I1 implementation phase. [The implementation of the second campaign \(the tunnel of Brussels\) has been delayed by 6 months in order to obtain the approval of Brussels Region. Indeed, the technical requirements for optimizing scientific experience \(empowered UV lamps installed in the tunnel\) were subjected to an evaluation by the Brussels Region in order to ensure the safety of motorists/ drivers. The implementation of the 2nd campaign has been conducted in January 2013.](#)

Field site optimization and design & Geographic classification of expected de-pollution performance / integrated assessment and cost benefit analysis/ International dissemination of results

During the implementation of the project, the management team realized that in order to conduct in satisfactory manner the field campaigns, the I3 action needs to be continuous during all the duration of the project, as a technical support to the field campaign. However there won't be any extra cost for this action.

Operational website & Website communication

The website has been on line since September 2010 and has been updated and used up to now.

Reporting

The inception report of the PhotoPAQ project has been sent on September 2010. [The date of the next report planned for the 31/03/2013 will be changed. Indeed, we will replace this report by the mid-term report \(31/03/2012\). The PhotoPAQ midterm report has been planned in our workplan \(pg 79 of the Life + agreement\) in March 2012 and the progress report in March 2013. Due to the insufficient amount of expenditures to make a pre financing request in March 2012, we would like to invert the midterm report and progress report as per the table below:](#)

Type of report	Deadline planned	Deadline foreseen	Status
Inception report	30/09/12	30/09/12	done
Midterm report	31/03/12	01/03/13	planned
Progress report	31/03/13	31/03/12	done
Final report	31/03/2014	30/09/2014	Planned

3/ -Screening about photoactive materials to be used in the experiments under atmospheric controlled conditions (P2) and in the field (I1 & I2)

Indicator(s): Number of materials investigated to be deployed in the field experiments:

- (A) CTG 'old' sample, Done
- (B) CTG 'new sample, Partly done
- (C) CTG Brussels tunnel product, Partly done
- (D) STO Photocatalytic paints, Done (BUW)
- (E) "boosted" material from the second tunnel campaign, Open

The activity can be regarded finished despite the problems below. However, some further testing would be desirable to assist the planned second Brussels tunnel campaign.

Problems encountered: Late delivery of samples, partly insufficient quality of supplied samples.

Description of the action done 01/01/2010 – 31/12/2012

The proposed laboratory measurements in Action P1 are important for both the preparation and duration of the planned field measurement campaigns as well as to provide input data for the planned model calculations in the PhotoPAQ project.

Partners involved in Action P1 are the CNRS-IRCELYON, the BUW at Wuppertal as well as the IfT at Leipzig (coordinating) to characterize the effectiveness and the influence on atmospheric processes of photocatalytic material used in the field campaigns under controlled conditions on the laboratory scale.

Due to problems described before, the Action P1 was delayed (cf. last reports). First samples (as coated glass plates) arrived in the laboratories 9 months after the project's starting date (addressed as 'old samples'). As the PIs of P1 requested new material, caused by the instability of the samples, this arrived in July 2011 (addressed as 'new samples'). In addition, after the Brussels tunnel campaign both the laboratories BUW and IfT took the original material used in the joint tunnel campaign and produced by Italcementi and also studied this in the laboratories. **Finally, new 'boosted samples' will be used in the second tunnel campaign.** During the experiments photocatalytic decomposition of different reactive nitrogen species (NO_x, NO_y) and volatile organic hydrocarbons was studied on the photocatalytic materials. The results indicate oxidation of the several pollutants while other show low reactivity. Mechanistic and kinetic description of the reactions allows estimation of potential atmospheric impact. Also, within P1 the photocatalytic material used in the Brussels tunnel experiments was applied in chamber studies in the Leipzig Chamber LEAK.

Steps of the implementation of the action P1 : General

- First samples from CTG arrived 9 month after the project started (Def.: old samples)
- No new raw material was delivered by CTG before the tunnel campaign in Brussels → the new raw material was taken along from the tunnel in Brussels after the campaign, caused by the recommended one month preparation time of the samples on sand blasted glass substrate, the main experiments started only in November 2011 (Def.: new samples) (IfT) **and in August 2011 (BUW).**
- LEAK experiments started in January 2012 → ongoing work (IfT)
- IfT focus for the laboratory studies in 2012 was on three different topics using the material which was taken along from the tunnel experiment in Brussels 2011. All results are described in detail below. First of all, we repeated some flow tube reactor experiments for NO_x, especially for NO by changing experimental conditions (i.e. variation of relative humidity, inlet concentration, light intensity, etc.). Furthermore we started experiments with our newly developed runoff reactor (ROR). After evaluation of

Short summary: Work in Wuppertal, Lyon and Leipzig led to a large data set on the different materials.

Name: Screening about photoactive materials to be used in the experiments under atmospheric controlled conditions (P2) and in the field (I1 & I2).

Short summary: Work in Wuppertal, Lyon and Leipzig led to a large data set on the different materials. The choice of the materials was, however, prescribed from technical demands and led by CTG. The material applied in the Brussels tunnel is now well characterized.

Difficulties met and solutions presented.

Due to the problems described before, the Action P1 was delayed. First samples (as coated glass plates) arrived in the laboratories 9 months after the project start (addressed as 'old samples'). As the PIs of P1 requested new material, in January 2011, this arrived in July 2011 (addressed as 'new samples'). Finally, after the Brussels tunnel campaign both the laboratories BUW and IfT took the original material used in the joint tunnel campaign and produced by Italcementi and also studied this in the laboratories. **Two goals of P1 have not yet been fulfilled successfully, due to the delays in getting the material to the laboratories and thus need more experimental studies:**

- Identification of gas phase and particulate "tracers" compounds for photocatalytic heterogeneous reactions to be searched for in experiments under atmospheric controlled conditions (P2) and in the field measurements (I1 and I2).
- Identification of low volatile photocatalytic reaction products in the aqueous runoff of coated model surface by bench top reactor experiments.

The P1 actions should be prolonged as this will enable to (i) study the tracers and organics degradation and (ii) operate the newly designed runoff reactor. There were substantial delays in the development of the new runoff reactor. The organic system studies still need to be performed at BUW and IfT. **We suggest extending the period of P1 activities to do the above organics/tracer and runoff studies. These laboratory results will be very valuable for the outdoor campaign in Bergamo in April 2013. Due to delays in material supply, hiring students and scientists on time and delays in runoff reactor design and realization, the laboratory experiments should be continued up to the end of the project at no budget impact.**

Description of the actions for the next period 01/01/2013 -31/12/2013

As stated above, the labs involved in P1 are heavily working on the samples available now but need another six months to fulfil the missing two items.

Lyon: P1 finished his laboratory studies on the effects of the different photocatalytical materials on NO and NO₂? on the first material delivered

BUW: **VOCs, tracer and further studies with HCHO and HNO₃**

IfT: Tracer/Organics and runoff studies foreseen. Investigations of model compounds (aldehydes such as HCHO, glyoxal, toluene) in the benchtop reactor and the runoff reactor are foreseen. Variation of irradiance is planned throughout. A second LEAK campaign is also planned. **Both IfT and BUW (and potentially CNRS) also will perform laboratory tests with the new "boosted" TX coating mortar from Italcementi which will be used in the second tunnel campaign in January 2013. IfT will continue measurements with the self-developed runoff reactor, especially to investigate possible reaction products of VOCs with the new boosted coating mortar. Furthermore IfT plan to do another LEAK campaign with the same coating mortar from Italcementi as we used before, but without titanium dioxide, to prove if some of our results are only due the properties of the pure material or due to the photocatalytic activity**

of the applied material. BUW also plans to do some further laboratory experiments with coating mortar samples, which were stored in the polluted tunnel, to confirm the proposed photocatalytic HCHO formation mechanism. The comparisons of P1 results (laboratory) with the tunnel experiments are required for consistency.

No additional costs due to the realisation of substitution test - Part of the budget (IFT) will be transferred to I2 to facilitate the phase 2 of the tunnel campaign with no impact on P1 as more experiments are now running with low associated costs at this stage of the project.

5.1.2. Action P2: Tests under controlled atmospheric conditions

Beneficiary responsible for implementation: CNRS- ICARE – Dr. W. Mellouki

Contributors: BUW, Paris12-LISA

Main Objective: Provide the protocols and techniques for real evaluation of the use and efficiency of selected photo-catalytic de-polluting materials under realistic and controlled conditions through a series of tests conducted in different laboratories and equipments.

Expected results:

1 /-Protocol from pilot tests in the selected chambers and materials / provide the protocols and techniques for evaluation of the use and efficiency of photocatalytic de-polluting materials on air quality

Indicator(s): Number of tests performed (25), Number of samples tested (5) at, Number of pollutants investigated: NO, NO₂, O₃, propene, pyrrole, HONO (6 in total)

2 /- Impact of the selected materials on the loss of air pollutants under atmospheric conditions

Indicator(s): Number of tests performed (25), Number of samples tested (5), Number of pollutants investigated: NO, NO₂, O₃, propene, pyrrole, HONO (6 in total)

3/ - Identification and characterization of gas phase tracers and particles that could be formed.

Indicator(s): Number of tests performed: 10, Number of samples tested : 5, Number of pollutants investigated: O₃, HONO, HCHO (3 in total).

Description of the action done 01/03/2010 – 31/12/2012:

Tests on different surfaces provided by CTG have been made using different facilities to check the behaviour of a number of pollutants on these surfaces. In addition, other types of materials, such as photocatalytic glass, were also investigated, since the provisions of samples from CTG were delayed.

As the sticking between the material provided and the glass substrate was not perfect, it was necessary to test the behaviour of these samples under vacuum prior to any use inside chamber which use vacuum session for cleaning (e.g., CESAM Chamber).

Four different chambers were used by partners 1b (ICARE) and 7(LISA)

- (i) 2 Indoor chambers made of Teflon having different volumes (250 L and 7300 L) irradiated by artificial light
- (ii) 1 indoor chamber (4200 l) made of stainless steel also irradiated by artificial light
- (iii) one outdoor chamber irradiated by sunlight. These facilities are equipped with modern and highly sensitive analytical equipment (<http://www.era-orleans.org/ERA-TOOLS/> and http://www.lisa.univ-paris12.fr/CESAM/Cesam_web-intro-eng.htm).

The tests were conducted on NO, NO₂, O₃, propene/NO_x and pyrrole (this later being used as gas tracer candidate). In addition to the samples provided by CTG, a number of tests were conducted on samples taken directly from the Tunnel in Brussels (see I2 action).

In each facility, in order to determine the effectiveness of the tested materials, several runs were performed in the presence of non-treated surfaces and with TiO₂ treated surfaces inside the chamber. Low concentrations of the studied pollutants have been introduced in the chambers in the presence and absence of the sample plates and the gas phase composition was continuously analysed. The results obtained in all facilities showed a decrease of NO_x in the presence of the treated surfaces, which may indicate an effect of TiO₂ on the atmosphere containing this pollutant. The planned tests were all conducted; however, more tests might be requested depending on the reformulation of the materials that might be used in actions I1 and I2. The main tests were performed; however, room is left for other possible tests related to the new field tests within actions I1 and I2. The last six months, additional tests were conducted on samples taken from the first tunnel campaign: Chambers of ICARE, LISA and IfT were used to conduct the tests; TiO₂ enriched (boosted TX) samples were also tested. The use of different type of chambers has been conducted to check the side effects in addition to percentage of TiO₂.

The tests were performed on different pollutants with and without light (NO, NO₂, O₃ and HONO), in order to check whether their measured loss rates under controlled conditions can be compared to the observations made during the campaign.

Tests were also conducted on tetrachloroethylene to check if it could be used as a tracer. This action has been extended in order to realize additional tests to overcome the problem of the photocatalytic materials (issues met during the first Brussels campaign). The additional tests showed that the removal efficiency towards NO_x for example was noticeable but no effect on tetrachloroethylene was observed. The results of the additional tests, helped to identify some problems met during the tunnel campaign (light intensity, poor properties of the commercial product used,...).

Steps of the implementation of this action:

- Test of the behaviour of the provided material under vacuum
- Tests in small chambers
- Tests in larger chambers

Gantt diagram : Starting date 01/01/2011–Ending date 31/12/2013

Indicators or precise activities list	Year	Results																											
		1 st Year						2 nd Year						3 rd Year						4 th year						5 th year			
		I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	
Protocols from pilot tests in the selected chambers and materials / Provide the protocols and techniques for evaluation of the use and efficiency of photocatalytic depolluting materials on air quality																													
Number of tests performed																													
Number of samples tested (5)	Planned																												
Number of pollutants investigated: NO, NO ₂ , O ₃ , propene, pyrrole, HONO (6 in total)	Actual																												
Impact of the selected materials on the loss of air pollutants under atmospheric conditions																													
Number of tests performed																													
Number of samples tested (5)	Planned																												
Number of pollutants investigated: NO, NO ₂ , O ₃ , propene, pyrrole, HONO (6 in total)	Actual																												
Identification and characterization of gas phase tracers and particles that could be formed																													
Number of tests performed																													
Number of samples tested	Planned																												
Number of pollutants investigated: O ₃ , HONO, HCHO (3 in total)	Actual																												

Deliverables (iv), (v): (deadline December 2011): The deliverables are available in appendix N°9.2 / 9.3.

Difficulties met and solutions brought:

The delivery of the sampled was delayed which led us to conduct a series of tests using other materials in order to prepare the test protocols. The adherence between the material and the substrate was not sustainable which have led to the necessity of carrying out additional test experiment to verifying that no durable contamination could arise from its use in simulation chambers.

Description of the actions for the next period 01/01/13- 31/12/2013

- More tests if required with the new formulation of the materials
- More tests with samples coming from the outdoor campaign and second tunnel campaign activities will be performed: starting in January 2013 for the 2nd campaign and in April 2013 for the outdoor campaign.

5.1.4. Action P3: Field studies scientific strategy and implementation

Beneficiary responsible for implementation: Paris12- LISA – Prof. Jean-François DOUSSIN

Contributors: CNRS-IRCELYON, CNRS-ICARE, BUW, IFT, CTG, Belgian Road Research Centre (BRRC), Aristotle University of Thessaloniki (AUTH-LHTEE)

Main Objective: Determine the field site and the campaign strategy

One of the key actions of the LIFE+ Photopaq project is to demonstrate on field the efficiency of photocatalytic materials to contribute to an improvement of the air quality. Hence, a specific strategy must be defined to make perceptible the change in air composition induced by the use of these materials.

Expected results:

- 1/ - General protocol of the field study
- 2 /- List of field requirement to be transferred to I1 and I2 actions
Indicators: Number of instruments deployed on the field.
- 3 /- Define parameters to be measured
Indicators: Gaseous species, Particulate matter and Light spectrum,
- 4 /-Define spatial and temporal distribution of the measurement
Indicators: Number of stations implemented (2)
- 5 /- List of parameters to be monitored to be transferred to P4 action and involved partners
Indicators: Monitoring of the parameters is completed

Means of verification:

Reports for meeting preparation, Project meetings (see minutes), e-mailing.
Every morning: field site meeting during campaign.

Description of the action done 01/01/2010 – 31/12/2012

The discussion about the field strategy has started 5 months earlier than expected in the proposal. All opportunities of interactions among partners have been taken through program meetings, e-mail exchange and bilateral working session.

It is decided that a comparison of the effect of active surfaces should be with one of the “normal” surfaces as the basic principle of the PhotoPAQ field campaigns.

The physical and chemical parameters to assess this effect have been identified:

- Gaseous species : ozone, NO, NO₂, nitrous acid, major hydrocarbons and oxygenated volatile organic compounds

- Particulate matter: PM₁₀, PM_{2.5}, organic fraction aerosol, nitrate fraction of the fine aerosol, sulphate fraction of the fine aerosol
- Light spectrum, wind speed and direction, temperature, relative humidity, rainfall (if applicable)

This list has been transferred to action P4 for the quality control required by our strategy.

Two strategies have been evaluated:

- (1) Monitor the targeted pollutants before and after the application of the active material
- (2) Monitor the targeted pollutants at the same time in two very comparable locations equipped and not-equipped with the active material.

Due to the highly variable nature of atmospheric composition in urban area it has been considered that the first approach would have required very long time measurement series (several months at the least) to expect any statistically relevant results. To better account, the chemical efficiency of the deployed photocatalytic material, the latter strategy has been chosen.

Tunnel strategy

The Brussels Tunnel has been found compatible with this approach. The specific strategy elaboration for the first field site and the implementation has been considered to require more time than the two months initially foreseen in the project agenda. As a consequence, it has been decided to start this part of the action P3 in advance. In particular, a highly detailed visit of the tunnel has been organised to choose the best tunnel section with respect to surface-to-volume ratio, car flow spatial regularity, microscale aerology and instruments deployment. A 100 meter long section has been targeted for the September 2011 campaign. A first measurement site has been equipped upstream the treated section (front station) while a second has been installed downstream (main station). A double strategy has been adopted: i) comparing front and main station data ii) comparing data recorded during irradiation period and dark period (as the depolluting material needs light to be effective).

In order to better account for the efficiency of the studied material a second tunnel campaign was initially planned for spring. The same strategy is planned but with an increased length of the tunnel section equipped with more intense new lighting systems and a “boosted” photocatalytic coating mortar. However, due to the stricter safety rules and to the associated additional workflow between Photopaq’s partners and the local authorities at Brussels, the second campaign has been postponed in January 2013. During the last six months, the analysis of the sensitivity of the parameters gathered during the first campaign and from the chambers experiments allow to define an updated list of parameters (a report sent by LISA on the extension of the photoactive zone in the Leopold II tunnel is available in the [Appendix 13.9](#)) and set up of a web base collaborative list of parameters/instruments (available in the [Appendix 13.10](#)). Dedicated session at the Thessaloniki meeting and at the Bergamo meeting has been organized.

Open field strategy

The choice of the second field campaign site has been the subject of many investigations. With the help of satellite imaging, the information available from the civil engineering companies in charge of the related urbanisms projects and information available to the consortium many potential sites have been carefully studied. Eventually a field site in southern Europe (Bergamo). Here a dual field site with high surface-to-volume ratio will be constructed (based on existing industrial facility) and equipped in an urban area.

The analysis of the various potential sites thanks to the documents sent by CTG, satellite photos and local air quality agencies and thanks to the dedicated sessions at the Thessaloniki meeting and at the Bergamo meeting has been conducted. All partners visited the site defined

in Petosino (Italy) during the last management meeting in Bergamo (November 2012) and the choice of Petosino site has been validated. The outdoor campaign should be organized in April-May 2013. Therefore, the group finalized a list of requirements for I1.

About the open field site campaign.

While it has been initially planned to conduct measurement in both the northern and the southern Europe, this strategy does not seem to bring additional demonstrating clues anymore. Indeed, from the P1 and P2 actions the effect of sunlight has been very well characterised and field campaign would not bring additional evidence or parameterization. On the contrary, it seems now obvious that finding adequate site with suitable surface-to-volume ratio and accounting for micro-aerology is really a key point for the demonstration process. In consequence, based on the P3 actions work, the consortium has decided to focus the PhotoPAQ field campaign in investigating this latter category of parameters.

Steps of the implementation of this action:

- January, 13th, 2010 (Lyon): Special session on general discussion of the field strategy to adopt, during the kick off meeting:
- January, 13th, 2010 (Lyon): Informal meeting LISA-ITCG : Browsing of field site possibility among Italcementi sites
- July, 16th, 2010 (Brussels): First visit of the Brussels Tunnel
- July, 16th, 2010 (Brussels): Report on Field studies scientific strategy and implementation during Management meeting
- July, 16th, 2010 (Brussels): Special session on outdoor field site during Management meeting
- July 2010 – September 2010 : Study of potential outdoor site in Brighton
- January, 31st, 2011 (Lyon): Report on Field studies scientific strategy and implementation during Management meeting
- February, 1st, 2011 (Lyon): Special session on outdoor field site during Management meeting
- February 2011: E-mail exchange to define the sampling strategy
- March 2011: Study of potential outdoor site in Lyon
- March 2011: Study of potential outdoor site in Strasbourg
- June, 6th, 2011 (Brussels): LISA special visit to the tunnel
- June 2011 – July 2012: Study of potential outdoor site in Metz
- June 2011: Field site strategy and requirements informal report distributed by LISA
- June 2011: Transfer of parameters to be qualified to P4
- July, 4th, 2011 (Brussels): Special meeting on tunnel strategy
- July 2011: Transfer field requirements to be qualified to I2
- November 2011 – January 2012: Study of potential outdoor site in Metz
- January, 27st, 2011 (Thessaloniki): Special session on outdoor field site during Management meeting
- Visit of the tunnel site in February 2012 to evaluate the conditions of the implementation of the second campaign.
- November, 8th and 9th 2012 (Bergamo): Special session on outdoor field site during Management meeting
- Visit of the tunnel 7th of December 2012

Gantt diagram: Starting date 01/01/2010 Ending date 31/12/2013

Indicators or precise activities list	Year	Results																										
		1 st Year						2 nd Year						3 rd Year						4 th year						5 th year		
		I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III
General protocol of the field study																												
Number of reports to the partners (pre results to follow up, define the parameters to measure....)	Planned																											
	Actual																											
List of field requirement to be transferred to I1 and I2 actions / Define parameters to be measure																												
Number of instruments deployed on the field.	Planned																											
	Actual																											
Gaseous species, Particulate matter and Light spectrum	Planned																											
	Actual																											
Define spatial and temporal distribution of the measurement																												
Number of stations implemented (2)	Planned																											
	Actual																											
List of parameters to be monitored to be transferred to P4 action and involved partners																												
Monitoring of the parameters is completed	Planned																											
	Actual																											

Deliverables (vi): (deadline February 2012): The deliverable is available on the appendix N°9.4.

Description of the actions for the next period: 31/01/2012-31/12/2013

Our experience from the last month has shown that the work on the field strategy is clearly deeply linked with the field actions. Indeed adjustment of the field strategy has to be carried out until the very last days before the campaign to take advantages from local opportunities.

- Participation to the second tunnel campaign (01/2013): Organization of a daily meeting during the campaign to organize and verify that the campaign complies with the strategy
- Definition of a detailed strategy for the outdoor campaign (site Petosino)
- Visit of the Petosino site in February 2013 & Meeting with CTG team (I1) for the street canyon precise definition (Feb 2013)
- Set up of a web base collaborative list of parameters/instruments (close interaction with P4)
- Analysis of the air quality data from the Bergamo area (ARPA Lombardia)
- Writing of an informal implementation reports

5.1.5. Action P4: Instrumentation Quality Insurance

Beneficiary responsible for implementation: BUW – Dr. Jörg Kleffmann

Contributors: CNRS-IRCELYON, CNRS-ICARE (Orléans), IFT (Leipzig), BRRC, CTG, Paris12-LISA (Paris)

Main Objective: The instrumentation's protocols for the field implementation, the calibration and thus the quality insurance have been implemented.

Expected results:

1/- Definition of the instruments used

Indicators: High quality (precision/accuracy) instruments to be used in the different actions have been selected (see results from P1, P2 and I2 actions).

2/ - Quality insurance

Indicators: Confirmation by the successful results from the intercomparison exercise. Well recorded long time experience of the involved groups with quality insurance.

3/ - Intercalibration exercises

Indicators:

- Duplicate NO, NO₂, HONO and CO₂ instruments have been successfully intercalibrated for both tunnel campaigns (differences <10%, in between the combined accuracy errors of both instruments, precision errors < 2%).
- HCHO, carbonlys, particle number, particle mass, particle composition showed higher deviations, problems were identified, to be solved in the next campaigns
- Unsuccessful intercomparison: CO, VOCs (one instrument failed) and THC (both instruments failed)

Means of verification:

Reports / deliverables

Project meetings (see minutes)

Exchange of calibration standards during the I2 campaigns

Successful results from the intercomparison exercises, published in:

- Publication in AMT (Atmos. Meas. Tech., 2012, 5, 149-159,) on the NO₂ interferences

Planned publications:

- Publication in AMT on the HONO intercomparison in the smog chamber
- Further publication in AMT on the I2 intercomparison after finalization of the data evaluation

Description of the action done 01/01/2010 – 31/12/12

All the instruments to be used in the tunnel campaign were defined in close co-operation with action P3 during different project meetings. Duplicate measurements of the following species were defined for the tunnel study: CO, CO₂, NO, NO₂, HONO, HCHO, VOCs, carbonlys, particle number, particle mass, particle composition, meteorology. Duplicate instruments were chosen, to ensure high precision of the concentration differences between the two tunnel sites caused by photocatalysis.

In addition, when using similar instruments, possible interferences, line artefacts, etc. will not significantly affect the concentration differences.

1) Definition of the instruments used:Starting date: January 2010

During the kick-off meeting and the first management meeting in Brussels in 2010 the different instruments to be used during the tunnel campaign were defined in co-operation with action P3. Since the photochemistry of the atmosphere and the subsequent formation of harmful photo-oxidants, like ozone (O₃), is controlled by the abundance of VOCs and reactive nitrogen oxides (NO_y: NO, NO₂, HONO, etc.), and since both groups of trace gases show also direct negative health effects (for example: NO₂, HONO, aldehydes, aromatics,...), the instrumentation will focus on these harmful trace gases. In addition, several particle instruments (e.g. two aerosol mass spectrometers) were chosen to quantify potential reduction of secondary organic particles.

See [Appendix 17.2](#) for more details

All duplicate instruments to be used in the second tunnel campaign in Brussels (I2) were defined. A slightly reduced set of instruments will be used caused by the results from the first campaign, still covering the main pollutants (NO_x, HONO, VOCs, HCHO, CO, CO₂ and particles). For the second campaign, the same type of instruments will be used at the two measurement sites of the tunnel to ensure a high precision of the expected concentration differences due to the photocatalytic activity. Discussions on the instruments to be used in the open field campaign (I1) in spring 2013 was initiated is now close to be finalized.

2) Quality insurance:Starting date: September 2010

All partners carefully checked their instruments used in the P and I actions. In addition, all groups used certified calibration standards, which were in addition exchanged and intercompared during the tunnel campaign. The concentration differences of the finally evaluated species during the tunnel campaigns were <10 % (typically <5 %), which demonstrates the high quality of the data. After harmonization, very high agreement and precision (1-2 %) was observed for the finalized data ($R^2 > 0.95$ for all correlation plots). Interferences for the used standard NO₂ instruments were recently quantified. Main interfering compound HONO was quantified in the tunnel and thus, can be corrected for. The systematic errors in the NO₂ data caused by the HONO interferences was <5 % under the tunnel conditions. For the open field campaign in Bergamo (I1) more selective NO₂ instruments will be used, since more severe interference problems are expected for the open atmosphere. Some problems were identified for some instruments during the first tunnel intercomparison. These instruments were carefully checked by the different groups to improve the performance for further campaigns:

- Different calibration procedure for one HCHO-Hantzsch instrument identified
- Performance tests for the AMS instruments done.
- Storage procedure of the VOC cartridges modified.
- Cartridge blanks identified as an important parameter.
- For CO other type of instrument chosen

3) Intercalibration exercises:

Starting date: May 2010

The two HONO LOPAP instruments used in the tunnel campaign were recently intercompared in the international FIONA campaign (<http://euphore.es/fiona/campaign.html>) in the large outdoor EUPHORE simulation chamber in Valencia, Spain. Good agreement of the two LOPAP instruments used in action I1 & I2, with the DOAS reference technique was observed, especially under conditions which are similar to the tunnel measurements.

In addition, interferences of the commercial NO₂ instruments used in the tunnel were recently determined under kerbside conditions (Villena et al., 2012), enabling a correction of the tunnel NO₂ data (I2).

All duplicate instruments were intercalibrated during the I2 campaign in September 2011 in the Leopold II tunnel in Brussels. The intercomparison data for CO₂, NO, NO₂, HONO is already finalized and a very successful intercomparison was obtained, with absolute differences <10% between each duplicate instruments. In addition, after harmonization, very low precision errors between the two sites of <1-2 % were obtained, which is of high importance for the data evaluation of action I2. The intercomparison of data for HCHO, other carbonlys, particle number, particle mass, particle composition showed lower agreement, reasons for which were identified later in laboratory tests. However, for CO and VOCs (one of the duplicate instruments failed) and THC (both instruments failed), no intercomparison results are available. As necessary constraint for the quantification of the photocatalytic effect, the precision error of the duplicate instruments must be smaller than the relative reduction of the pollutant. Thus even low photocatalytic reduction of major pollutants (NO_x) of only 2 % could be quantified.

Steps of the implementation of this action:

- Definition of instruments (2010)
- HONO intercomparison in a smog chamber (May 2010)
- NO₂ intercomparison in kerbside station (2010)
- Data quality insurance (start September 2010, with action P1)
- Intercomparison exercise in the tunnel (May/June and September 2011).

Gantt diagram: Starting date 01/01/2010 Ending date 31/12/2013

Indicators or precise activities list	Year	Results																										
		1 st Year						2 nd Year						3 rd Year						4 th year						5 th year		
		I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III
General protocol of the field study																												
Number of reports to the partners (pre results to follow up, define the parameters to measure....)	Planned																											
	Actual																											
List of field requirement to be transferred to I1 and I2 actions / Define parameters to be measure																												
Number of instruments deployed on the field.	Planned																											
	Actual																											
Define spatial and temporal distribution of the measurement																												
Number of stations implemented (2)	Planned																											
	Actual																											
List of parameters to be monitored to be transferred to P4 action and involved partners																												
Monitoring of the parameters is completed	Planned																											
	Actual																											

Deliverables:

No deliverables were planned in the proposal, however, the actual deliverables are:

- Definition of instruments for the I2 campaign in Brussels
- Publication in AMT on interferences of commercial NO₂ instruments to be used for the correction of the tunnel data
- Validated (smog chamber) HONO measurements
- Successful intercomparison for CO₂, NO, NO₂ and HONO
- Validated and harmonized data for both tunnel stations to be used for data evaluation of the photocatalytic decomposition of pollutants in action I2

Difficulties met and solutions brought:

- The NO₂-LOPAP instrument planned to be used in I2 was not in operation in September 2011. Thus, only the two standard chemiluminescence instruments were used. However, data were corrected using the experience from the interference study (Villena et al., 2012). Corrections were typically <5 % in the tunnel.
- The intercomparison for CO, VOCs and THC were not successful since one or both of the duplicate instruments failed. Intercomparison will be repeated in the next tunnel campaign.

Description of the actions for the next period: 31/01/2012- 31/12/2013

- Definition of instruments: Final definition of the instruments to be used during the open field campaign in Bergamo in 2013 (I1).
- Quality insurance: Continuous quality check of the instruments used in P1, P2, I1, I2.
- Intercalibration exercises: Finalization of the intercomparison data from the first I2 tunnel campaign for HCHO, carbonyls, particle number, particle mass, particle composition: the intercomparison for CO, and VOCs will be repeated in the next I2 tunnel campaign, in addition to the other instruments: all instruments used in the I1 action in Bergamo will be intercompared again at the I1 field site.
- Publication of the results on workshops, conferences and international journals.
- Intercomparison exercise for the second tunnel campaign in Brussels (I2) in January 2013.
- Different CO instruments will be used in the second tunnel campaign (I1) caused by the malfunction of the instruments used in the first campaign.
- Further intercomparison experiments and in the open field campaign in Bergamo (I1) in April 2013

- Peer review publication on the intercomparison exercises planned.

5.1.6. Action II: In situ monitoring campaign – 1

Beneficiary responsible for implementation: CTG

Contributors: All other groups

Main Objective: The main objective of this action is to acquire data (weather, pollution ...) relative to an adequate urban outdoor site where a coating mortar photocatalytic product is applied and to assess the impact of this application on the local pollution level.

Expected results:

To define a protocol to carry out a monitoring campaign in a typical urban environment

Indicator: Protocol implemented for the outdoor campaign

To build a de-polluting site, by applying photocatalytic cement based materials

Indicators: Field site campaign conducted

To collect data based on the defined monitoring campaign methodology

Indicator: Collection of the field site data

Description of the action done 01/01/2010 – 31/12/2012

As already announced, this action has been shifted toward the end of the project, without any consequence on the overall project organisation and workflow. The actions done up to now lead to define a protocol to carry out a monitoring campaign in a typical urban environment. The main actions were to define the ideal monitoring site conditions, to identify corresponding sites and to make them validated by partners. The back and forth discussions finally led to abandon the idea to lean on renovations and to build our own experimental site. The definition of requirements has been initially done regarding a street with canyon profile. Those initial requirements have been based on prescriptions done during the first meetings by partners and by our own knowledge on air pollution monitoring.

The most relevant are:

- Kind and texture of photocatalytic surface applied
- Geometry of the surface
- Type of worked completed
- Pollution level
- Influence of the local traffic
- Local wheater
- Influence of building and site geometry
- Ability/easiness to install monitoring equipments

From the characteristics thus defined, the search for an optimal site has been led in collaboration with commercial departments of local subsidiaries of Italcementi Group in France (Ciments Calcia) in Belgium (CCB), Spain (FYM) and in Italy (Italcementi). This work involves about 10 persons from Italcementi Group. The work mainly consisted in canvassing and in organising meetings either internal (about 4 meetings) or with public administrations either to lean on an already existing renovation project or to generate it (about six meetings). To help in presenting the project and the above requirements a powerpoint presentation has been transmitted to the various involved local subsidiaries of Italcementi Group. Main actions consisted in organising meeting and phone conferences and sending emails. The discussion with public administration (between initial contact and tangible proposal) usually spread out during 6 months. This task has been initiated early comparing to the schedule in the project proposal taking advantage of the fact that the tunnel site (task I2) was already chosen.

Three sites in France, three in Italy and one in Spain have been identified during the period. For the most promising ones, data have been collected (geometry, meteorological data, traffic and pollution level) and presented to partners for validation. None of them have been validated because all the requirements were not fulfilled and in particular for what concerns the possibility to apply the photocatalytic product on the façades. This difficulty arises from the fact that façades of the sites didn't belong to the public administration but to separate private owners which makes impossible any negotiation.

The discussions during Management meeting in Thessaloniki (23-26th of January 2012) have led to change the specification of the site and to turn to isolated squares (one with and one without photocatalytic material). Then a disused industrial site owned by Italcementi in Bergamo (Italy) has been identified (Via David), but it was not possible to use it because it is foreseen to be dismissed in short time. Therefore, during the Corsica Symposium, where all partners were present (14-16th May 2012), a new site has been proposed (one with and one without photocatalytic material). Then an industrial site owned by Italcementi Group in Petosino (Italy) has been identified. After the visit of the field site during the fifth management meeting in Bergamo, the consortium agreed that the site matches all requirements needed for the planned outdoor campaign.

See map and pictures in the Appendix 16.

This site is near the city centre in a suburb where high background pollution is present; it is close to a busy road with high pollution level due to the daily traffic. The protocol used will be similar to the one used in the I2 action except the missing light on/off option.

Now this outdoor campaign is about to enter its operational phase as it is planned to take place from April 8th to May 10th, 2013. However a budget modification of the CTG beneficiary is hereby requested for the preparation of the site, for the monitoring campaign previewed. The initial budget category "equipment" (40K€) will be transferred to the budget category "prototype" and a part of personnel cost (20K€) will be transfer also to prototype. The estimated cost for the implementation of the I1 campaign with the 2 streets canyon is 85K€.

Now the I1 plan is settled and will be active in 2013, with some delay to the initial plan.

Steps of the implementation of the action I1:

To fulfil this main objective the following steps are required:

- To determine the requirements for the construction site towards photocatalytic materials and related parameters (orientation, light intensity ...)
- To identify the monitoring site (Italy or France) corresponding to the previously defined requirements
- To collect preliminary data (geometry, weather, pollution level, traffic...) on the identified site which could be used as input for modelling
- To define a protocol to carry out a monitoring campaign in an urban environment. If existing data are not sufficient a ante operam monitoring campaign can be organised
- Identification of the site, definition of the works to be done to fulfil the program with an optimization of resources and minimization of costs.
- Obtain authorization for using the selected site
- Production of the material to be applied.
- Building the site with the application of photocatalytic material produced by CTG

The step 1 serves as basis to take contact with public administrations. The expected result is to be informed of adequate site renovations and availabilities for applying photocatalytic product.

- February 2013: Accurate evaluation of the cost for the preparation of the site for the outdoor campaign and definition of the field strategy with the partners
- March 2013: installation of the panels (without the coating)
- April-May 2013: pre-campaign and measurement campaign

5.1.7. Action I2: field campaign in Brussels tunnel

Beneficiary responsible for implementation: BRRC

Contributors: All partners

Main Objective: In situ monitoring campaign _2

The Action I2 deals with one of the two field campaigns to demonstrate the photocatalytic effect on the air quality. The Leopold II tunnel in Brussels was taken as field site. The objective of I2 is the demonstration of the photocatalytic efficiency and the determination of the most important parameters which have to be fulfilled in the case of a tunnel application.

Expected results:

1/ - A protocol to carry out the monitoring campaign in a tunnel environment.

Identification of the monitoring site (logistical as well as technical).

Definition of the monitoring site conditions (geometry, level of pollution, traffic, ventilation,...).

Identification of parameters for the measuring campaign.

Indicator: Protocol implemented

2 / - The realisation of the field trial: application of photocatalytic materials as well as installation of lighting system in tunnel.

Identification of the lighting system with prescriptions towards efficiency and disturbance of driver.

Identification of contractor in order to install the material and the lighting system and to prepare the technical room for the measuring campaign.

Identification of optimal painting device in order to install the material in the tunnel.

Installation of lighting system and product.

Indicator: Installation of the lighting system and the photocatalytic material

3 / -Data collection during the pre- and main monitoring campaigns in June and January 2013

Installation of the equipment.

Collection/ elaboration of raw data.

Comparison and post operam evaluation of monitoring results.

Indicator: Collection of the field site data

Means of verification:

Data provided to the partners of the project through mail and internet (PhotoPAQ website, data base provided by partners, see the dedicated site).

Log book of the measuring campaign, data collected on the internal site, presentation of the results at the 3rd management meeting in Thessaloniki (24-26th of January, 2012). The logbook is available in the appendix N°13.1 or the intranet website.

Description of the actions done 01/01/2010 – 31/12/2012

Due to practical reasons, it was decided at the kick-off meeting in Lyon (13-14 January 2010) to have the field campaign in the tunnels of Brussels (action I2) before the field

campaign in the canyon street (action I1). This shifted the application period from year 3, trimester IV to year 2, trimester IV.

The determination of the exact field trial section was done in different steps. First, a general impression of all partners was obtained during the first management meeting of July 15th and 16th 2010 through discussion during the meeting and a visit of the tunnel. Consequently, data has been collected in order to be able to give an estimation of the reduction through modeling (I3) and in order to develop the field strategy (P3). Following data were collected:

- Geometry of the tunnel: plans have been provided and measurements were done inside the tunnel. These documents are available in [appendix N°13.2](#)
- Level of pollution (NO_x) from the continuous measurements which are done by the BIM-IBGE (Brussels environmental institute).
- Amount of traffic by measurements done by the Brussels ministry of Transport and Mobility
- Ventilation schemes. These documents are available in the [appendix N°13.4](#).
- Pollution of the surrounding through contacts with BIM-IBGE.

In November 2010, a meeting between BRRC, CTG and Italcementi local subsidiary CCB in Belgium took place to discuss the practical aspects of the tunnel renovation process, and to set up the tender specifications. The minutes are available on the [appendix N°13.6](#): these practical issues were further discussed during the 2nd PhotoPAQ Management meeting held on the 31st of January and 2nd of February 2011 in Brussels. During that meeting the results of the initial modeling (by LTHEE) were also presented.

A pre-campaign was organized in the tunnel (measurements by BUW and BRRC) in order to get the first impression on the conditions in the tunnel, to quantify the pollution level (NO_x and CO₂), to quantify NO_x/CO₂ ratios before renovation (for comparison with the September campaign) and to identify the increase of pollutants by emissions in the selected tunnel section. This pre-campaign made it possible to define CO₂ as a ‘tracer’ for emissions’. The results have been reported during the tunnel implementation meeting: the 3rd Management meeting (with all partners) held on July 4th 2011 in Brussels. A report on the pre campaign is available on the [appendix N°13.3](#)

The lighting was provided through DISANO, an Italian company, which had already the necessary experience on the installation of photocatalytic lighting in a tunnel in Rome. The demands asked to them were the determination of the optimal placing of the lamps, the calculation of the light intensity and the risk of interference of the lights with the users of the tunnel (cars and motorcycles). The direct contacts were made through CTG, but final approval was done by the BRRC in close collaboration with the Brussels’ Government in order to assure the safety of the tunnel users. The offer and results of the calculation were transmitted through mail (08/07/2011). The order has been placed on the 20th of July 2011.

Since special safety demands are applicable for the workers in the tunnel, the contractor VSE which is already assigned for the maintenance of the tunnel was taken as contractor for the application of the photocatalytic product and for the installation of the lighting. This allowed us to have a more flexible timing and enabled the fast installation of the material and lighting and the preparation of the technical room for the measurement equipment. Specifications were written and a tender was obtained to carry out the works.

The planning and details of the installation were discussed during the tunnel implementation meeting on the July 4th 2011 in Brussels. A detailed working plan is available [appendix N°13.5](#). The Brussels’ Government as well as the contractor VSE were present at this meeting. An action plan was set up. Details are given in the minutes of the meeting.

Prior to the application of the product, a trial was done at the premises of VSE (on 15/07/2011, [appendix N°13.8](#)) in order to find the correct painting equipment and in order to transfer the knowledge from CTG to the contractor. This was done in the presence of technical people of CTG and BRRC. At the same moment, the lamp armature was tested.

The strategies of the measurements as well as the type of pollutants to be measured are reported in activity P3. Within this action, also prescriptions for the installation of the sampling lines were provided to BRRC and VSE.

The treatment of the data and calculation of the results was supervised by CNRS-LISA under P3.

The action I2 has been implemented in September 2011 and encountered a series of issues ([Appendix 13.12](#)) due to a low lighting intensity and fast passivation of the commercial products used. A second monitoring campaign has been performed in January 2013, for this reason we request an extension of the I2 implementation phase. The implementation of the second campaign (the tunnel at Brussels) has been finally delayed by 6 months (from spring 2012 to January 2013) in order to obtain the approval of Brussels Region. For this an external evaluation by a Belgian University has been asked for through the Brussels Region. The report is added in [Appendix 13.13](#). Indeed, the technical requirements for optimizing scientific experience (empowered UV lamps installed in the tunnel) were subjected to an evaluation by the Brussels Region.

In order to finance the second campaign, we request an amendment on budget categories and the budget of our partners: the partners BUW, IFT, Lisa, ICARE and IRCELYON accepted to reallocate ca; 20 K€ from their consumable or other cost budget category to I2/prototype budget category. Thus 100K€ will be reallocated to the prototype budget category/ I2.

Prior to the start of the second tunnel campaign a test has been conducted in order to see the activation possibilities of the new product. To do so, the product has been applied on plates and put in the tunnel for a certain time. After this, light has been put on the product in order to see the reactivation of the product. The results are summarized in [Appendix 13.14](#).

The optimisation of the lamps is done by DISANO through CTG. A detailed planning was discussed with VSE in order to put the product and the lamps in the tunnel. The application of the product itself was done by an Italian firm, which was contacted by CTG. The planning of the second campaign is given in [Appendix 13.15](#).

See annex 17.3 for more details.

Due to problems with the covers of the lamps, which broke due to the heat produced by the lamps, a delay of 2 weeks was needed in order to fix the problem. Due to this delay the measuring campaign was done from January 21st till February 1st. The accommodation during the campaign is organised by the BRRC. The choice was set on the hotel Frederiksborg in combination with one apartment in the neighbourhood of the technical room.

Steps of the implementation of the action I2

The detailed planning of the first tunnel campaign was as follows:

- 14-22 June 2011: pre-campaign
- July 5th 2011: order towards VSE
- July 15th 2011: pre-test painting at VSE
- July 20th 2011: order towards DISANO (lighting)
- August 22nd – September 9th 2011: cleaning of tunnel vault, application of material, installation of lighting system and organization of technical room
- September 9th – September 23rd 2011: measuring campaign

- February 2012 : Visit of partner LISA (see [Appendix 13.9](#))
- March 2012 : list of instrument to be deployed for the 2nd Campaign (see [Appendix 13.10](#))
- Regular contact between all partners by the organization of tele-conferences between March and July 2012
- March 2012: Pre campaign done by BRRC team
- Contact with Brussels Region in order to get the approval for a second campaign

The implementation of the second campaign (the tunnel of Brussels) has been delayed of 6 months in order to obtain the approval of the Ministry of Mobility and Transport of the City of Brussels. Indeed, the technical requirements for optimizing scientific experience (power UV lamps installed in the tunnel) were subjected to an evaluation by the Ministry for Mobility and Transport of the city of Brussels in order to ensure the safety of motorists. The implementation of the 2nd campaign has been conducted in January 2013.

- November 2012: the material has been placed within the tunnel [Appendix 13.16](#))
- Indication of the enlarged test site: visit of the tunnel by CNRS-LISA& BRRC on the 7th of December 2012 (technical room and tunnel).
- New specifications towards the lighting system (last semester 2012)
- Preliminary tests (lab scale) to see whether the tunnel surface can be activated under the tunnel conditions with UV (BRRC, March-December 2012)
- New specifications towards the contractor (March & October-December 2012)
- Application of the material, installation of the lighting system: December 2012

Gantt diagram: Starting date 01/01/2011 Ending date 31/12/2013

Indicators or precise activities list	Year	Results																										
		1 st Year						2 nd Year						3 rd Year						4 th year						5th year		
		I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III	IV	V	VI	I	II	III
To define a protocol to carry out a monitoring campaign in a typical urban environment																												
Identification of the monitoring site ((logistical as well as technical)	Planned																											
Definition of the monitoring site conditions ((geometry, level of pollution, traffic, ventilation,...))																												
Identification of the monitoring site (Belguim)	Actual																											
To build a depolluting site, by applying photocatalytic cement based materials																												
Identification of the lighting system	Planned																											
Identification of contractor in order to install the material and the lighting system																												
Identification of optimal painting device	Actual																											
Installation of lighting system and product																												
To collect data based on the defined monitoring campaign methodology																												
Installation of the equipment	Planned																											
Collection/ elaboration of raw data																												
Comparison and post operam evaluation of monitoring results	Actual																											

Difficulties met and solutions brought:

First Tunnel campaign in September 2011:

- Tunnel section was not painted entirely, but only about 70 m of planned 90 m
- No 'burn-free' period was foreseen for the photocatalytic material: due to the tight schedule of placement of the material and the lamps, the material could not be activated by the UV-light prior to the measuring campaign.
- Misaligned orientation of lamps at beginning of main campaign: change of lamps placement
- Light intensity was lower than expected. This could be one of the main reasons together with the lack of activation period and the too short tunnel section for the low photocatalytic effect.

- Defect of one CO₂-sensor, but not a problem caused by the perfect similarity of both sites (the down-wind data can be used)

Second Tunnel campaign in January 2013:

- THC-sensors (both) and CO (one) failed
- Due to the increase of light intensity, the Brussels Region asked for an external study before they gave green light for the second campaign. This led to a postponement of the campaign by 6 months.
- Due to impurities in the glass covering the lamps and punctual heating by the lamps, some of the glasses broke after the lamps have been switched on. A large discussion with DISANO was done on this during the period of December 27th and January 6th.
- The data of the aerometers were lost for 1 day but some additional data were gathered by the third aerometer.

Description of the actions for the next period: 31/01/2012- 31/12/2013

A second measuring campaign has been carried out in **January 2013**. The second measuring campaign will imply following steps:

- Contact with Brussels Region in order to get the approval for a second campaign
- Indication of the enlarged test site: visit of the tunnel by CNRS-LISA on the 9th of February (technical room) and by BRRC on the 15th of February (tunnel).
- New specifications towards the lighting system (January-March 2012): through mail
- Preliminary tests (lab scale) to see whether the tunnel surface can be activated under the tunnel conditions with UV (BRRC, March 2012)
- New specifications towards the contractor (March 2012)
- Application of the material, installation of the lighting system: April 2012
- Activation period of the material: April-May 2012
- Application of the shutters to secure the lighting system: January 14th 2013
- Approval by the Brussels Region: January 15th 2013
- Lights on for the second tunnel campaign: January 15th 2013
- Activation period of the material: January 15th – 21st 2013
- Measurement campaign 21st January 2013-01 February 2013 (installation of the instruments, calibration and harmonization of the instruments, measuring campaign and removal of the instruments)
- Removal of the armatures after the measuring campaign.
- Evaluation of the results with the Brussels Region.

5.1.8. I3 Numerical modelling campaign and data analysis

Beneficiary responsible for implementation: Aristotle University of Thessaloniki (AUTH-LHTEE)

Main Objective: The main objectives of Action I3 are the following:

- Preliminary assessment of the air quality for the greater field trials regions in Italy/France and Belgium
- Field site selection and design optimization
- Urban de-pollution modeling for the selected field site configurations
- Assessment of the measured de-pollution effectiveness of the selected covering materials from the field campaigns
- Quality assurance, evaluation and validation of numerical modeling results
- Integrated assessment and cost benefit analysis

Indicators: Numerical model done and available on the website

Means of verification

Frequent reporting of the numerical modeling results to the partners during the MC, Technical and Implementation meetings

Presentations of the results in scientific conferences and workshops.

Deliverables

Expected results:

The expected results from Action I3 are essentially numerical modeling results for:

- Field site selection and design
- Expected achievable de-pollution in the field site
- Field measurements analysis and assessment of the de-pollution effectiveness of the selected samples : *Indicators: field measurements are collected and assessed*
- Numerical modeling technique evaluation and validation : *Indicators: Evaluation and validation of numerical modeling results are available on the website*
- Integrated assessment and cost benefit analysis in the selected regions of the field sites
Indicators: Report on cost benefit analysis is available on the website
- The demonstration tool as operational software to be disseminated : *Indicators: tool will be made available online*

Description of the action done : 01/06/2010 – 31/12/12

The main aims and objectives of this Action are the following:

- To perform a preliminary assessment of the current state of the air quality for the greater regions of the selected location where the field trials will-take place.
- To optimise the design of the measuring campaign and assess the potential de-pollution effectiveness of the selected photo catalytic covering materials based on numerical modelling results.
- To assess the de-pollution effectiveness of these materials for the specific cases of the planned field trials by analyzing the data collected during the measurement campaigns.
- To evaluate the numerical modeling results and validate the performance of the modelling methodology which will be employed based on comparisons between numerical results and field measurements via the employment of appropriate statistical methodologies.
- To perform an integrated assessment and cost benefit analysis

As it was already reported during the first reporting period, Action I3 will start on mid-September 2010 and will finish by the end of the project. As a first step, in accordance with the main objectives of Action I3, during the period September 2010 – February 2012 the following actions were completed. A review of the air quality on the greater Brussels area was first conducted. The tunnel Leopold II is situated on a heavy traffic area of the region and as expected, accumulates high concentrations of air pollutants associated to traffic emissions and especially NO_x.

In addition, after the selection of the site for the outdoor field campaign in Bergamo, an extensive review of the air quality of the greater Bergamo area was performed. The results show that the greater Bergamo area suffers from high levels of air pollution, particularly of PMs. Figure 1 presents the average daily value of PM₁₀ concentrations based on measurements gathered from three different stations inside the city of Bergamo. In addition, table 1, presents the number of exceedances of the set EU limit values for the protection of human health (*EU Directive 2008/50/EC*) from one station in Bergamo. Detailed information for the assessment of the air pollution levels in the city of Bergamo can be found in deliverable vii.

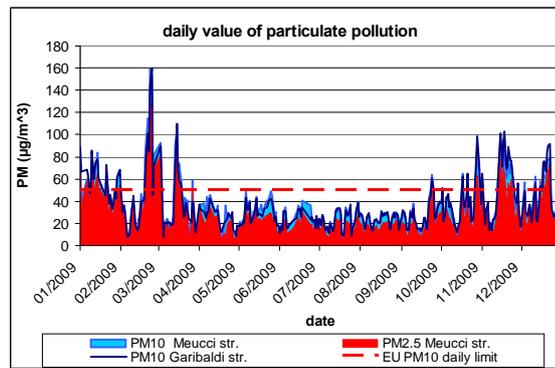


Figure 1: Daily value of PM10 concentration in 2009 from three station in the city of Bergamo

	Measured value	Legal nature of the opposed limit	EU limit
NO ₂	26	Number of exceedances of the hourly threshold of 200 µg/m ³	18
	56.67 57	Annual mean concentration µg/m ³	40
PM ₁₀	72	No of exceedances of the daily threshold of 50 µg/m ³	35
	36.93 37	Annual mean concentration µg/m ³	40

Table 1: Number of exceedances of the EU limit values for NO₂ and PM₁₀ in the station of Garibaldi street

See [Appendix 17.4](#) for more details

Steps of the implementation of the action I3:

- At the time when this 2nd set of simulations for the Brussels tunnel were performed, information for the traffic loads were provided only for the morning peak hours, measured during October 2009. In addition to this after the completion of the first phase of the field trial, a 3rd set of numerical results has already been initiated in order to recreate the situation during the entire day, using as input boundary conditions measurements for the traffic load and the wind speed inside the tunnel. The reason for initiating this 3rd of numerical simulations, is the need to evaluate and validate the numerical modeling technique which was applied based on real life measurements.

At the time when this 2nd set of simulations were performed, information for the traffic loads were provided only for the morning peak hours, measured during October 2009. In addition to this after the completion of the first phase of the field trial, numerical simulation were performed in order to recreate the situation during the entire day, using as input boundary conditions measurements for the traffic load and the wind speed inside the tunnel.

- In addition, after the 1st phase of the field trial in the Leopold II tunnel was completed, the consortium decided to proceed with a 2nd phase, scheduled to take place during January 2013. Hence in addition to the 3rd set of numerical simulations which, as it was pointed out above would serve to validate the numerical modeling technique, a 4th set of simulation will be conducted to account for the 2nd phase of the field trial in the Leopold II tunnel, as additional effort, not initially foreseen. Based on the measurements gathered during this 2nd phase we will be able to assess, from a cost – benefit point of view, the effectiveness of the proposed numerical modeling technique with measurements taken in different geometries within the same tunnel and during different seasonal conditions. Furthermore, having validated the numerical modeling technique as proposed above we will then be able to apply for extended periods of time in order to perform a cost – benefit analysis. In addition, numerical simulations were performed in order to account for the 2nd phase of the field trial in the Leopold II tunnel which as it has already been stated it was completed on February 2013, as

additional effort, not initially foreseen. The effectiveness of the proposed numerical modeling technique is also currently been validated based on the measurements gathered during the two phases of the field trial in Leopold II. After the validation of the numerical modeling technique, it will be applied for extended periods of times. Based on the measurements gathered during this 2nd phase and the modeling results a cost – benefit analysis (currently underway) for the Leopold II area is expected to be completed by the end of the project.

- Based on the measurements which we have already gathered from the 1st phase of the field trial we will assess the expected de-pollution, under the conditions that existed during the period of the 1st phase. After the completion of the 2nd phase of the experiment, we will collect and analyze the measurements in the same way as in the 1st phase. By doing so, we will then compare the existing conditions during the two phases and come up with significant conclusions about what would be the optimum conditions inside the tunnel in order to achieve the maximum de-pollution and what that maximum de-pollution should be. The 2nd phase of the experiment was completed on January 2013. The collection and categorisation of the measurements is already underway. After the collection and analysis of these measurements, we will compare the existing conditions during the two phases (1st and 2nd) and come up with significant conclusions about what would be the optimum conditions inside the tunnel in order to achieve the maximum de-pollution and what that maximum de-pollution should be.

- Furthermore, based on the fact that a 2nd phase of the field trial will take place in Leopold II tunnel and the corresponding need to proceed with a 4th set of numerical simulations, upon its completion an initial version of deliverable viii, “Numerical modeling results for the optimization of the field sites and the expected achievable de-pollution” will be submitted. Unfortunately, it was not previously possible to submit it, as the need to proceed with a 2nd field trial also resulted in additional activities for this action which are expected to be completed in Spring 2012, following the foreseen schedule for the completion of the 2nd phase of the field trial.

-It should also be noted that the location for the conduction of the outdoor experiment in Bergamo - Italy, as it was foreseen in the proposal, was only selected during the 4th MC meeting. Hence the first version of the aforementioned deliverable will only include results from the Leopold II field trial. It is therefore suggested to shift the submission of the final version towards the end of the project, when the data from the trial in Bergamo, Italy will also have been collected and analyzed.

At this point it should be noted that the initial version of deliverable viii, “Numerical modeling results for the optimization of the field sites and the expected achievable de-pollution” will be submitted after the analysis of the field trial measurements from the 2nd phase. The full version of this deliverable will be submitted after the completion of the outdoor campaign in Bergamo. The outdoor campaign is scheduled to take place during the period April - May 2013. Analysis of these measurements is expected to be completed by the end of October 2013. After the analysis of these measurements, numerical modeling results will need to be evaluated and validated. Based on this, the submission of the final version of this deliverable is foreseen for May 2014.

- In view of the fact that a site for the outdoor field trial was recently selected, at the moment a thorough review of the air quality in the greater Bergamo area is underway. We have already collected a significant amount of historical data for the local meteorological conditions and the urban background concentrations of selected pollutants. In addition, we are seeking to obtain data for the evolution of the traffic fleet and the traffic emissions over the years. This review is expected to be finished by the end of May 2014. Together with the review that has already been performed for the Brussels area, they will form the complete and

- Finalize the review of the air quality over the greater Bergamo area and the corresponding deliverable (vii). / The review of the air quality over the greater Bergamo area and the corresponding deliverable (vii) have been finalized.
- Finish the analysis of the field measurements from the 1st phase of the Leopold II field trial.
- Collect and analyze the field measurements from the 2nd phase of the Leopold II field trial.
- Finalize the necessary numerical simulations for the Leopold II field trial (3rd and 4th series of simulations)/ Finalization of the simulations for the Leopold II field trial (3rd and 4th series of simulations).
- Collection and analysis of the field trial measurements from the 2nd phase of the Leopold II campaign and comparison with the corresponding measurements from the 1st phase.
- Use the measurements collected and analyzed from the two phases of the field trial in Leopold II in order to evaluate and validate (quality assurance procedure) the numerical methodology applied.
- Submit the initial version of deliverable viii.
- Perform an initial series of simulations for the selected location for the outdoor trial in Bergamo – Italy.
- Collect and analyze the data from the outdoor field trial / Collection and analysis of the measurements from the outdoor field trial in Bergamo.
- Use field trial measurements as input boundary conditions and perform a 2nd set of numerical simulations in order to evaluate and validate the numerical modeling methodology for outdoor applications.
- Perform a cost-benefit analysis based both on field trial measurements and numerical modeling results for the socioeconomic benefits arising from the application of the proposed photocatalytic covering materials.
- Develop a demonstration tool as operational software to be disseminated/ Development and dissemination of the demonstration tool.
- Submit final versions of deliverables ix, x and xi/ submission of deliverables ix, x and xi
- Numerical modelling for the outdoor campaign in Bergamo
- Evaluation and validation of the numerical modeling methodology for outdoor applications.
- Perform a cost-benefit analysis based both on field trial measurements and numerical modeling results for the socioeconomic benefits arising from the application of the proposed photocatalytic covering materials.

5.1.9. Action D1 - Website (2010-2014)

Beneficiary responsible for implementation: CNRS-IRCELYON

Contributors: CNRS-IRCELYON

Main Objective: Implementation of the website within the six months following the project's start date.

Expected results:

- 1/ - Implementation of the website
- 2/ - Monthly update of the website and the intranet website.

Steps of the implementation of the action:

- The website is online at <http://photopaq.irceylon.univ-lyon1.fr/>. The website was set only 3 months after the project starting date i.e., on April 1st.

from companies and academics from research laboratories. JEP 2011, September 2011, provides a timely update on research breakthroughs on photocatalytic materials and methods devoted to mechanisms understanding, recent standardization methods, latest applications of photocatalysis, including: air and water purification, hygiene, self-cleaning materials, outdoor and indoor coatings for roads and buildings.”

With an international audience of over 300 innovators, academic experts and business leaders in photocatalysis, JEP 2011 aimed to help bring breakthroughs in the field from laboratory to marketplace. The JEP 2011 program included state of art talks by European leaders in the field and specially tailored poster sessions to promote exchange on the latest results. Bilateral meetings opened an opportunity to exchange with other delegates.

As a sponsor, PhotoPAQ had the opportunity to have an exhibitor stand, with 2 grids (100x170), one table (120x70) and 2 chairs. The PhotoPAQ management team decided to make a short movie on the PhotoPAQ field campaign in order to be a communication support which could be used in the JEP organization. The short movie is available online (<http://photopaq.ircelyon.univ-lyon1.fr/PhotoPAQ-campaigns/Indoor-campaign>). The impact of broadcasting the PhotoPAQ movie was immediate, attracted by this documentary, many contacts with academics researcher and industrials have been done. The movies have been screened during these 2 days conferences. The pictures of the stand are available in appendix N°11.2 and are available on the website “section images”.

Impacts: 250 Brochures (available in the [Appendix 7](#)) have been added in the welcome booklets distributed by the JEP organization committee. Moreover 200 brochures have been distributed by the PhotoPAQ Junior Project manager during the 2 days workshop. The documentary on the first PhotoPAQ field site has been displayed continuously during 2 days.

PhotoPAQ organized in May 2012 its LIFE+ workshop: Photocatalysis: Science and Application for Urban Air Quality, with a contribution of Eurochamp2. The emphasis of this discussion meeting was on urban air quality and its possible improvement by photocatalysis. The meeting aimed at bringing together scientists from different fields (atmospheric chemistry, catalysis, photocatalysis : 60 participants), industry and representatives of local governments (e.g., cities, regions...). The scientific program was elaborated to address topics that cover the general aspects of air pollution, addressing mainly sources from transportation and its processing in the atmosphere and active ways to improve air quality in cities. The meeting consisted of a few but exhaustive talks by selected speakers, followed by intensive discussions. In addition poster sessions were organized where all participants were able to present their studies. Topics that cover the general aspects of air pollution, addressing mainly sources from transportation and its processing in the atmosphere and active ways to improve air quality in cities were discussed

The main objective of this workshop was to bring together an audience from various origins (scientific, industrial, etc...) and make sure that they start interacting on the topic of the application of photocatalysis from the underlying science to its application for urban air quality. This objective was clearly met as intensive exchanges took place among the participants.

[See Appendix 15: Scientific programme, list of conferences, pictures...](#)

b) Presentation of the PhotoPAQ project to international conferences

The PhotoPAQ project has been advertised in the following international conferences:

- Workshop on Atmospheric Chemistry: kinetics and spectroscopy, 24-26 February 2010, University of Bayreuth
- Session d’information sur le programme LIFE+, Paris, France, May 2010

- Coating mortar Day, 21/10/2010 - Workshop « Traiter les pollutions » par la photocatalyse by CCB/Italcementi, Brussels, Belgium.
- 20 et 21 janvier 2011 : Carrefour de la Recherche, Colloque international sur la ville durable et Convention d'affaires Green City - Marne-la-Vallée ([appendix N°12.1](#))
- 2-6 October 2011: 14th International Conference on Harmonization within Atmospheric Dispersion Modelling for Regulatory Purposes/ Kos Island, Greece ([appendix N°12.4](#)).
- The participation to the 3rd International workshop on Regional Air Quality Improvement in rapidly Developing Economic Regions 12-13 Nov 2011, Guangzhou, China: Mr Mellouki "Keynote talk" ([appendix N°12.2](#))

“Following the success of the 1st and 2nd Workshop on Regional Air Quality Management in Rapidly Developing Economic Regions, with the great supports from the environmental authorities and academic institutes in Guangdong Province and the Hong Kong Special Administrative Region, we plan to hold “The 3rd Workshop on Regional Air Quality Improvement in Rapidly Developing Economic Regions” themed by “Environment, Climate and Energy” on 12-13 November 2011 in Guangzhou, China. This Workshop is aimed at building a high-level academic platform for environmental experts, technicians, government and enterprise managers, etc. to communicate their views on recent hot issues related to Environment, Climate and Energy in China and over the world.”

- Our partners Italcementi, participated to « Benefits and risks of nanotechnologies for the environment » 31 January 2012, Brussels

“A first Cefic workshop organised in May 2011 confirmed the need of dialogue on real life contributions of nanotechnologies. To build on this first exchange Cefic would like to discuss with you about several other real life contributions of nanotechnologies in major applications such as energy efficient tyres (Michelin), renewable plastics (Vegetal & Mineral Water SAS), performance construction chemicals - key to European sustainability and competitiveness.”

The agenda and the presentation of Mr Gian Luca GUERRINI are available on the [appendix N°12.3](#)

- Presentation of results at the "Gemeinsame Jahrestagung von SETAC GLB und Fachgruppe Umweltchemie und Ökotoxikologie der GDCh" in Leipzig September 2012. See [Appendix 12.5](#)
- Presentation of PhotoPAQ project to the local French authorities “Conseil Régional du centre” during a lab visit and to the Orleans Residents (students, ...) during the “fete de la science”. See [Appendix 12.9](#) & [Appendix 12.10](#)
- 15-17 October 2012, presentation of the Photopaq activities on Atmospheric Photocatalytic Processes: Impacts on the Free Troposphere and Urban Environment by Christian George at the workshop on Urban Air Quality – the Role of VOC and NO_x hold at Istanbul, Turkey.
- The 14th International Conference on Harmonisation within Atmospheric Dispersion Modelling (HARMO 14th, <http://www.harmon14.gr/>)
- The 4th International Symposium on Transparent Conductive Materials (former TCOs - <http://www.tcm2012.org/>)

c) Communication’s impact of the first PhotoPAQ field campaign

PhotoPAQ consortium focuses its communication plan on the 2 field campaigns.

On the 8th September 2011, PhotoPAQ launched by a press conference its first field campaign in the Leopold II tunnel in Brussels from 22:00 to 23:45 on the field site.

second tunnel campaign. The organic system studies still need to be performed at BUW and IfT. These laboratory results will be very valuable for the new Brussels tunnel campaign #2 foreseen for May 2012 and for the second outdoor campaign. Due to delays in material supply, hiring students and scientists on time and delays in runoff reactor design and realization, the lab experiments should be continued. The P1 actions should be prolonged as this will enable to (i) study the tracers and organics degradation and (ii) operate the newly designed runoff reactor. The organic system studies still need to be performed at BUW and IfT. The period of P1 activities need to be extent to do the above organics /tracer and runoff studies. These laboratory results will be very valuable for the outdoor campaign in Bergamo in April 2013.

- The results obtained for the P2 actions in all facilities showed a decrease of NO_x in the presence of the treated surfaces, which may indicate an effect of TiO₂ on the atmosphere containing this pollutant. The planned tests were all conducted; however, more tests might be requested depending on the reformulation of the materials that might be used in actions I1 and I2. This action required to be extended in order to realize additional tests to overcome the problem of the photocatalytic materials (issues met during the first Brussels campaign). The additional tests showed that the removal efficiency towards NO_x for example was noticeable but no effect on tetrachloroethylene and other VOCs was observed. The results of the additional tests, helped to identify some problems met during the tunnel campaign (light intensity, poor properties of the commercial product used...).

- The experience from the last months has shown that the work on the field strategy is clearly deeply linked with the field actions. Indeed adjustment of the field strategy has to be carried out until the very last days before the campaign to take advantages from local opportunities : Participation to the second tunnel campaign and organization of a daily meeting during the campaign to organize and verify that the campaign complies with the strategy, definition of a detailed strategy for the outdoor campaign, visit of the Petosino site in February 2013 and set up of a web base collaborative list of parameters/instruments (close interaction with P4), analysis of the air quality data from the Bergamo area (ARPA Lombardia)

- All instruments to be used in action I1 in Bergamo will be defined, a continuous quality check of the instruments used in P1, P2, I1, I2 the finalization of the intercomparison data from the first I2 tunnel campaign which will be also repeated in the next I2 tunnel campaign. All instruments used in the I1 action in Bergamo will be intercompared again at the I1 field site, publication of the results, conferences and international journals.

Implementation actions:

- The action I1 will involve the following action to be achieved: To obtain final authorization to use the identified site, to finalize the measurement protocol, to collected data, to optimize the application. After the decision of the field site: Meteorological measurements on the site and investigation on some meteorological internet site with the history of weather in the region will be done. The definition of the field strategy with the partners and the installation of the site and the measurement campaign will be conducted (December-February 2013/ Meteorological measurement, January 2013: define the field strategy, March 2013: installation panels, April 2013: pre campaign main campaign April/May 2013).

- A second measuring campaign in the tunnel will be carried out in May 2012. Thus, the PhotoPAQ consortium will enlarged test site: visit of the tunnel by CNRS-LISA on the 9th of February 2012 (technical room) and by BRRC on the 15th of February (tunnel), define new specifications towards the lighting system (January-February 2012), do the preliminary tests (lab scale) to see whether the tunnel surface can be activated under the tunnel conditions with UV (BRRC, February 2012), define new specifications towards the contractor (February-

March 2012), apply the material, installation of the lighting system: March 2012, do the measuring campaign: May 2012. The second campaign has been carried out in January 2013.

Name of the Milestone	Code of the associated action	Deadline	Deadline Progress report	Actual Deadline (Midterm report)
Laboratory testing of photocatalytical material	Action P1	30/12/2011	31/12/2013	31/12/2013
Built a depolluting site, by applying photocatalytic cement-based materials	actions I1 + I2	30/06/2011	30/09/2013	31/12/2013 (I2) 30/06/2014 (I1)
Collected data based on the defined monitoring campaign methodology	actions I1 + I2	30/06/2012	30/09/2013	31/12/2013 (I2) 30/06/2014 (I1)
Collected data based on the defined monitoring campaign protocol	actions I1 + I2	31/12/2012	30/09/2013	31/12/2013 (I2) 30/06/2014 (I1)
Tests under controlled atmospheric conditions	Action P2	31/12/2011	31/12/2013	31/12/2013
Field studies scientific strategy and implementation	Action P3	31/12/2011	30/09/2013	31/12/2013
Instrumentation Quality Insurance	Action P4	30/06/2013	30/09/2013	31/12/2013
In situ monitoring campaign – 1	Action I1	31/12/2012	31/12/2013	30/06/2014
In situ monitoring campaign – 2	Action I2	31/12/2012	30/09/2013	31/12/2013 (I2)
Field site optimization and design	Action I3	30/04/2011	31/12/2013	30/06/2014
Integrated assessment and cost benefit analysis	Action I3	30/06/2013	31/12/2013	30/06/2014
Geographic classification of expected de-pollution performance	Action I3	31/12/2012	31/12/2013	30/06/2014
Operational website	Action D1	30/06/2010	31/09/2010	30/06/2014
Website communication	action D1	On going	31/12/2013	30/09/2014
Reporting	Action D2	31/09/2010 31/03/2013 31/03/2014	Done 31/03/2012 31/03/2013 31/03/2014	30/09/2014
International dissemination of results	Action D3	31/12/2013	31/12/2013	30/09/2014

6. Financial part

6.1 Putting in place the accounting system

The accounting system being used in this project corresponds to the CNRS financial service available at Lyon (www.dr7.cnrs.fr). As a consequence, the financing monitoring of PhotoPAQ will be made at the best possible level.

As coordinator, the CNRS collected the financial statement and the supporting documents on six month basis (as agreed in the CA). The internal procedures (financial, mission reimbursement...) of the beneficiaries' partners are available under request. During the implementation of the programme and the collection of the supporting document, the internal rules for the depreciation of the equipments and the reimbursement of the mission are in the [Appendix 18: Financial and administrative documents](#). Other required intern documents are available upon request.

The beneficiaries use internal accounting reference for all supporting documents:

<u>Beneficiary</u>	<u>Account ref of the project</u>	<u>Name of planed auditors</u>
1A_ IRCELYON	LIFE08 ENV/F0047 OTP 100329	Accountant CNRS _Certified auditor
1B_ ICARE	LIFE08 ENV/F0047 OTP 302983/1B1INSIS	Accountant CNRS _Certified auditor
2_ IFT	LIFE08 ENV/F0047 R0902600	Dr Muser Treuhand –und Beratungsgesellschaft mbH Wirtschaftsprüfungsgesellschaft - teuerberatungsgesellschaft Morrweidenstrasse 10 20148 Hamburg
3_ BUW	LIFE08 ENV/F0047 C0307701A	
4_ CTG	LIFE08 ENV/F0047 2006702	
5_ Auth LHTEE	LIFE08 ENV/F0047 83963	
6_ BRRC	LIFE08 ENV/F0047	
7_ LISA	LIFE08 ENV/F0047 10R03011A-CE	Accountant University _Certified auditor

Time sheets were collected and submitted for approval to the MoT during the visit. We noticed that all were approved and have been used for this period. We noticed also that concerning the partner University Paris XII that only the expenses performed by the beneficiaries (i.e., CNRS and Paris XII) are eligible. The partner was informed of this limitation. The beneficiaries will provide in the final report their chart of their organization in order to justify the signatory of the time sheet.

1.1. Continued availability of co financing.

The co-financing in this project is associated to the two field campaigns, actions I1 and I2. Despite the fact that the planning of both actions have been modified (see above), again without any impact on the project objectives nor on the workflow, these field studies are currently being organised as expected, underlining the continued availability of co-financing.

1.2. Costs incurred (summary by cost category and relevant comments).

Budget breakdown categories	Total cost in €	Eligible Cost in €	% of total eligible costs	TOTAL Cost for the period 01/01/10-31/12/12 in €	Eligible expenses for the period 01/01/10-31/12/12 in €	% of the budget breakdown categories / total expenses	%/total expenses declared	% /Budget
1. Personnel		2 786 409	74,86%		1 618 840	72%	77%	58%
2. Travel and subsistence		220 095	5,91%		95 969	5%	5%	44%
3. External assistance		15 000	0,40%			0%		
4. Durable goods						0%		
Infrastructure		0	0,00%			0%		
Equipment (49,48%)	78 100	38 650	1,04%	38798	19 399	1%	2%	50%
Prototype (100%)	200 000	200 000	5,37%	171415	171 415	9%	8%	86%
5. Land purchase / long-term lease		0	0,00%			0%		
6. Consumables		334 540	8,99%		140 772	8%	7%	42%
7. Other Costs		127 500	3,43%		60 521	3%	3%	42%
8. Overheads		256 546	6,89%		1 474 84	7%		47%
Total without overheads	3 761 644	3 722 194		2 126 315	2 106 916			
TOTAL with overheads	4 018 190	3 978 740	100%	2 273 799	2 254 400			

Comments on the expenses for the period 01/01/2010 -31/12/2012 and the foreseen cost per budget category.

- Direct Personnel Cost:

The personnel cost represents ~~81,7~~ **77%** of total expenditures declared for this reporting period. This budget category represents the most important part of the expenses at this time of the project. **58%** of the budget category has been declared as spent.

The statement of the personnel cost is a compilation of the financial data collected every 6 months by the coordinator: thus we presented the personnel cost statement with 2 annual salary cost per calendar year per agent. In the financial final report, the data will be present in different manner.

CTG: 20 K€ will be reallocated to I1/ prototype and it will come from personnel cost/I2 actions. CTG did not declare any time for technicians in I2 action for the reporting period (initial Budget is 21 400€). The personnel cost declared for the I2 action was mainly about engineer and senior scientist. The experience of the work done in the preparatory actions and during the implementation of the indoor campaign did not require technician expertise: the visit on the field site and the analysis done by the engineers and the scientists was sufficient. However the CTG's technician's skills will be necessary for the outdoor campaign in Bergamo. As the implementation of the I2 campaign has been finalized (second indoor campaign conducted in January 2013), the reduction of this part of the consumable budget category won't affect the I2 objectives.

-Travel and Subsistence Cost:

The travel expenses represent ~~6%~~ **5%** of total expenditures declared. These expenses include travel and subsistence cost for the management meeting, the field "tunnel" campaign, and dissemination actions (JEP, symposiums...). **44 %** of this initial budget category has been declared as spent. Indeed 2 of the 3 conferences planned in the D3 actions have been carried out: the associated travel costs are included in this report. Moreover, the I2 action has been

realized, and the travel cost for this action are almost all reported. The balance of this budget category will be used for the I1, dissemination actions and for the coordination activities.

-External Assistance:

The consortium agreed that each beneficiary will conduct an external audit in its own laboratory. It is more relevant and the better way to evaluate the efficiency of the use of the Life+ funds. Therefore this amount has not been yet expensed. **The audits will be conducted before the end of the project and the budget will be expensed and distributed proportionality to the partners.**

-Equipment:

Life+ stickers which will be put on the equipment bought by Life+ funds will be done in the first semester 2012. The design has been elaborated and stickers were produced. 2 NOx-Analyzer for chemical measurement has been bought by the partners IFT and one laptop for this specific instrument. Another laptop has been bought by BRRC to be used to the instruments during the first field campaign. All these equipments were planned in the initial budget. As the “outdoor” campaign did not start and is planned for the next period, CTG did not use its budget planned (40 000 Euros). **40 K€ will be reallocated to I1/ prototype and it will come from equipment cost/I1 actions.** CTG did not declare any expense for the reporting period (initial budget is 40K€): buying monitoring apparatus is no longer relevant regarding the time life of the project (18 months). Moreover the consortium found (as the experience of action I2) that the apparatus of the partners can be deployed and are sufficient for monitoring campaigns. So we ask for a transfer of 40k€ to Prototype budget line taken from equipment. Stickers has been produced and distributed to all partners in November 2012; the pictures of the equipments (with PhotoPaq stickers) will be provided in the final report.

-Prototype:

As the “outdoor” campaign did not yet started and is only planned for the next period, CTG did not use its associated budget (140 000 Euros). This amount will be used for both I1 or I2 second campaign. The action I2 has been implemented in September 2011 and encountered a series of issues due to a low lighting intensity and a fast passivation (due to high pollution levels and high surface roughness) of the commercial product used. A second measuring campaign has been carried out in the tunnel at Brussels in January 2013 in order to overcome these difficulties. In this second campaign, the test site has been enlarged, the light intensity increased and more efficient products were used. This financial statement includes the global cost of the first campaign but also the skim coat and the prototype of the new lighting design for the second campaign.

In order to finance the second campaign (I2), we request an amendment on this budget category. The request will be sent by mid April latest. The partners BUW, IFT, LISA, ICARE and IRCELYON accepted to reallocate ca; 20 K€ from their consumable or other cost budget categories to I2/prototype budget category. **Thus 100K€ will be reallocated to the prototype budget category/ I2.** The partners CTG accepted to reallocate ca; 40K€ from its equipment budget category and 20K€ from personnel cost budget category to I1/prototype budget category. **Thus 60K€ will be reallocated to the prototype budget category/ I1 within the CTG budget**

Thus the balance of the prototype budget category will be used for the payment of the implementation of the Indoor campaign (I2: 100 K€) and the Outdoor campaign (85 K€).

The reallocation of the use of the prototype budget category per actions will allow the consortium to reach the objectives of the I1 and I2 actions.

-Consumables:

The consumables costs represents ~~7,8%~~ 6% of total expenditures declared for this reporting period, (~~84 422~~ 140 772 Euros). These expenses include mainly chemicals and materials for the preparatory and implementation actions. The production of 200 brochures distributed during the dissemination is under this budget category.

In order to finance the second campaign, we request an amendment on this budget category: the partners LISA, IFT and IRCELYON accepted to reallocate ca; 20 K€ from their consumable budget category to I2/prototype budget category.

IRCELYON:

- 10K€ coming from this budget category was dedicated to the P1 actions and will be allocated to I2/prototype. IRCELYON declared 9 000euros for the reporting period. As the action will end on the 31/12/13, and as the remaining budget of 3000 Euros will be sufficient for fully filled the objectives.
- 5 000 K€ coming from this budget category was dedicated to the P4 actions and will be allocated to I2/prototype. IRCELYON did not declared any expenses for the reporting period. As the action will end on the 31/12/13 the objectives will be reached.
- 5 000 K€ coming from this budget category was dedicated to the I1 actions and will be allocated to I2/prototype. IRCELYON did not declared any expenses for the reporting period. The budget available (2500Euros) is sufficient for consumables the implementation of I1 actions.

ICARE:

- 2K€ will be reallocated to I2/ prototype and it will come from consumables/P4 action (materials for experiments). ICARE did not declare any expenses for the reporting period (initial budget is 5K€). As the action will end on the 31/12/13, and as the remaining budget is about 3 000€, the objectives of P4 action will be fulfilled.

IFT:

- 5 K€ will be reallocated to I2/ prototype and it will come from consumables /P1 action (materials for experiments). IFT declared 32 K€ for the reporting period (initial budget is 40 K€). As the action will end on the 31/12/13, and as the remaining budget is about 3 000€, the objectives of P1 action will be fulfilled.
- 5 K€ will be reallocated to I2/ prototype and it will come from consumables/I1 action (materials for monitoring campaigns). IFT did not declare any expenses for the reporting period (initial budget is 20K€). The remaining budget (15K€) is sufficient for the implementation of I1 actions.
- 10 K€ will be reallocated to I2/ prototype and it will come from consumables/I2 action (materials for monitoring campaigns). IFT declared 8 500€ for the reporting period (initial budget is 19 790€). As the implementation of the I2 campaign has been finalized (second indoor campaign conducted in January 2013), the reduction of this part of the consumable budget category won't affect the I2 objectives.

LISA:

- 5 K€ will be reallocated to I2/ prototype and it will come from consumables/P2 action (Chemicals and standards, gases, maintenance of the analytical instrumentations, tubing,

etc). LISA declared 3 422€ for the reporting period (initial budget is 9 800€). As the action will end on the 31/12/13, the objectives of P2 action will be fulfilled with the remaining budget (1378€).

- 5 K€ will be reallocated to I2/ prototype and it will come from consumables/P4 action (Chemicals and standards, gases, maintenance of the analytical instrumentations, tubing, & Standards diluted COV gas cylinder, standard diluted NOx cylinders). LISA did not declare any expenditure for the reporting period (initial budget is 6 700€). As the action will end on the 31/12/13, the objectives of P4 action will be fulfilled with the remaining budget (1 700€).
- 10K€ will be reallocated to I2/ prototype and it will come from consumables/I2 action (Chemicals and standards, gases, maintenance of the analytical instrumentations, tubing, etc). LISA declared 9 500€ for the reporting period (initial budget is 21 400€). As the implementation of the I2 campaign has been finalized (second indoor campaign conducted in January 2013), the reduction of this part of the consumable budget category won't affected the I2 objectives.

-Other Costs:

The 15 120 Euros declared for this reporting period is mainly coming from the dissemination actions (D1, website, conference, implementation actions...). A documentary of the I1 field campaign has been done in order to be used in the dissemination actions, especially for the participation in the JEP (explained in the technical part). However all other actions planned are conducted. The "Other cost" expenses represent 3% of total expenditures declared for this reporting period (60 521€). In order to finance the second campaign, we request an amendment on this budget category: the partners ICARE and BUW accepted to reallocate ca; respectively 18 K€ & 20 K€ from their other cost category to I2/budget category "prototype"

ICARE: 18 K€ will be reallocated to I2/ prototype and it will come from other cost /P2 actions. ICARE declared 6 600€ for the reporting period (initial budget is 25 500€). Initially, it has been planned that ICARE will use the budget for their own simulation chambers. However it was not possible to do internal invoice. Thus some expenses incurred for the maintenance of the chambers and small materials have been bought. As the action will end on the 31/12/13, the objectives of P2 action will be fully filled.

BUW: 20 K€ will be reallocated to I2/ prototype and it will come from other cost/P2 actions. BUW did not declare any expense for the reporting period (initial budget is 25 500€). In the P1/P2 actions BUW is working mainly to understand the mechanisms and kinetics of the photocatalytic decomposition of nitrogen oxides, O3 and VOCs on the coating mortar samples used in I1/I2 actions. During the first years it became evident, that the primary reactions studied are much more complex than expected at the start of the project. However, without understanding the primary oxidation steps in detail, we think that a study of even more complex secondary chemistry in larger smog chambers and the influence of photocatalysis on that chemistry, will not give very concluding results. Thus, we decided to bring more effort in the better understanding of the primary chemistry and will use the budget, which was planned for the outdoor smogchamber studies in Valencia." As the action will end on the 31/12/13, the objectives of P2 action will be fully filled.

Thanks to the budget modification requested (increment the prototype budget category for the 2 implementation actions); PhotoPAQ project will be able to reach its objectives in satisfactory manner:

- The second Indoor campaign gives the opportunity to fill all our scientific requirements and analysis. The cost of the both Indoor campaign (first in September 2011 and the

second in January 2013) is evaluated to 270 €, 170K€ has been reported in PhotoPAQ financial statement. And 100 K€ are still pending.

- The implementation of the Outdoor campaign with all necessary requirements is estimated to 85 K€; the quotation is available upon request. The consortium PhotoPaa decided to conduct the Outdoor campaign with the implementation of 2 streets canyon instead of one planned in order to guarantee the scientific requirements. The prototype budget available for the Outdoor campaign (I1) is 85 K€, which is the budget required for the implementation with the 2 streets canyon (optimum design).

Breakdown of costs for Actions in Euro (excluding overhead costs)																							
		1. Personnel			2. TRAVEL				4. EQUIPEMENT			4.c Prototype			6. CONSUMABLES			7. Other cost					
	Short name of action	Budget Perso cost	Expensed perso cost 01/01/10-31/12/12	%	Budget Travel	Expensed travel 01/01/10-31/12/12	%	3. External assistance	Budget Equip	Expensed 01/01/10-31/12/12	%	Budget proto	Expensed 01/01/10-31/12/12	%	Budget conso	Expensed 01/01/10-31/12/12	%	Budget others	Expensed 01/01/10-31/12/12	%	TOTAL Budget	TOTAL Expensed	% budget
C1	Project Management by the coordinating beneficiary	65 837	52735	83%	0	2 063		15 000				0			0						80 837	56 798	70%
C2	Monitoring the effectiveness of the actions (2010-2014)	157 722	128 491	81%	67 485	39 520	59%	0				0			0				1 559		225 207	169 571	75%
P1	Laboratroy testing of photocatalytical material	515 506	306 583	59%	2 440	2 143	88%	0	32 000	35 473,91	111%	0			104 100	60 924	59%				654 046	405 123	62%
P2	Tests under controlled atmospheric conditions	272 733	176 616	65%	4 800		0%	0				0			40 800	13 570	33%	51 000	6 573		369 333	196 759	53%
P3	Field studies scientific strategy and implementatio	89 705	86 327	96%	5 800	492		0				0			0						95 505	86 819	91%
P4	Instrumentation Quality Insurance	240 676	101 296	42%	11 440			0				0			22 700	3 032	13%	4 000			278 816	104 328	37%
I1	In situ monitoring campaign – 1	524 348	143 491	27%	56 230	1 219		0	43 000	2 043,99	5%	140 000			63 900	5 633	9%	6 000	1 703		833 478	154 089	18%
I2	In situ monitoring campaign – 2	472 591	301 527	64%	67 100	35 941	54%	0	3 100	1 280,21	41%	60 000	171 415	286%	84 040	54 530	65%	6 000	4 868	81%	692 831	569 562	82%
I3	Numerical modelling campaign and data analysis	278 450	197 420	71%	0			0				0			0						278 450	197 420	71%
D1	Website	32 344	32 400	100%	0			0				0			5 000	0	0%				37 344	32 400	87%
D2	Reporting	50 928	27 483	54%	0			0				0			14 000		0%		10 210		64 928	37 693	58%
D3	International dissemination of results	85 569	62 471	73%	4 800	14 591	304%	0				0			0	3 082		60 500	35 608	59%	150 869	115 753	77%
	TOTAL without overheads	2 786 409	1 618 840	58%	220 095	95 968	44%	15 000	78 100	38 798	50%	200 000	171 415		334 540	140 772	42%	127500	60521	47%	3 761 644	2 126 315	

PhotoPAQ

Action	1. Personnel				2. TRAVEL			3. External assistance	4. EQUIPEMENT				4.c Prototype				6. CONSUMABLES				7. Other cost				TOTAL Budget	TOTAL Budget MODIFIED
	Budget Perso cost	Expensed perso cost 01/01/10 - 31/12/12	Budget REVIS ED	BALANCE TO EXPENSE	Budget Travel	Expensed travel 01/01/10- 31/12/12	BALANCE TO EXPENSE		Budget Equip	Expensed 01/01/10- 31/12/12	Budget REVIS ED	BALANCE TO EXPENSE	Budget proto	Budget REVIS ED	Expensed 01/01/10- 31/12/12	BALANCE TO EXPENSE	Budget conso	6. Consumables REVISED	Expensed 01/01/10- 31/12/12	BALANCE TO EXPENSE	Budget others	7. Other costs REVISED	Expensed 01/01/10- 31/12/12	BALANCE TO EXPENSE		
C1	65 837	54 735	65 837	11 102	0	2 063	-2 063	15 000				0	0			0	0		0				0	225 207	80 837	
C2	157 722	128 491	157 722	29 231	67 485	39 520	27 965	0				0	0			0	0	0	0			1 559	-1 559	654 046	225 207	
P1	515 506	306 583	515 506	208 923	2 440	2 143	297	0	32 000	35 473,91	32 000	-3 474	0			0	104 100	94 100	60 924	33 176			0	369 333	644 046	
P2	272 733	176 616	272 733	96 177	4 800		4 800	0				0	0			0	40 800	20 800	13 570	7 230	51 000	13 000	6 573	6 428	95 505	311 333
P3	89 705	86 327	89 705	3 378	5 800	492	5 308	0				0	0			0	0						0	278 816	95 505	
P4	240 676	101 296	240 676	139 380	11 440		11 440	0				0	0			0	22 700	14 100	3 032	11 068	4 000	4 000	4 000	833 478	270 216	
I1	524 348	143 491	524 348	380 857	56 230	1 219	55 011	0	43 000	2 043,99	3 000	40 956	140 000	200 000	0	85 000	63 900	63 900	5 633	58 267	6 000	6 000	1 703	4 297	692 831	853 478
I2	472 591	301 527	452 591	171 064	67 100	35 941	31 159	0	3 100	1 280,21	3 100	1 820	60 000	160 000	171 415	100 000	84 040	60 640	54 530	6 110	6 000	6 000	4 868	1 132	278 450	749 431
I3	278 450	197 420	278 450	81 030	0		0	0				0	0			0	0					0	0	37 344	278 450	
D1	32 344	32 400	32 344	0	0		0	0				0	0			0	5 000	5 000	0	5 000		0	10 210	-10 210	64 928	37 344
D2	50 928	27 483	50 928	23 455	0		0	0				0	0			0	14 000	14 000		14 000		0	0	150 869	64 928	
D3	85 569	62 471	85 569	23 098	4 800	14 591	-9 791	0				0	0			0			3 082	-3 082	60 500	35 608	24 892	3 761 644	150 869	
	2 786 409	1 618 840	2 766 409	1 167 569	220 095	95 968,7	124 126,3	15 000	78 100	38 798	38 100		200 000	360 000	171 415	185 000	334 540	272 540	140 772	131 768	127500	89 500	6052 1	2897 9	3 761 644	3 761 644

Comments on the expenses for the period 01/01/10 -31/12/12 and the foreseen cost per action:

- Action C1 & C2*: Project Management by the coordinating beneficiary and monitoring the effectiveness of the actions (2010-2014). The percentage of expenditure is 54 % and 45 70 % for the midterm period. The remaining budget will cover the personnel cost despite the project's no-cost extension. Four coordination meetings are planned up to the end of the project.
 - Action P1*: As explained in the technical part, the P1 actions will be extended. Thus more consumables are needed and personnel cost will be declared for the next 6 months in order to achieve the project's objectives. 54-62% of the revised budget planned has been reported. Thus PhotoPAQ won't face extra cost for the extension of this action.
 - Action P2*: ICARE as action leader and all associated beneficiaries did not reported all their expenses about the use of the atmospheric chambers. The percentage of expenditure is 64% for the midterm period. 38 K€ will be reallocated to I2/ prototype and it will come from other cost/P2 actions from BUW and ICARE partners; it has been planned that ICARE will use the budget for their own simulation chambers. However it was not possible to do internal invoice. Thus some expenses incurred for the maintenance of the chambers and small materials have been bought and BUW decided to bring more effort in the better understanding of the primary chemistry and will transfer its budget.
 - *Action P4*: In order to guarantee the success of this action and of the two next implementation actions, consumables are needed. That why only 2% of the planned budget is expensed for this action.
- ⇒ The preparatory actions will end the 31/12/13, thus no extra cost due to the extension period will occur. **Moreover, 76 600€ coming from consumables or other cost budget category** will be reallocated in order to finance the second outdoor campaign.
- *Action I1 and I2*: The remaining budget for the I1 and I2 will be necessary in order to conduct the second campaign in Brussels and the "outdoor campaign". The foreseen budget for the second campaign I2 is 80 K€ and the foreseen budget for the I1 campaign is 200Keuros.

This financial statement includes the global cost of the first campaign but also the skim coat and the prototype of the new lighting design for the second tunnel campaign. Thus the balance of the prototype budget category as requested in the amendment will be used for the payment of the implementation of the indoor campaign (I2: 100 K€) and the outdoor campaign.

Thanks to the budget modification requested (increment the prototype budget category for the 2 implementation actions); PhotoPAQ project will be able to reach its objectives in satisfactory manner.

The second Indoor campaign gives the opportunity to fill all our scientific requirements and analysis. The cost of the both Indoor campaign (first in September 2011 and the second in January 2013) is evaluated to 270 €, 170K€ has been reported in PhotoPAQ financial statement. And 100 K€ are still pending. The implementation of the Outdoor campaign with all necessary requirements is estimated to 85 K€; the quotation is available upon request. The consortium PhotoPaq decided to conduct the Outdoor campaign with the implementation of 2 streets canyon instead of one planned in order to guarantee the scientific requirements. The prototype budget available for the Outdoor campaign (I1) is 85K€, which is the budget required for the implementation with the 2 streets canyon (optimum design).The reallocation of the use of the prototype budget category per actions as requested will allow the consortium to reach the objectives of the I1 and I2 actions. Moreover, the extension of the duration of the programme is required to achieve the I1 objectives, with no additional extra cost.

-Dissemination actions (D1, D2, and D3): During this period, the website has been implemented (the cost incurred was higher than planned), the brochures have been done, one international conference has been conducted..... The action for the next period is the organization of 2 international symposium, one in Corsica in May 2012 and one in Lyon in 2013. There is no extra cost forecast. *The last conference for the PhotoPAQ dissemination action will be conduct in the first semester 2014. The remaining budget available is 25K€. The extension of the duration of the project, we allow us to conduct the last PhotoPAQ symposium, with the presentation of the results of the both campaigns.*

7. Annexes

Appendix 1 Minutes of the meetings

- Appendix 1.1 : First Management meeting
- Appendix 1.2 : Second Management meeting
- Appendix 1.3 : Third Management meeting
- Appendix 1.4 : Fourth Management meeting
- Appendix 1.5 : Fifth Management meeting

Appendix 2 Job description EPM

Appendix 3 PhotoPAQ Consortium agreement

Appendix 4 Monitoring templates

Appendix 5 Press announcement

Appendix 6 Press release

Appendix 7 Picture of the notice board during I2 and T-shirts/ Brochures

Appendix 8 Intranet PhotoPAQ procedures

Appendix 9 Deliverables

Appendix 10 Newsletters

Appendix 11 JEP

Appendix 12 Colloques

Appendix 13 Notes and documents I2 campaign

Appendix 14 LIFE+ Outputs Indicators

Appendix 15 PhotoPAQ Symposium_Corsica May 2012

Appendix 16 Notes and documents I1 campaign

Appendix 17 Preliminary results for Preparatory and Implementation action

Appendix 18 Financial and administrative documents