INVESTMENT FACT SHEET

Pilot investment in Parma

Version 2

Project index number and acronym	CE1226 AWAIR
Responsible partner (PP name and number)	PP1 - Arpae (Regional Agency for Prevention, Environment and Energy in Emilia-Romagna)
Linked to pilot action (number and title)	A.T2.2 “Pilot Actions at target FUAs and tools development” D.T2.2.3 “Pilot tests (technological) implemented in specific FUA according to specific features and needs”
Project website	https://www.interreg-central.eu/Content.Node/AWAIR/AWAIR.html
Delivery date	02/2021

Description and technical characteristics of the investment

The sensor-based instruments described in the following were used in the activities related to A.T2.2 “Pilot Actions at target FUAs and tools development”. In particular, these instruments have been used in the technological pilot actions implemented in the Parma FUA (D.T2.2.3 “Pilot tests (technological) implemented in specific FUA according to specific features and needs”). More specifically, the devices are 4 purchased AQMesh pods (Environmental Instruments Ltd., UK) to monitor: particulate matter (PM10, PM2.5, PM1) using an optical particle counter; carbon dioxide (CO2) using an infrared sensor; nitrogen dioxide (NO2) using an electrochemical sensor. Additional 4 upgraded AQMesh pods to monitor nitrogen oxides (NO2 and NO) and ozone (O3) using electrochemical sensors were used as well.
The network based on the 4 purchased devices was deployed in the first 2 months during 2020, when the air quality monitoring in a school building took place in the Parma FUA. Three devices were located inside the primary school named “Parmigianino Cocconi”, located in Parma, while the remaining pod was located just outside the school building, to have a reference background concentration in the immediate surroundings of the school for a comparison with indoor measurements. The 3 indoor pods were located in different classrooms, with very similar characteristics in terms of size of the room, number of students and exposure to outdoor pollutants. The network of AQMesh pods is the way to compare three different ventilation protocols issued for each classroom, defining the opening and closing of the classroom windows as well as doors during SAPEs. In addition, the effect of an air purifier was taken into account during the indoor air quality monitoring to test the effective impact of these devices and the possibility of using them in case when air quality is particularly bad.
As for the 4 upgraded pods, they were used for the performance analysis of sensor-based instruments to assess air quality at the FUA level. The pods were located next to reference stations belonging to Arpae air quality network in order to verify the reliability of a procedure based on field calibration of the instruments with respect to the reference monitors. The final goal of this mixed network is the assessment of the accuracy of measurements after a following relocation of sensor-based pods in other areas with similar characteristics. This procedure is essential in order to obtain reliable results. In general, the calibration certified by the manufacturers is often unsatisfactory in order to assess the quality of sensor-based systems. The motivation is due to the fact that the sensors are tested under laboratory conditions and not in field. Therefore, a relevant part of the work must address the inter-comparison with reference instruments before a fruitful establishment of mixed networks which are the final goal when using sensor-based instruments. It must be clear that an essential preliminary step before the implementation of any kind of network including sensor-based instruments is the field calibration of the equipment at locations similar to those where the pods will be deployed, as it was extensively analyzed in the framework of the pilot actions implemented in Parma FUA. The results obtained with the field calibration in Parma were very encouraging and showed the potential of using these devices. The more detailed spatial and temporal information about the air quality conditions in a specific area is a first straightforward benefit which one can expect when using sensor-based instruments. The advantages of such equipment are very relevant. They are cheap and therefore the number of devices which could be deployed for specific intensive monitoring campaign in specific areas could be larger than when using standard monitors. In addition, the use and maintenance of sensor-based instruments is quite easy and avoids some of the constraints associated with the use of reference air quality monitors.

Investment costs (EUR) including a break-down of main cost items

No. 4 AQMESH pods (Environmental Instruments Ltd., UK) instruments to monitor NO_2 using Alphasense sensor NO2-B43F, NO using Alphasense sensor NO-B4, O_3 using Alphasense sensor OX-B431 and temperature, relative humidity and pressure. Sensors are electrochemical for all gases and solid state for the remaining parameters. Pods work at usual weather conditions (-20°C / +40°C for temperature and 0/100% for relative humidity); an IP65 enclosure guarantees protection from water and dust as well as other meteorological agents.
These pods were already available at Arpae Emilia-Romagna and the following costs are related to the upgrade of the equipment and for the replacement of old sensors.
Unit cost: € 3 007,30
Total cost (unit cost x 4): € 12 029,20

No. 4 AQMESH pods (Environmental Instruments Ltd., UK) to monitor PMx using an Optical Particle Counter (OPC) over 24 dimensional channels (independent measure for PM_1, $PM_{2.5}$ and PM_{10}), CO_2 using Non-Dispersive Infra-Red (NDIR) sensor, NO2 using electrochemical sensor and temperature, relative humidity and pressure. Pods are compatible both with power grid (220 V) and with solar panel (indoor and/or outdoor). Pods work at usual weather conditions (-20°C / +40°C for temperature and 0/100% for relative humidity); an IP65 enclosure guarantees protection from water and dust as well as other meteorological agents.
The costs in the following refer to the purchase of the pods in the framework of AWAIR Project.

Unit cost: € 10 065,00
Total cost (unit cost x 4): € 40 260,00

Investment location		
NUTS 3	**Address (Street, house number, postal code, city, country)**	**GPS coordinates**
ITH52	Primary School Parmigianino-Cocconi, Piazza A. Rondani 1, 43125 Parma (PR)	
ITH52	Station "Saragat", Via Saragat, 43052 Colorno (PR)	Lat. 44.93°, Long. 10.38, Height 30 m
ITH52	Station "Montebello", Via Montebello, 43123 Parma (PR)	Lat. 44.79°, Long. 10.34°, Height 55 m
ITH52	Station "Cittadella", Parco Cittadella, 43123 Parma (PR)	Lat. 44.80°, Long. 10.33, Height 60 m
ITH52	Station "Badia", Badia di Torrechiara, Torrechiara, 43013 Langhirano (PR)	Lat. 44.66°, Long. 10.29°, Height 202 m
ITH54	Station "Gavello", Via Gazzi, Gavello, Mirandola (MO)	Lat. 44.93°, Long. 11.18°, Height: 4 m

ITH54	Station "Giardini", Via Giardini 543, 41124 Modena (MO)	Lat. 44.64°, Long. 10.91°. Height 39 m
ITH54	Station "Parco Ferrari", Parco Ferrari, 41126 Modena (MO)	Lat. 44.66°, Long. 10.91°, Height 30 m
ITH54	Station "Remesina", Via Remesina, 41012 Carpi (MO)	Lat. 44.80°, Long. 10.89°, Height 25 m

Duration and process of investment implementation

Start date	End date
03/2018	02/2020

Major milestones of investment implementation

Milestones of investment related to the upgrade of 4 AQMesh pods already owned by Arpae:

- Start of direct award contract: 07/2018
- Order emission date: 08/2018
- Delivery date: 11/2018
- Start of field activity: 12/2018
- End of field activity: 09/2019

Milestones of investment related to the purchase of 4 AQMesh pods:

- Start of public tender: 08/2019
- Order emission date: 10/2019
- Delivery date: 12/2019
- Start of field activity: 12/2019
- End of field activity: 02/2020

Ownership and durability of the investment (e.g. maintenance, financing)

The equipment used in the technological pilot actions implemented in Parma could be easily relocated in other places, building different networks with variable spatial and temporal scales. In this respect the creation of mixed networks putting together reference monitors with low-cost equipment is a cutting-edge technology. An approach similar to that applied to the school buildings may be applied also to other location, where other vulnerable people spend most of their lives. Examples of these locations may be hospitals, nurseries, or assisted living centers for elderlies. In this respect, it will be possible to monitor air quality conditions in these places, eventually assessing the effectiveness of adaptation measures (such as the ventilation protocols implemented in the school buildings) which can represent a way to reduce the adverse effect of SAPEs on vulnerable people in the place where they spent most of their lives. It is also easy to realize the transferability of these actions (definition of a joint pilot action in the schools of the FUAs involved in the Project). These advantages may have a positive impact also outdoor, for example, when monitoring the impact of traffic restrictions in small and/or specific areas. The increased availability of data could finally become a way to increase knowledge and awareness by the citizens also in the paradigm shift emerging in the framework of environmental monitoring.
The investment developed during the AWAIR Project lifetime allows Arpae to have a relevant number of instruments of the same kind, giving reliable results to monitor most relevant air quality parameters as it was shown in the pilot technological tests developed in Parma. In addition, Arpae had the possibility of testing the process of upgrading the instruments already owned through the replacement of the "old" sensors reaching the natural end of lifetime for such devices. The replacement is quite straightforward and gives as a result a kind of "new" equipment which can be deployed for some years. Arpae will maintain these instruments with own resources in order to use them in future field campaigns to monitor air quality

References to related pilot action (output fact sheet) and relevant deliverables (e.g. pilot action report, studies) and web-links.
If applicable, additional documentation, pictures or images to be provided as annex

The relevant reference deliverables are:

- Joint Deliverable D.T2.2.2-D.T2.2.3 "Pilot tests - Parma FUA" with the annexes describing in more details the technological pilot tests: "La misura di inquinanti atmosferici con sensori elettrochimici – Verifiche in campo di accuratezza e precisione"; "Appendice – Taratura in campo in un singolo sito – Periodo invernale"; "Le campagna di monitoraggio della qualità dell'aria a Parma durante le Stagioni invernali 2018-19 e 2019-20 – Azione pilota nell'ambito del Progetto Interreg-CE AWAIR".
- Deliverable D.T2.2.6 "Assessing the effectiveness of mitigation and adaptation actions/measures at Parma FUA".
- Deliverable D.T2.2.8 "Joint Pilot Action in a pool of schools - FUA of Parma".

The relevant output factsheet is:

- O.T2.1. – Pilot actions for mitigation and adaptation to SAPEs (https://www.interreg-central.eu/Content.Node/AWAIR/O.T2.1-Parma-final.pdf).

Image 1. The 4 upgraded AQMesh pods.
Image 2. One of the purchased AQMesh pods (the one equipped with the solar panel).

Image 1: monitoring station