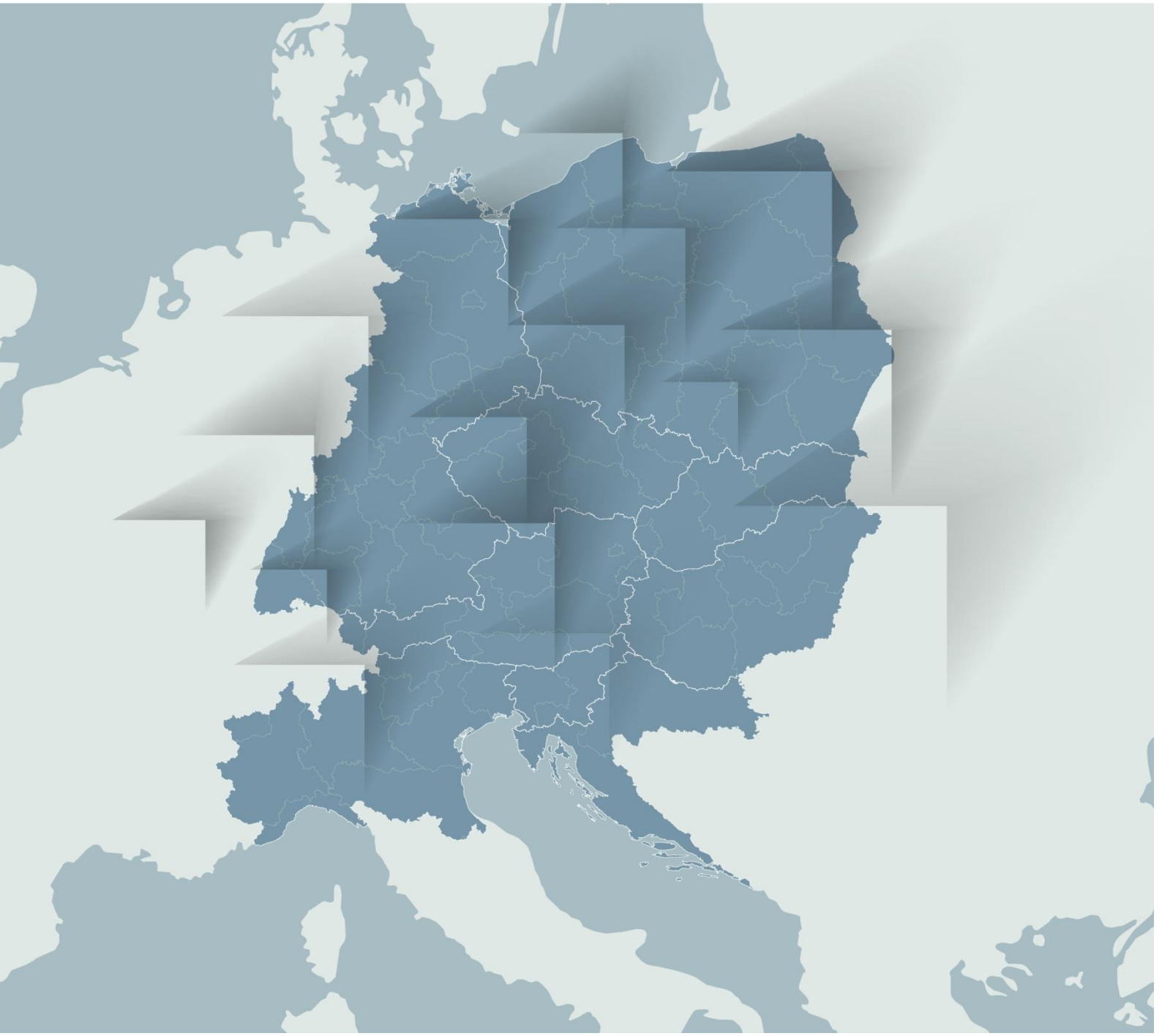
Interreg CENTRAL EUROPE
European Union
European Regional Development Fund

AWAIR

D.T2.2.3
Summary report of the technological pilot test - FUA Parma



The documents listed in the following are available as annexes to the joint deliverable D.T2.2.2-D.T2.2.3 The main focus of the reports is the detailed description of the different activities related to the technological pilot actions carried out in Parma FUA during winter seasons 2018/19 and 2019/20.

TECH Annex #1

Report “La misura di inquinanti atmosferici con sensori elettrochimici - Verifiche in campo di accuratezza e precisione” (in Italian).

(“Atmospheric pollutants measure using electrochemical sensors - Assessment of accuracy and precision during field campaign”).

TECH Annex #2

Appendice al Report precedente “Taratura in campo in un singolo sito - Periodo invernale” (in Italian).

(Appendix to the previous Report “Field calibration in a specific location - Winter period”).

TECH Annex #3

Report “Le campagne di monitoraggio della qualità dell'aria a Parma durante le stagioni invernali 2018/19 e 2019/20” (in Italian).

(“Air quality monitoring campaigns in Parma during winter seasons 2018/19 e 2019/20”).

The report labelled TECH Annex #1 (and its Appendix labelled TECH Annex #2) describes the results of the performance and the assessment of accuracy of sensor based equipment in the air quality evaluation at Parma FUA level. The interest in such equipment is due to the fact that they are proving to be a very promising tool to increase the information about the spatial and temporal distribution of air pollution at the local scale.

The need to evaluate the performance of this kind of instruments comes from several issues that have been raised in scientific literature about the accuracy and precision of such monitors when used during field campaigns. Main current calibration solutions from the manufacturers are limited to laboratory sensor testing under controlled conditions. This approach often provides unsatisfactory results during ambient air monitoring making the field calibration essential when using air quality sensors.

During Parma pilot actions, the different systems have been compared after multiple relocation in different seasons (summer and winter) and in different sites (near reference air quality stations, each representative of urban and suburban background, rural environment and traffic sites). The pollutants considered in this analysis are ozone (O_3) and nitrogen dioxide (NO_2) and the results obtained in the inter-comparison between reference stations and sensor based equipment (AQMesh) are presented.

AQMESH were initially calibrated in field (near Parma reference stations) and then relocated near Modena reference stations keeping the same kind of background. Data showed very good performances for ozone sensors both in summer and winter seasons, with high correlation with reference stations (R^2 higher than 0,9) and good accuracy (root-mean-square error between 10 and 15 $\mu g/m^3$ in summer and between 3 and 8 $\mu g/m^3$ in winter). Results for NO_2 are more complex: relevant measurement errors characterize the summer inter-comparison in the urban and suburban background (R^2 in the range 0,22-0,611 and normalized root-mean-square error in the range 37-68%). On the other hand, winter results (when larger

concentrations of this pollutant are present) are much better, with R^2 in the range 0,848-0,973 and normalized root-mean-square error in the range 7-21%).

The report TECH Annex #2 deals with an analysis of the results obtained when field calibration of the AQMESH instruments is carried out in a single site, disregarding the specificity of the location for the field calibration. In this case, the results obtained during the winter season are quite good, even if a site specific field calibration guarantees a better accuracy.

The report labelled TECH Annex #3 contains an overview of the pilot actions implemented in the Parma FUA during the winter seasons 2018/19 and 2019/20 (from October to April in the following year), that is the period when most pollutant concentrations peak in the urban area. As a consequence of such high concentrations specific restrictions aiming at the reduction of the atmospheric pollution are issued. The availability of a large database of information may be the basis to set-up a detailed analysis of the air quality conditions in the Parma urban area. The database may also be a support for the local administrators in the Parma FUA in order to have a quantitative assessment of the impact of the mitigation strategies in the area.

The focus is not only on the "standard" pollutants such as particulate matters (PMx), nitrogen oxides (NOx), ozone (O_3), benzene (C_6H_6), carbon monoxide (CO), which are monitored according to specific air quality regulatory requirements. In addition, black carbon (BC) and ultra-fine particles (UFPs) were included in the monitoring campaigns in Parma FUA. These further air quality parameters are not yet included in the EU list of pollutants to be monitored: for these parameters no reference or limit values were already established but their negative impacts on human health have already been emphasized by WHO. Epidemiological studies give a solid basis to the association between cardiovascular and respiratory pathologies and mortality on one side and exposure to black carbon to the other. Under a toxicological point of view, black carbon may act as an universal carrier for a number of chemical substances. Therefore, a reduction of the exposure to particulate matters containing black carbon should lead to a reduction of the health effects associated to particulate matters. These considerations suggest the importance of having a quantitative information of the actual black carbon concentration and of the variability during the winter season, keeping into account the innovative character of this monitoring activity.

The report contains also information about the distribution of the traffic related pollutants both during the course of the day and during the course of the week. The main objective is to highlight how the availability of a database related to both "standard" atmospheric pollutants (subject to continuous monitoring) and "non-standard" pollutants represents a great added values to have a relevant and consistent amount of information related to air quality conditions. This aspect is not restricted to the possibility of increasing knowledge relating to these aspects, but also to the possibility of setting up the basis for a detailed analysis of the spatial and temporal relationship of data collected by the instruments that can be deployed. This aspect is particularly relevant with respect to the evaluation of the expected reduction of atmospheric pollutant concentrations due to mitigation strategies in the urban areas.