

Deliverable D3.3: Summary document of Milan city demonstration measurement campaign

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see also CARES website: <https://cares-project.eu/cares-milan-res-complete/>



CARES remote
emission sensing
campaign in Milan
completed



November 5, 2021



News



Summary

- This summary document provides an overview of the preparatory work completed as well as the measurements themselves. Results of the measurements will only become available later and are not part of this document. Results will be documented in D3.4 (Summary report on partner cities' measurement campaigns).

Attainment of the objectives and explanation of deviations (1/3)

Description of work related to deliverable as given in DoW

- The primary objective of the demonstration measurements in Milan was to track the policy effectiveness of the Milan Low Emission Zone (LEZ) and to demonstrate the role that remote sensing can play in this context.
- Against this primary objective, it was of great importance to be measuring within the city center as well as in its outskirts.
- A second key objective of the measurements in Milan was to test a variety of remote emission sensing (RES) instruments in practice, in a real-life city context, and to compare the various technologies to each other.
- A third objective was the comparison of the RES measurements with PEMS measurements in a real-world setting.



Attainment of the objectives and explanation of deviations (2/3)

Time deviation from original DoW

- Measurements in Milan were originally planned for February 2021, and to be the second among the three CARES city demonstration measurement campaign. However, as measurements in Prague and Krakow got pushed back due to implications from the COVID pandemic, measurements in Milan took place first in September and October 2021.

Attainment of the objectives and explanation of deviations (3/3)

Content deviation from original DoW

- The initial target was to measure 100,000 vehicles. However, the primary objective to collect data inside and outside the Low Emission Zone led to lower traffic volumes at the measurement sites that had to be selected than expected. The effect of the pandemic likely worsened the vehicle passages rate. In addition, the second objective to compare various RES technologies considerably narrowed down our candidates for testing sites within the city center.
- An addition to the original plan was the involvement of the Joint Research Center of the European Commission for additional PEMS-measurements



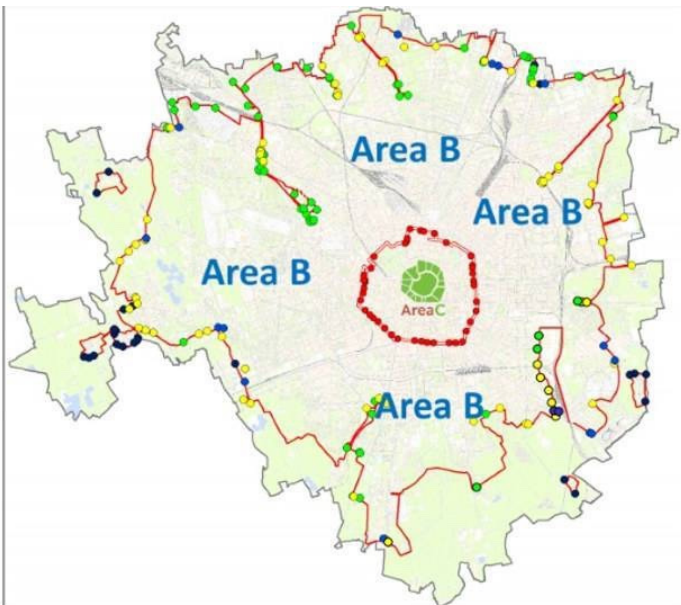
Participating organizations

- **Hager Environmental & Atmospheric Technologies (HEAT):** EDAR open-path system at two locations (measuring NO, NO₂, HC, CH₄, CO, CO₂, PM).
- **Technical University Graz (TUG):** Point sampling (measuring black carbon, CO₂, PN) at two locations.
- **Airyx:** ICAD NO_x / NO₂ / CO₂ analyzer, applied to TUG point sampling measurements.
- **Innovhub & AMAT:** Using a mobile air quality cabin and a set of advanced sensors next to the emission measurements. In addition, four high-emitter vehicles equipped with PEMS to pass by the different RES devices.
- **University of York (UoY):** Point sampling with selected ion flow tube mass spectrometer (SIFT-MS) to measure health-hazardous speciated volatile hydrocarbons.
- **European Commission Joint Research Centre (JRC) at Ispra:** Invited to test two Euro 6 low-emitter PEMS-equipped vehicles in the two EDAR-equipped sites.



Testing locations

- 3x point sampling + 1x open path collocated in Area C (Madre Cabrini)
- 2x point sampling in Area C (Bazzoni)
- 1x open path unit located in Area B to maximize data collection (Cilea)



Measurement timing

- 4 weeks from late September to mid-October 2021
- Originally, the measurements were timed around the planned tightening of the Milan Low Emission Zone requirements on October 1, 2021

Postponed due to the extension of the national state of emergency for Covid-19 pandemic

~~Introduction of new level of LEZ stringency~~

September 2021

S	M	T	W	T	F	S
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

2x Point sampling (TUG – Airyx)

-3x Point sampling (TUG-Airyx-UoY) + open path (EDAR)
-1x open-path standalone (EDAR)

UoY left Milan
TUG – Airyx PS moved to second location

PS first installation
HEAT installation

October 2021

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

- First 2/3 weeks in Area C at one lane via Madre Cabrini + EDAR in Area B at one lane via Cilea
- 4th week in the 2-lane road via Bazzoni

Testing location: via Madre Cabrini (1/2)

Co-location of CARES point sampling, HEAT EDAR and PEMS to study vehicle emissions



Testing location: via Madre Cabrini (2/2)

Air quality vs vehicle emissions monitoring (EDAR)

Airborne concentrations & weather measurements
(Reference instruments and advanced sensors)

Vehicle emissions measurements



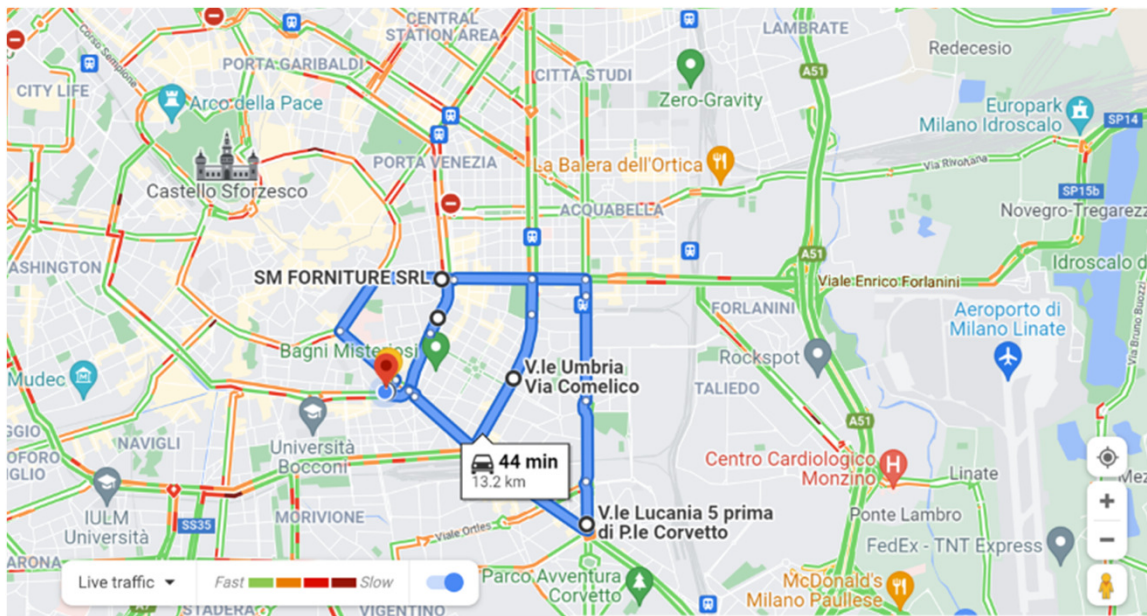
Testing location: via Cilea HEAT EDAR and PEMS measurements



Testing location: via Bazzoni - CARES point sampling



Additional monitoring campaign in Milan: Speciated Volatile Organic Compounds (VOC) monitoring by the University of York on different traffic level routes



Lessons learnt:

1 a) Milan campaign preparation challenges

- **COVID-19 emergency situation was well managed** through good planning (also based on September/October 2021 few contagions) and a favorable local/national situation (more than 80% of the population fully vaccinated in September 2021).
- **Over six months preparation and uncountable e-mails and video calls to define the sampling sites.** E.g., conflicting needs between the open-path system (EDAR) and point sampling units (interfering plumes, accelerating conditions, two lane roads, parking lots available, etc.) to be related to real conditions and real constraints → final sites were defined early July, meaning little time for the campaign to be organized and start.
- **Public soil occupation permissions**, both for road, parking areas and sidewalk: a lot of time spent in administrative practices and costs for soil occupation taxes.
- Electrical power supply plants on public soil (1): **Availability of electrical connections** near the identified sampling sites. **Realization of conformity plants** perfectly sounds with technical and safety standards.
- Electrical power supply plants on public soil (2): **Grounding need**. Nearby condominiums did not provide availability for the access and the usage of their grounding plants or of their gardens for grounding. The grounding was finally realized on public soil excavating sidewalks.

Lessons learnt:

1b) Milan campaign preparation challenges

- Logistic issues: **road signs** positioned according to the local Regulations as for timing and position and **Local Police involvement** for traffic diversions and road closures.
- Safety (1): Being on public soil we had to **take care of both the safety of pedestrians and drivers** (motorcyclists, cyclists, etc.) by installing appropriate sidewalk signage as well as cable protectors. Not allowed any modifications of the setup as it was not considered by the already obtained permissions (e.g., no sampling tubes in the middle of the road).
- Safety (2): Being on public soil we had to protect very expensive technical and scientific instrumentation. Time and money spent for a **security service during nighttime** to prevent thefts and vandalism and to **extend instrumentation insurances**.
- **GDPR issue**: The detection of license plates forced us to prepare an informative for citizens and to define the ownership of their data and their treatment and management modes.
- At the beginning of the measuring campaign, it could be useful for colleagues **to be at the measuring place to present the campaign to interested people or use an explaining brochure in the local language.**

Lessons learnt:

2) Milan campaign management

- **Deployment and demounting:** road closure for EDAR and air quality cabin roadside installation. Coordination with the Local Police of Milan. Strict respect of spaces and times for which the occupations were permitted.
- **Electrical supply:** coordination with the electricians for the **switch on and switch off** of power supply and power connections to EDAR, vans, air quality cabin. Availability to manage unforeseeable power-off situations (twice in Cilea, one on Sunday).
- **Coordination for technical measurements:** in parallel measurements for long periods need continuous update between the different partners (e.g. coordination for PEMS tests in parallel with EDAR, Point Sampling and Air Quality measurements). For optimizing communication, e-mail was an effective tool but also a videocall, several phone calls, chats and on-site meetings were necessary.
- Planning **precise location for the same sampling point for any instrumentation** would facilitate the alignment of the measured emission data (not a secondary issue to be faced).

Lessons learnt:

3) Milan campaign closure

- Safety was effectively guaranteed for pedestrians, drivers, all CARES technicians and researchers and CARES instruments.
- Good measurements datasets were finally obtained by all partners. A lower number of valid measurements achieved (around 34,000 total EDAR+TUG) due to some days with heavy rain, a couple of unforeseen power supply switch-offs in Cilea and interfering plumes in urban canyon.

Lessons learnt: 4) Milan campaign conclusions

The organization and the management of the Milan campaign required extensive efforts made by researchers, technicians and officers. This could be an obstacle for a large-scale deployment of certain types of RES by local authorities.



Next steps

- On-going: Post-processing of emissions measurement data, including quality control
- On-going: Obtaining and linking license plate data from the Italian Ministry for Transport
- Upcoming: Detailed analysis of anonymized data to distill conclusions about emission levels, RES instrument performance and comparability, etc.



CARES

CITY AIR REMOTE EMISSION SENSING



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