



# WP2: The CARES cloud-based database platform, City and Science Apps

**CARES**  
CITY AIR REMOTE EMISSION SENSING

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## CONSORTIUM PARTNERS





# CARES

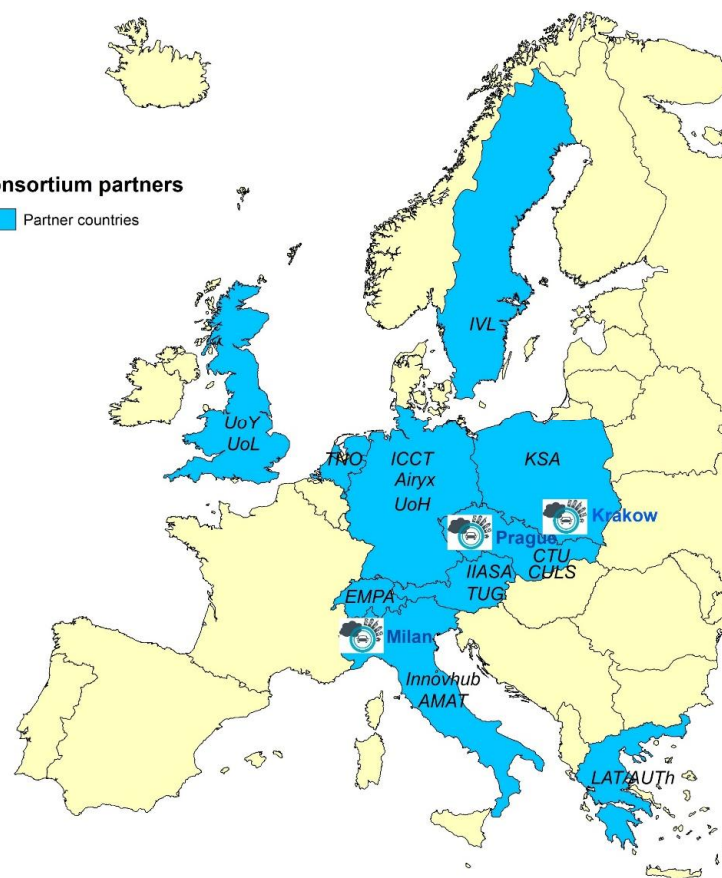
CITY AIR REMOTE EMISSION SENSING

## an H2020 flagship project bringing together remote emission sensing expertise worldwide



Consortium partners

Partner countries



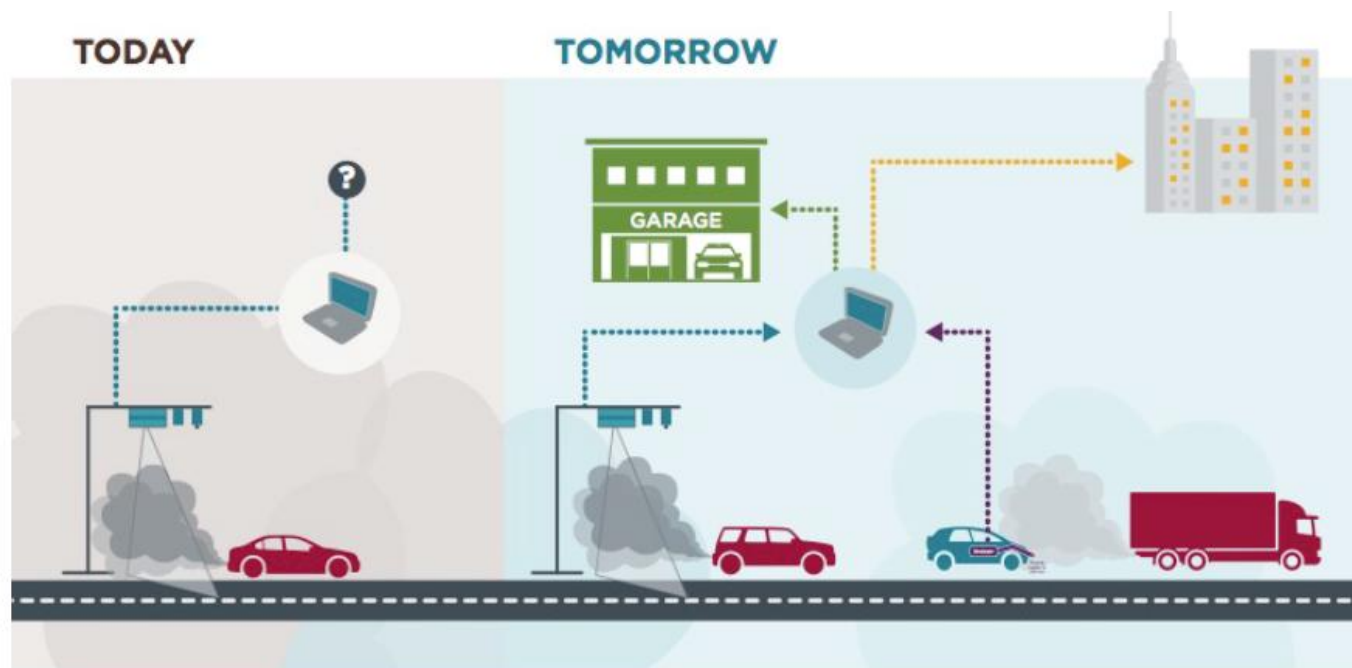
Commercial remote sensing service providers:



# Overall objective



**“Reduce the hurdles for practical applications of remote emission sensing (RES) and to make it a widespread means of both monitoring and enforcing improvements in road vehicle emissions.”**





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# DATA INFRASTRUCTURE

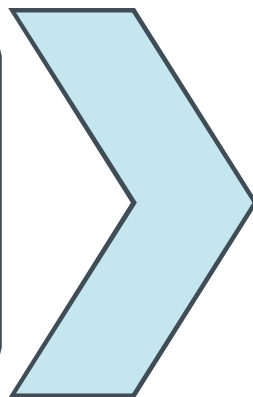
## Current Practice



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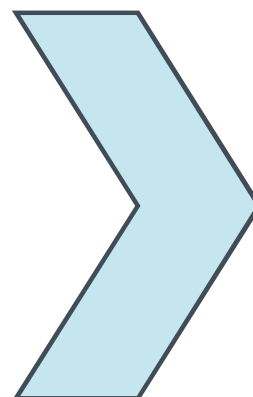
### Measurement Data (Flat):

As provided by commercial RS providers (fixed format?)  
e.g. CSV file format.  
Straight-forward data solution / sharing.



### Relational Database:

Fixed schema forces conformity but lacks flexibility.  
e.g. MySQL is a well understood enterprise level database solution.



### CONOX:

Comprehending  
Combining  
COMparing Real Driving Emissions  
COLlaborating on NOx RDE and Remote Sensing measurements.

RS database Home About Contact

Hello J.E.Tate@its.leeds.ac.uk! Log off

## ERMES Remote Sensing database

1368609 vehicle passages in database

- Manage campaigns
- Manage sites
- Manage instruments
- Manage institutions
- Search VehiclePassages

Borken-Kleefeld, J., Bernard, Y., Carslaw, D., Sjödin, A., Tate, J., Gian-Marco, A., De la Fuente, J., McClintock, P., Gentala, R., Hausberger, S., Jerksjö, M. 2019. Contribution of vehicle remote sensing to in-service/real driving emissions monitoring - CONOX Task 3 report. Commissioned by the Federal Office for the Environment (FOEN), Switzerland.  
[https://www.ivl.se/download/18\\_34244ba71728fcb3f3fa5b/1591705759730/C295.pdf](https://www.ivl.se/download/18_34244ba71728fcb3f3fa5b/1591705759730/C295.pdf) [Accessed 12/05/2021]

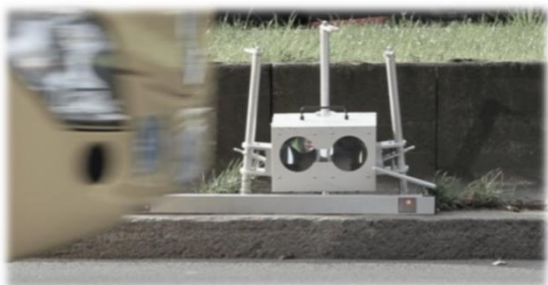


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Remote Sensing



Plume Chasing



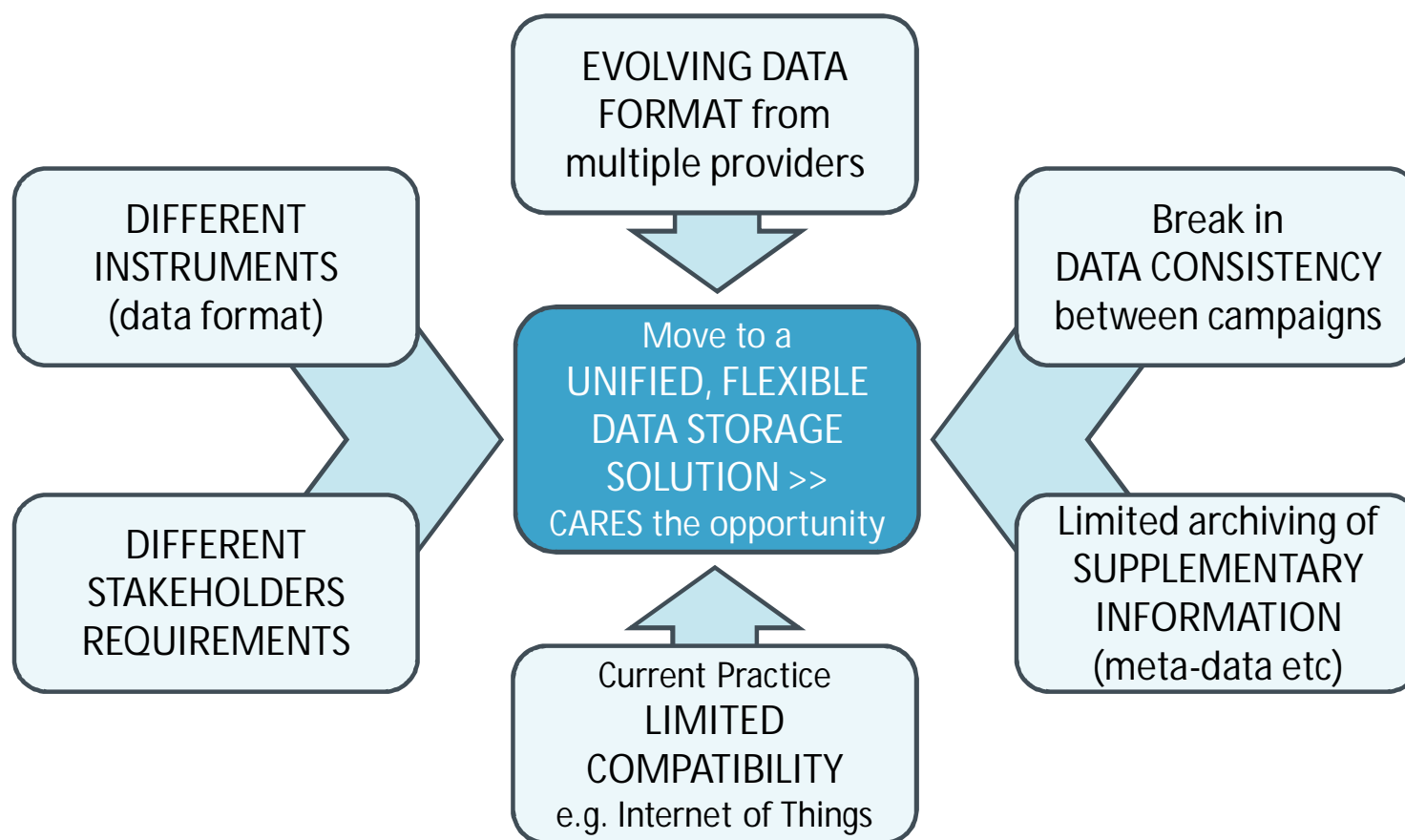
Point Sampling





# DATA INFRASTRUCTURE

## The challenge



# System Overview

- Hidden, encrypted
- Institution Password secure
- Human error
- Least secure

## User's Computer

Project Website:  
Accessed by Office 365 credentials;  
Content specific to user

Analysis scripts, e.g., R:  
Access granted user by user, not preferred  
approach

## Data Devices

Data collected during  
CARES project

Data

Data

Legacy data (e.g.,  
CONOX)

Data

Data

## Secure MS Azure Platform manages access

Secure Virtual Machine

Science  
App

City App

Additional  
apps (tbd)

CARES Database  
(Cosmos DB)

CONOX test set

Test Track  
Experiment

Test City 1  
Experiment

Encrypted database environment



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Putting real-world locally collected data at the heart of decision making

Flexible database that can accept data from a range of sources

Modern cloud-based data platform

Engaging front-end apps for different stakeholders

Managed security and user access

Compatible with established methods

Apps hosted on secure virtual machines, no need to code share

Futureproof database that can adapt to future changes

Integration with PowerBI, Synapse and other big-data tools

IoT capable



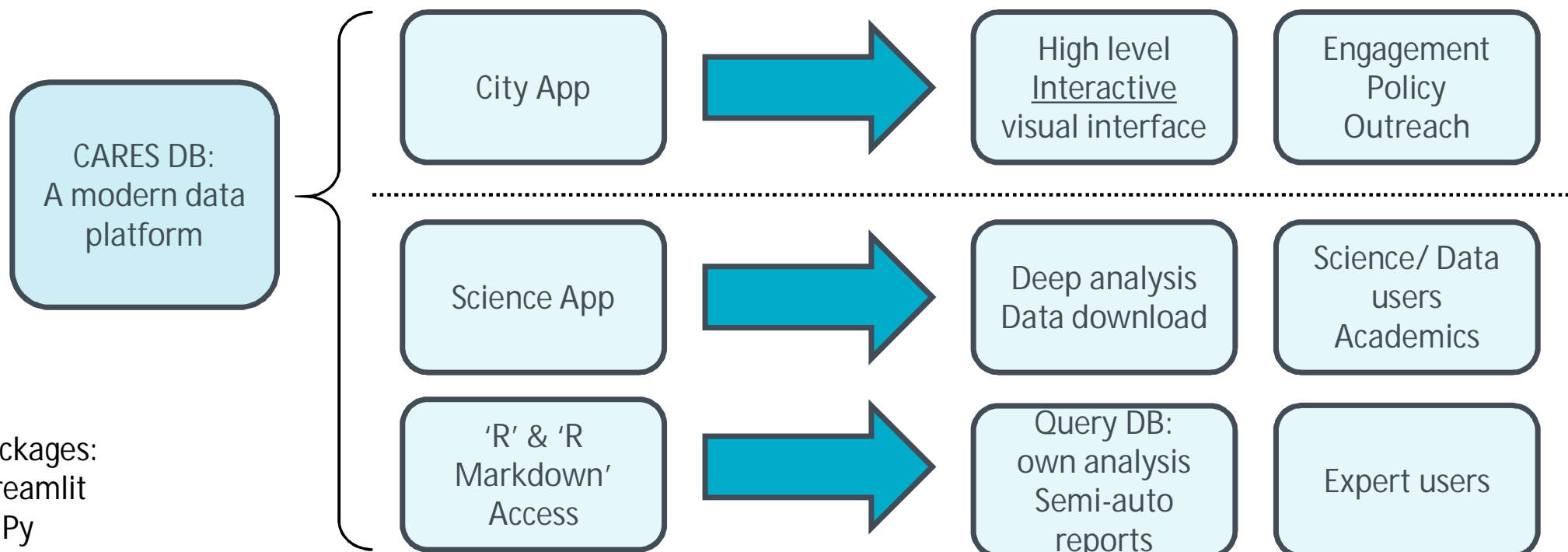


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# Developing New Data Platforms



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Packages:  
Streamlit  
SciPy  
NumPy  
Pandas  
Altair  
Azure.Cosmos



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# City App – Examples (from “LIVE” demo)



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Configuration:

Select Plot Mode

Vehicle Type Filter

Vehicle Fuel Filter

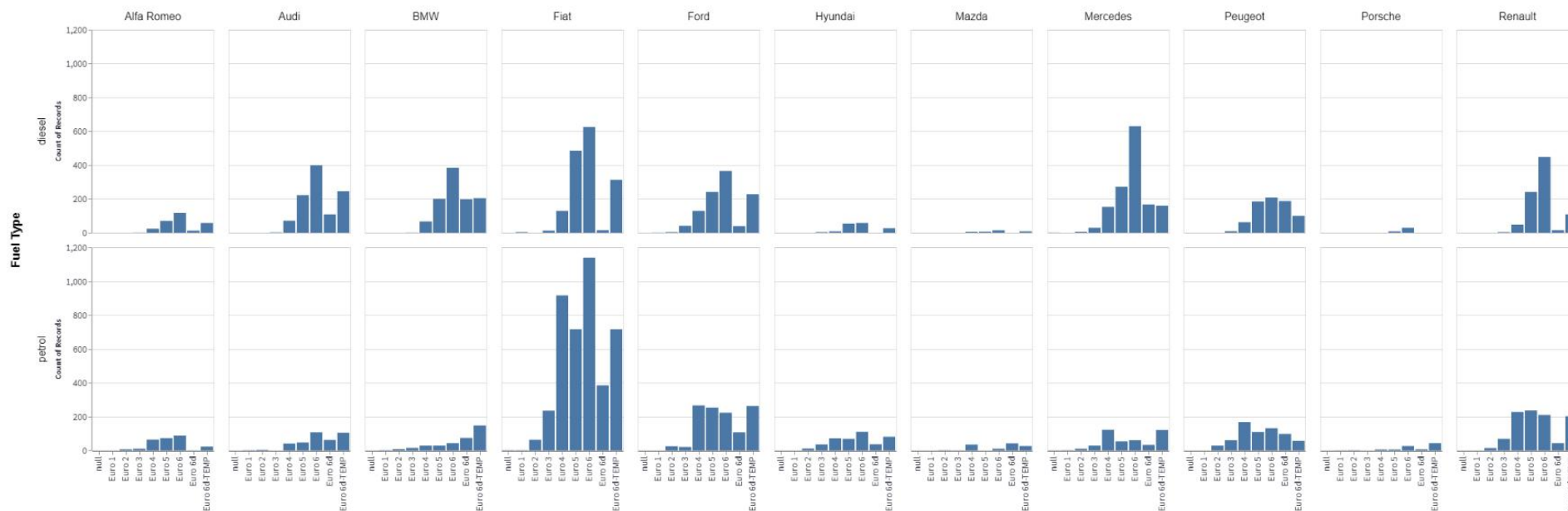
Fleet Breakdown by Manufacturer

Audi x BMW x Fiat x Ford x Mazda x Renault x Peugeot x  
Alfa Romeo x Porsche x Mercedes x Hyundai x

diesel x petrol x

Fleet Breakdown by Manufacturer

Manufacturer / Emission Standard





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# City App – Examples (from “LIVE” demo)



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Select Plot Mode

Vehicle Site Filter

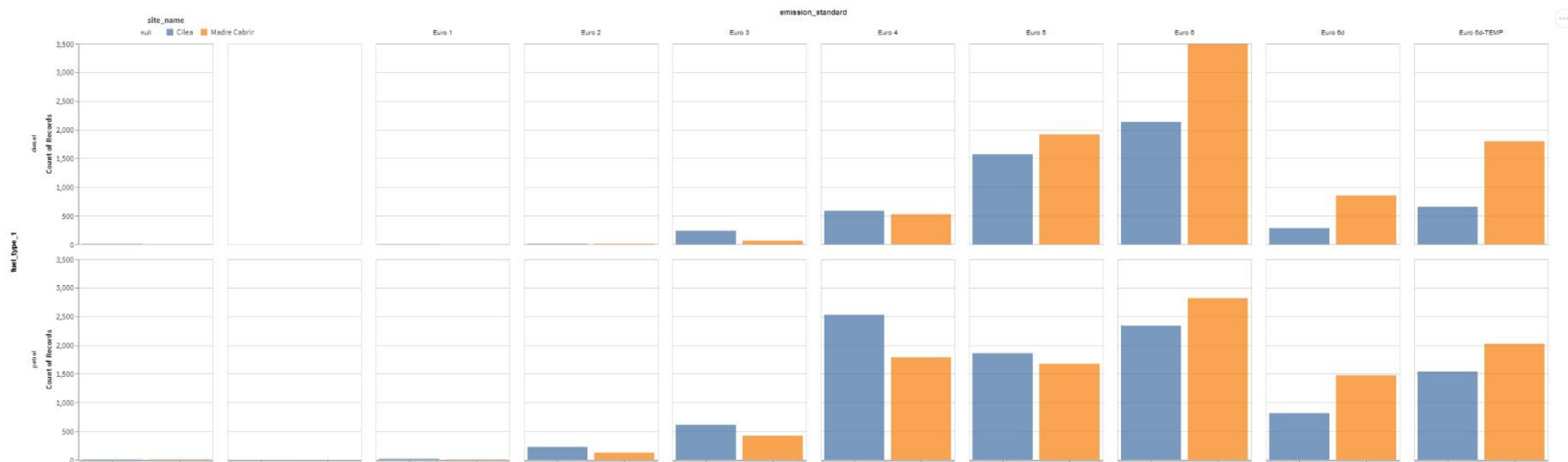
Vehicle Fuel Filter

Fleet Breakdown by Location

Madre Cabrini x Cilea x

diesel x petrol x

Fleet Breakdown by Location





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# City App – Examples (from “LIVE” demo)



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Select Plot Mode

Interactive Fleet Breakdown by Fuel and Euro Class

Vehicle Type Filter

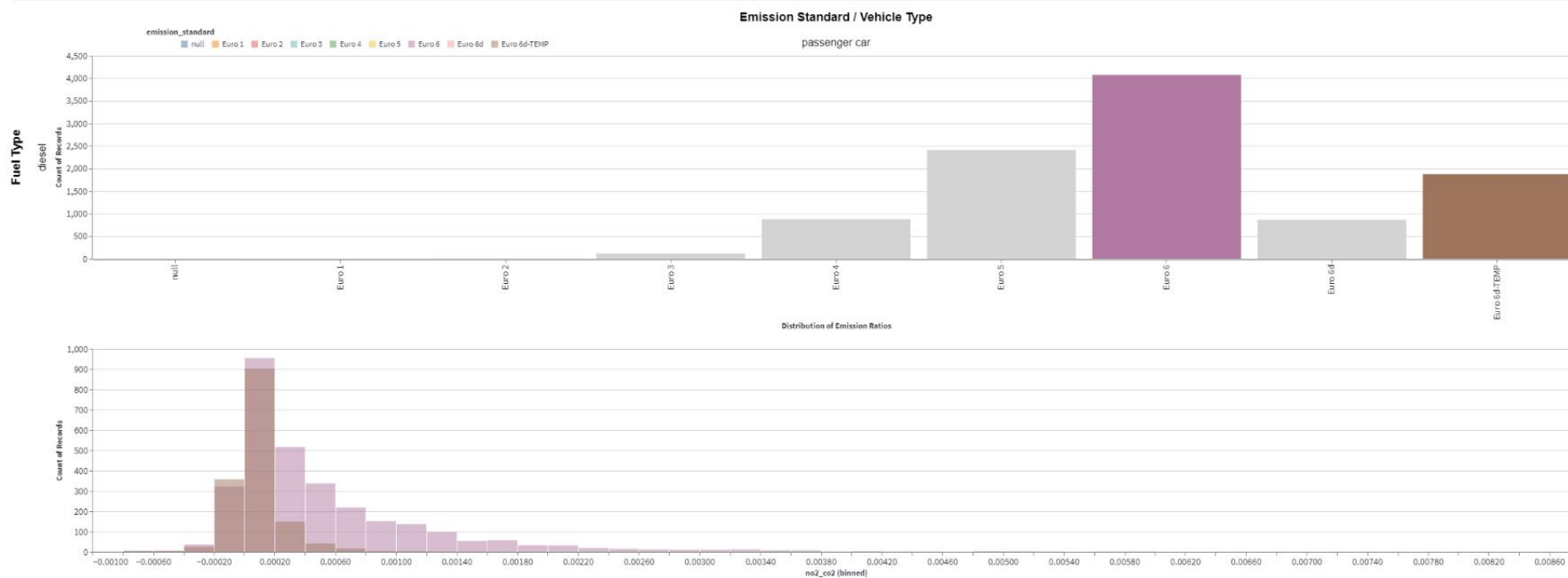
passenger car

Vehicle Fuel Filter

diesel

Select parameter to view in more depth:

no2\_co2





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# Science App – Examples (from “LIVE” demo)



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## Further analysis

Select types for further analysis:

point\_sampling\_data...

Set peak threshold

0.82

Select horizontal separation

5

Select peak width

3

## Peak analysis for point\_sampling\_data\_co2\_ppm

Peak analysis is performed using the SCIPY package

	Index	Peak Width	Normalised Width Value	Peak Start	Peak End	Peak Centre	Human Date Time	TIMESTAMP_MS
0	0	10.1556	0.8055	23.6027	33.7583	32	2021-06-22 11:13:02	1,624,360,382,000.0000
1	1	6.5544	0.8095	58.1289	64.6833	60	2021-06-22 11:13:30	1,624,360,410,000.0000
2	2	13.2121	0.8072	80.0298	93.2419	86	2021-06-22 11:13:56	1,624,360,436,000.0000
3	3	5.7240	0.8049	112.1004	117.8244	114	2021-06-22 11:14:24	1,624,360,464,000.0000
4	4	5.2392	0.8232	139.1693	144.4085	140	2021-06-22 11:14:50	1,624,360,490,000.0000

## Background analysis

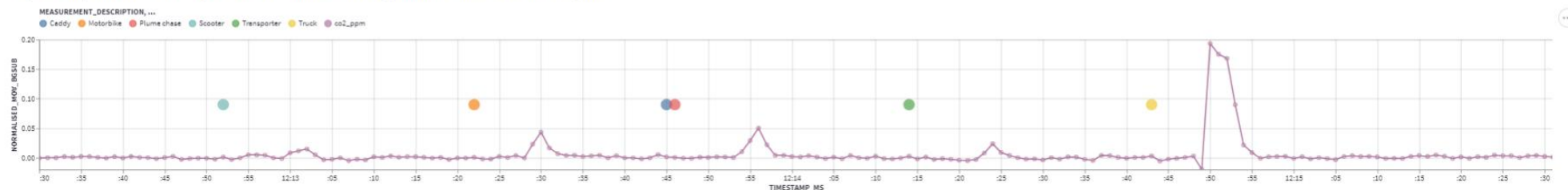
The local background value is calculated using values that are not part of a peak. The values selected for calculating the background are shown below:

[...]

The mean value of the background values is 0.80674 and the standard deviation of the background is 0.00198

## Plot for type point\_sampling\_data\_co2\_ppm

The y-axis of this plot has been normalised against its local maximum value and a background subtraction of 0.807 has also been applied





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## OUTLOOK



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PROGRESS	DEVELOPMENT
Proof of concept of cloud-based DB technology & administration (£)	Expand data sets & users: seek feedback
Demonstrated multiple technologies in the field	Investigate potential of IOT, PowerBI and other modern ways of working
Understanding the potential of new platforms and methods	Expand capabilities and features of apps



Thank you for your attention!  
**For more information**

- Check our website: <https://cares-project.eu>
- Follow us:



<https://www.linkedin.com/company/city-air-remote-emission-sensing-cares>

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