bettair®

Mapping Air Quality

4t Congrés Qualitat de l'aire

Josep Perello
CEO and Co-founder
jperello@bettaircities.com
+34 678478856

Francisco Ramírez
Lead Scientist
framirez@bettaircities.com
+34 685617817

https://bettaircities.com

Accurate air pollution mapping on a previously unimaginable scale

Outstanding accurate air pollution data

Artificial Intelligence algorithms trained during years in multiple cities for maximum accuracy.
+3M€ Intellectual property investment.

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Mapping Air Quality

Data gathering ➡ Auto calibrated AQM + Cartridge Design ➡ Artificial Intelligence ➡ SaaS

Raw Sensor Data

- Temperature
- Atmospheric Pressure
- Relative Humidity
- Air Pollutants…
  - NO_2, O_3, NO, CO, SO_2
  - H_2S, VOC, NH_3
  - Particulate Matter
    - PM_1, $PM_{2.5}$, PM_{10}
  - Greenhouse Gases
    - CO_2
- Ambient Noise

All sensors inside an easy to replace cartridge

Post processing Algorithm
2 years without calibration

Machine Learning Techniques

Accuracy according to CEN/TS 17660-1:2022 Class-1

Air quality - Performance evaluation of air quality sensor systems - Part 1: Gaseous pollutants in ambient air

Low cost Air Quality Monitoring **Platform**

Data insights
Air quality maps
Air pollution forecast
Citizen Mobile apps

Easy-to-use SW Platform

Easy access to the air quality data by means of an online dashboard (or by API)

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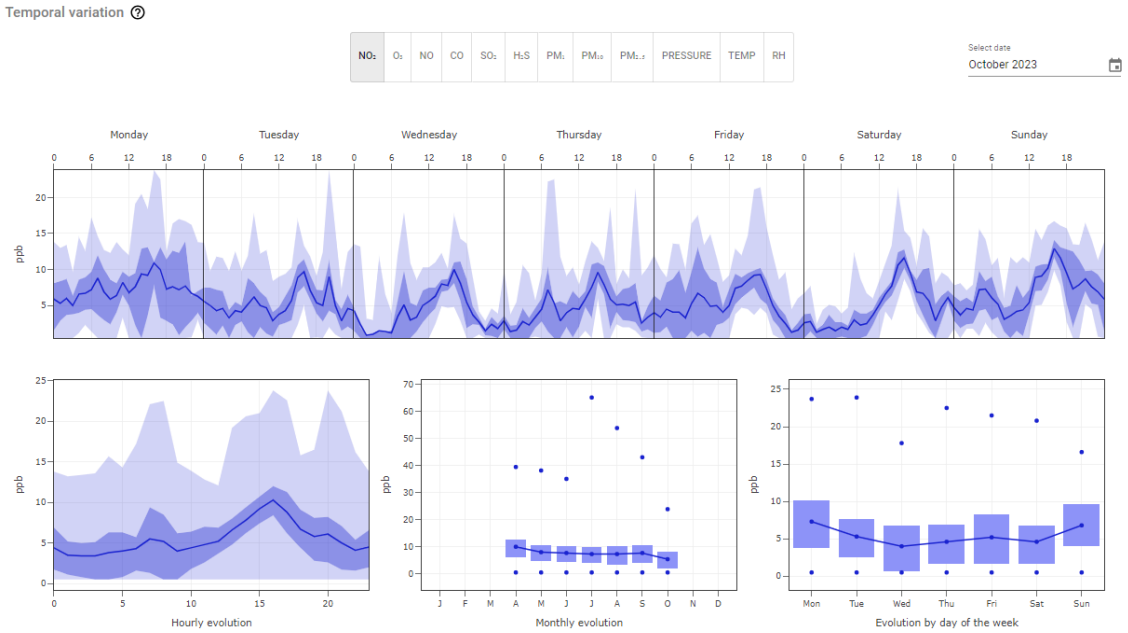

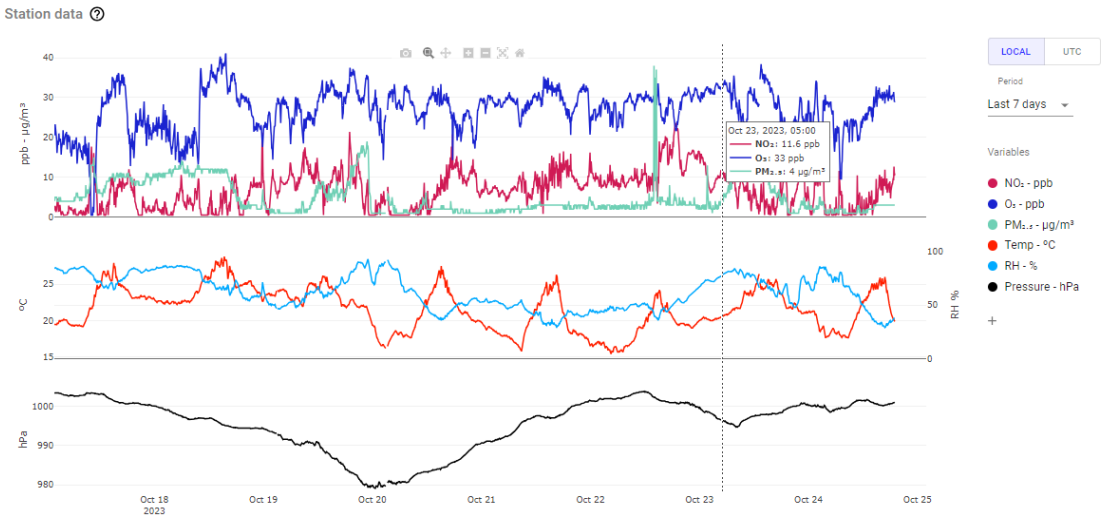

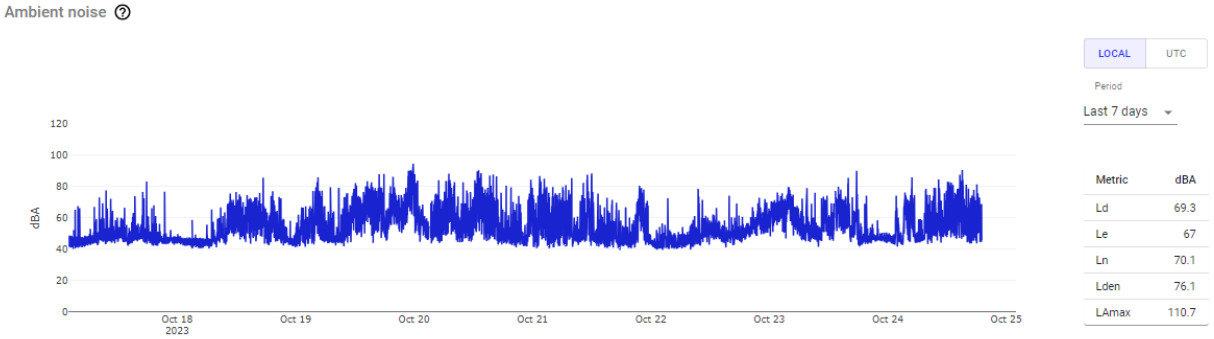

Automatic reports

Possibility to generate unlimited number of automatic reports detailing the pollution

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Legal thresholds

Table 4 shows the exceedances of the limits established by RD102/2011, RD1052/2022 and RD34/2023 for each station. It is important to consider that all calculations are made from the data included in the report period (1 August 2025 - 9 October 2025).

The limits applied to each contaminant are detailed in the table 3.

Table 3: Limit information RD102/2011, RD1052/2022 and RD34/2023

Limit	ZBE	Type	Threshold	Annual limit
NO_2 HLV	Yes	Hourly average limit exceedances	200 µg/m³	18 times
NO_2 ALV	Yes	Annual average value	40 µg/m³	-
PM10 DLV	Yes	Daily average limit exceedances	50 µg/m³	35 times
PM10 ALV	Yes	Annual average value	40 µg/m³	-
PM2.5 ALV	Yes	Annual average value	25 µg/m³	-
SO_2 HLV	No	Hourly average limit exceedances	350 µg/m³	24 times
SO_2 DLV	No	Daily average limit exceedances	125 µg/m³	3 times
CO LV	No	Exceedances of daily maximum moving average 8h	10 mg/m³	1 time
O_3 LV	No	Exceedances of daily maximum moving average 8h	120 µg/m³	25 times

Table 4: Mean values and exceedances of the limits established by RD102/2011, RD1052/2022 and RD34/2023

Station	NO_2 HLV	NO_2 ALV	PM10 DLV	PM10 ALV	PM2.5 ALV	SO_2 HLV	SO_2 DLV	CO LV	O_3 LV
BET00240013	0	31 µg/m³	0	8 µg/m³	7 µg/m³	0	0	0	0

Sensor NO_2

The mean concentration of NO_2 at station BET00240013 for the period August 1, 2025 - October 9, 2025 was 31 µg/m³ and the maximum hourly concentration recorded was 97.7 µg/m³, (more statistic can be found at table 8). Figure 8 shows the trend charts of sensor NO_2. Figure 9 shows the trend charts of sensor NO_2. Figure 10 shows the time series of NO_2 in daily grouping.

Table 8: hourly statistics of the sensor NO2 of the station BET00240013

Min	Percentile 25	Mean	Percentile 75	Max
10.7 µg/m³	23.3 µg/m³	31 µg/m³	36.4 µg/m³	97.7 µg/m³

Figure 8: Data trends of NO_2 station BET00240013 in station time zone (Europe/Madrid)

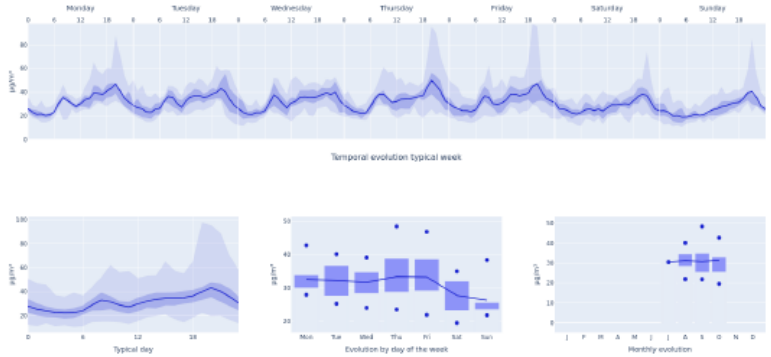


Figure 9: Pollution Rose of sensor NO_2 station BET00240013

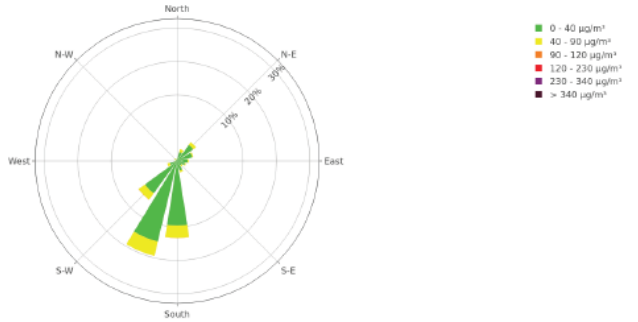
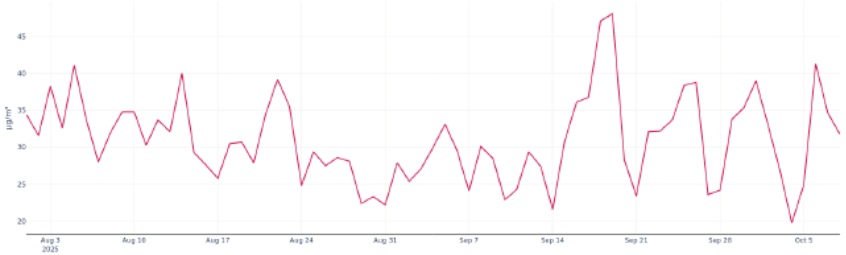


Figure 10: daily average of NO_2 station BET00240013 in Europe/Madrid time zone



Our master distributor – dnota medioambiente

dnota medioambiente is a National Accreditation entity that can homologate equipment

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Mapping Air Quality

d·nota

ENAC
Entidad Nacional de Acreditación

Distributors of **premium brands** of traditional equipment with offices in Barcelona and Madrid.

Thermo SCIENTIFIC Synspec b.v. DIGITEL enviro-sense

They **build up traditional Air Quality Monitoring** (AQM) stations in several regions in Spain and they are also **in charge of the maintenance** of these AQM stations.

The group also possess an **environmental lab in Canada.** H²Lab

Dnota medioambiente (Oscar Navarro – Managing Director):
"We had been testing different devices for years and we were impressed with the precision, accuracy and repeatability of the bettair® technology, which does not require any type of on-site calibration or maintenance during the lifetime of the sensing cartridge"

bettair® Accuracy

Co-location test leaded by recognised third parties

WINNER
Most accurate multi-pollutant sensor
Outdoor - Overall
2023

WINNER
Best accuracy for ozone
Outdoor - Overall
2021-2023

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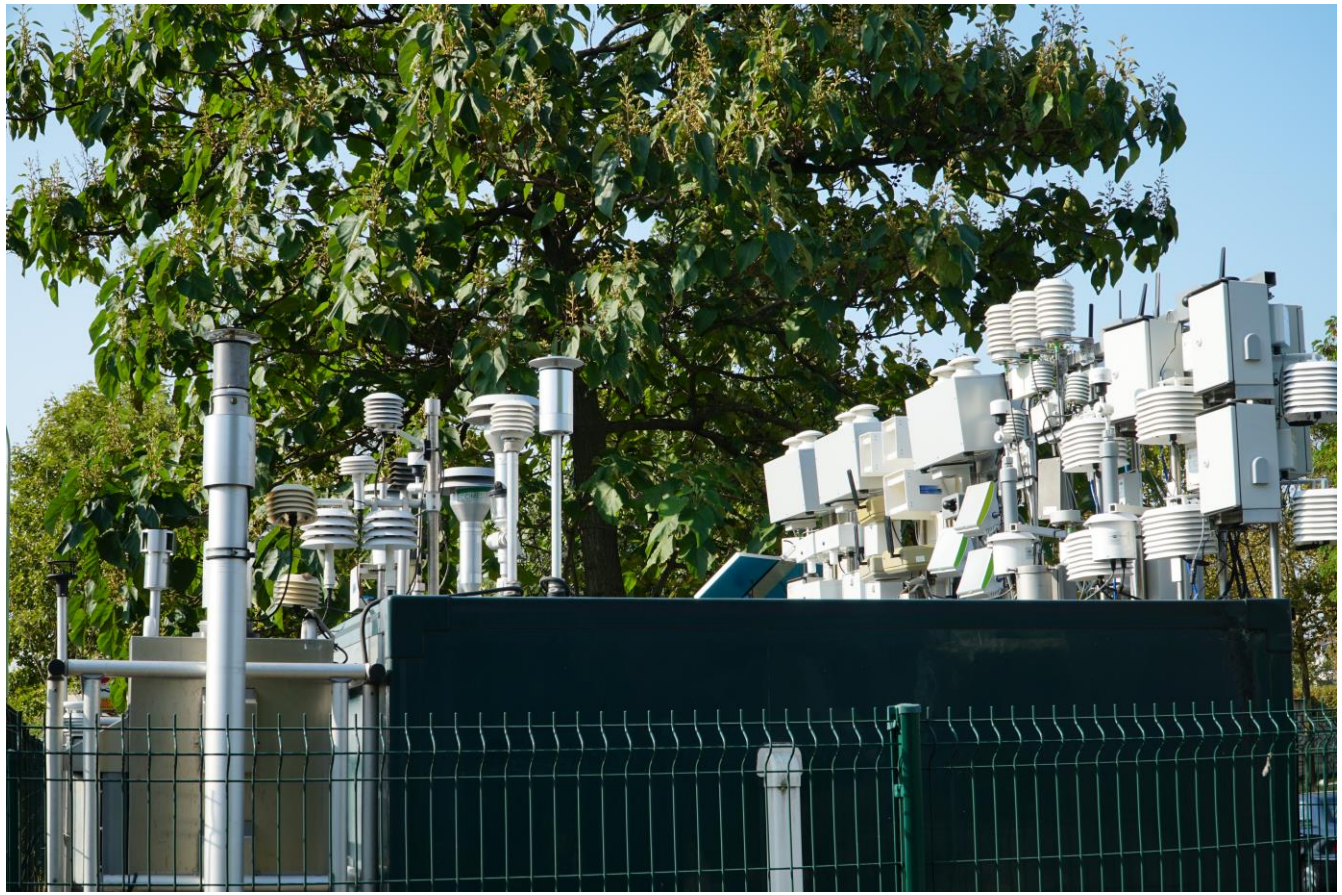
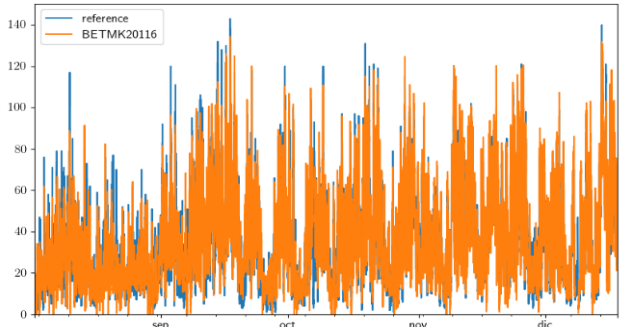
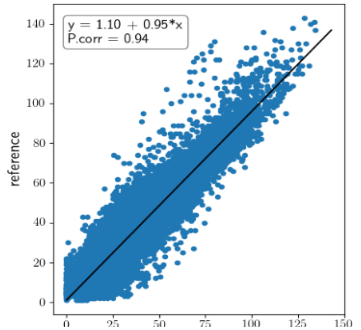
UNIVERSITY OF CAMBRIDGE
Diputació Barcelona
AIRLAB SOLUTIONS POUR NOTRE AIR
d·nota
SGS

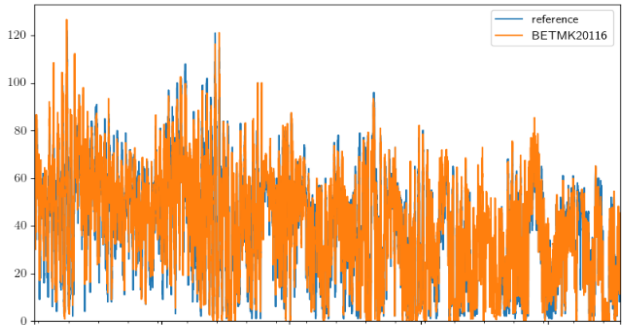


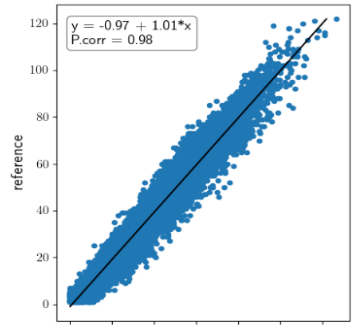
NO2





O3





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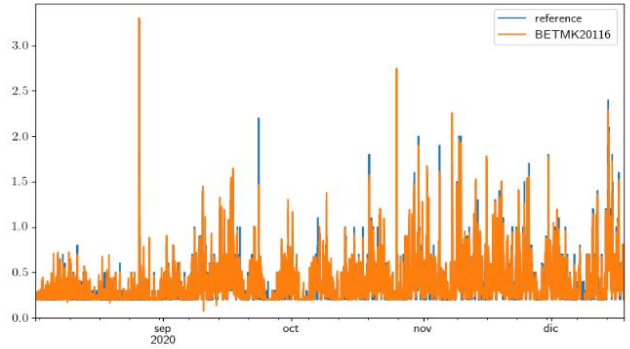

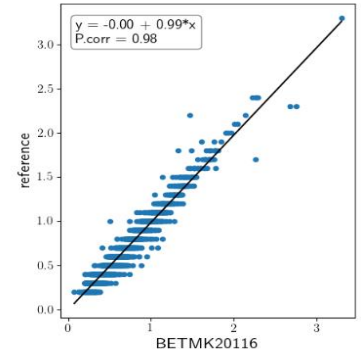

Who trust us

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Mapping Air Quality

Organismos

Ajuntament de Llinars del Vallès
Ayuntamiento de Málaga
SPQR ROMA CAPITALE
Ajuntament de Girona
Diputació Barcelona xarxa de municipis
Ajuntament de Palau-solità i Plegamans
Ajuntament de Montcada i Reixac
Ajuntament de Castelldefels
Ayuntamiento de BAENA
Ajuntament de L'Hospitalet
AJUNTAMENT DE SantCugat
Ajuntament de Dosrius
Port Tarragona
Viladecans
Ajuntament de Manlleu
Ajuntament de Mollet del Vallès
Ajuntament del Prat de Llobregat
Comune di Pordenone

Empresas

CONSTRUCCIONES RUBAU
d·nota
SGS
etra
Omniflow
ADTEL
ControlCat seguretat intel·ligent
nexusgeographics MAPPING YOUR WORLD
CospLaan CONSTRUIMOS GRANDES IDEAS
ROGASA
RACC
trafficnow

Case studies - Sectors

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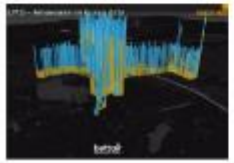
	Sector	Aplications
	**Regulatory Networks**	Hybrid & Near-regulatory compliance, urban planning, identifying air pollution problems, severity assessment
	**Urban & Mobility**	Second & third tier cities, health & communities, Low Emission Zones (LEZs), Turistic destinations, urban hotspots, Sustainable Development, Intelligent Traffic Systems (ITS)
	**Infrastructures, Ports & Airports**	Emission monitoring, bulk & cargo handling, pollutant dispersion tracking, sustainable investments & electrification, tunnels
	**Construction & Development**	Impact assesment, Monitoring dust & particulate matter emissions, ensuring compliance, Health & Safety, land use zoning
	**Mining & Extractive**	Particulate matter impact assement & mitigation, NO_2, CO_2 emissions, evaluating air quality improvements post-interventions

	Sector	Aplications
	**Waste & Odours**	Odour impact assesment & management, particulate control around waste facilities, landfills, public awareness, complaint management
	**Industry & Agrifood**	Odour, toxic, & greenhouse gases, emissions, informing building codes, permitting processes
	**Oil & Gas**	Monitoring VOCs, methane leaks, implementing emergency public health interventions
	**Research & Consultancy**	Providing hyperlocal air quality data for environmental studies, urban planning, assessing air quality pre- and post-policy interventions

Balearic Island Hybrid Regulatory Network

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Mapping Air Quality

Balearic Island Hybrid Regulatory Network

Stakeholders: dnota | Govern Illes Balears | City of Palma LEZ operator
Sector: Regulatory Networks

Challenge

The Air Quality Control Agency of Balearic Islands needed to start learning how to enhance their existing network to align with the new Best Available Technology (BAT) and upcoming European Ambient Air Quality Directive.

Their goal was to implement a hybrid system combining reference-grade monitoring stations with advanced sensor technology to expand coverage, maintain data accuracy, and support urban protection initiatives, including the upcoming Low Emission Zone (LEZ) in Palma de Mallorca.

Context

- Hybrid network: 8 AQMS + 10 Bettair nodes.
- Supports LEZ starting Jan 2025.
- Meets CEN/TS 17660-1:2021 standards for indicative gas monitoring accuracy.

Solution

To enhance the network, dnota deployed 10 Bettair nodes around Palma de Mallorca's historic center. These nodes monitor pollutants such as NO_2, NO, O_3, CO, PM_1, $PM_{2.5}$, and PM_{10}, as well as temperature, humidity, and pressure.

Strategically placed, the nodes improve spatial coverage and align with the European Ambient Air Quality Directive by delivering data with indicative monitoring accuracy.

Regular co-location tests with reference stations confirmed performance, with metrics like ozone uncertainty below 25% and R^2 above 0.85.

This hybrid setup bridges high-accuracy reference stations and affordable sensors, supporting urban protection initiatives, particularly the LEZ.

Additionally, a Bettair node was installed at Palma de Mallorca Airport for broader coverage.

Technologies

Bettair node


Bettair Platform

Bettair API

Outcomes

The project established the Balearic Islands as a pioneer in hybrid air quality monitoring. This aligns with European regulations and supports the LEZ deployment in the Palma de Mallorca.

Given the Mediterranean's vulnerability to high tropospheric ozone levels, regional authorities are required to adopt improvement plans. Co-location tests confirmed Bettair nodes' reliability, with ozone uncertainties below 25% and R^2 above 0.85 - those of Class1 and indicative requirements.

The system meets indicative standards and provides a cost-effective solution for urban air quality monitoring, positioning the region as a leader in sustainable urban management.

More Information

- Data from campaign executed with bettair nodes: https://www.caib.es/sites/atmosfera/es/campanas_con_equipos_electrometricos
- Balearic Islands' efforts to manage ozone pollution, https://www.caib.es/sites/atmosfera/es/plan_de_ozono_de_las_illes_balears/

Var	O3	O3
Q	Q3-2023	Q1-202
pearson	0.92	0.94
r2	0.84	0.88
R2	0.84	0.86
rmse	8.83	9.81
mean_bias	-0.09	3.7
median_bias	0.54	2.96
slope_CEN	0.91	0.83
intercept_CEN	4.37	4.93
xp_uncertainty	22.17	34.22
CEN_class_out	1	1

Related projects

Bettair has empowered 80+ cities, ITS operators and LEZs worldwide with indicative air quality solutions, including Rome (Italy), Montreal (Canada), Novi Sad (Serbia), Swansea (UK), Lüdenscheid (Germany), and Barcelona (Spain).

Project details

Dates:	2023
Location:	Palma de Mallorca, Spain
Sector:	Regulatory Networks
Customer:	Dnota (as system intergator)
Final Users:	Govern de les Illes Balears
Products:	10 x Nodes, SaaS Platform, Wind Sensor, API
Parameters:	• NO2, NO, NOx, CO, O3 ppb • PM1, PM2.5, PM10 ugr/m2 • Noise, Temperature, Humidity, Pressure

Govern de les Illes Balears
Conselleria d'Empresa, Ocupació i Energia
d·nota

Municipality of L'Hospitalet de Llobregat - LEZ

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CASE STUDY

#Urban #AirQuality #LEZ #SustainableMobility #ITS

Accurate data for Low Emission Zone (LEZ) in Hospitalet

Stakeholders: ADTEL | Hospitalet de Llobregat
Sector: Urban

Challenge

L'Hospitalet de Llobregat faced increasing air quality issues exacerbated by urban density, heavy traffic, losgitics and industrial activity.

Despite having several regulatory Air Quality Monitoring Stations (AQMS), the city lacked granular, localized environmental data essential for pinpointing pollution hotspots and implementing precise climate adaptation strategies.

Moreover, a new regulation obliged the city to design and deploy a Low Emission Zone (LEZ).

Context

L'Hospitalet is located SouthWest, of Barcelona's, at the acess from Madrid and Valencia. It faces high pollution from passing vehicles. And it's also a logistics hub for the nearby port, airport and industrial areas.

Solution

Adtel, a Spanish company specializing in telecommunications, was awarded the tender for supplying and installing technological elements necessary for the full deployment of the Low Emission Zone (LEZ) in L'Hospitalet. To address the need for accurate and real time Air Quality data, Adtel partnered with Bettair to deploy more than 40 IoT-based sensors across the city.

These sensors provide real-time, high-resolution data compliant with CEN TS 17660, on pollutants such as nitrogen dioxide (NO_2), nitric oxide (NO), nitrogen oxides (NO_x), carbon monoxide (CO), ozone (O_3), sulfur dioxide (SO_2), and hydrogen sulfide (H_2S) in parts per billion (ppb). They also monitor particulate matter (PM_1, $PM_{2.5}$, PM_{10} in $\mu g/m^3$), as well as environmental parameters including noise levels, temperature, humidity, and atmospheric pressure.

The project includes the integration of data into the city's intelligent traffic system through the Bettair API, complementing another 20+ Bettair sensors in public buildings, climate shelters and spaces like schools, ensuring comprehensive environmental monitoring.

Technologies


Bettair node


Bettair Platform


Wind Sensor

Bettair API

Outcomes

This comprehensive monitoring approach enabled the city to implement informed policies promoting sustainability and urban resilience.

Bettair's sensors helped identify and mitigate air quality risks, enabling the city to optimize urban mobility plans and improve public health outcomes. And the high-precision data facilitated the enforcement of Low Emission Zones (LEZ), reducing vehicular emissions.

Additionally, the city enhanced its network of climate shelters, contributing to increased urban resilience. L'Hospitalet has since become a benchmark for integrating smart air quality technologies into municipal governance and urban planning.

More Information

Discover how other European capitals are managing their LEZs: London Ultra LEZ, Madrid Central, Brussels LEZ

Related projects

Bettair has empowered 80+ cities, ITS operators and LEZs worldwide with indicative air quality solutions, including Rome (Italy), Montreal (Canada), Novi Sad (Serbia), Swansea (UK), Lüdenscheid (Germany), and Barcelona (Spain).

Project details

Dates:	2023
Location:	Hospitalet de Llobregat, Spain
Sector:	Urban
Customer:	Adtel
Final Users:	Hospitalet de Llobregat
Products:	40 x Nodes, SaaS Platform, Wind Sensor, API
Parameters:	• NO2, NO, NOx, CO, O3, SO2, H2S ppb • PMI, PM2.5, PMI0 ugr/m2 • Noise, Temperature, Humidity, Pressure

Ajuntament de L'Hospitalet

ADTEL

Municipality of Novi Sad (RS) – Urban & Mobility

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CASE STUDY

#NoviSad #Hyperlocal #SmartCity #SustainableCity #API

Massive hyperlocal deployment at Novi Sad

Stakeholders: City of Novisad | DunavNET | NoviSad Institute for Public Health
Sector: Urban & Mobility

Challenge

Novi Sad, Serbia's second-largest city, faces rising air pollution due to urban growth, traffic, residential heating, and nearby power plants.

With the goal of improving public health and urban sustainability, the city needed a robust air quality monitoring system.

The system had to be integrated in the Smart City platform. And would capture hyperlocal data to guide evidence-based policies aimed at reducing pollution and protecting its growing population.

Context

- Part of a national strategy to improve Air Quality
- 80 Bettair nodes across critical zones
- Integrated with DunavNET's IoT platform

Solution

To address growing air pollution, Novi Sad deployed 80 Bettair nodes in two phases, with 40 already installed in key areas such as the historic center, major traffic routes, and suburban neighborhoods. These locations were strategically selected to capture hyperlocal air quality data in areas with high public interaction and pollution exposure:

- Historic Center: I high road traffic areas, such as hospitals, schools, universities.
- Urban Ingress and Egress Routes: Key access routes, where vehicle traffic is dense.
- Outlying Residential Areas: Nodes were installed in suburban neighborhoods.

The data, managed through DunavNET's secure Smart City IoT platform, offers comprehensive insights into pollution sources like traffic emissions, coal-based residential heating, and power generation.

This hyperlocal monitoring system empowers city authorities to develop targeted strategies such as promoting electric vehicles, upgrading heating systems, and collaborating with power plants to reduce emissions.

Technologies

Bettair node


Bettair Platform

Bettair API

Outcomes

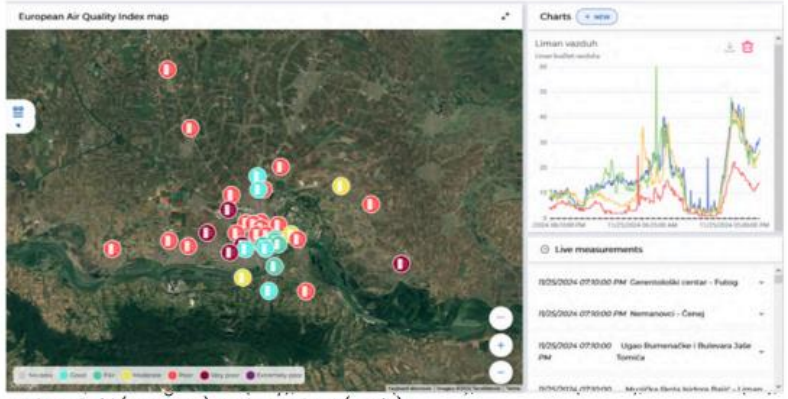
Established Novi Sad as a regional leader in Smart City initiatives and air quality innovation:

- Empowered authorities to implement data-driven policies and targeted interventions for emissions reduction in traffic, heating systems, and power plants.
- Marked the first instance of hyperlocal air quality sensor deployment in Serbia, setting a benchmark for other European cities.
- Strengthened citizen well-being and environmental awareness by addressing pollution challenges.

Open data plans in phase two will further increase transparency, foster innovation, and support long-term sustainability goals.

Testimonials

"We're pleased with our purchase of 80 air quality monitoring devices from Bettair. The devices are working well, meeting our needs, and have been a great addition to our air quality monitoring efforts." Dejan Drajic's, Senior Researcher, DNET Lab at DunavNET



Lüdenscheid (Germany), and Barcelona (Spain).

Project details

Dates:	2023
Location:	Novi Sad, Serbia
Sector:	Urban
Customer:	Dunav NET
Final Users:	City of Novi Sad
Products:	80 x Nodes, SaaS Platform, Wind Sensor, API
Parameters:	• NO2, NO, NOx, CO, O3, SO2 ppb • PM1, PM2.5, PM10 ugr/m2 • Noise, Temperature, Humidity, Pressure

Град Нови Сад
City of Novi Sad

DUNAV NET

Municipality of Lüdenscheid (DE) – Urban & Mobility

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CASE STUDY

#Lüdenscheid #DKV #ITS #SmartCity #SustainableCity #API

Supporting Lüdenscheid´s sustainable mobility initiative

Stakeholders: City of Lüdenscheid | DKV | Enervie Service | MCZ | dnota
Sector: Urban & Mobility

Challenge

Lüdenscheid, Germany, aimed to improve urban mobility and sustainability through digitalization. As part of the "Digitalization of Municipal Traffic Systems" (DKV) funding program, the city needed to deploy an integrated network of sensors for air quality, weather, and traffic monitoring. Bettair nodes were chosen to provide high-resolution data for pollutants and environmental conditions in real-time, enhancing decision-making capabilities.

Context

- Part of a big LoRaWAN network environment together with other sensors (weather, traffic, etc.)
- Project Funded by DKV to monitor air quality of the

Solution

As part of Lüdenscheid's urban digitalization initiative, 15 Bettair nodes were deployed within a LoRaWAN environment alongside weather and traffic sensors.

These calibration-free nodes monitor NO_2, O_3, NO, CO, PM_1, $PM_{2.5}$, PM_{10}, temperature, humidity, pressure, and noise pollution. The Bettair Cloud Platform provides the city with user-friendly visualizations and real-time analytics, enabling effective traffic management and environmental interventions.

The integration of Bettair nodes into a larger smart city network ensures a holistic approach to urban mobility, offering insights not only on air quality but also on traffic patterns and weather conditions. This comprehensive system supports Lüdenscheid's goal of enhancing urban life through sustainable and data-driven solutions.

Technologies


Bettair node


Bettair Platform

Bettair API

Outcomes

The deployment of Bettair nodes in Lüdenscheid delivered impactful results:

- Established a comprehensive monitoring system for air quality, traffic, and weather conditions.
- Provided real-time, high-resolution data on pollutants such as NO_2, O_3, and particulate matter.
- Enhanced traffic management capabilities with integrated environmental insights.
- Leveraged LoRaWAN technology for efficient, large-scale data collection and processing.

This project, funded by the DKV program, exemplifies how cities can adopt smart technology to address air quality challenges and improve urban mobility.

Did you know that

A Carbon-Neutral Factory in Lüdenscheid: In 2020, ABB opened its first carbon-neutral factory in Lüdenscheid. This facility features: 3,500 sqm of rooftop solar panels generating 1,100MWh of clean power annually; A co-generation plant; A 200kW battery storage system; The ability to generate 14% more energy than it consumes. More info

Related projects

Bettair has empowered 80+ cities, ITS operators and LEZs worldwide with indicative air quality solutions, including Rome (Italy), Montreal (Canada), Novi Sad (Serbia), Swansea (UK), Lüdenscheid (Germany), and Barcelona (Spain).

Project details

Dates:	2023
Location:	Lüdenscheid, Germany
Sector:	Urban
Customer:	MCZ, Enervie Service (ITS)
Final Users:	City of Lüdenscheid, Germany
Products:	15 x Nodes, SaaS Platform, API
Parameters:	• NO2, O3, NO, CO ppb • PMI, PM2.5, PMI0 ugr/m2 • Noise, Temperature, Humidity, Pressure

DKV · Stadt Lüdenscheid · Enervie Service · MCZ Umwelttechnik · a·nota

Municipality of Las Rozas – Urban & Mobility

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#UrbanAirQuality #SmartCities #IoTSensors #AirQualityMonitoring

CASE STUDY

Enhancing Air Quality in Las Rozas

Stakeholders: Municipality of Las Rozas de Madrid | dnota
Sector: Urban & Mobility

Challenge

Las Rozas de Madrid, a vibrant municipality near Spain's capital, faces air quality challenges due to urban growth and increased vehicular traffic. To safeguard public health and maintain environmental standards, the city required a precise, real-time air quality monitoring system capable of identifying pollution hotspots and informing policy decisions.

Context

- Urbanization: 100k inhabitants growing city, traffic emissions rise.
- Seasonal Pollution Variability: Winter PM, summer ozone concerns.

Solution

In November 2024, dnota was awarded a project to implement Bettair IoT air quality sensors throughout Las Rozas. These state-of-the-art sensors provide real-time data on key pollutants, including $PM_{2.5}$ and PM_{10} particles.

The compact design ensures seamless integration with existing urban infrastructure. The deployment also includes upgrading the city's monitoring network's software and hardware systems, ensuring accurate data collection and real-time analysis.

The work also includes upgrading the software and hardware systems used in the monitoring network. This will ensure that the data collected is accurate and available for analysis in real time. This is essential to ensure a timely response to any increase in pollution levels. This ensures the health and well-being of airport staff and passengers.

Technologies

Bettair node


Bettair Platform

Bettair API

Outcomes

The implementation of Bettair® sensors has empowered Las Rozas to:

- Identify Pollution Hotspots: Enabling targeted interventions to reduce emissions.
- Enhance Urban Planning: Incorporate air quality data into development strategies.
- Promote Public Health: Provide residents with information to minimize exposure to pollutants.
- Strengthen Environmental Policies: Base regulations on accurate, real-time data.

By leveraging advanced IoT technology and real-time data analytics, Las Rozas de Madrid is taking significant strides toward ensuring a healthier environment for its residents and setting a precedent for smart city initiatives worldwide.

More info

Discover this and other projects by dnota

https://www.dnota.com/en/sensors-intelligent-cities-air-quality-in-rozas/

Related projects

Bettair has empowered 80+ cities, ITS operators and LEZs worldwide with indicative air quality solutions, including Rome (Italy), Montreal (Canada), Novi Sad (Serbia), Swansea (UK), Lüdenscheid (Germany), and Barcelona (Spain).

Project details

Dates:	2024
Location:	Las Tozas, Spain
Sector:	Urban
Customer:	dnota (system integrator)
Final Users:	Municipality of Las Rozas de Madrid
Products:	11 x Nodes, SaaS Platform, API
Parameters:	• NO2, O3, NO, CO ppb • PMI, PM2.5, PMI0 ugr/m2 • Noise, Temperature, Humidity, Pressure

Ayuntamiento de Las Rozas

d·nota

Municipality of Swansea (UK)

bettair
Mapping Air Quality

Swansea Burn Alert: Tackling Air Pollution from Stoves

Stakeholders: University of Nottingham | Cyngor Abertawe Swansea Council | Health & Wellbeing 360 | Swansea University Prifysgol Abertawe | Llywodraeth Cymry Welsh Government | Enviro Technology | dnota
Sector: Urban & Mobility

Challenge

Residential wood stoves have become the UK's leading source of fine particulate matter (PM), significantly impacting urban air quality. With over 5,000 wood stoves in Swansea households, the city needed a sensor-based solution to monitor pollution levels and engage residents in responsible stove usage.

This project marks Wales' first advisory system for stove users. Watch more here.

Context

- Wood stoves are now the UK's #1 source of fine particulate matter.
- Over 5,000 wood stoves installed in Swansea.

Solution

To tackle pollution from residential wood stoves, Swansea deployed 18 Bettair nodes equipped with solar panels and advanced environmental sensors. These devices measure NO_2, O_3, PM_1, $PM_{2.5}$, PM_{10}, noise levels, and weather conditions, including wind speed and direction (via four Calypso ultrasonic anemometers).

The Bettair Cloud Platform provides real-time analytics, visualizing pollution trends and generating advisory alerts for residents.

By informing stove users about the impact of their emissions, Swansea promotes behavior change to reduce pollution. Integrated within Swansea's broader air quality strategy, this system sets a precedent for data-driven public health interventions, demonstrating how sensor networks can empower cities to manage urban air quality challenges effectively.

Technologies


Bettair node


Bettair Platform

Bettair API

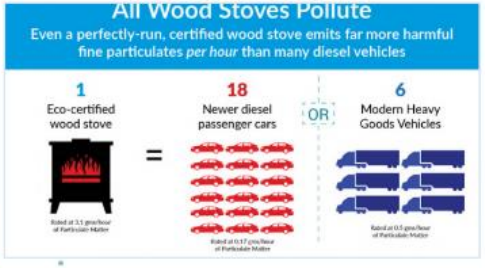

Wind Sensor

Outcomes

The Swansea Burn Alert initiative is delivering measurable improvements in air quality management:

- Provided real-time data to pinpoint air pollution hotspots.
- Enabled the city to issue advisory alerts, encouraging responsible stove use.
- Facilitated data-driven public health policies to mitigate fine particulate pollution.
- Enhanced environmental awareness among Swansea residents, reducing unnecessary emissions.

The project not only improves local air quality but also strengthens community engagement, illustrating the power of sensor-based solutions in shaping sustainable urban environments.



Related projects

Bettair has empowered 80+ cities, ITS operators and LEZs worldwide with indicative air quality solutions, including Rome (Italy), Montreal (Canada), Novi Sad (Serbia), Swansea (UK), Lüdenscheid (Germany), and Barcelona (Spain).

Project details

Dates:	2024
Location:	Swansea, Wales
Sector:	Urban
Customer:	Enviro Technology (sustem integrator)
Final Users:	University of Nottingham
Products:	15 x Nodes, Solar kits, SaaS Platform, API
Parameters:	• NO2, O3 ppb & PMI, PM2.5, PMI0 ugr/m2 • Noise, Temperature, Humidity, Pressure • Wind Speed & Direction

Port of Tarragona - Infraestructures

bettair
Mapping Air Quality

CASE STUDY

#PortOfTarragona #Ports #Odours #chemicals #EmissionControl

Port of Tarragona hybrid network for PMs & Odours

Stakeholders: Port of Tarragona Authority | dnota | chemical hub | citizens
Sector: Infrastructures, Ports & Airports

Challenge

The Port of Tarragona, a major hub for industrial and chemical activities, faced challenges in monitoring and mitigating emissions that could impact the surrounding urban environment.

While VOC campaigns are carried out regularly, and the existing network tracked pollutants and environmental parameters, a need for higher spatial and temporal resolution emerged to better understand the dispersion of port emissions and their potential effects on nearby communities.

Context

- Southern Europe's fertilizer and petrochemical strategic hub..
- 33+ multinational companies and 100+ chemical products.
- Connects 60 global ports.
- 150,000 residents impacted by emissions.

Solution

The Port of Tarragona integrated Bettair's advanced air quality sensors into its existing monitoring network, managed by dnota.

Bettair nodes were strategically installed along a line between the port and the city to deliver real-time, high-resolution data on key pollutants, including PM_{10}, $PM_{2.5}$, VOCs, SO_2, and H_2S.

These nodes provide critical insights into the dispersion of emissions, ensuring that potential impacts on the urban environment are continuously assessed. The Bettair Cloud platform further enriched the system with Wind Rose and Pollution Rose functionalities, enabling visualization of pollution patterns and sources.

This robust integration not only improves emission tracking but also aids compliance with CO_2 reduction commitments and fosters better air quality management for Tarragona's residents.

Technologies


Bettair node


Bettair Platform


Wind Sensor

Bettair API

Outcomes

The integration of Bettair nodes, complemented by the advanced features of the Bettair Cloud platform, has revolutionized air quality monitoring at the Port of Tarragona.

- Authorities advance in their sustainability Strategy with real time data to feed indicators.
- Real-time high-resolution data enhances understanding of potential impacts on the city.
- Pollution Rose functionality identifesng patterns and sources to aid decision making
- Empowered stakeholders to mitigate risks, optimize operational responses, and advance public health initiatives.

This innovative system demonstrates how Bettair technology supports Tarragona's commitment to sustainable port operations and urban air quality management.

More Information

For more information on the Port of Tarragona's commitment to sustainable operations, explore the "Best Practices Guide: Handling of Solid Bulk Materials" This guide outlines effective strategies to minimize emissions and ensure environmentally responsible bulk handling.

Related case studies

Bettair extends its expertise in port air quality monitoring to other key locations, including Las Palmas de Gran Canaria and a proof-of-concept in the Port of Valencia, demonstrating innovative solutions for emission tracking and environmental management in maritime hubs.

Project details

Dates:	2022
Location:	Tarragona, Spain
Sector:	Infrastructures, Ports
Customer:	Dnota
Final Users:	Tarragona Port Authority
Products:	3 x Nodes, SaaS Platform, Wind Sensor, API
Parameters:	• VOCs, SO_2, H_2S ppb • PMI, PM2.5, PMI0 ugr/m2 • Wind, Noise, Temperature, Humidity, Pressure

Port Tarragona

d·nota

Municipality of Piera – Waste & Odours

bettair
Mapping Air Quality

Piera: Small village tackles air quality

Stakeholders: Piera Municipality | Sentilo IoT Platform
Sector: Urban | Waste & Odors

Challenge

Piera, with a population of 18,000 lies close to the Catalonia's largest landfill.

Despite potential impacts from landfill emissions, the nearest air quality monitoring station is 15 km away in Martorell.

Piera faced challenges in assessing air quality and addressing contaminants like NO_2, PM2.5, H_2S, and VOCs effectively.

Context

- Small town with 18,000 residents
- 5Km from a major landfill
- Lack of a nearby air quality monitoring station

Solution

Bettair Cities deployed two static air quality monitoring nodes in Piera, specifically tailored to measure a wide range of pollutants, including NO_2, CO, PM2.5, H_2S, VOCs, and noise levels.

Compact and calibration-free, these devices integrate seamlessly with the Sentilo smart city platform. Through Bettair's user-friendly platform, Piera officials now access real-time, high-resolution air quality data.

The platform provides advanced analytical tools, including on-map graphics and automatic professional reports.

The nodes provide critical insights into traffic-related pollutants and emissions from the landfill, empowering the municipality to adopt informed environmental and health interventions.

Technologies


Bettair node


Bettair Platform

Bettair API

Outcomes

With Bettair's solution, Piera successfully:

- Identified local air quality trends, including the impact of landfill emissions
- Established a foundation for monitoring previously unmeasured H_2S and VOCs
- Improved public awareness and trust through transparent data sharing

This deployment underscores how small municipalities can leverage advanced air quality monitoring to enhance sustainability efforts, even with limited resources.

More Information

sentilo

Piera uses Sentilo, an open-source smart city platform, to centralize air quality data. Sentilo enables real-time monitoring, trend analysis, and data-driven decisions.. Learn more: www.sentilo.io

Related projects

Bettair is carrying out plenty of similar deployments in small municipalities that due to urban developments find themselves near infrastructures or industries that impact air quality.

One example is La Canonja, a town of 6,000 residents (7 km²) in Tarragona, Catalonia, located near Southern Europe's largest chemical hub. With the deployment of two Bettair devices, La Canonja can now monitor its air quality effectively. Many other small towns face similar challenges, suffering the impact of nearby landfills, water treatment plants, and various industries without access to proper air quality monitoring systems.

Project details

Dates:	2024
Location:	Piera (Catalonia, Spain)
Sector:	Urban
Customer:	Piera Minucipality
Final Users:	Piera
Products:	2 x Nodes, SaaS Platform, Wind Sensor, API
Parameters:	• NO2, NO, CO, O3, H2S, VOC ppb • PMI, PM2.5, PMI0 ugr/m2 • Noise, Temperature, Humidity, Pressure

Vila de Piera

sentilo

Municipality of Baena – Waste & Odours

bettair
Mapping Air Quality

CASE STUDY

#WasteToPower #Odours

Monitoring Air Quality Near Baena's Biomass Power Plant

Stakeholders: Municipality of Baena
Sector: Urban | Waste & Odors

Challenge

Baena, near Córdoba, Spain, is renowned for its olive oil production, a key economic driver.

The town hosts a 25MW biomass power plant that utilizes olive by-products for renewable energy, reducing electricity costs by 17%.

While supporting sustainability goals, its emissions raised air quality concerns. Authorities needed to assess whether the plant contributed to pollution or if other sources, like traffic, played a larger role.

Context

- Baena is a major olive oil production hub.
- The 25MW biomass power plant uses olive waste and is one of Europe's largest of its kind.

Solution

To evaluate air quality impacts from the biomass power plant, Baena installed four Bettair nodes equipped with anemometers to measure NO_2 levels and assess pollution dispersion.

This setup enables authorities to correlate pollutant concentrations with wind speed and direction, determining whether emissions originate from the plant or common urban sources like traffic.

By integrating data into Bettair's Cloud Platform, officials gain real-time, high-resolution insights into air quality trends. The system allows decision-makers to assess environmental sustainability alongside economic benefits, ensuring that renewable energy projects do not negatively impact public health. Baena's approach sets a model for balancing industrial activity with environmental responsibility using advanced sensor-based monitoring.

Technologies

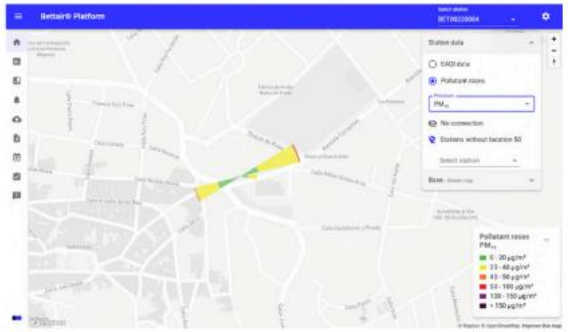
Bettair node | Bettair Platform | Wind Sensor | Bettair API

Outcomes

The deployment of Bettair nodes in Baena provides:

- Accurate source attribution: Correlating NO_2 levels with wind patterns to identify pollution sources.
- Community awareness: Offering transparent insights into local air quality and industrial emissions.

By leveraging sensor-based monitoring, Baena ensures its biomass energy transition aligns with air quality and public health objectives.



Related projects

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Project details

Dates:	2023
Location:	Baena (Spain)
Sector:	Urban | Waste & Odors
Customer:	Municipality of Baena
Final Users:	Municipality of Baena
Products:	4 x Nodes, SaaS Platform, Wind Sensor, API
Parameters:	• NO2, NO, SO2, O3, H2S, VOC ppb • PM1, PM2.5, PM10 ugr/m2 • Noise, Temperature, Humidity, Pressure, Wind

SocioBee Project – Research & Consultancy

bettair
Mapping Air Quality

bettair

CASE STUDY

#CitizenScience #SOCIOBEE #Wearables #EnvironmentalPolicy

SOCIO-BEE: Wearables for socio-environmental Observations & Behavioral change

SOCIO-BEE

Stakeholders: SOCIO-BEE EU Consortium
Sector: Research & Consultancy

Challenge

Europe's air quality policies require a blend of traditional monitoring and innovative approaches to tackle the variability of urban pollution.

SOCIO-BEE sought to empower citizens with tools to measure and mitigate air pollution, using advanced Bettair wearable sensors to ensure accurate, actionable data.

The project's aim was to amplify citizen engagement while providing reliable technology for precise air quality monitoring.

Context

- 18 organizations across Europe
- Pilot Cities: Ancona (Italy), Maroussi (Greece), Zaragoza (Spain)
- European Commission (Horizon 2020 initiative)
- Local governments, schools, and NGOs

Solution

SOCIO-BEE combined citizen science and cutting-edge technology, with Bettair sensors at the heart of its monitoring efforts.

These wearable devices enabled participants to collect real-time data on pollutants like NOx, PM, and O_3 while walking, commuting, or engaging in campaigns.

The wearable sensors provided the reliability and granularity required for informed decision-making, amplifying the project's impact by capturing hyperlocal pollution patterns often missed by traditional methods.

Citizens, from schoolchildren to seniors, were protagonists in this initiative, identifying hotspots and contributing to urban planning solutions. Bettair's role as the "magic wand" ensured that citizen efforts were backed by accurate and actionable data, bridging community engagement and scientific rigor.

Technologies

Bettair wearable | Bettair Platform | 3D video maps | Bettair API

Outcomes

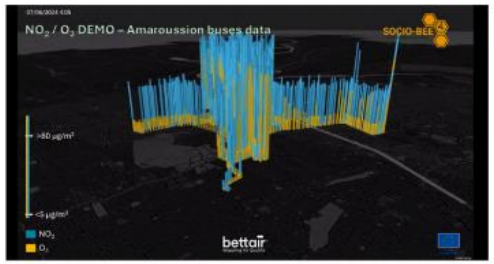
SOCIO-BEE's success hinged on the synergy between community-driven engagement and the advanced technology provided by Bettair.

Citizens played a central role, but it was Bettair's wearable sensors that transformed their participation into scientifically robust air quality data, empowering actionable solutions. This collaboration created a reliable framework for tackling urban air pollution.

- Expanded monitoring capabilities to gather hyperlocal data in underrepresented areas.
- Identified pollution hotspots, equipping policymakers with precise data to craft policies.
- Engaged diverse demographic groups, fostering environmental stewardship.

More Information

- **White Paper**: An in-depth overview of the SOCIO-BEE project, showcasing how citizen participation can enhance environmental monitoring and policy development.
- **Policy Briefs**: Three briefs that outline the outcomes of the pilots in Ancona (Italy), Maroussi (Greece), and Zaragoza (Spain), offering key insights for local and national policymakers.



Related projects

Bettair participates in cutting-edge R&D projects like NEOTEC, advancing air quality algorithms; FF4EuroHPC, enhancing pollution mapping with high-performance computing; SOCIO-BEE, fostering citizen science; ATHLETE, linking pollution data to health studies; and BettairVOC, targeting volatile organic compounds to address urban air quality challenges.

Project details

Dates:	2022 - 2024
Location:	Ancona (Italy), Maroussi (Greece), Zaragoza (Spain)
Sector:	Research & Consultancy
Customer:	SocioBee Consortium, European Comission
Final Users:	Citizen, policy makers, researchers
Products:	200+ personal exposure monitors
Parameters:	• NO2, NO ppb • PM1, PM2.5, PM10 ugr/m2 • Temperature, Humidity, Pressure

Horizon 2020 European Union Funding for Research & Innovation

Zaragoza

CEN/TS 17660-1:2022 & CEN/TS 17660-2:2024

bettair® Mapping Air Quality

Technical specifications (TS) to evaluate performance of gas and PM sensor systems according the new Directive 2024/2881/CE.

- NO2, NO, CO, SO2, O3, PM2.5, PM10.
- Different certifications according to climatology and
- Site typology: suburban, urban, rural. Traffic / background.
- DOES NOT apply for INDUSTRIAL SITES, HARBORS, CONSTRUCTION SITES, QUARRIES, etc.
- Dual methodology:
  - Laboratory Testing
  - Field evaluation (several locations 40+ days)
- Classification CEN/TS 17660-1:2022 (Gas sensors)
  - Limitations:
    - Slope deviation and intercept
    - Expanded uncertainty
    - Between sensor uncertainty
  - Class 1 – (like Indicative Measurement)
  - Class 2 – (like Objective Estimation)
  - Class 3 - (Not in AAQ Directive 2024/2881)
  - Other
- Classification CEN/TS 17660-2:2024 (PM sensors)
  - The same than for gases
  - Evaluate sensors measure fine and course fraction of PM in lab
  - Evaluate hygroscopic growth impact on PM sensor measurements (RH from 0% to 95%)

Compound	Averaging period		LV	UAT	LAT	AT or CL	DQO of Class 1 sensor system	DQO of Class 2 sensor system	DQO of Class 3 sensor system
	h	year	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³ (% of LV)	µg/m³ (% of LV)	µg/m³ (% of LV)
SO_2	1	–	350	–	–	500	88 (25 %)	263 (75 %)	700 (200 %)
SO_2	24	–	125	75	50	20	–	–	–
NO_2	1	–	200	140	100	400	50 (25 %)	150 (75 %)	400 (200 %)
NO_2		1	40	32	26	–	–	–	–
O_3	8a	–	120	84	60	–	36 (30 %)	90 (75 %)	240 (200 %)
O_3	1	–	–	–	–	240	–	–	–
Benzene	–	1[b]	5	3,5	2	–	1,5 (30 %)	5 (100 %)	10 (200 %)
			mg/m³	mg/m³	mg/m³		mg/m³ (% of LV)	mg/m³ (% of LV)	mg/m³ (% of LV)
CO	8[c]	–	10	7	5	–	2,5 (25 %)	7,5 (75 %)	20 (200 %)

CEN/TS 17660-1:2022 & CEN/TS 17660-2:2024

bettair®
Mapping Air Quality

Technical specifications (TS) to evaluate performance of **gas and PM sensor systems** according the **new Directive 2024/2881/CE**.

- **NO2, NO, CO, SO2, O3**, **PM2.5**, **PM10**.
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    - Expanded uncertainty
    - Between sensor uncertainty
  - Class 1 – (like **Indicative Measurement**)
  - Class 2 – (like **Objective Estimation**)
  - Class 3 - (**Not in AAQ Directive 2024/2881**)
  - Other
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  - The same than for gases
  - **Evaluate sensors measurements of fine and course fraction of PM in lab**
  - **Evaluate hygroscopic growth impact on PM sensor measurements (RH from 0% to 95%)**

Compound	Averaging period		LV	UAT	LAT	AT or CL	DQO of Class 1 sensor system	DQO of Class 2 sensor system	DQO of Class 3 sensor system
	h	year	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³ (% of LV)	µg/m³ (% of LV)	µg/m³ (% of LV)
SO_2	1	–	350	–	–	500	88 (25 %)	263 (75 %)	700 (200 %)
SO_2	24	–	125	75	50	20	–	–	–
NO_2	1	–	200	140	100	400	50 (25 %)	150 (75 %)	400 (200 %)
NO_2		1	40	32	26	–	–	–	–
O_3	8a	–	120	84	60	–	36 (30 %)	90 (75 %)	240 (200 %)
O_3	1	–	–	–	–	240	–	–	–
Benzene	–	1[b]	5	3,5	2	–	1,5 (30 %)	5 (100 %)	10 (200 %)
			mg/m³	mg/m³	mg/m³		mg/m³ (% of LV)	mg/m³ (% of LV)	mg/m³ (% of LV)
CO	8[c]	–	10	7	5	–	2,5 (25 %)	7,5 (75 %)	20 (200 %)

CEN/TS 17660-1:2022 & CEN/TS 17660-2:2024 to EN

Roadmap:

- Write and Release Test Specifications (2015 to 2024)
- **Independent Third-party** assessment (funded DG Env) (2025 to 2028)
- Changes, Improvements and comments added to TS (2028-2029)
- European Norm – EN17660 (from 2029 onwards)
- Currently Undergoing Efforts for Worldwide Standarization (ISO)

Meanwhile:

TS 17660 "*The competent body performing the required tests should be able to demonstrate that it works in conformity with the requirements of internationally accepted standards for test laboratories.*"

NOTE 1: EN ISO/IEC 17025 is the harmonized internationally accepted standard that applies.

NOTE 2 A formal accreditation by a member body of the European Accreditation Organisation to EN ISO/IEC 17025 is a demonstration of conformity

Current status:

No test laboratories have accreditation (ISO17025 -labs) nor way to get it (ISO17065-bodies)

Test cannot start before formal accreditation?

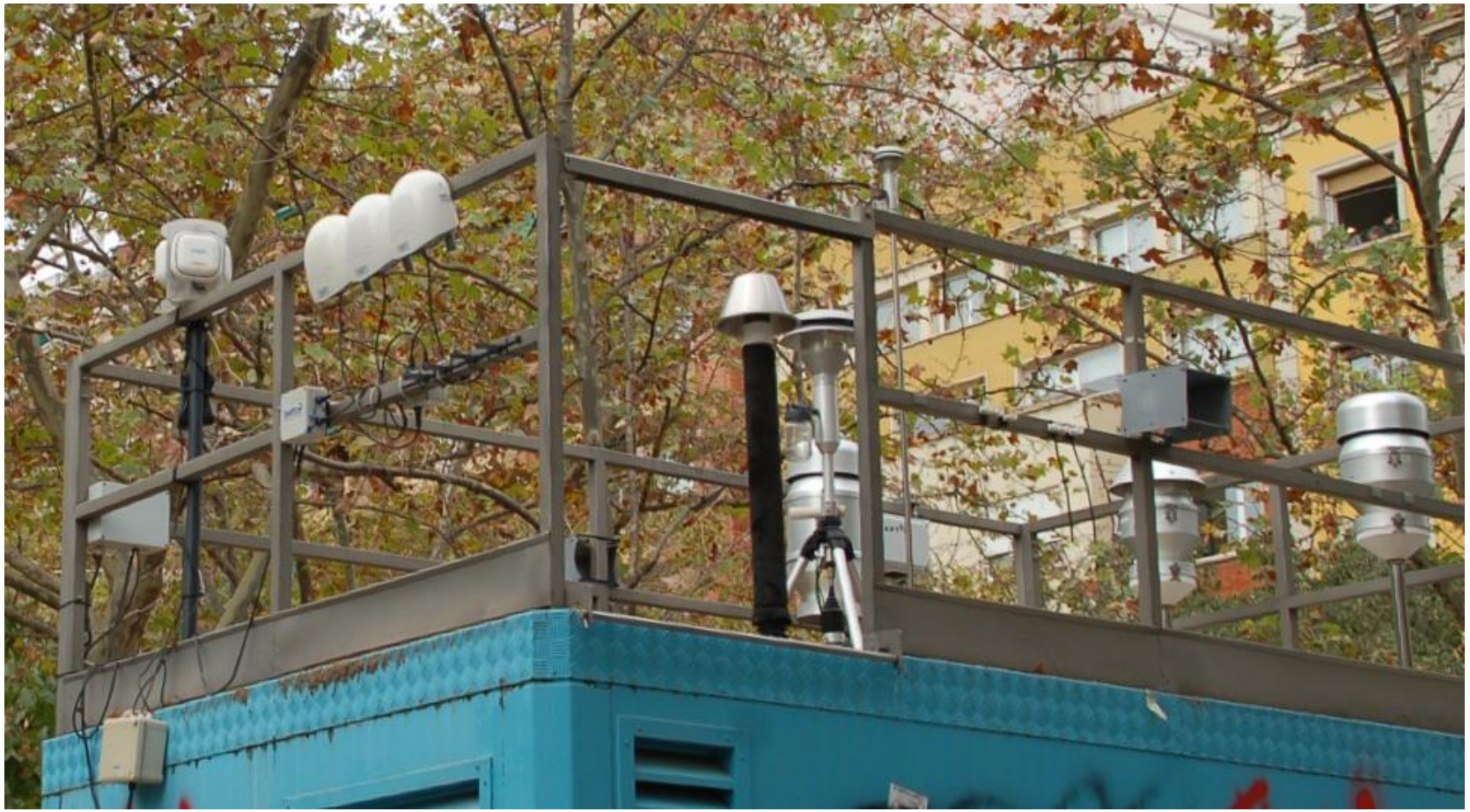
Control mechanism for labs performing these test?

Who will use the results to do the final certification?

CEN/TS 17660-1:2022

Eixample (Barcelona), April 2022 to April 2025

January - February 2023 (59 days)

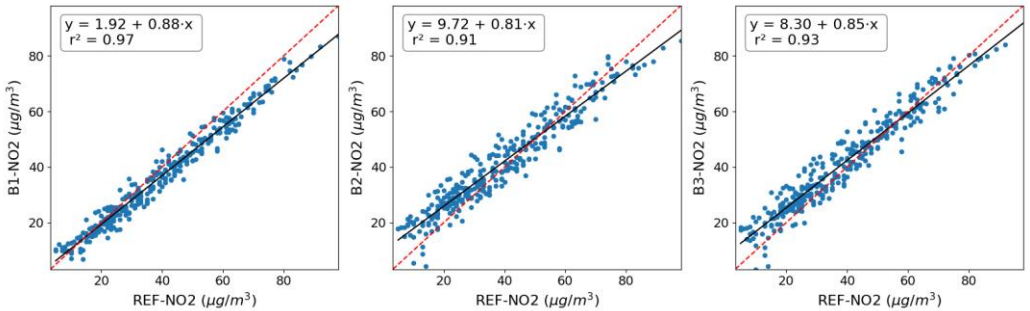


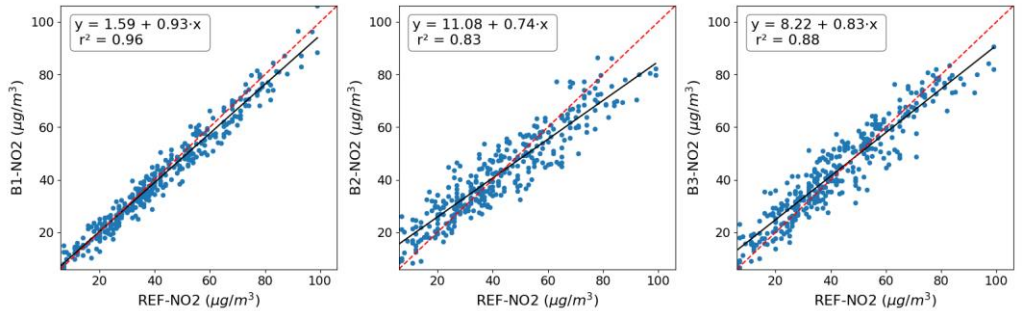
CEN/TS 17660-1:2022

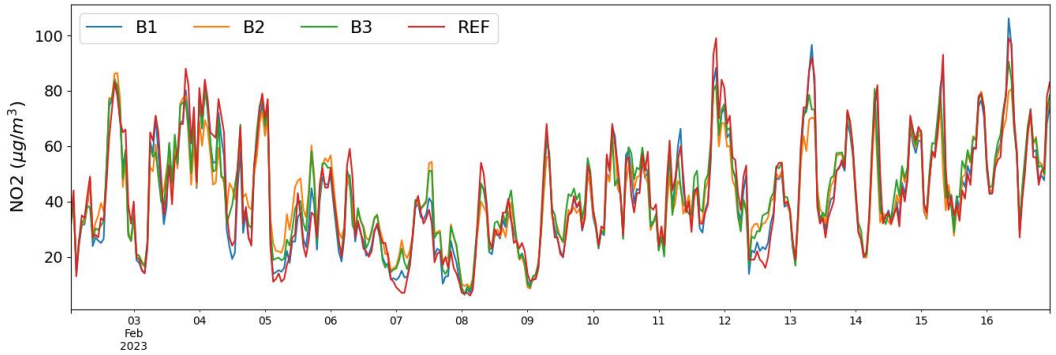
bettair® Mapping Air Quality

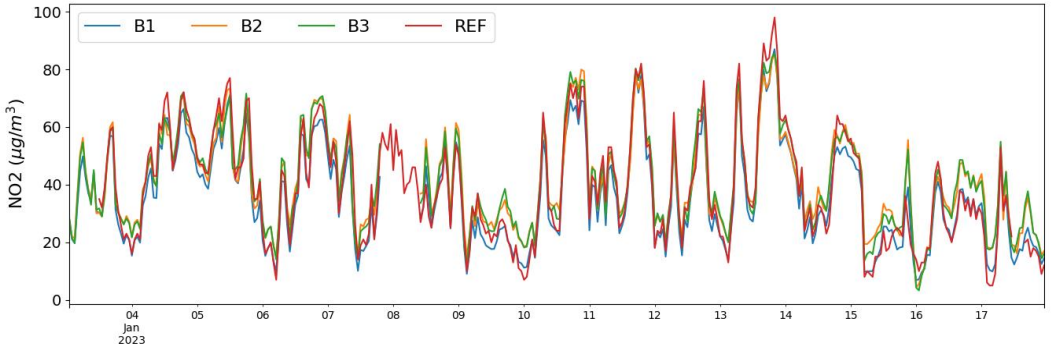
Eixample (Barcelona), April 2022 to April 2025

NO_2 January - February 2023 (59 days)









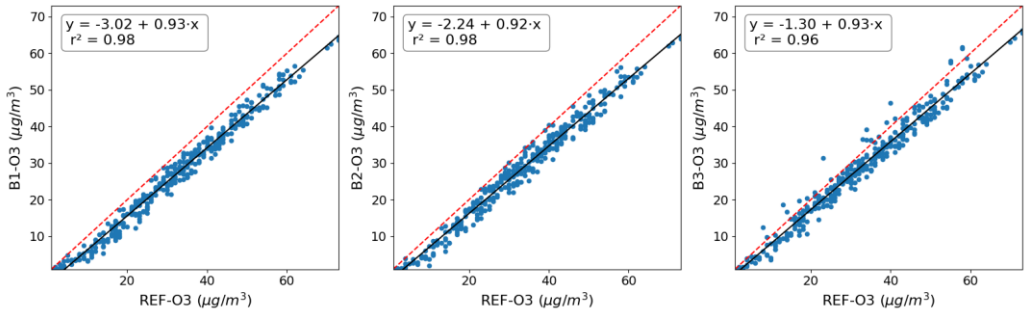
Parametros estadísticos	Unidades	Sensor 1	Sensor 2	Sensor 3	Clase 1	Clase 2	Clase 3
Datos capturados	%	95.2	90.9	96.1	90	50	-
Intercepcion eje linea regresion (a)	µg/m3	2.5	6.5	5.8	−9.8<=a<=9.8	−19<=a<=19	−33<a<33
Pendiente regresión lineal (b)		0.89	0.85	0.87	0.78<=b<=1.29	0.60<=b<=1.67	0.43<=b<=2.33
R2		0.96	0.87	0.87			
RMSE	µg/m3	3.5	5.1	6.0	-	-	-
Between sensor uncertainty	µg/m3	3.1			< 7.6	< 15	< 31
Expanded uncertainty at LV	µg/m3	38.0	48.4	41.9	50	150	400

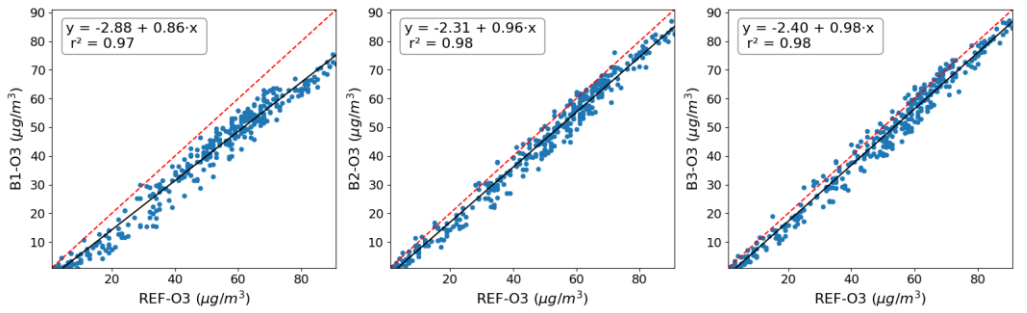
CEN/TS 17660-1:2022

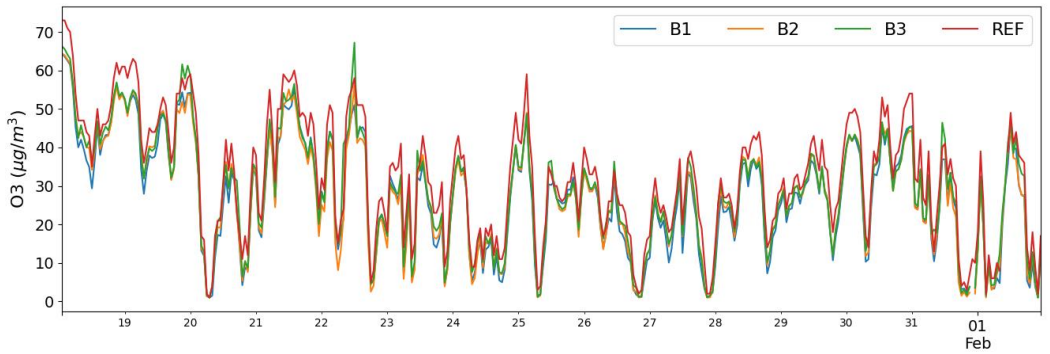
bettair®
Mapping Air Quality

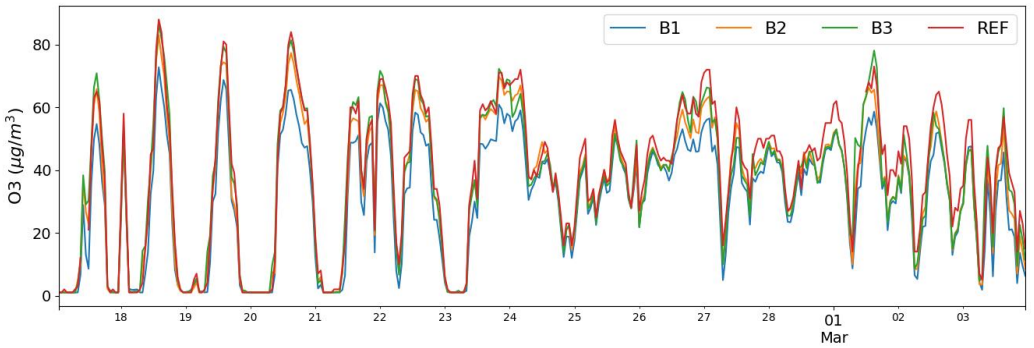
Eixample (Barcelona), April 2022 to April 2025

O_3 January - February 2023 (59 days)









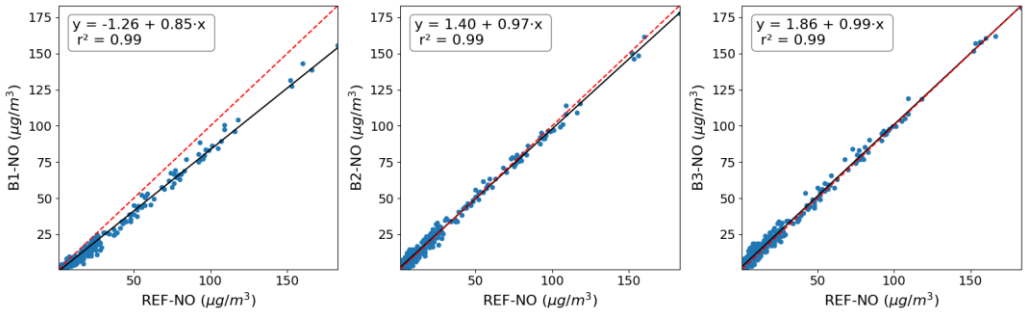
Parametros estadísticos	Unidades	Sensor 1	Sensor 2	Sensor 3	Clase 1	Clase 2	Clase 3
Datos capturados	%	95.2	90.9	96.1	90	50	-
Intercepcion eje linea regresion (a)	µg/m3	-1.2	-1.1	-0.6	−9,8<=a<= 9,8	−19<=a<=19	−33<=a<=33
Pendiente regresión lineal (b)		0.87	0.92	0.95	0.78<=b<=1.29	0.60<=b<=1.67	0.43<=b<=2.33
R2		0.89	0.98	0.96			
RMSE	µg/m3	3.9	3.1	4.0	-	-	-
Between sensor uncertainty	µg/m3	3.1			< 8	< 12	< 24
Expanded uncertainty at LV	µg/m3	35.3	21.8	16.1	36	90	240

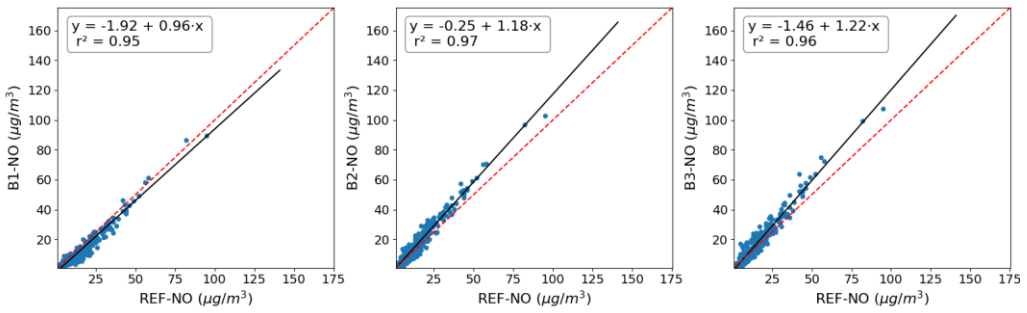
CEN/TS 17660-1:2022

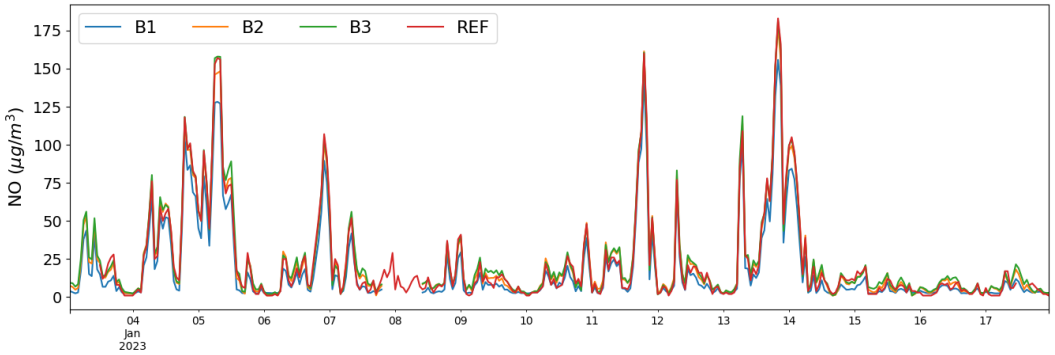
bettair® Mapping Air Quality

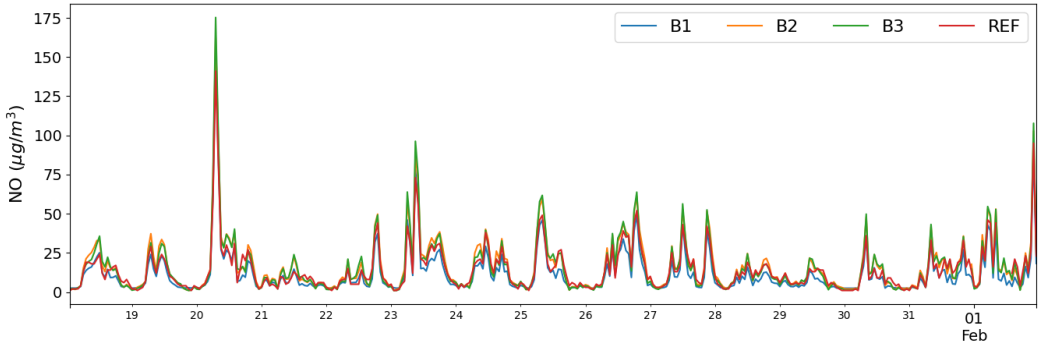
Eixample (Barcelona), April 2022 to April 2025

NO January - February 2023 (59 days)









Parametros estadísticos	Unidades	Sensor 1	Sensor 2	Sensor 3	Clase 1	Clase 2	Clase 3
Datos capturados	%	95.2	90.9	96.1	90	50	-
Intercepcion eje linea regresion (a)	µg/m3	-1.8	0.6	0.3	−6,4<=a<=6,4	−12<= a<=12	−22<=a<=22
Pendiente regresión lineal (b)		0.89	1.01	1.07	0.78<=b<=1.29	0.60<=b<=1.67	0.43<=b<=2.33
R2		0.98	0.98	0.98			
RMSE	µg/m3	3.4	3.5	4.2	-	-	-
Between sensor uncertainty	µg/m3	3.9			<=5	<=10	<=20
Expanded uncertainty at LV	µg/m3	48.6	9.3	30.4	50	150	400

bettair®
Mapping Air Quality

The **novelty** lies on:

- Electronics
- Mechanics
- Post-processing algorithm

AI accurate, small and cost-effective sensing devices allows to measure Air Quality in cities.

Josep Perello
CEO and Co-founder
jperello@bettaircities.com
+34 678478856

Francisco Ramírez
Lead Scientist
framirez@bettaircities.com
+34 685617817