

NanoSen-AQM

Development and field validation
of a low-cost low-power system based
on nanosensors for real-time air
pollution monitoring

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Spanish Research Council



CSIC

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS



Outline



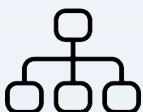
General



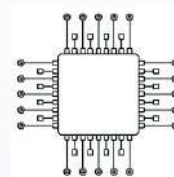
Partnership



Objectives



Work plan



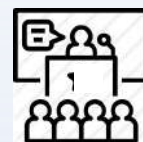
Results



Products



Indicators



Dissemination

General



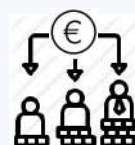
2017 (2nd call)



1.950.000 €



1.462.500 €



11 partners | ES (7), FR (2), PT (2)



April 2018 – June 2021 | 39 months = 36 + 3



Partnership

11 Beneficiaries: ES (7), FR (2), PT (2)

Consejo Superior de Investigaciones Científicas Instituto de Tecnologías Físicas y de la Información	CSIC-ITEFI
Universidad de Extremadura Escuela de Ingenierías Industriales	UEX
Junta de Extremadura Consejería de Medio Ambiente y Rural, Políticas Agrarias y Territorio	SOFG
Diputación de Ávila Área de Asuntos Europeos, Energía, Promoción y Turismo	Diputación de Ávila
Área Metropolitana de Barcelona	AMB
Sistemes Avançats d'Energia Solar Tèrmica SCCL	AIGUASOL
Universidade de Évora Escola de Ciência e Tecnologia	UÉvora
Universidade de Coimbra Faculdade de Ciências e Tecnologia	FCTUC
Centre National de la Recherche Scientifique Centre Interuniversitaire de Recherche et d'Ingénierie des Matériaux	CNRS-CIRIMAT
Centre National de la Recherche Scientifique Laboratoire d'Analyses et d'Architecture des Systèmes	CNRS-LAAS
Ray Ingeniería Electrónica SL	RAY-IE

2 Associates (ES)

Confederación Ecologistas en Acción	EEA-CODA
Universidad Politécnica de Madrid Escuela Técnica Superior de Ingenieros Industriales	UPM-ETSII

Academia



R&D



SME



Public Administration



NGO



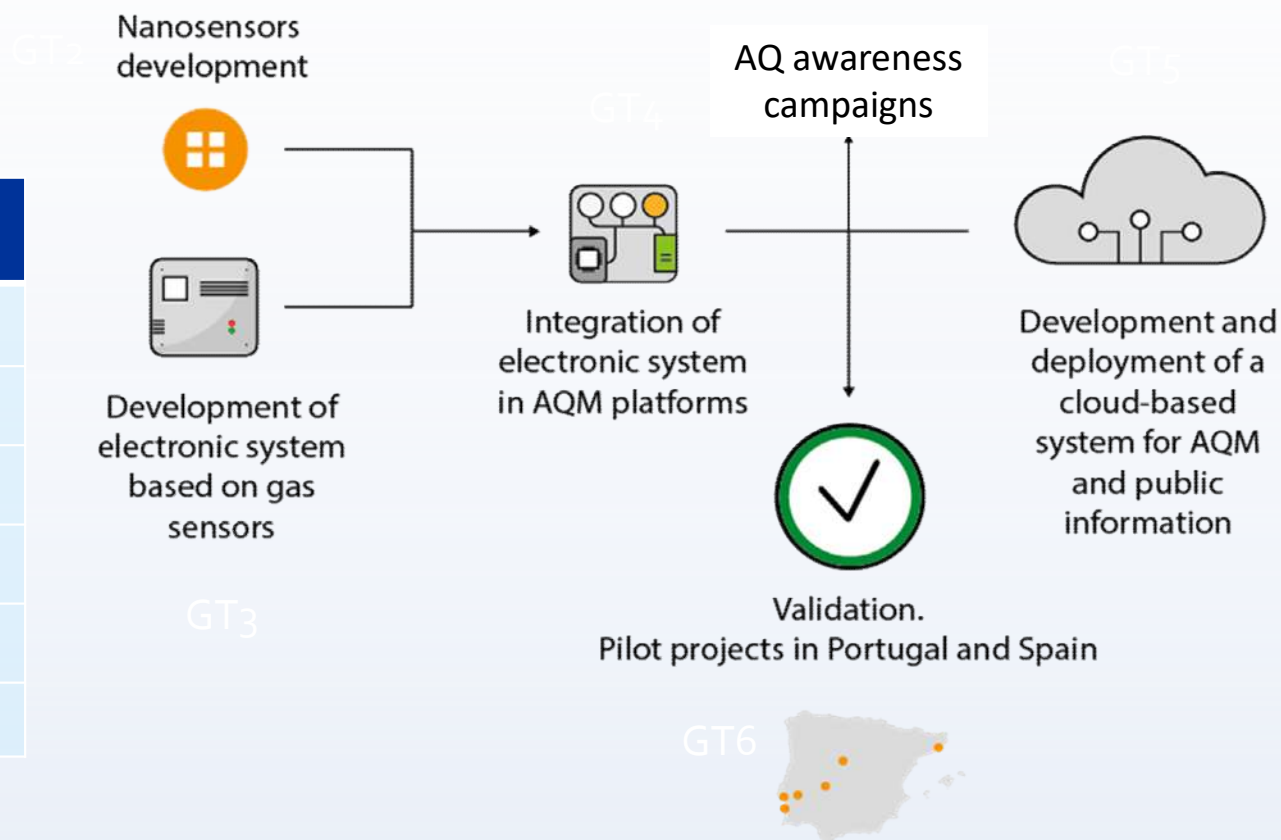
Objectives

General	Specific	
To develop a real-time electronic system of low-cost and low-power consumption enabling massive, distributed and ubiquitous air pollution monitoring	O1	To reduce energy consumption and fabrication cost and to improve detection properties of gas sensors
	O2	To develop a low-cost, low-power, real-time multisensor system for long-term continuous monitoring of air pollution
	O3	To develop a smart cloud system capable to control a network of multisensor systems, generate an exploit air quality data, including air quality forecast and information to target groups

Work Plan

Task Groups

GT1	Technical specifications
GT2	Nanosensors & commercial sensors
GT3	Multisensor systems
GT4	Platforms for multisensor systems
GT5	Cloud system
GT6	Field campaigns



Field Campaigns



June 2020 — January 2021

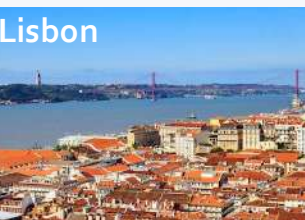
NATURAL



RURAL



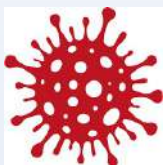
URBAN



INDUSTRIAL



Field Campaigns

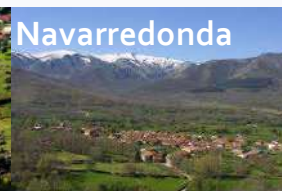


November 2020 — June 2021

NATURAL



RURAL



URBAN



INDUSTRIAL



Main Results

Technologies

Innovative active materials for gas sensors

Nanomaterials

NM

Micromachined platforms for gas sensors

Micro-electro-mechanical systems

MEMS

Technologies for depositing nanostructured active layers for gas sensors

Nanotechnology

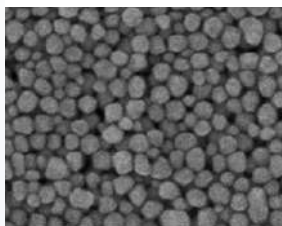
NT

Distributed cloud computing for managing, processing and exploiting multisensor data

Machine learning

ML

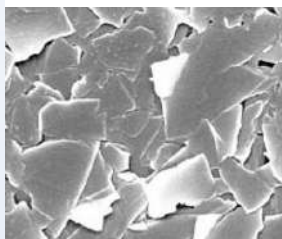
Nanoparticles



Nanofibers



Graphene



Cleanroom



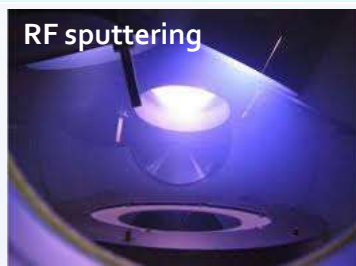
Silicon wafer



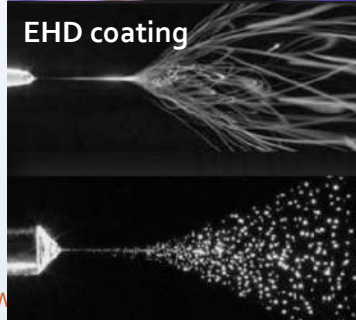
Microchip



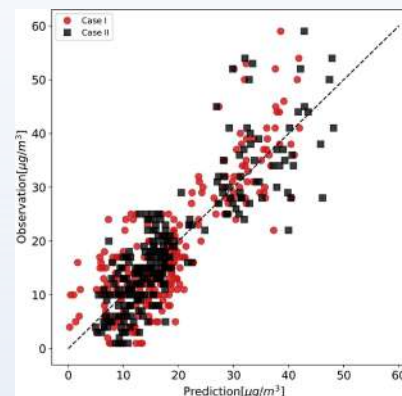
RF sputtering



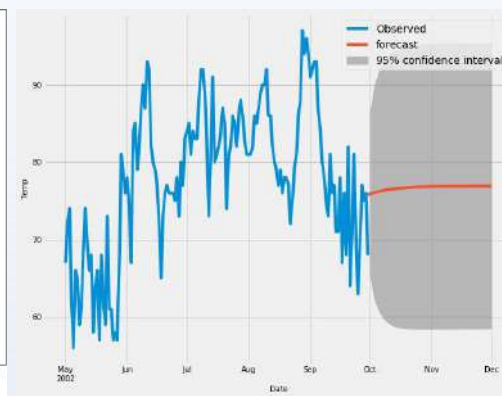
EHD coating



Sensor calibration



Pollutant concentration prediction



Main Products

P2.1

Prototypes of **nanosensors** for target pollutants

P3.1

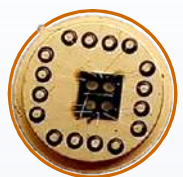
Prototypes of real-time **multisensor systems** for monitoring air pollution

P5.1

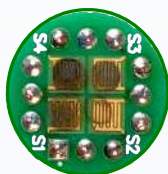
Prototype of **cloud platform** as a service on air quality

P2.1 Nanosensors

Metal Oxide



Graphene

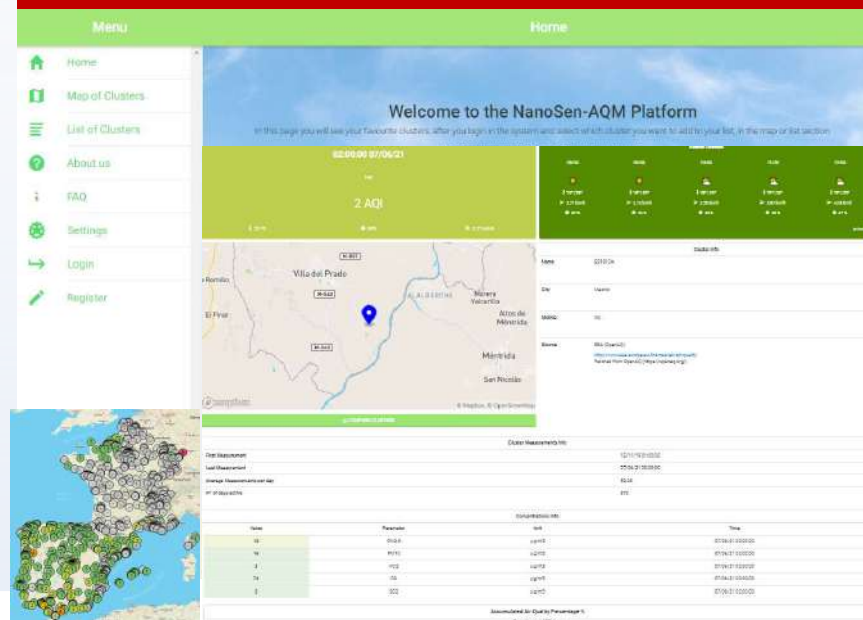


P3.1 Multisensor Systems



P5.1 Cloud Platform

Web, Smartphone (Android, iPhone)

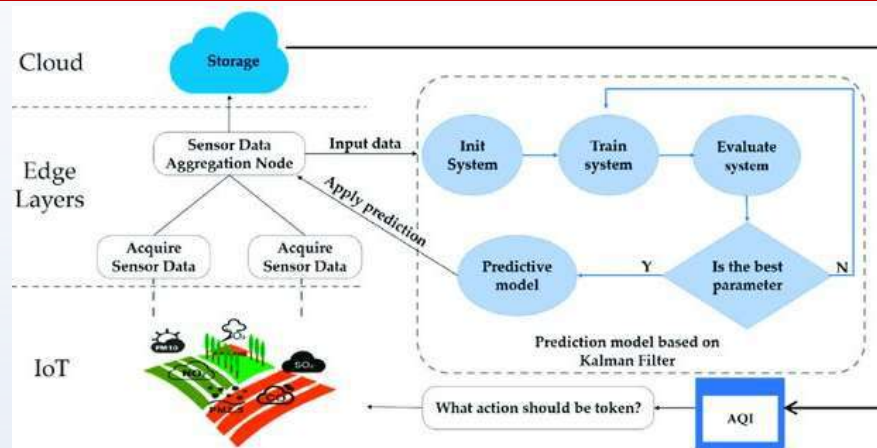
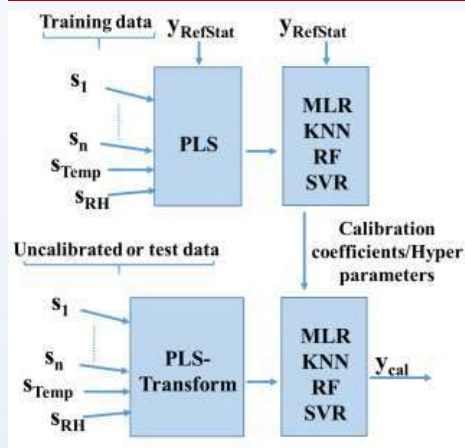


GT	Other Products	
GT5	P5.2	Machine learning models for calibrating sensors and predicting air quality
	P6.1	Field campaigns for monitoring air quality
GT6	P6.2	Assessment manual for air pollution sensors
	P6.3	Awareness campaigns on air quality

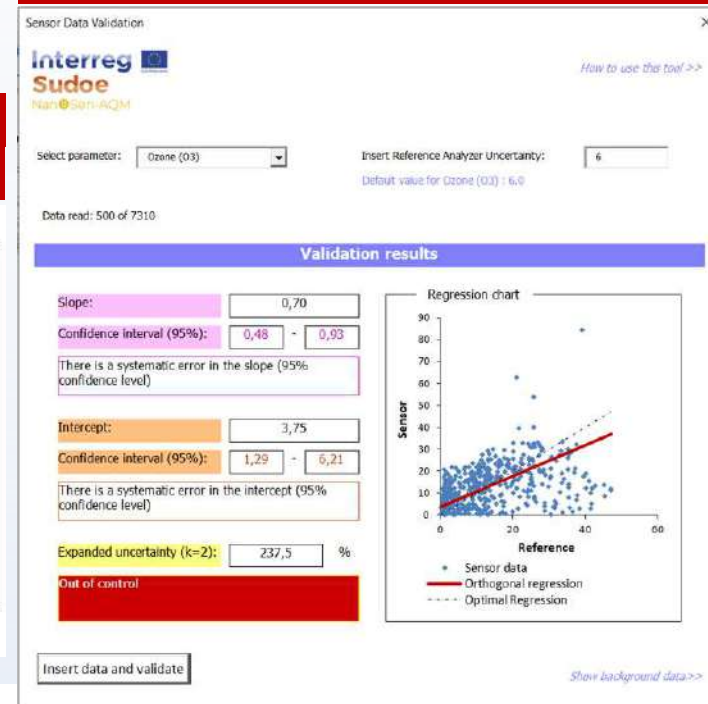
P5.2 Machine learning models

Sensor calibration

Air quality forecast



P6.2 Air quality sensor assessment (App)



Main Product		Indicator	#	
P2.1	Nanosensors	R&D	4	3 + 1
P3.1	Multisensor systems	SME	10	1 + 9
P5.1	Cloud platform	SME	1	

Sensors, sensor calibration (lab), sensor validation (field)



Electronic circuits, printed circuit boards (PCB)



Air quality monitoring services



Commercial sensors (OEM), sensors systems (Ssys)



Software, computer components



Project Events

European Workshop
May 20th-21st, 2019
Toulouse

Low-Cost Sensors and Microsystems
for Environment Monitoring



ST community in gas sensors

AQ officers in municipalities

Students, professors, and
researchers of universities

Outreach Activities				#
Journals	Proceedings (9)			9
Conferences	Oral (24)	Poster (12)	Exhibitor (2)	38
University	Graduate Thesis (11)	Master Thesis (2)		13
Mass media	Press (3)	Radio (2)	TV (1)	6
Public	Semana de la Ciencia y la Tecnología (2)	Noche Europea de los Investigadores (2)	Semana Europea de la Movilidad (1)	3



Special Issues



Special Issue "Wireless Sensor Network for Air Quality Monitoring and Control"

Dr. Jesús Lozano
Dr. Saverio De Vito
Dr. José Pedro Santos
Guest Editor

Deadline for manuscript submissions: **closed (31 October 2019)**.



Special Issue "Smart Sensing Technology for Environmental Monitoring"

Dr. Eduardo Pinilla-Gil
Dr. Elena Bernalte Morgado
Dr. María del Carmen Hurtado-Sánchez
Guest Editors

Deadline for manuscript submissions: **closed (31 March 2021)**.



Special Issue "Real-Time Air Quality Monitoring Systems"

Prof. Dr. Catarina Silva
Prof. Dr. Filipe Araujo
Guest Editors

Deadline for manuscript submissions: **31 July 2021**.



an Open Access Journal by MDPI

PM Sensors for the Measurement of Air Quality

Guest Editors
Dr. Esther Hontañón, Dr. Brigida Alfano

Deadline
 31 October 2021

mdpi.com/si/81469

Special Issue
Invitation to submit



an Open Access Journal by MDPI

Machine Learning Methods for Low - Cost Air Quality Evaluation and Prediction

Guest Editors
Dr. Esther Hontañón, Prof. Bernardete Ribeiro

Deadline
 31 October 2021

mdpi.com/si/82714

Special Issue
Invitation to submit



Lionel
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