

AGENDA: Round-Table

Action TD1105 ROUND-TABLE DISCUSSIONS

Chairman: Michele Penza, Action Chair

17:30 - 18:30

Italian National Agency for New Technologies, Energy and Sustainable Economic Development - ENEA, Brindisi, Italy

Breakthroughs in Environmental Sensor Technology for Green-Economy in Europe

17:30 - 17:40

Urban Europe: Air Pollution Control in Smart Cities

Michele Penza, COST Action TD1105 Chair, ENEA, Brindisi, Italy

17:40 - 17:50

FP7 MACPoll Project: Metrology for Low-Cost Sensor Technologies in Air Quality Control

Laurent Spinelle, JRC, Institute for Environment and Sustainability, Ispra, Italy

17:50 - 18:00

CMOS Sensors for Harsh Environments (on behalf of EC Project SOI-HITs Consortium)

Florin Udrea, Action SIG1 Deputy, Cambridge CMOS Sensors Ltd, Cambridge, UK

18:00 - 18:10

NDIR Gas Sensors Ready for Automotive Applications

Hans Martin, Action WG4 Leader Team, CEO of SenseAir SA, Delsbo, Sweden

18:10 - 18:20

50th Anniversary of Metal Oxides Gas Sensors: Which Future for Emerging Sensor Technologies?

Marcel Bouvet, Action Sub-WG1.3 Leader, Université de Bourgogne, Dijon, France

18:20 - 18:30

Discussion of Action Participants: Comments and Inputs on Priorities, R&I Needs, Strategies, Roadmap for future joint-activities of Action TD1105 EuNetAir

18:30

CLOSING OF WGs and SIGs MEETING

European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

SECOND SCIENTIFIC MEETING

Working Groups and Management Committee

at University of Cambridge

Queens' College, Cambridge, 18 - 20 December 2013

ROUND-TABLE : *Breakthroughs in Environmental Sensor Technology for Green-Economy in Europe*

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 2: 2013 - 2014

URBAN EUROPE: Air Pollution Control in Smart Cities

 **COST**
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



Michele Penza

Function in the Action: Action Chair

ENEA - Brindisi, Italy



EUROPEAN SCIENCE FOUNDATION ESF provides the COST Office through a European Commission contract

OUTLINE

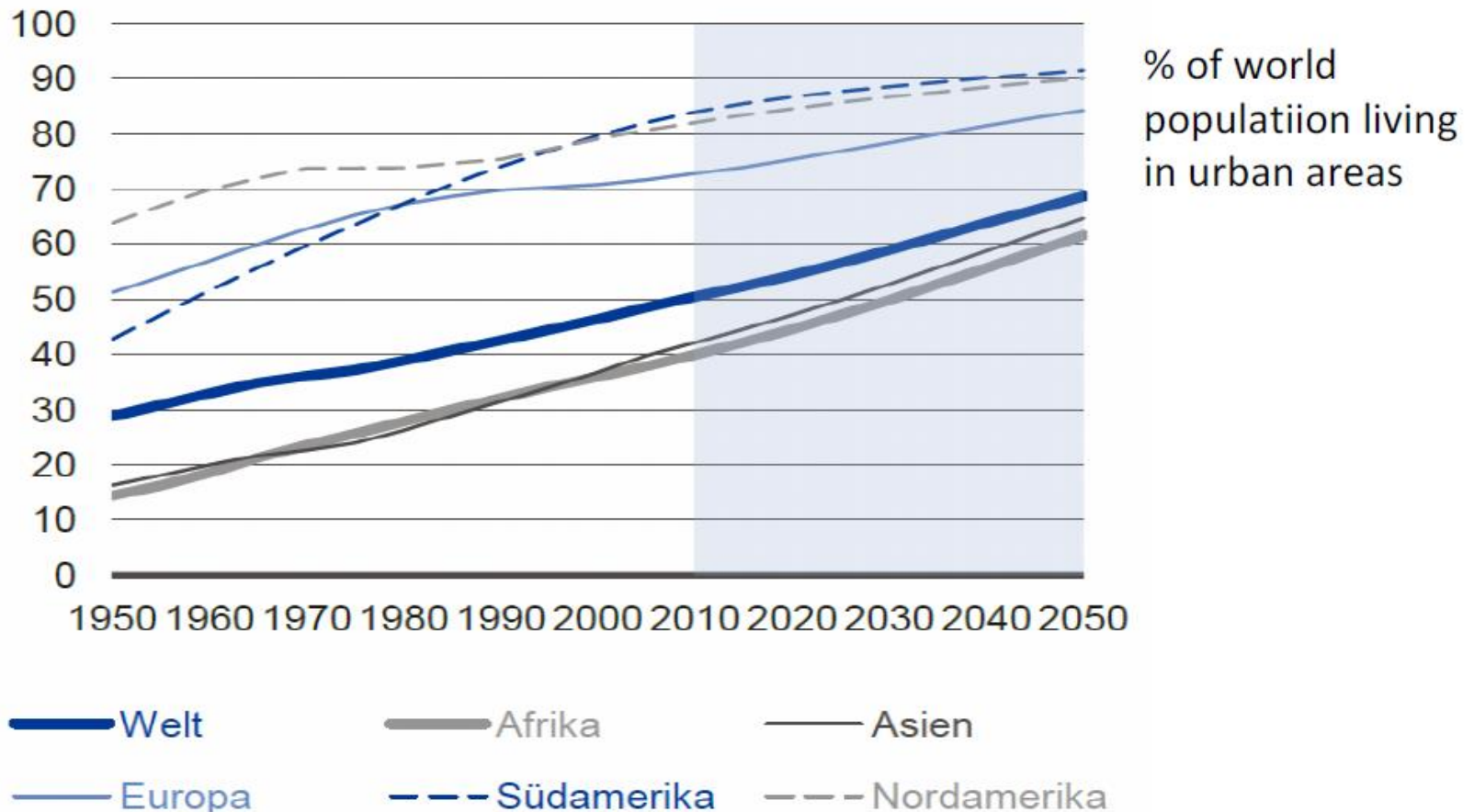
- **URBAN EUROPE: Joint Programming Initiative**
 - Strategic Research Agenda
 - Trends and Challenges
- **SMART CITIES & COMMUNITIES:**
 - Competitive Low-Carbon Energy Technologies
 - Examples of Application/Demonstration in European Cities
- **AQ MONITORING IN EUROPE:**
 - Data Quality Objectives (DQO) of AQ DIRECTIVE (2008/50/EC) on Ambient Air Quality and Cleaner Air for Europe (CAFE)
- **ENERGY CHALLENGE WP 2014-15:**
 - Call from Social Challenge 5 (**Expected on October 2014**):
2015: Improving the Air Quality of European Cities

URBANISATION AS GLOBAL CHALLENGE:

URBAN EUROPE - Joint Programming Initiative



Urbanisation as a Grand Challenge



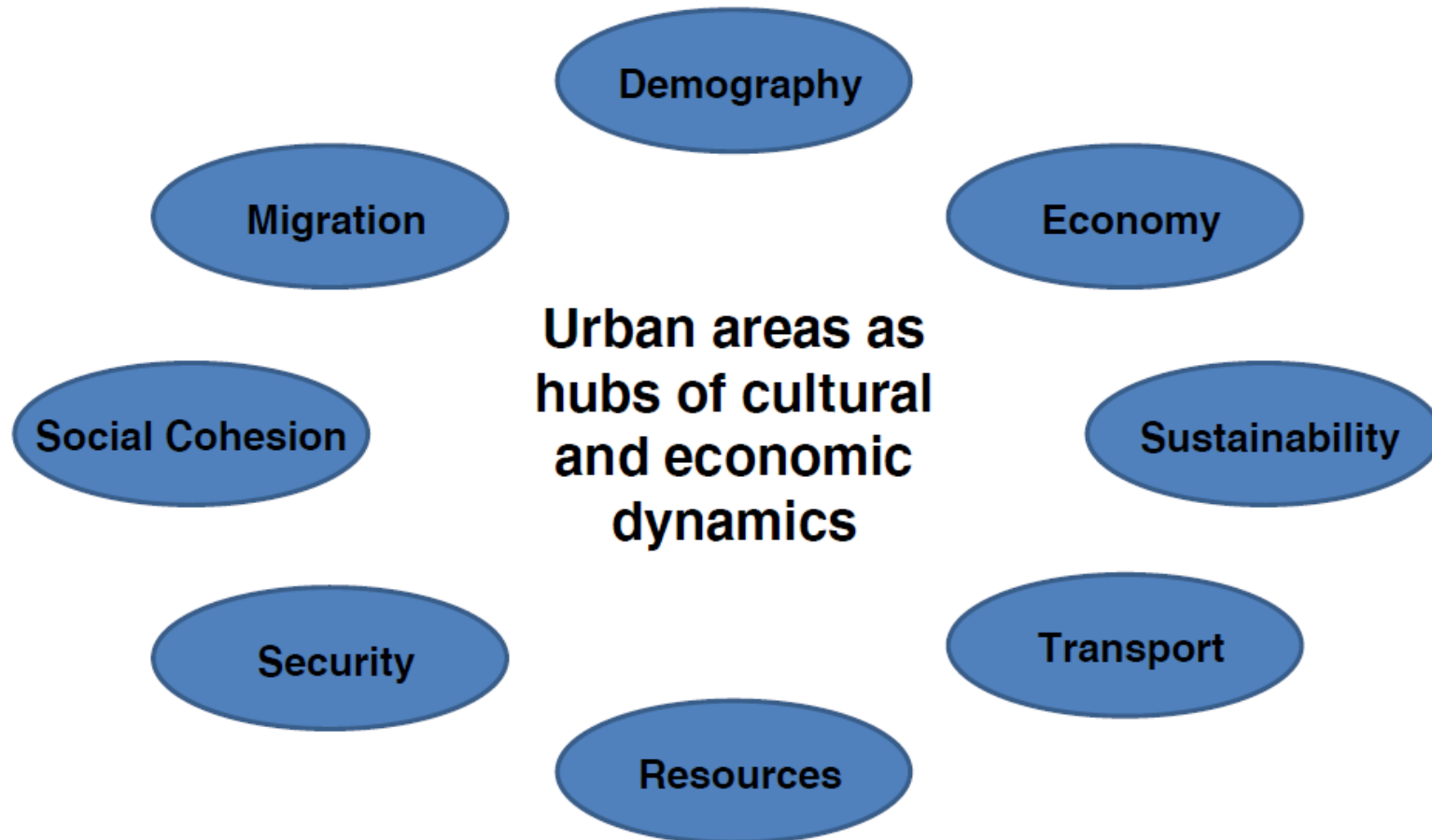
Quelle: UN Population Division

URBANISATION AS GLOBAL CHALLENGE:

URBAN EUROPE - Joint Programming Initiative



Urban Challenges



URBANISATION AS GLOBAL CHALLENGE:

URBAN EUROPE - Joint Programming Initiative

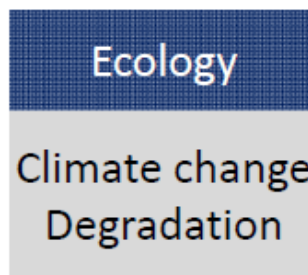
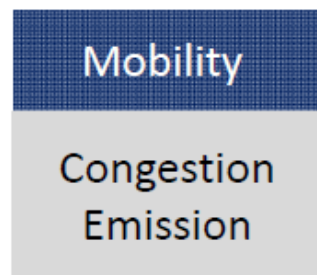
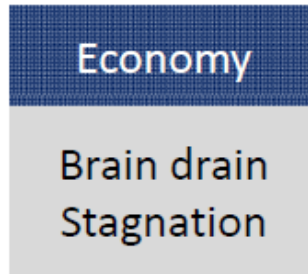
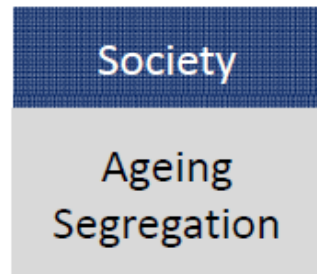
URBAN EUROPE
Joint Programming Initiative

Strategic Research Framework – Process

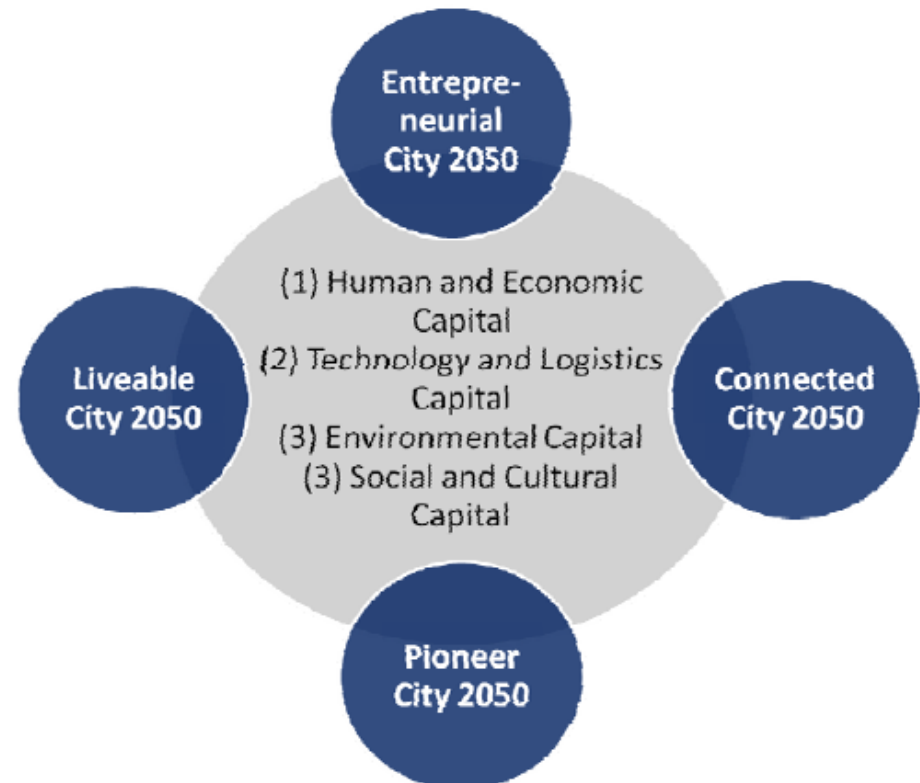
4 pillars
representing challenges



4 integrated city images
representing research demands



Urban Europe Vision & Mission



URBANISATION AS GLOBAL CHALLENGE:

URBAN EUROPE - Joint Programming Initiative

Smart Cities
Member States Initiative

Cities are complex organisms



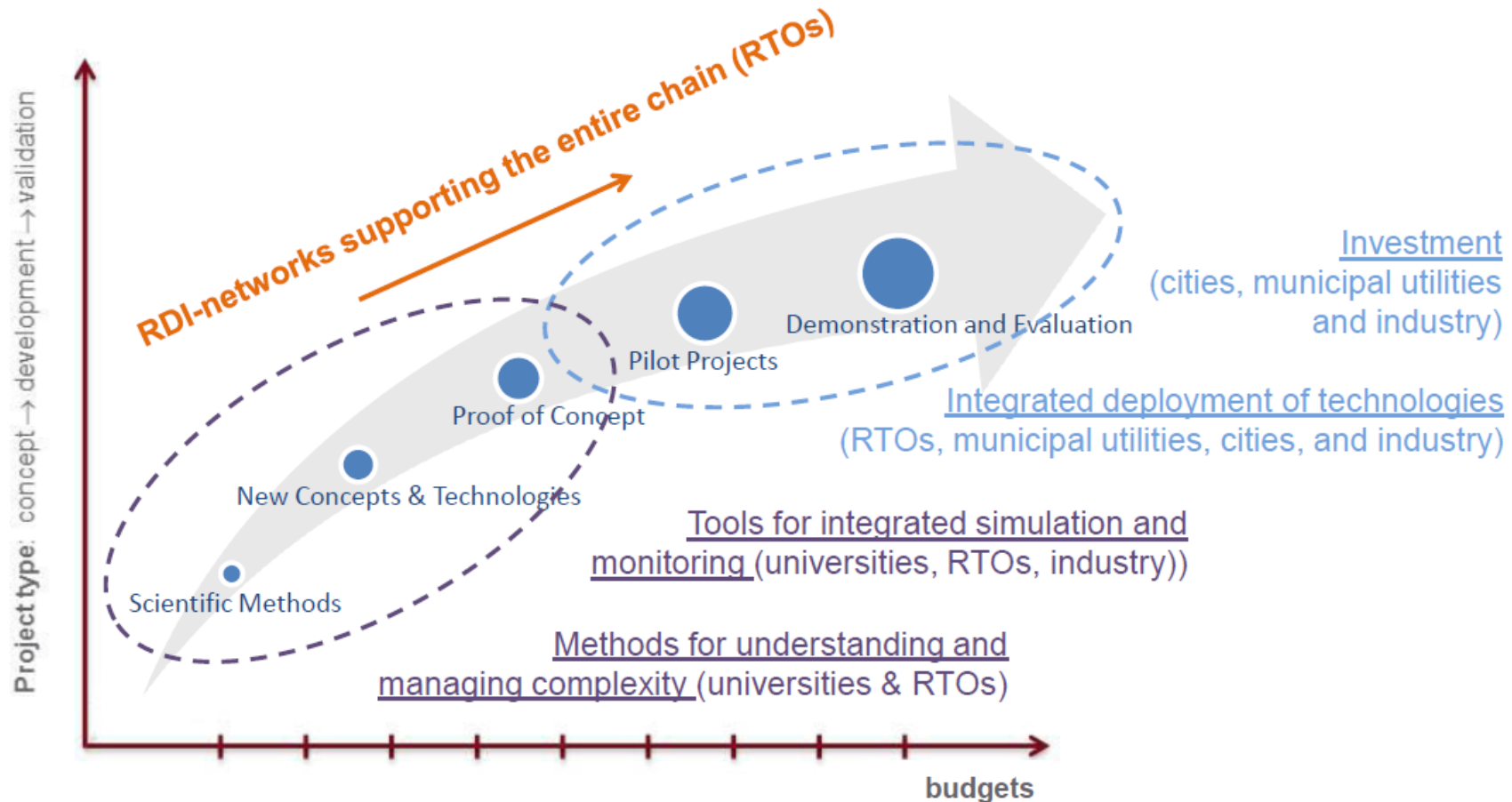
- A city cannot be understood by only looking at its buildings, or its transportation system, or its energy distribution, or even its people.
- A city is made up of the intricate interactions and exchanges of all its people, information, money, systems, and infrastructure.
- The high complexity of this interdependence is complemented by a **slow pace of change in demography and infrastructure**, making it hard to discern causes and effects.
- To understand how a city functions and how its development can be influenced by policy, investment, or technology is therefore a complex task.

URBANISATION AS GLOBAL CHALLENGE:

URBAN EUROPE - Joint Programming Initiative

Smart Cities
Member States Initiative

Actors Driving Innovation in the Urban Field



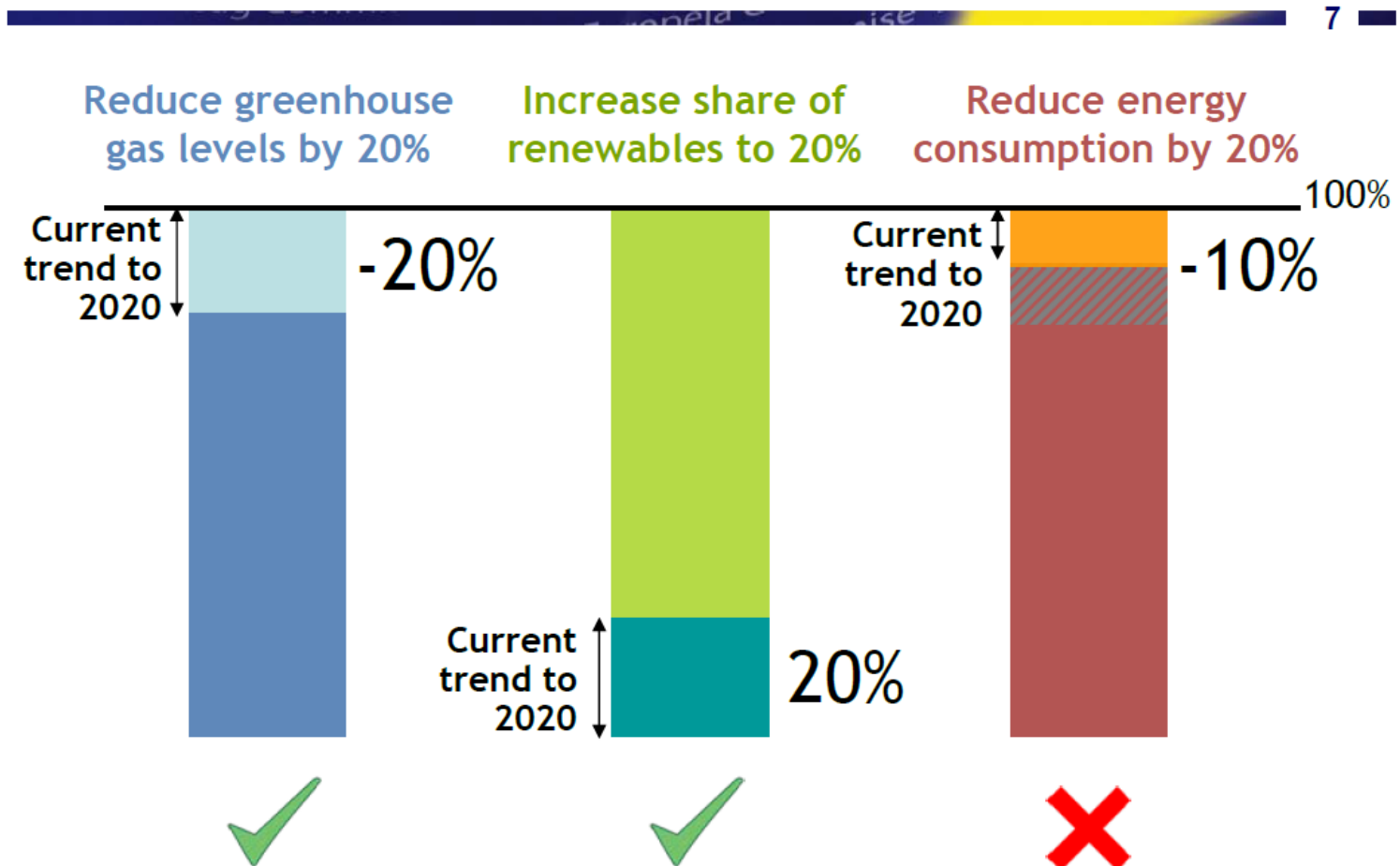
RTO = research and technology organisation

URBANISATION AS GLOBAL CHALLENGE:

ENERGY PRIORITIES OF EUROPE

J. M. Barroso, EC President to EU Council on 4 February 2011

Meeting our “20-20-20 by 2020” goals

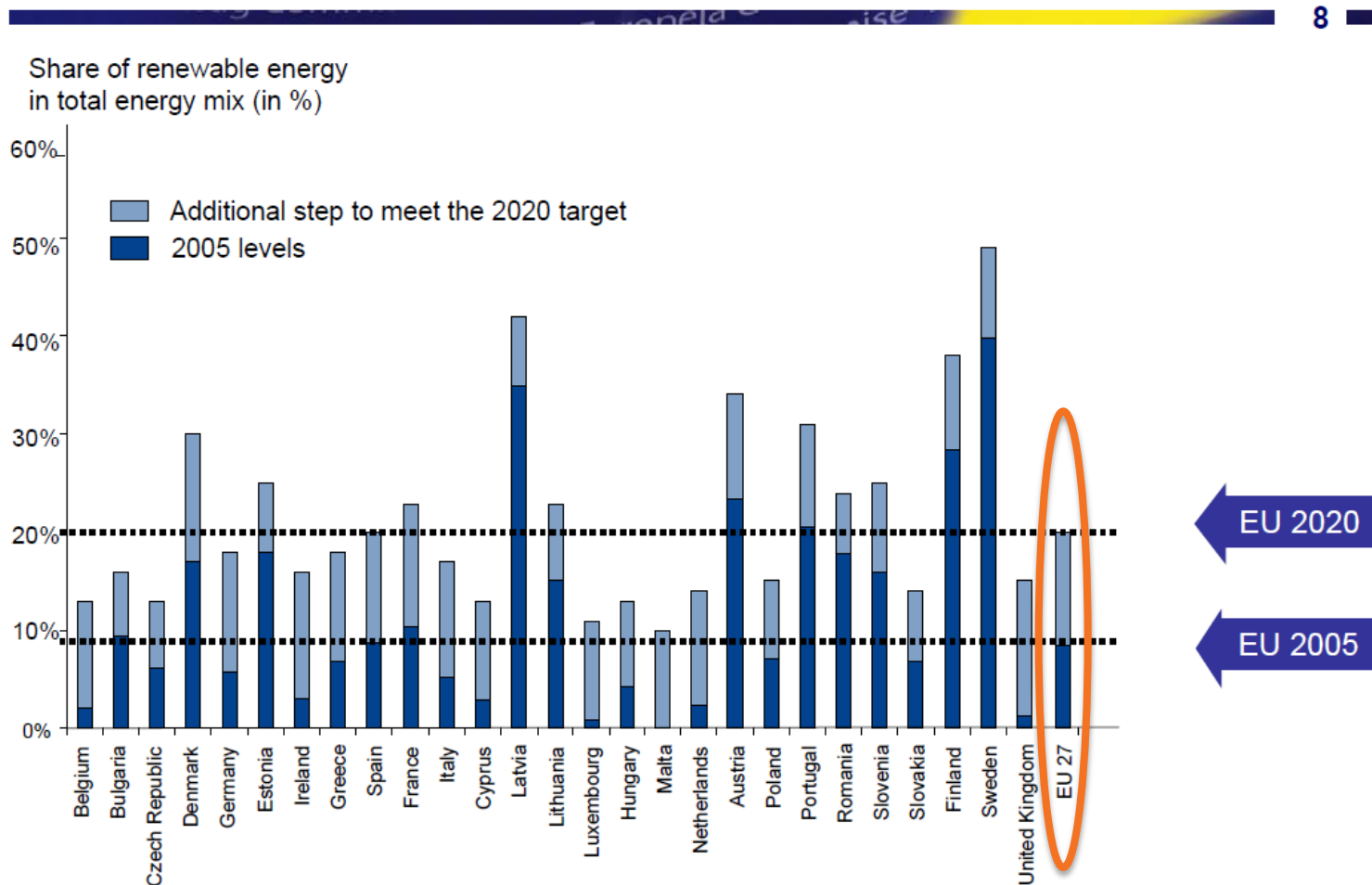


URBANISATION AS GLOBAL CHALLENGE:

ENERGY PRIORITIES OF EUROPE

J. M. Barroso, EC President to EU Council on 4 February 2011

What the EU renewable target means

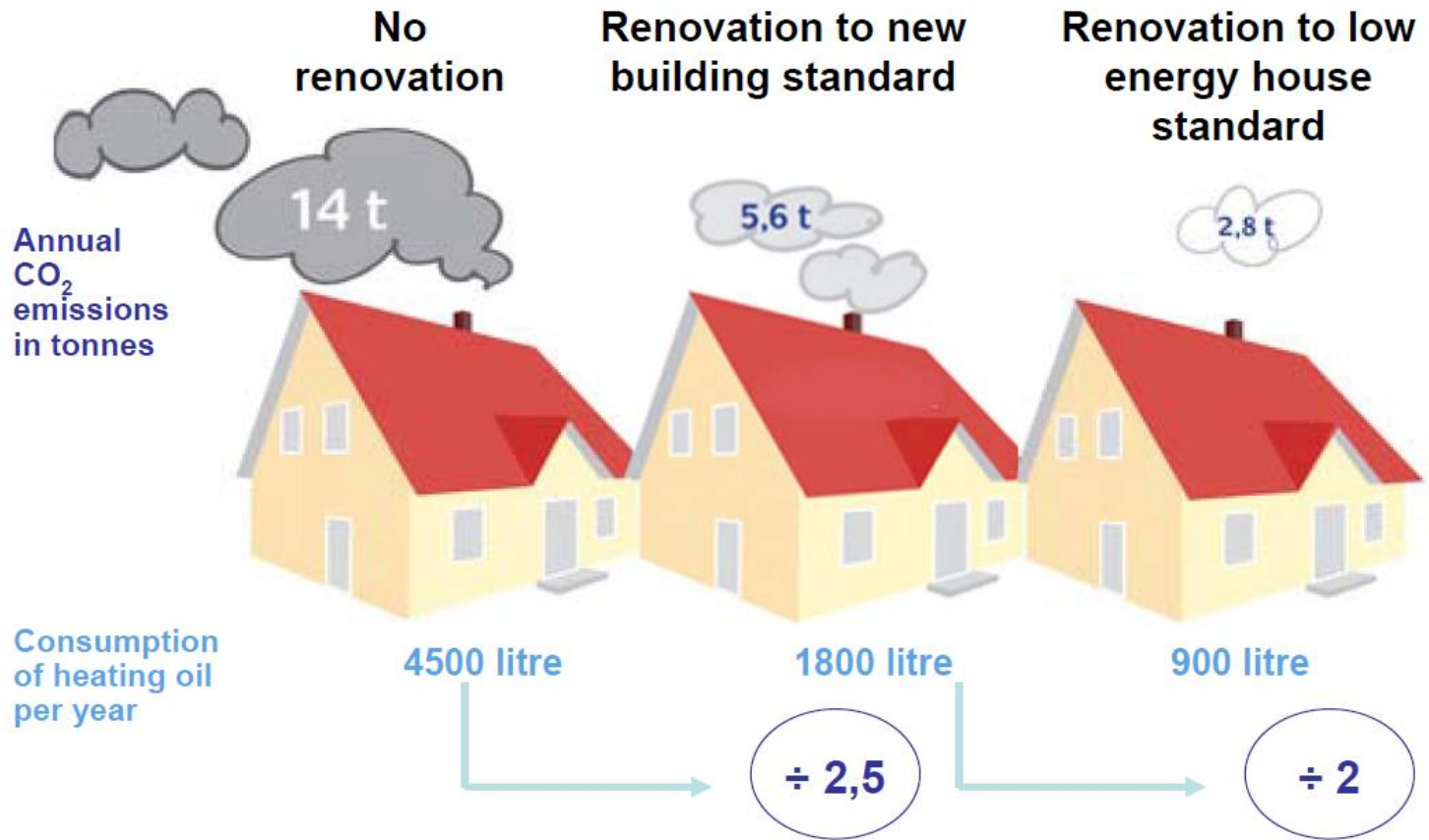


URBANISATION AS GLOBAL CHALLENGE: ENERGY PRIORITIES OF EUROPE

J. M. Barroso, EC President to EU Council on 4 February 2011

What improving energy efficiency means for a single family house built in the 70s (150 m²)

15



EXAMPLES OF SENSORS DEMONSTRATION IN EU CITIES

London: Heathrow Airport

SNAQ-Heathrow project: Wireless Sensors Network

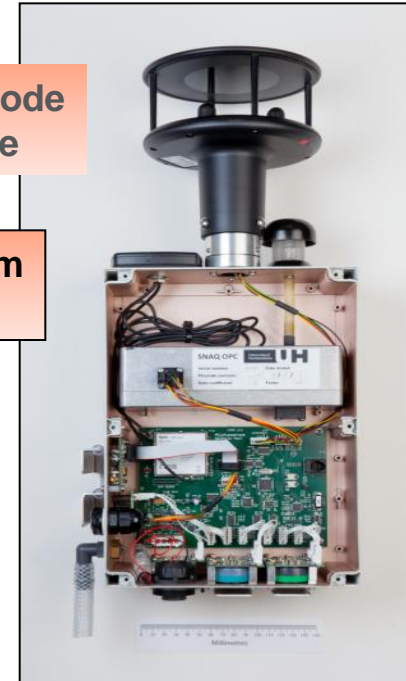
Courtesy by Rod Jones and Alphasense Ltd

- ~ 36 sensor nodes located in and around the airport
- Web: <http://www.snaq.org/>



SNAQ sensor node
by Cambridge

~49 x 22 x 16 cm
~2.8 kg



 UNIVERSITY OF
CAMBRIDGE

University of
Hertfordshire 

 **Alphasense**
THE SENSOR TECHNOLOGY COMPANY

 MANCHESTER
1824

 Heathrow

 BRITISH
AIRWAYS

 **NPL**
National Physical Laboratory

 Imperial College
London

 Cambridge Environmental Research Consultants
Environmental Software and Services

 **cost**

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EXAMPLES OF SENSORS DEMONSTRATION IN EU CITIES

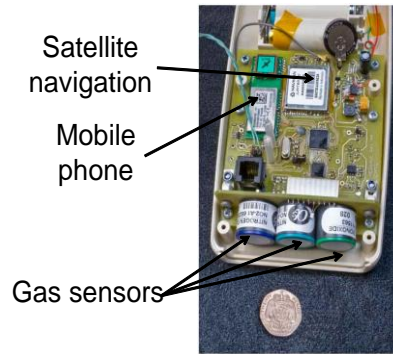
Cambridge: City

MESSAGE project: Wireless Sensors Network

Courtesy by Rod Jones and Alphasense Ltd



Sensor units components



Simple operation!



400 gm (incl. batteries)

UNIVERSITY OF CAMBRIDGE

Lisbon
13-14 November 2009

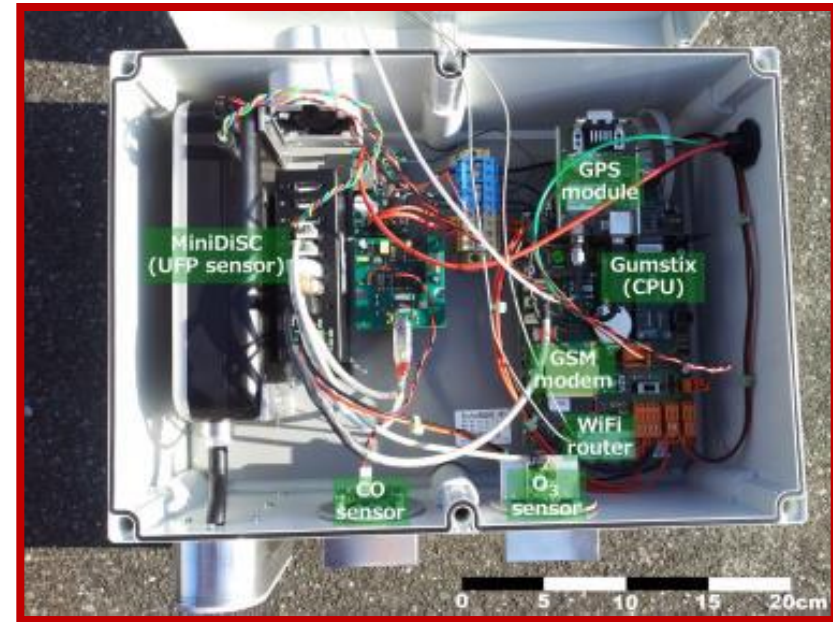
message

EXAMPLES OF SENSORS DEMONSTRATION IN EU CITIES

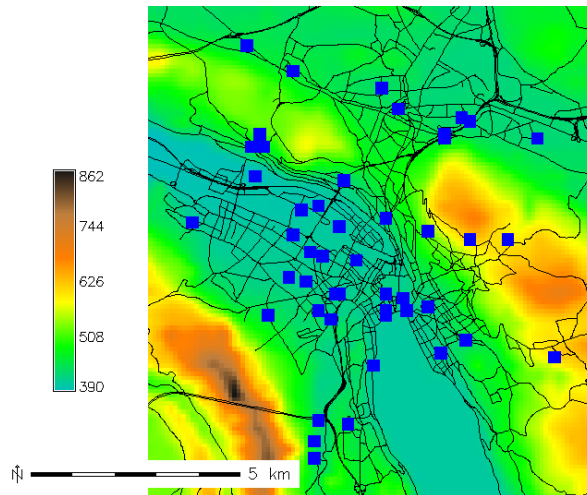
Lausanne and Zurich: City

OpenSense project: Wireless Fixed/Mobile Sensors Network

Courtesy by Karl Aberer and OpenSense Consortium



**Sensor Node for Air Quality Monitoring:
CO, NO_x, O₃, UFP, etc.**

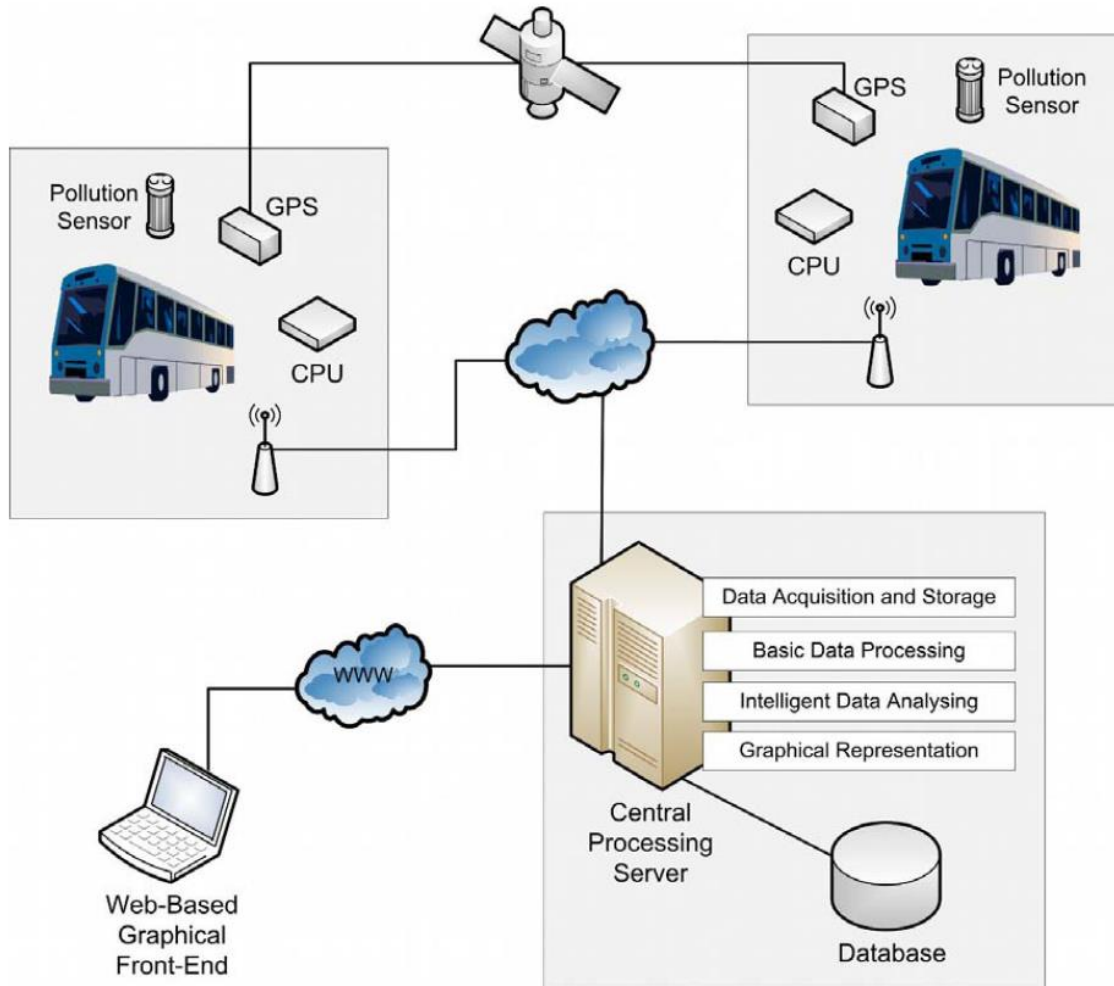


EXAMPLES OF SENSORS DEMONSTRATION IN EU CITIES

Vigo and La Coruna: City

Mobile Wireless Sensors Network on Public Transportation

Courtesy by F. Lopez-Pena et al., Sensors & Transducers, 8, 13-25, February 2010



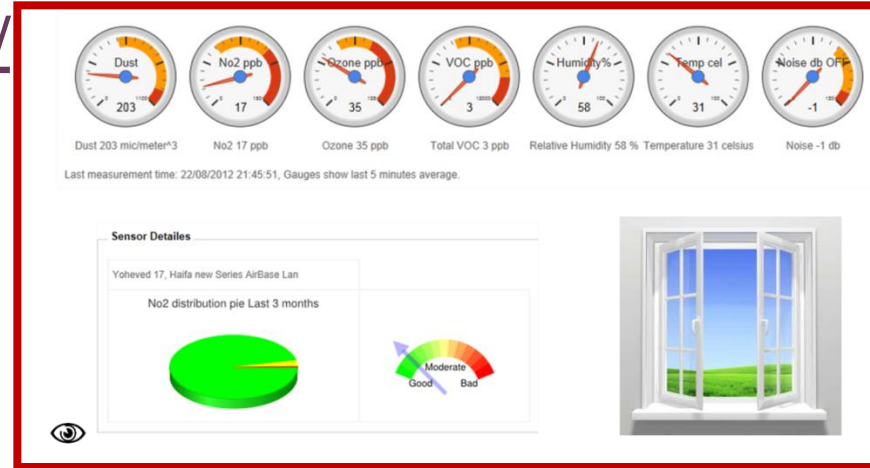
**Mobile Sensor Node
for Air Quality Monitoring:
CO, NO_x, O₃, SO₂, CO₂, T, RH**

EXAMPLES OF SENSORS DEMONSTRATION IN EU CITIES

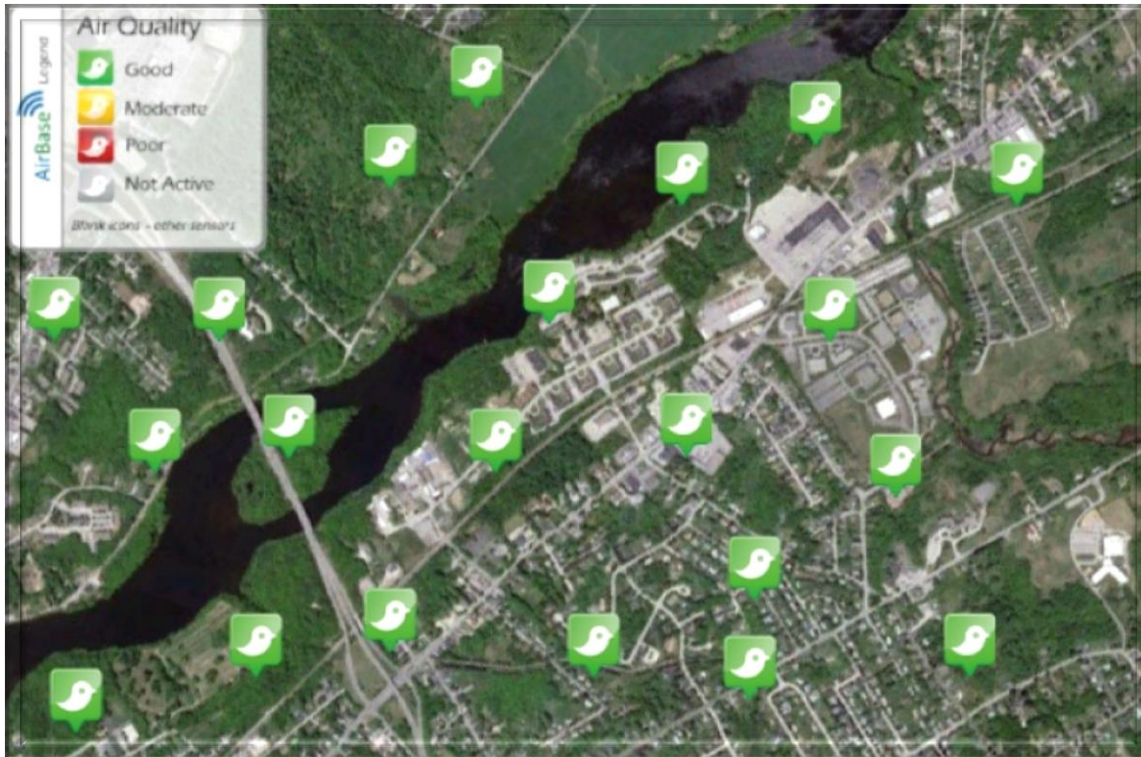
Copenhagen and Other Cities around World Wireless Fixed AQ Sensors Network

Courtesy by Raviv Yatom, Airbase Systems Ltd

Live Data: <http://sensors.myairbase.com/>



Airbase **CanarIT** AQ sensor-node:
NO₂, O₃, VOC, PM, Noise, T, RH



EXAMPLES OF SENSORS DEMONSTRATION IN EU CITIES

Dubai: Network in City

Wireless Fixed AQ Sensors Network

Courtesy by Paul Pickering, Aeroqual Ltd

AEROQUAL, AQM 60 - Air Quality Sensors Station:

CO, NO_x, O₃, SO₂, H₂S, VOC, NMHC, CO₂, TSP,
PM₁₀, PM_{2.5}, PM_{1.0}, Meteorological Parameters: T,
RH, Wind velocity/direction



Dubai Municipality

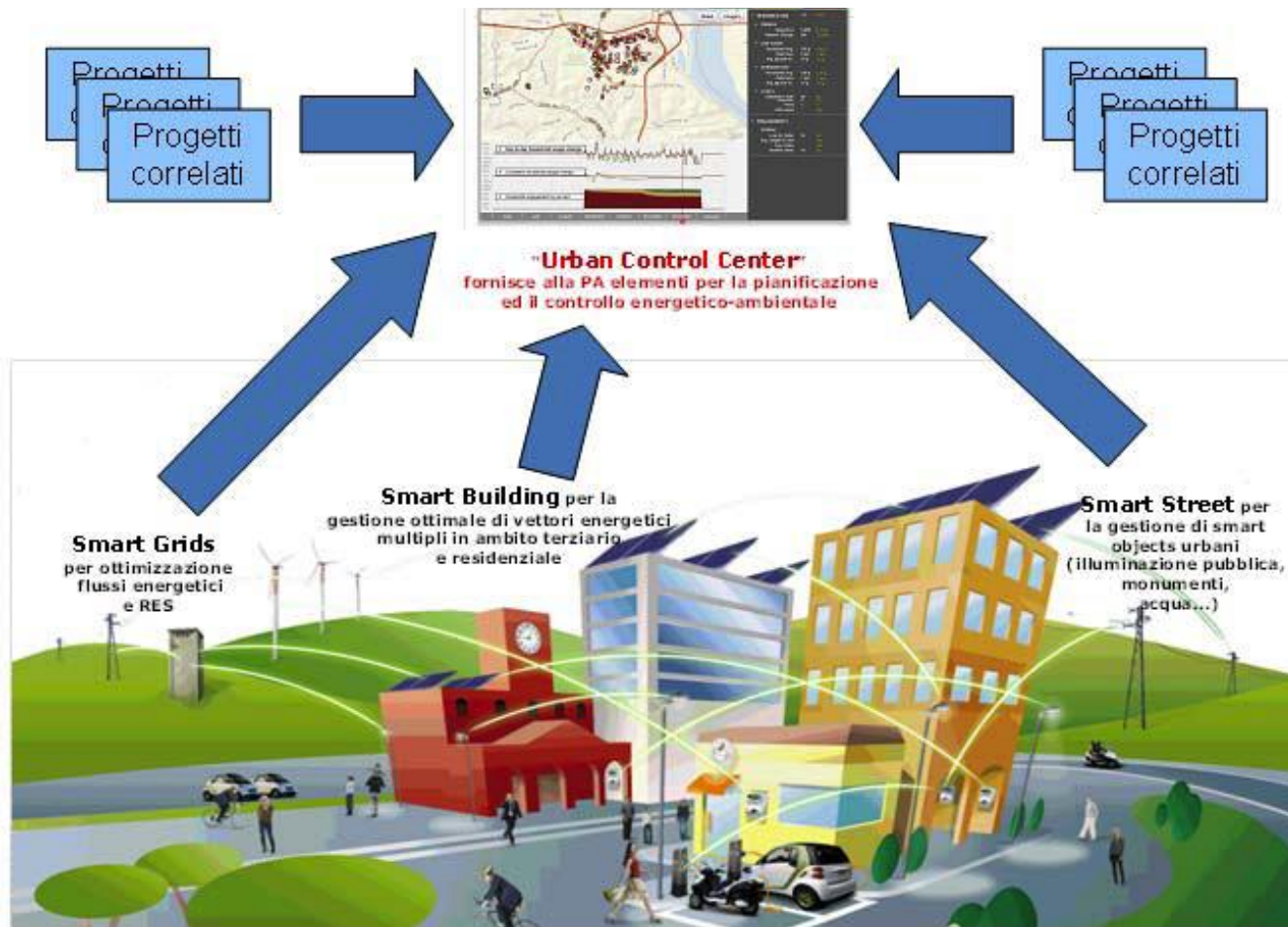


EXAMPLES OF SENSORS DEMONSTRATION IN EU CITIES

Bari, Italy: City RES-NOVAE national IT project:

Networks, Buildings, Streets for New Challenges towards Environment and Energy

Courtesy by RES-NOVAE Consortium



Demonstration an integrated solution for urban context with distributed Energy functionalities (smart grids), management of buildings network, management of streets and real-time environmental monitoring in City are cooperative.

IT NATIONAL PROJECT RES-NOVAE: APPLICATIONS SCENARIO

Smart City Bari

Smart Grid

Integration Renewables

Energy Storage Systems

Smart Grids
(Distributors)

Urban Renewables ed
Ecobuildings

Building Diagnostics
& Control

Active Demand
Management

Smart District
(Aggregators)

Urban Data
Center
(Municipality)

Energy

Environment

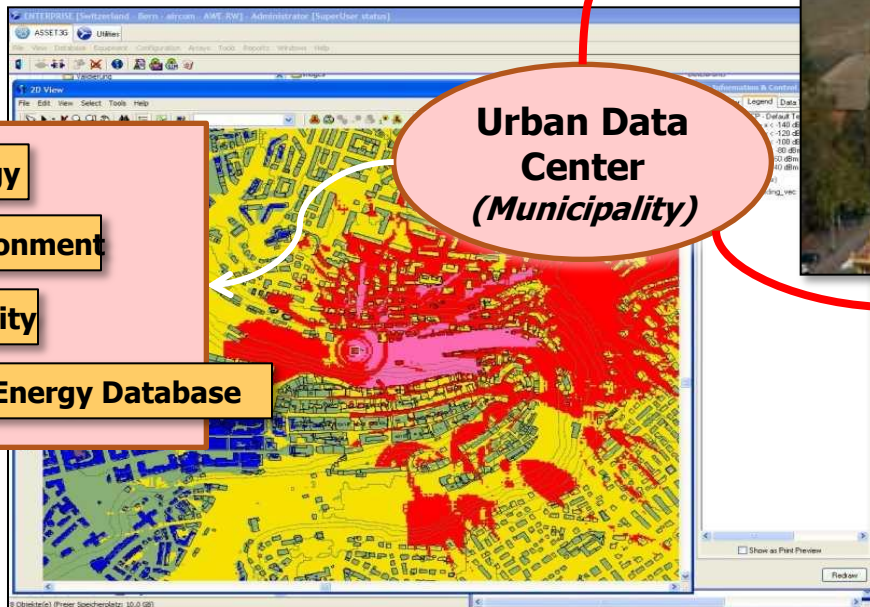
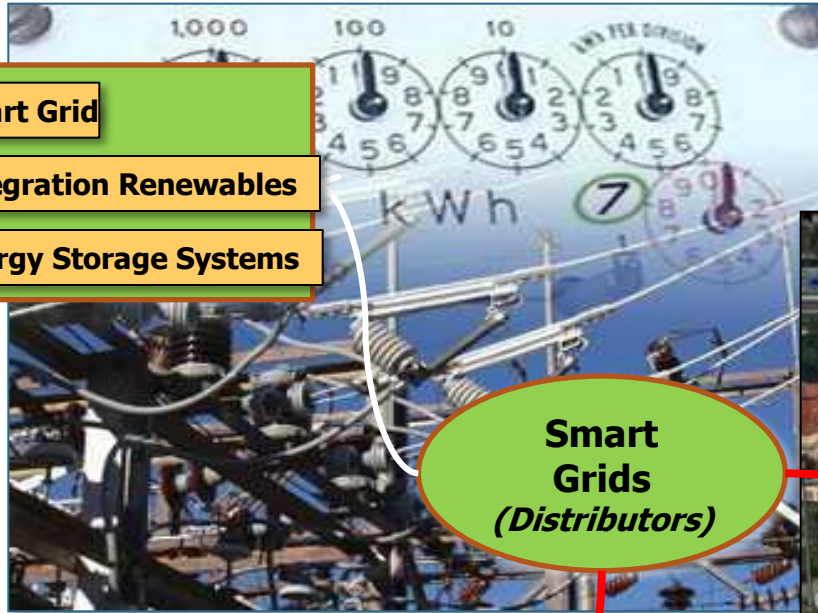
Mobility

City-Energy Database

Smart Street Control

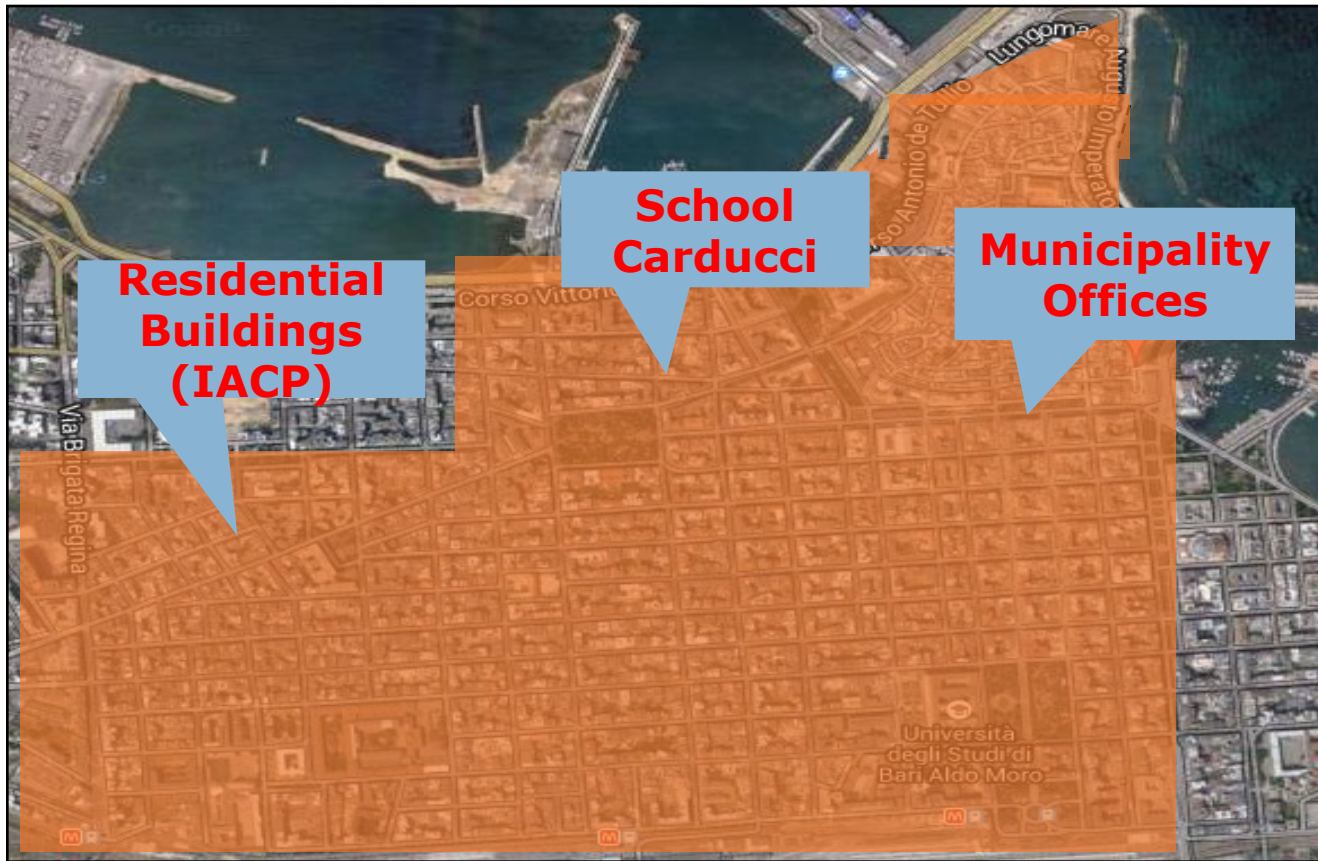
Public Light control

Smart Urban Objects



IT NATIONAL PROJECT RES-NOVAE: APPLICATIONS SCENARIO

Smart City Bari



ENEA AQ Sensor Node



**Real-World Scenario for Sensor Technology Demonstration:
Schools, Public Offices, Buildings**

CURRENT STATUS in AIR QUALITY SENSORS



Michel Gerboles, JRC-Ispra, IES

Fixed measurements: definition

'fixed measurements' means measurements taken at fixed sites to determine the levels in accordance with the relevant *Data Quality Objectives* (DQO);

Fixed measurements are mandatory in zones and agglomerations where the upper assessment thresholds are exceeded.

AQD: European DIRECTIVE 2008/50/EC on ambient air quality and cleaner air for Europe, art. 2

CURRENT STATUS in AIR QUALITY SENSORS



Michel Gerboles, JRC-Ispra, IES

AQD: Data Quality Objectives (DQO)

	SO ₂ , NO ₂ /NOx , CO	Benzene	O ₃
Uncertainty for fixed measurements	15 %	25 %	15 %
	Fluoresc., chemil., NDIR	automatic GC or pumped sampling	UV photometry
	<i>demonstration of equivalence would be mandatory to use micro-sensors</i>		

CURRENT STATUS in AIR QUALITY SENSORS



Indicative methods: definition

'indicative measurements' means measurements which meet *data quality objectives* that are less strict than those required for *fixed measurements*;

AQD: European Directive 2008/50/EC on ambient air quality and cleaner air for Europe, art. 2

Michel Gerboles, JRC-Ispra, IES

CURRENT STATUS in AIR QUALITY SENSORS



AQD: Data Quality Objectives (DQO)

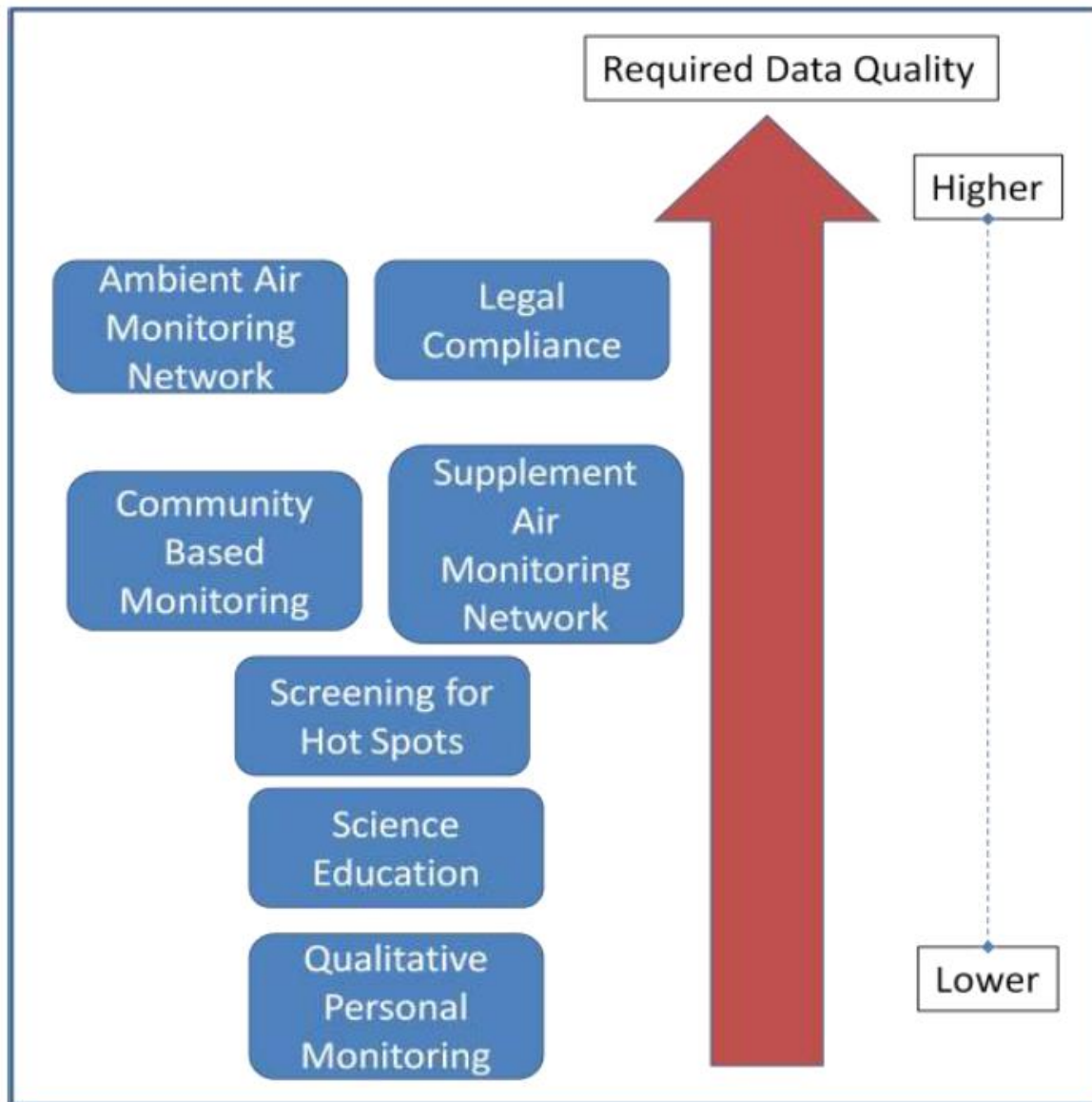
	SO ₂ , NO ₂ /NO /NO _x , CO	Benzene	O ₃
Uncertainty for fixed measurements	15 %	25 %	15 %
Uncertainty for indicative measurements	25 %	30 %	30 %
	diffusive samplers, <i>micro-sensors</i>		

Michel Gerboles, JRC-Ispra, IES

Roadmap for Next Generation Air Monitoring

U.S. Environmental Protection Agency

Data Quality Requirements for the range of NGAM applications



US EPA, March 2013:

Tim Watkins, US EPA
Watkins.Tim@epa.gov

Viens Matthew, US EPA
Viens.Matthew@epa.gov

<http://epa.gov/research/airscience/docs/roadmap-20130308.pdf>

New Sensor Technologies

- **Miniaturisation of MOX**: huge number of publications on nano particles, nano-wire, carbon nanotubes: no commercial sensors yet
- **Graphene sensors** (material with low resistance able to enhance sensitivity) - no commercial sensors yet
- **Chemical filter** directly coated on the sensing layer to avoid cross-sensitivity (NO_2 and O_3)
- **Low-cost and Low-power Gas Sensors** (Alphasense Ltd, SenseAir SA, UST GmbH, SGX-Sensortech SA, Sensichips srl, Figaro Inc, FIS Inc, etc.) in integrated air-quality stations (Unitec, Aeroqual, Contec, Libelium, Environnement, etc.), personal light badge

FUTURE TRENDS in AIR QUALITY SENSORS

European Policy for the use of sensors

- Micro-sensors:
 - - **for now**: not mentioned, not foreseen in European legislation for regulatory purposes
 - - **European Members States** shall demonstrate that the Data Quality Objective for Indicative Methods is met (*national projects*).
- **For now**, the European Commission mainly observes the results of some Research projects related to micro-sensors: *MACPoll*, *AIRMONTECH*, *FP7- ENV.2012.6.5-1* (air quality monitoring in a "Smart City" context with community involvement, *S3-EURUSSIA*, *COST Action TD1105 EuNetAir*, etc. ...)

ENERGY CHALLENGE WP 2014-15:

Call from Social Challenge 5 (Expected on October 2014):

2015: Improving the Air Quality of European Cities

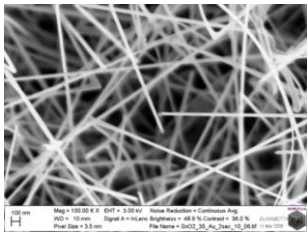
Specific Challenge: The majority of the European Population lives in urban environments where citizens are frequently exposed to levels of air pollution exceeding the limit values established by the European directives.

Scope: Development of technological options and strategies to fight against air pollution and climate change ensuring the involvement of the main sectors transport, energy and agriculture.

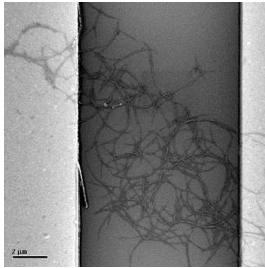
Research will include the development and applications of tools in support of air quality governance in the EU Member States and regions, integrated assessment tools for the design of adequate abatement strategies including source apportionment advanced techniques to determine the origin of air pollution to reduce the negative effects of air pollution on human health and climate change.

Expected Impact: Improved air quality in EU cities.

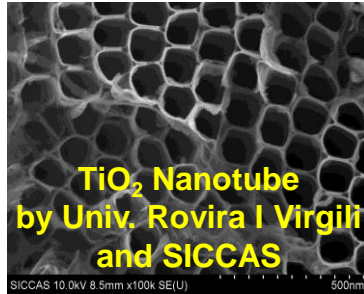
Selected Examples of Gas Sensors and Sensor Systems



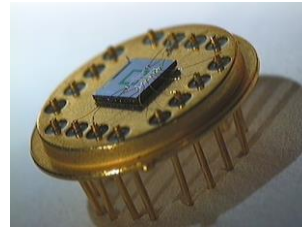
Metal oxide (SnO₂) Nanowires nets
by Univ. of Brescia



Carbon Nanotubes
by Ames NASA



TiO₂ Nanotube
by Univ. Rovira I Virgili
and SICCAS



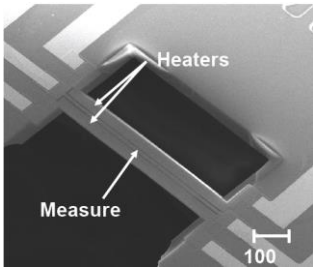
GasFET by EPFL, CH



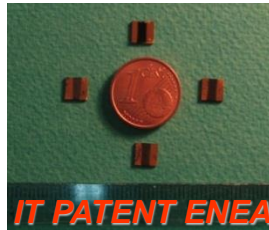
UNITEC srl, ETL3000
multi-component outdoor
air quality monitor



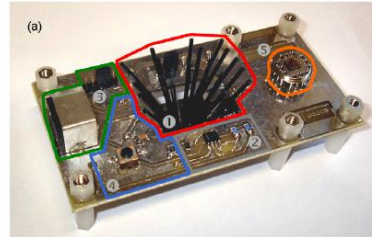
AEROQUAL, AQM 60
Air Quality Sensors Station



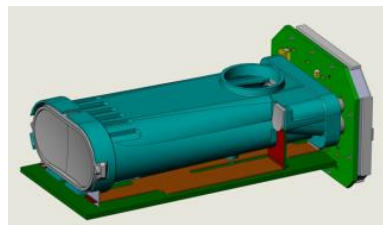
Cantilever Sensor by DTU, DK



Carbon Nanotube Gas Sensors
IT PATENT ENEA

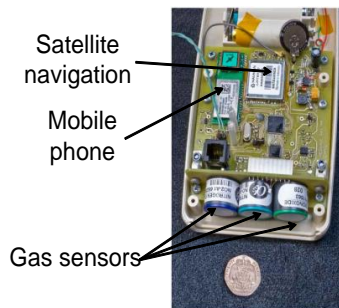


Autonomous Gas Sensor System
by IREC and Univ. of Barcelona



SenseAir SA,
A Robust Low-Cost NDIR Sensor
Platform for sub-ppm Gas Detection

Sensor units components



Simple operation!

400 gm (incl. batteries)



An **Octocopter**, the first platform on which we (*Max Planck Institute for Biogeochemistry, Jena, Germany*) tested a measurement sensor package for air quality sensors.



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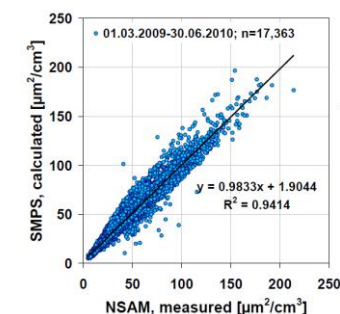
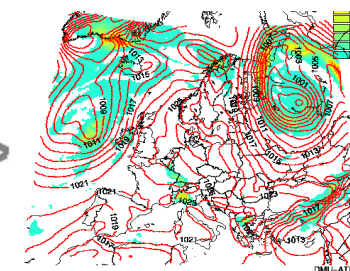
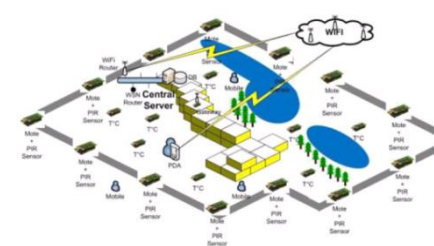
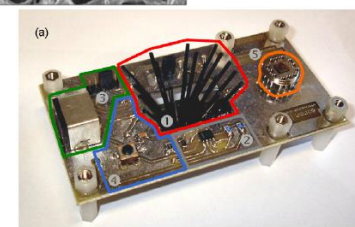
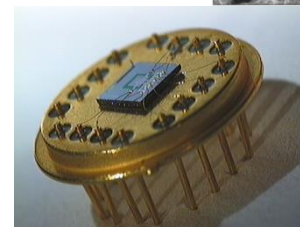
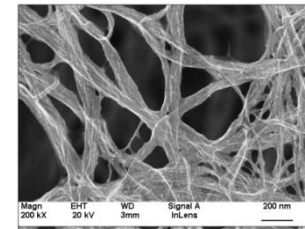


Lisbon
13-14 November 2009



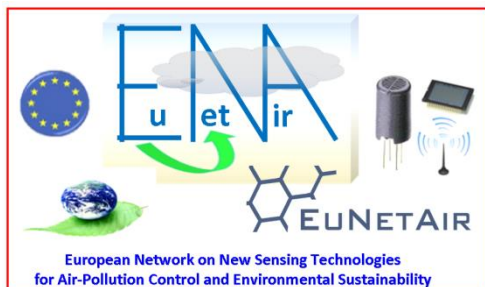
Challenges addressed by Action TD1105

- **Nanomaterials for AQC sensors**
- **Low-cost Gas Sensors**
- **Low-power Sensor-Systems**
- **Wireless Technology (*Environmental Sensors Network*)**
- **Air Quality Modelling**
- **Environmental Measurements**
- **Standards and Protocols**



Contact Details

 **cost**
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



- **CSO Approval:** 01 Dec. 2011
- **Kick-off Meeting:** 16 May 2012
- **Start of Grant:** 01 July 2012
- **End of Grant:** 30 June 2016

www.cost.eunetair.it

MC Chair:

Dr. Michele Penza, ENEA, IT
michele.penza@enea.it

MC Vice Chair:

Prof. Anita Lloyd Spetz
Linköping University, SE
spetz@ifm.liu.se

Grant Holder:

Dr. Corinna Hahn
Eurice GmbH, DE
c.hahn@eurice.eu

Scientific Secretary:

Dr. Annamaria Demarinis Loiotile
annamaria.demarinis@uniba.it

Science Officer:

Dr. Deniz Karaca
deniz.karaca@cost.eu

**Administrative
Officer:**

Dr. Kent Hung
kent.hung@cost.eu

Rapporteur ESSEM:

Prof. Kostantinos Kourtidis (GR)
kourtidi@env.duth.gr

Rapporteur MPNS:

Prof. Joaquim Manuel Vieira (PT)
jvieira@cv.ua.pt

Rapporteur CMST:

Prof. Antonio Lagana (IT)
lagana05@gmail.com

http://www.cost.eu/domains_actions/essem/Actions/TD1105