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

COST Action TD1105

OPEN SESSION COST EuNetAir on
New Sensing Technologies for Air Pollution Detection: Trends & Challenges

CORE-GROUP MEETING at EUROSENSORS-2015 Conference
Concert Hall, Freiburg, Germany, 9 September 2015

COST Action TD1105: OVERVIEW & PLANS

Michele Penza
Action Chair
ENEA - Brindisi, Italy
michele.penza@enea.it
AGENDA

10:30 - 12:30  Open Session COST: New Sensing Technologies for Air Quality Monitoring
Chairperson: Michele Penza, ENEA, Brindisi, Italy

10:30 - 10:50  COST Action TD1105: European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability. Overview and Plans
Michele Penza, Action Chair, ENEA, Brindisi, Italy

10:50 - 11:10  Performance Evaluation of Amperometric Sensors for the Monitoring of O₃ and NO₂ in Ambient Air at ppb Level
Laurent Spinelle, Manuel Aleixandre, Michel Gerboles, JRC, EC DG ENV, Institute for Environment and Sustainability, Ispra, Italy

11:10 - 11:30  LTCC, New Packaging Approach for Toxic Gas and Particle Detection
Anita Lloyd Spetz, M. Sobocinski, N. Halonen, D. Puglisi, J. Juuti, H. Jantunen, M. Andersson, Action Vice-Chair, Linkoping University, Linkoping, Sweden

11:30 - 11:50  Low-Cost Fabrication of Zero-Power Metal Oxide Nanowire Gas Sensors: Trends and Challenges
Jordi Samà, Juan Daniel Prades, Olga Casals, Guillem Domènech-Gil, Sven Barth, Isabel Gracia, Carles Cané, Francisco Hernández-Ramírez, Albert Romano-Rodríguez, Action MC Substitute, Universitat de Barcelona, Barcelona, Spain; Technical University Vienna (TUW), Institut for Material Chemistry, Vienna, Austria; Consejo Superior de Investigaciones Científicas (CSIC), Institut de Microelectrònica de Barcelona (IMB-CNM), Bellaterra, Spain; Catalonia Institute for Energy Research (IREC), Barcelona, Spain

11:50 - 12:10  Integrated Sensor Systems for Indoor Applications: Ubiquitous Monitoring for Improved Health, Comfort and Safety
Andreas Schuetze, WG2 Leader and MC Member, Saarland University, Saarbrucken, Germany

12:10 - 12:30  Towards Disposable Sensing Platforms and Analytical Instruments for Air Quality Monitoring
Danick Briand, Action MC Member, EPFL, Neuchatel, Switzerland
OUTLINE

• COST Action TD1105 *EuNetAir*: Some Features
• Examples of AQ Sensors Applications in the Real-World
• European Directive on *Ambient Air Quality (2008/50/EC)*: the Role of the AQ Sensors and Related Activities
• Concluding Remarks

*Wednesday, 9 September 2015*
Concert Hall, Freiburg, Germany
Excess reactive nitrogen represents a major environmental threat that is only now beginning to be fully appreciated. At a global level, humans have more than doubled the production and cycling of reactive nitrogen, leading to a plethora of impacts that interact across all global spheres: atmosphere, biosphere, hydrosphere and geosphere.

Sutton et al., 2009

Nitrogen Pollution: \(\text{NO}_x, \text{N}_2\text{O}, \text{NH}_3, \text{NH}_4, \text{NO}_2^-, \text{NO}_3^-, \text{etc.}\)
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
COST Action TD1105 **EuNetAir**: Working Groups

**MANAGEMENT COMMITTEE:**
- Editorial Board
- Dissemination
- Training Schools
- Gender Balance
  - Early Stage Researchers (ESR)
  - Short-Term Scientific Mission (STSM)
  - Intellectual Property Rights (IPR)
  - Local Organizing Committee (LOC)

**CORE-GROUP & STEERING COMMITTEE**

**SPECIAL INTEREST GROUPS**
- **SIG 1**: Network of Spin-offs
- **SIG 2**: Smart Sensors for Urban Air Monitoring in Cities
- **SIG 3**: Guidelines for Best Coupling Air Pollutant-Transducer
- **SIG 4**: Expert comments for the Revision of the Air Quality EU Directive

**INTERDISCIPLINARY GROUPS**

**WG1**: Sensor Materials & Nanotechnologies

**WG2**: Sensors, Devices & Systems for AQC

**WG3**: Env. Measurements & Air Pollution Modelling

**WG4**: Protocols & Standardisation Methods

**www.cost.eunetair.it**

**Action Size (July 2012 - May 2016):**
200 Experts from 120 Teams - 31 Countries
<table>
<thead>
<tr>
<th>Country</th>
<th>MC Members (58): Male (69%) - Female (31%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Dr. Anton KOCK</td>
</tr>
<tr>
<td>Belgium</td>
<td>Dr Jan THEUNIS; Dr Anne-Claude ROMAIN</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Dr Dimitar SYRAKOV; Dr Ivan NEDKOV</td>
</tr>
<tr>
<td>Croatia</td>
<td>Dr. Irena CIGLENECKI-JUSIC; Prof. Vedran BILAS</td>
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<tr>
<td>Czech Republic</td>
<td>Dr. Vera KURKOVA; Dr. Zdenek ZELINGER</td>
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<tr>
<td>Denmark</td>
<td>Prof. Ole HERTEL</td>
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<tr>
<td>Estonia</td>
<td>Prof. Raivo Jaaniso</td>
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<tr>
<td>Finland</td>
<td>Prof. Kaarle HAMERI; Prof. Jyrki LAPPALAINEN</td>
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<tr>
<td>France</td>
<td>Prof. Marcel BOUVET; Prof. Jerome BRUNET</td>
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<tr>
<td>Germany</td>
<td>Prof. Andreas SCHUETZE; Dr Corinna HAHN</td>
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<tr>
<td>Greece</td>
<td>Prof. George PAPADOPOULOS; Prof. Costas KARATZAS</td>
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<tr>
<td>Hungary</td>
<td>Ms Krisztina LABANCZ; Dr Zita FERENCEZ</td>
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<tr>
<td>Iceland</td>
<td>Dr Arnrgrimus THORLACIUS</td>
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<td>Ireland</td>
<td>Dr. Francesco PILLA; Prof. John WENGER</td>
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<tr>
<td>Israel</td>
<td>Dr. Liad ORTAR; Prof. Hossam HAICK</td>
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<tr>
<td>Italy</td>
<td>Dr. Michele PENZA; Prof. G. SBERVEGLIERI; Dr. G. DE GENNARO</td>
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<tr>
<td>Latvia</td>
<td>Dr. Iveta STEINBERGA; Dr. Gita SAKALE</td>
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<tr>
<td>Luxembourg</td>
<td>Dr Arno GUTLEB</td>
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<td>Macedonia Rep.</td>
<td>Dr. Igor ATASANOV; Dr. Ljupcho GROZDANOVKI</td>
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<tr>
<td>Netherlands</td>
<td>Dr Sywert BRONGERSMA; Dr. Ernie WEIJERS</td>
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<tr>
<td>Norway</td>
<td>Dr Nuria CASTELL BALAGUER; Dr. Philipp SCHENEIDER</td>
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<tr>
<td>Poland</td>
<td>Dr Monika KWOKA; Prof. Janislaw GAWRONSKI</td>
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<tr>
<td>Portugal</td>
<td>Prof. Bernadete RIBEIRO; Prof. Carlos BORREGO</td>
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<tr>
<td>Romania</td>
<td>Dr Marcel IONICA; Dr Roxana Mioara PICTICESCU</td>
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<tr>
<td>Serbia</td>
<td>Dr. Anka CVETKOVIC; Dr. Milena JOVASEVIC-STOJANOVIC</td>
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<tr>
<td>Slovenia</td>
<td>Dr Grisa MOCNIK; Dr Rahela ZABKAR</td>
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<tr>
<td>Spain</td>
<td>Prof. Juan Ramon MORANTE; Prof. Eduard LLOBET VALERO</td>
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<td>Sweden</td>
<td>Prof. Anita LLOYD SPETZ; Prof. Ingrid BRYNTSE</td>
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<td>Switzerland</td>
<td>Dr Danick BRIAND; Dr. Nicolas MOSER</td>
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<tr>
<td>United Kingdom</td>
<td>Dr John SAFFELL; Prof. Roderic JONES</td>
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<tr>
<td>Turkey</td>
<td>Prof. Zafer ZIYA OZTURK; Prof. Mehmet Fatih DANISMAN</td>
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**Kick-off Meeting Brussels 16 May 2012**

**Management Committee**

<table>
<thead>
<tr>
<th>Country</th>
<th>MC Substitutes (33)</th>
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<tbody>
<tr>
<td>Austria</td>
<td>Dr Stefan DEFREGGER</td>
</tr>
<tr>
<td>Belgium</td>
<td>Dr Julien DELVA</td>
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<tr>
<td>Czech Republic</td>
<td>Dr. Roman NERUDA</td>
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<tr>
<td>Denmark</td>
<td>Dr. Lise Lotte SORESEN</td>
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<tr>
<td>Finland</td>
<td>Prof. Jorma KESKINEN</td>
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<tr>
<td>France</td>
<td>Dr Jean SUISSE; Prof. Alain PAULY</td>
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<tr>
<td>Germany</td>
<td>Dr. Daniela SCHONAUER-KAMIN</td>
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<td>Dr. Thomas KUHLBUSCH</td>
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<td>Dr. Juliane ROSSBACH</td>
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<td>Greece</td>
<td>Prof. George KIRIKIADIS</td>
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<td>Iceland</td>
<td>Prof. Zoltan HORVATH</td>
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<td>Ireland</td>
<td>Dr. Roberto SIMMARANO</td>
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<td>Italy</td>
<td>Dr. Marco ALVSI; Dr. Saverio DE VITO</td>
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<td>Latvia</td>
<td>Dr. Beti ANGELEVSKA</td>
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<td>Netherlands</td>
<td>Dr. Joao Paulo TEIXEIRA</td>
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<td>Dr. Ana Margarida COSTA</td>
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<td>Poland</td>
<td>Prof. Cristina RUSTI</td>
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<td>Portugal</td>
<td>Dr. Marcel Adrian IONICA</td>
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<td>Romania</td>
<td>Dr. Judith RODRIGUEZ</td>
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<td>Dr. Jordi LLOSA</td>
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<td>Slovakia</td>
<td>Dr. Davor DOBNIKAR</td>
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<td>Croatia</td>
<td>Dr. Albert ROMANO-RODRIGUEZ</td>
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<tr>
<td>Germany</td>
<td>Dr. Christoph HUEGLIN</td>
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<td>Iceland</td>
<td>Prof. Necmettin KILINC</td>
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<td>Ireland</td>
<td>Prof. Julian GARDNER</td>
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<tr>
<td>Hungary</td>
<td>Dr Robin NORTH; Prof. Florin UDREA</td>
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31 COST Countries (Parties) have already signed Memorandum of Understanding (MoU)

PARTIES: 31
already accepted MoU

Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Luxembourg, The Former Yugoslav Republic of Macedonia, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
COST Action TD1105 EuNetAir: 7 Non-COST Countries and 8 Non-COST Institutions

Non-COST Countries: Australia, Canada, China, Morocco, Russia, Ukraine, USA

Non-COST Institutions: CSIRO (Australia); University of Waterloo (Canada); Chinese Academy of Sciences, Shanghai Institute of Ceramics (China); University of Agadir IBN Zohr (Morocco); National Research Center Kurchatov Institute (Russia); O.M. Marzeiev Institute for Hygiene and Medical Ecology of Academy of Science of Ukraine (Ukraine); Southern Illinois University Carbondale, NASA Ames Research Center (USA).
**Action Participation Statistics**

*EuNetAir COST PARTNERSHIP*  
**June 2015**

- **COST Parties**: 31
- **COST Organizations**: 123
- **UNIVERSITIES**: 55
- **RESEARCH CENTERS**: 39
- **SMEs**: 16
- **SPIN-OFFs**: 9
- **AGENCIES**: 4

![Pie chart showing participation statistics](chart.png)
EXAMPLES OF APPLICATIONS FOR AQ SENSORS AND AQ SENSOR-SYSTEMS

• **Wireless Sensor Network** around Heathrow airport for AQ Monitoring
  *by University of Cambridge and Alphasense (UK)*

• **Mobile Sensors on Public Transportation** (e.g., bus, tram) for *near real-time pollution detection* in the city
  *by EMPA, EPFL, ETHZ, Switzerland*

• **Stationary Sensors Node and Portable Sensors** for AQ Monitoring
  *by ENEA (Italy) and JRC-IES (EC)*

• **Joint-Exercise Sensors-versus-Analyzers** in Aveiro (Portugal)
  *by IDAD (Portugal) and 15 EuNetAir partners*
~ 50 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
AQ MOBILE 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\textsubscript{x}, O\textsubscript{3}, UFP, etc.

Mobile AQ sensors complement stationary sensors network
IT NATIONAL PROJECT **RES-NOVAE: OUTDOOR APPLICATIONS**

AQ ENEA Sensors Fixed Nodes Network distributed in Bari (Italy)
Urban Control Center (UCC) collects data from City.
MicroSensors for Urban Air Quality Monitoring

Wireless Sensor-Node Network for Air Quality Monitoring

**Hardware:**

A. AQ Multiparametric Sensor Node: NO$_2$, O$_3$, CO, SO$_2$, PM$_{10}$, T, RH
B. Electronics: Raspberry PI, Modem GSM, SIM Card, Wi-Fi
C. Database: saving data in real-time on a server (*IBM Italia collaboration*)
SENSOR TECHNOLOGIES: Proofs-of-Concept

NASUS GAS SENSOR BOX

M. Penza et al., COST Brescia Meeting at EUROSENSORS 2014, 7 - 10 Sept. 2014
M. Penza et al., Special Session Smart Cities Sensors at IEEE SENSORS 2014, 2 - 5 Nov. 2014

Courtesy from ENEA

Real Measurements in collaboration with JRC-IES, Ispra, Italy

4 sensors (Electrochemical) to detect air-pollutants (e.g., CO, NO₂, SO₂)
H₂S, T and RH

Air Quality Index (AQI) by NO₂ Sensor and NOₓ Chemiluminescence Analyzer
Aveiro Joint-Exercise Intercomparison & WG Meeting

13 - 27 October 2014: Starting Joint-Exercise (2 weeks duration)
14 - 15 October 2014: EuNetAir WG1-WG4 Meeting

EuNetAir Air Quality Joint-Exercise Intercomparison 2014

Local Organizers: Prof. Carlos Borrego and Dr. Ana Margarida Costa (IDAD)

Air Quality Monitoring campaign at Aveiro (Portugal) city centre 2014

COST partners (15 teams joined from 12 COST Countries) installed their microsensors side-by-side to compare performance with referenced equipment in the Air-Quality Mobile Laboratory.

Continuous measurements: CO, benzene, NOx, SO\textsubscript{2}, PM\textsubscript{10}, VOC, Temperature, humidity, wind velocity, wind direction, solar radiation, precipitation
1st EuNetAir Air Quality Joint-Exercise Intercomparison

- Micro-sensors typologies and monitored pollutants:
  - Electrochemical sensors:
    - NO, NO$_2$, CO, O$_3$, SO$_2$
  - Optical sensors:
    - PM1, PM2.5, PM10
  - Metal Oxide Semiconductor based sensors (MOS):
    - NO$_2$, COV, CO, O$_3$, SO$_2$
  - Non dispersive infrared technology sensors (NDIR):
    - CO$_2$
  - Photoionization detection sensors (PID):
    - COV$_t$

Carlos Borrego, IDAD, Aveiro, Portugal
### AQD: Data Quality Objectives (DQO)

<table>
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<tr>
<th></th>
<th>$\text{SO}_2$, $\text{NO}_2$/NO /NOx, CO</th>
<th>Benzene</th>
<th>$\text{O}_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertainty for <strong>fixed measurements</strong></td>
<td>15 %</td>
<td>25 %</td>
<td>15 %</td>
</tr>
<tr>
<td>Uncertainty for <strong>indicative measurements</strong></td>
<td>25 %</td>
<td>30 %</td>
<td>30 %</td>
</tr>
<tr>
<td></td>
<td>diffusive samplers, <strong>micro-sensors</strong></td>
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Michel Gerboles, JRC-Ispra, IES
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, KEY-VOCs, CITI-SENSE, COST Action TD1105 EuNetAir**, etc. …)
Open Questions of the Air Quality Sensors

• Lower Accuracy compared to Reference Methods
• Cross-sensitivity and low Selectivity
• Low Stability and Drift to be corrected periodically
• Calibration needs periodically (e.g., at least 1 calibration/month)
• Regular Maintenance of the in-field AQ sensor nodes
• Data Quality Objective (European Directive 2008/50/EC) to be addressed for *Indicative Measurements* by demonstration of the equivalence to use microsensors for AQ monitoring
Advantages and Benefits of the Air Quality Sensors

• Low-cost for deployment in Cities at high spatial-temporal resolution
• Suitability for personal exposure studies
• Suitability for emission source information
• Outdoor monitoring of gases (NO2/NO, O3, CO, SO2, H2S, tVOCs, CO2, NH3, etc.)
• Outdoor monitoring of particulate matter (PM10, PM2.5, PM1.0, UFP)
• Indoor monitoring of gases (CO, VOCs, benzene, formaldehyde, naphthalene, toluene, etc.) and PM (PM10, PM2.5, PM1.0)
• Combination of sensors with modelling for micro-scale analysis (1-2 mt resolution)
Focus Group Meeting EuNetAir

Innovation on Environmental Sensor Technologies

hosted by Siemens, Munich (Germany), 29 April 2015

SIEMENS

Local Organizer:
Dr. Olivier von Sicard
Siemens AG
Munich (Germany)

Participation:
• 15 Participants
• 10 COST Countries

Output:
Planned Report on
Innovation on Environmental Sensor Technologies
FOURTH SCIENTIFIC MEETING: WG & 7th MC Meeting
hosted by Linkoping University, Linkoping (Sweden), 3 - 5 June 2015

Local Organizer:
Prof. Anita Lloyd Spetz,
Linkoping University,
Linkoping (Sweden)

FOCUS ON:
Outdoor Applications

- 4 June 2015: Roundtable on the European Sensor-Systems Cluster (ESSC)
- 22 June 2015: AMA Science Proceedings (max 4 pages Templated) with DOI
- Spring 2016: Special Issue JSSS (Copernicus) - Peer Review Process
Meetings/Workshops/Training Schools planned for upcoming year (Year 4: 1 July 2015 - 15 May 2016): EXTENSION: 15 Nov. 2016 - tbc!

• WG1-WG4 Meeting on Air Quality Monitoring and Calibration: Horizons in Sensing Technologies, Methods and Modelling - Start of the 2nd EuNetAir Air Quality Joint-Exercise Intercomparison organized by the VINCA Institute, Belgrade (Serbia), 13 - 14 Oct. 2015. Local organizer: Dr. Milena Jovasevic-Stojanovic, VINCA.

• The 4th International Workshop of the COST Action TD1105 on Innovations and Challenges for Air Quality Control Sensors at FFG (National AT COST Office), Wien (Austria), 25 - 26 February 2016. Local organizer: Dr. Anton Kock, MCL.

• The Action 4th International Training School on Modelling, Methods and Technologies for Air Quality Control at Emdrup Campus in Copenhagen, by Aarhus University (Denmark), 19 - 22 April 2016. Local organizer: Prof. Ole Hertel, Aarhus University. Trainees: 13-15 expected. Trainers: 3-4 expected.
MC/WG Meetings planned for the upcoming year (Year 4: 1 July 2015 - 15 May 2016): EXTENSION: 15 Nov. 2016 - tbc!

- **5th SCIENTIFIC MEETING: WGs Meeting and 8th MC Meeting on New Sensing Technologies for Indoor Air Quality Monitoring: Trends & Challenges** at Bulgarian Academy of Sciences, Sofia (Bulgaria), 16 - 18 Dec. 2015. **Local organizers:** Prof. Ivan Nedkov and Prof. Dimiter Syrakov, BAS

- **6th SCIENTIFIC MEETING: WGs Meeting and 9th MC Meeting on New Sensing Technologies for Outdoor Air Quality Monitoring** at Czech Academy of Sciences, Prague (Czech Republic), 5 - 7 October 2016. **Local Organizers:** Prof. Zdenek Zelinger, Dr. Vera Kurkova, Dr. Roman Neruda, CAS

- **Special Session EuNetAir / Core-Group Meeting to EUROSENSORS 2015**, Freiburg (Germany), 6 - 10 September 2015
OUTREACH ACTIVITIES from Action TD1105

COST Action TD1105 - EuNetAir
European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability - EuNetAir

Action website: www.cost.eunetair.it
hosted by ENEA

Dr. Marco Alvisi, Webmaster Coordinator
Sebastiano Dipinto, Valerio Pfister, Gianfranco Zingarelli, Webmaster Team

Social Scientific ESRs Network (SSEN) by LinkedIn
Members: >50 - Moderators: M. Viana, M. Minguillon

4° CALL for Short Exchange Visits launched on September 2015
Short Term Scientific Mission: 9 TO BE FUNDED by 15 May 2016

Dr. Jan Theunis, STSM Coordinator EuNetAir

Issue 2: published on June 2013
Issue 3: published on Dec. 2013
Issue 4: published on June 2014
Issue 5: published on Dec. 2014
Issue 6: published on June 2015

Prof. Ralf Moos, Editor-in-Chief
Dr. Daniela Schonauer-Kamin, Editorial Board Manager
Symposium planned at EMRS Spring Meeting 2016
Lille (France), 2-6 May 2016

Advanced Functional Materials for Environmental Monitoring Sensors and Energy Systems Applications

Proceedings of Symposium EMRS Spring Meeting 2016 to be published under peer-review process in Beilstein Journal of Nanotechnologies (IF 2014: 2.3)

• Peer-review process  Open Access journal without publication fee (http://www.beilstein-journals.org/bjnano).

• Symposium Organizers:
  ✓ Michele Penza, ENEA, Italy
  ✓ Anita Lloyd Spetz, Linkoping University, Sweden
  ✓ Albert Romano-Rodriguez, Barcelona University, Spain
  ✓ Meyya Meyyappan, NASA Ames Research Center, USA

• Deadline for abstract submission: 15 January 2016

http://www.emrs-strasbourg.com
Expected Impact by Action TD1105

- European Leadership on AQC Science & Technology
- Development of Green-Economy
- Support to Sustainable Development
- Support to Monitoring System of Clean Air for Europe
- Fostering Research & Innovation on New Sensing Technologies for Environmental Monitoring
**Contact Details**

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**MC Vice Chair:** Prof. Anita Lloyd Spetz  
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**Grant Holder:** Dr. Corinna Hahn, Dr. Juliane Rossbach  
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**Scientific Secretary:** Dr. Annamaria Demarinis Loiotile  
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**Science Officer:** Dr. Deniz Karaca  
deniz.karaca@cost.eu

**Administrative Officer:** Dr. Andrea Tortajada  
andrea.tortajada@cost.eu

**CSO Approval:** 01 Dec. 2011  
Kick-off Meeting: 16 May 2012  
Start of Grant: 01 July 2012  
End of Grant: 15 May 2016

[www.cost.eunetair.it](http://www.cost.eunetair.it)

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

**TD1105 selected as Top-Story by COST Association**
Some CONCLUSIONS and Future Activities

• Low-cost Micro-sensors should not substitute but supplement routine monitoring devices, at the moment.
• Use of portable systems based on low-cost solid-state gas sensors to supplement high-cost standard chemical analyzers should be possible for some pollutant gases.
• Further long-term investigations in order to extend the range of air-pollutants detectable by low-cost solid-state gas sensors at higher accuracy.
• Further sensor-system miniaturization and integration with commercial electronics (e.g., smartphones, tablets, etc.) for community participatory environmental sensing.
• Air Quality Control Fixed/Mobile Sensors Network for Smart Cities Applications
• Air Quality Index (AQI) to inform general public.
ACKNOWLEDGEMENTS

Freiburg, Germany, 6 - 9 September 2015

HORIZON 2020
EUROPEAN UNION FUNDING
FOR RESEARCH & INNOVATION