Sustainability Dimensions

Annual Report of the Laboratory of Heat Transfer and Environmental Engineering - Mechanical Engineering Department, Aristotle University Thessaloniki, Greece

2006

The Laboratory of Heat Transfer and Environmental Engineering belongs to the Energy Section of the Mechanical Engineering Department of the Aristotle University Thessaloniki, Greece. The Laboratory is responsible for eleven pre-graduate courses in the Mechanical Engineering Department, while also supervising 30 doctoral candidates in the frame of their graduate studies. Furthermore, it has a long record of research and consulting activities, both at national and international level. The staff of the Laboratory includes 3 senior scientists, 29 young researchers and 6 technical and administrative members. Most of the research funds of the Laboratory originate from competitive programmes of the European Commission, although 2006 we received also substantial grants from national funding agencies. In the last years, the mean annual turnover of the Laboratory has been of the order of 0.8 million €.

This year the Laboratory hosted two important activities of ACCENT, the Network of Excellence on Atmospheric Composition Change. On May 29/30 we organised a workshop on Model Benchmarking with the intention to define procedures for atmospheric model quality assurance applicable to all relevant scales, i.e. the entire range from climate models to microscale models for street canyons applications. The discussions revealed considerable differences in the approaches followed so far by the various modellers communities, yet there has been agreement that a higher degree of coherence is feasible.

The second ACCENT event, in the period 9-12 October, combined the Interdisciplinary Training Workshop "Air Quality in the Mediterranean for the Next Generation" and the so-called Hellenic ACCENT day (HAD). The former consisted of a sequence of modules attended by twenty-five young atmospheric scientists from 13 countries. HAD's objective was to promote collaborative work between Greek scientific groups working on climate change and air pollution, thus maximising the potential Greek input to ACCENT.

In fact, 2006 has been a turbulent year for Greek Universities: Intense discussions took place on potential changes to the legal framework of tertiary education in Greece. Students reacted with extreme scepticism and demonstrated this with occupations, resulting in delays in the examination procedures. The discussions on the legal amendment continue and hopefully there will be consensus between the members of the academic community and the Ministry of Education.

Another subject of turbulent discussions in the last months of 2006 are two major public works that will soon be under construction in Thessaloniki: The city's subway and a underwater vehicle tunnel. The former is generally accepted as a decisive step for improving traffic conditions in the city, although the associated construction phase will severely disrupt the day-by-day city life over more than 6 years. The underwater tunnel is much more controversial because of severe doubts on the fitness-for-purpose of the intervention, while there is much scepticism on the tardy decision to request that tunnel users pay a toll. In this context it should be noted that the Laboratory was involved in the Environmental Impact Assessment studies for both major interventions, and thus it participates at the discussion bearing in mind that its highly emotional character does not necessarily favour arriving at reasonable conclusions.

Finally yet importantly, our Laboratory received in 2006 the ISO 9001:2000 certification. This demonstrates the effectiveness of our quality management system and suggests our staff members' dedication to conducting excellent research and providing high quality services.

Prof. Dr. Nicolas Moussiopoulos
Laboratory Director

Seismic Risk Management of Life-lines (SRM - LIFE)

Transportation systems (roadways, railways, port and airport facilities, bridges and tunnels), water/wastewater and power supply, natural gas and telecommunication networks, the so called lifelines and infrastructures, as well as critical-strategic facilities (i.e. administration buildings, medical health facilities and networks, fire fighting stations and facilities) play a crucial role in the quality of life, public service, level of security and economy of urban systems. For this reason, all decision makers, public authorities, service providers, as well as private companies that own and manage such systems need a concrete evaluation of the possible impact that a seismic event could have on their lifeline networks and essential facilities. It is equally important to have in advance an overview of the possible earthquake damage impact on the lifeline systems for different seismic hazard scenarios, while obtaining an illustrative picture of the functionality level within a Metropolitan city in the periods of crisis and recovery.

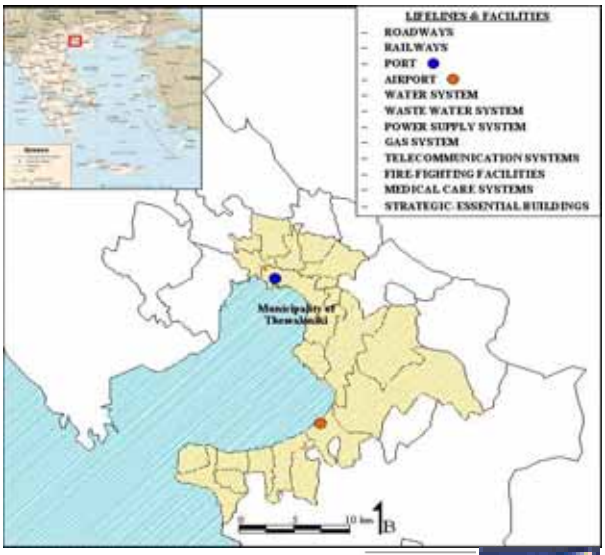
In addition to the above, the development of an efficient restoration strategy plan for each particular lifeline network that will consider the interactions and interdependence between the various networks inevitably depends on the accurate knowledge of the expected distribution and intensity of earthquake induced damages that correspond to each particular seismic scenario.

Within the context of these requirements, the SRM-LIFE project aimed to develop a general and modular methodology in order to:
(a) Estimate the vulnerability of lifeline systems, infrastructure and critical facilities for different earthquake-risk scenarios.
(b) Quantify and evaluate the impact of potential earthquake events to the lifeline systems, infrastructures and on the city activities as a whole taking into account the strong synergy among lifelines and city-population activities.
(c) Develop appropriate pro-seismic retrofitting schemes together with post-seismic emergency and restoration strategies.
Further objectives of the SRM-LIFE project were to:
(d) Perform a specific microzoning study of the metropolitan area of Thessaloniki including a detailed geotechnical mapping of the area with full engineering description of the physical, mechanical and dynamic properties of all soils formations and
(e) Construct a complete GIS data base and inventory-classification by defining the typology of all lifeline systems, infrastructures and essential facilities.

The final scope and deliverable of the project will be the development of a comprehensive modular methodology and tool for “Seismic Risk Management of Lifelines” (SRM-LIFE), performed in a GIS platform and format that will be applied and validated in the metropolitan area of Thessaloniki.

The Laboratory has mainly contributed to the vulnerability assessment of the water supply, waste water and natural gas network lifeline systems. Maps in GIS format illustrate the distribution and the severity of damages for the three aforementioned systems and for the three seismic scenarios in the metropolitan area of Thessaloniki. Fragility curves that take into account the anchored or unanchored features of the network subcomponents were proposed according to four damage states (slight/ moderate/ extensive/ complete damage).

Moreover, LHTEE has contributed to the evaluation of the ‘global value’ of the lifeline systems under consideration for normal, crisis and recovery periods. A general-purpose urban system analysis was developed in order to provide access to the effects of different damage scenarios of lifeline systems to the, also affected by the earthquake, urban fabric and to the economic/social activities of the population.



Project funded by General Secretariat for Research and Technology (Ministry of Development). Major Partners: Laboratory of Soil Mechanics and Foundation Engineering, Laboratory of Reinforced Concrete, Laboratory of Transport Engineering, Laboratory of Telecommunications.
Contact: Prof. Nicolas Moussiopoulos, moussio@eng.auth.gr

Monitoring and Evaluation of Indoor Climate and Air Quality Conditions in the White Tower, to be Used as the City Museum of Thessaloniki

Old, historic buildings are usually featuring poor indoor environmental quality and low energy performance. Still, many of these buildings are converted into museums, attracting large numbers of visitors. Therefore, interventions are needed to maintain high levels of thermal comfort and indoor air quality. In that sense, indoor environmental quality is a dominant feature.

The objective of the project was to monitor and evaluate the indoor climate and air quality conditions in the Whiter Tower and to determine for necessary interventions improving indoor environmental quality whilst limiting the energy demands.

The first phase of the work was to monitor for a whole year the indoor climate conditions and the CO_2 concentration prevailing in the building. The evaluation of the measuring results showed that the temperature levels are quite acceptable for both the heating and the cooling season, without significant daily fluctuations. On the other hand the levels of relative humidity are often exceeding the acceptable limits, as proposed by the international thermal comfort and indoor air quality guidelines and standards. Also the experiments conducted showed that the concentration of CO_2 is above the proposed limit of 1000ppm, when a single space is overcrowded. Finally the measurements of the building's infiltration and of the air flow field showed that higher levels of ventilation can reduce CO_2 concentration levels and sometimes control sufficiently the relative humidity levels.

Taking into account that: a) implementing a contemporary HVAC system in a historic building results in not acceptable architectural changes and b) the visual impact of the possible interventions on the internal and external view of the building has to be minimal, we concluded that appropriate air dehumidifiers, combined with well placed window fans consist the best solution for improving indoor environmental quality. Air dehumidifiers can maintain relative humidity in acceptable levels, whilst window fans supply fresh air from outdoors to the internal spaces maintaining satisfactory indoor air quality. The operation of the window fans does not aggravate relative humidity levels indoors, since they are programmed to work only when the ambient relative humidity is below 60%.

Various scenarios were considered, with respect to: a) the number of people occupying each internal space and b) the air change rate. The results showed that when 8 persons occupy an internal space and the air movement is supported by the operation of the window fans, the solution that we have suggested could improve the indoor environment quite adequately.

Finally, a set of secondary measures was proposed in order to support the main interventions, like the replacement of the existing doors of the internal spaces with new perforated doors, which support the air movement from the internal spaces to the stair-case.

The final outcome of the project is that, although integrating a central HVAC system in the White Tower is not possible due to the very tight morphological and architectural restrictions set by the nature of the building, there is still a way of establishing acceptable indoor thermal comfort and air quality by introducing high quality portable devices installed in the most discrete possible way.

Project funded by the Museum of Byzantine Culture (2004-2006).

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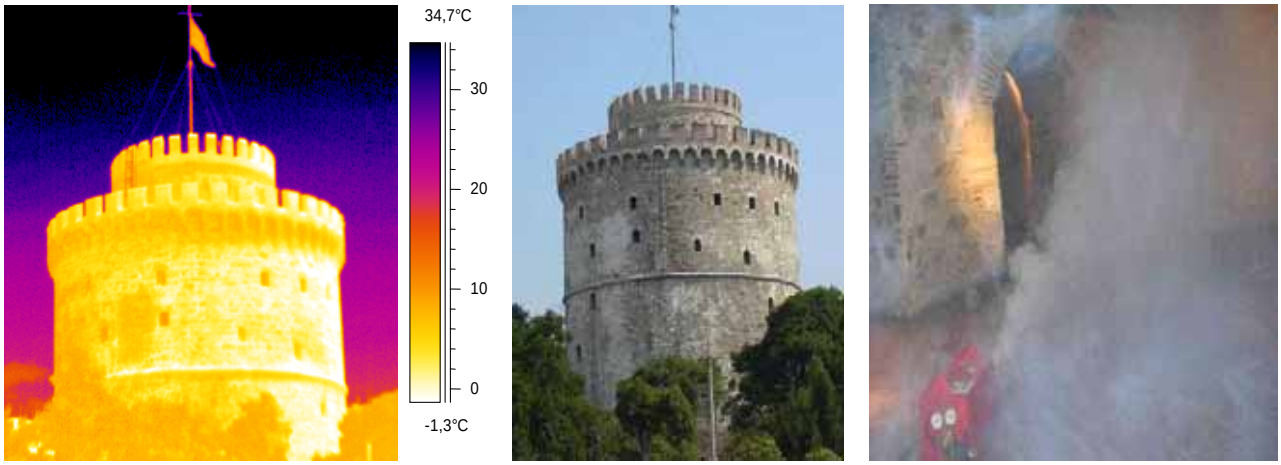

Photocalytic Innovative Coverings Applications for Depollution Assessment (PICADA)

The phenomena of facades soiling and staining are probably as old as cities themselves, but industrial pollution has only exacerbated the problems with impacts on both the quality of the urban environment and the life cycle cost of buildings. In urban areas the levels of gaseous pollutants are relatively high due to increased emissions. The problem is particularly intense especially in urban hotspots like street canyons. Pollution has a negative effect on human health and results in the aesthetic degradation of the urban environment.

The primary objective of the PICADA project was to reduce the cost and increase the performance of innovative coverings for sheet-like applications in order to make available affordable, really sustainable products whose large applications may be combined with already existing techniques in order to improve the quality of the urban built environment. Such materials exhibit both de-soiling and de-polluting properties due to the photocatalytic properties of TiO_2 which has been added in their matrix. As a result, they are able to degrade NO_x as well as various other organic pollutants. PICADA products are expected to remove from the atmosphere most part of various noxious compounds such as NO_x, VOC's, PM10 particles and O_3. Moreover, treated surfaces are expected to keep clean from typical urban soiling factors such as bacteria, algae and organic compounds. The PICADA project has led to three different products:

A mortar to be used as a façade covering either in the construction industry or as a waterproofing material for renovation.

A cementitious coating (almost a mineral paint) which may be widely used for decoration and surface aspect maintenance.

A translucent coating similar to a protecting varnish for historical monuments and classified buildings maintenance.

The main contribution of LHTEE was the assessment of the depollution effectiveness of a range of TiO_2 based PICADA products through (a) extensive numerical modeling with MIMO, the Laboratory's own CFD code for micro-scale applications, (b) field measurements during a campaign which took place in Guerville, France and (c) wind tunnel measurements on a model under a scale of 1/50 of the Guerville field site. Furthermore, the Laboratory contributed to the development of an easy to use tool for the prediction of the expected depollution of specific PICADA products within complex urban structures. Additionally, a methodology was developed for assessing the cost effectiveness of the products and for performing a cost benefit analysis for their future large scale application at both the street and city scales. The numerical and physical modeling results, as well as the field measurements have shown that the range of the façade covering materials developed within the frame of the PICADA project are an effective "trap" for both traffic emissions and pollutants from other sources. Finally, in order to verify the quality of numerical predictions regarding the expected depollution effectiveness of these materials in possible future large scale applications, MIMO was evaluated and validated on the basis of both the field and wind tunnel measurements with very satisfactory results.

Project funded by CEC, GROWTH Measurements & Testing, Infrastructures (2002-2005). Major Partners: GTM Construction, CTG, Millennium Inorganic Chemicals Ltd, Dansk Beton Tecknic, Centre Scientifique et Technique du Bâtiment, CNR ICITE, National Center for Scientific Research Demokritos.

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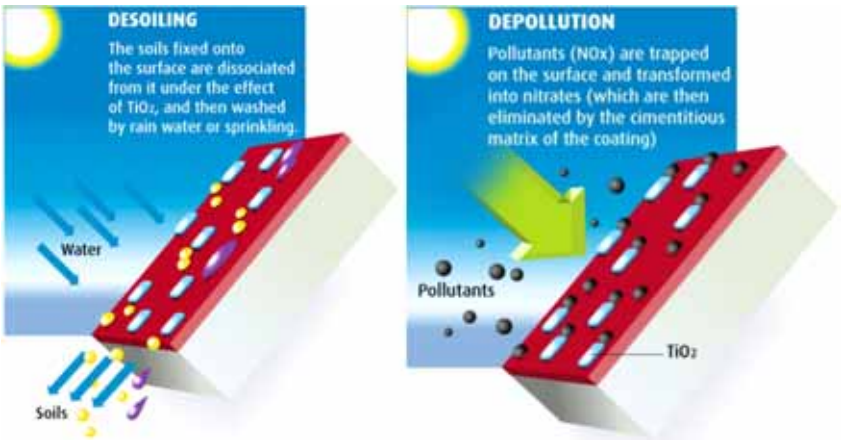

The de-soiling and de-polluting abilities of the PICADA materials are due to the introduction of suitable amounts of titanium dioxide.

Rural Advice and Support Units for Integrated Energy Management in Buildings (RURASU)

Establishing in rural areas a project that concerns design and advice support units for buildings is a difficult process. It presupposes a well planned setup action agenda, a detailed schedule of operation and a sound monitoring of the work carried out. If these factors are neglected, then –as it often happens- new organizations may have to stop after a short period of work due to unsatisfied expectations or financial reasons.

The objective of the RURASU project was to offer targeted services to consumers, energy and building professionals and municipalities in order to promote renewable energies and efficient use of energy in the built environment in two Mediterranean countries, Greece and Spain, and two north countries of Europe, Germany and Scotland. The project is co-ordinated by two experienced DASUs (Design and Advice Support Units) Pieriki Anaptixiaki S.A, in northern Greece, and eza! (Energie- & Umweltzentzrum Allgaü), in southern Germany, which transfer their knowledge to the new DASUs South AYRSHIRE council, in Scotland and OFAER Subbetica, in Andalucia, Spain. Scientific support to that project is offered by LHTEE, the Group of Building Environmental Studies of the Physics Department at the University of Athens, WIP KG, the University of Strathclyde in Glasgow, the University de Càdiz (UCA) and the "Agenda Anadaluza de la Energie Consejerío de innovation, Ciencia Y Empresa".

Part of the RURASU agenda was not only to promote the implementation of the new DASUs but also to give an additional push to the existing units in Greece and Germany. For that scope, specifically for Greece there have been a number of actions, including:

- Providing information to local and regional authorities, chambers of specific professions and administrations on all related European directives.
- Setting up a list of the energy audits of public buildings, which will be used to calculate heating and cooling loads.
- Organizing training courses to promote the use of renewable energies as an auxiliary or basic form of energy and
- Publication of those actions on the following web pages: www.rurasu.info and www.pieriki-anaptixiaki.gr/energy. The publications consist of brochures about wind energy and its use, geothermal heat pumps, biomass, active solar systems, photovoltaic systems and transparent elements and openings.
- Providing for each participating country the Information Acquisition Tool, IAT. The IAT, is an accurate and detailed instrument for local and regional market players. It is based on the fact that lots of information is already available but has to be made accessible. This information has been gathered and made available, by means of the IAT, over the internet.

The final goal of that bouquet of actions is to reduce energy cost in each participating country and to promote the RES for heating.

Project funded by the "Intelligent Energy – Europe", Programme of the European Community Grant Agreement EIE/04/223/S07.38603, Duration: 01/2005-06/2007 (30 months)

Coordinator: Pieriki Local Development Agency S.A. (PIERIKI S.A.) – Greece. Major Partners: University of Cadiz, (UCA), Spain, Institute of Accelerating Systems and Applications, (IASA), Greece, Energie-& Umweltzentrum Allgäu gGmbH, (eza!), Germany, WIP KG, (WIP KG), Germany, University of Strathclyde, (UoS), United Kingdom.
Subcontractor: Laboratory of Heat Trensfer and Environmental Engineering, LHTEE,

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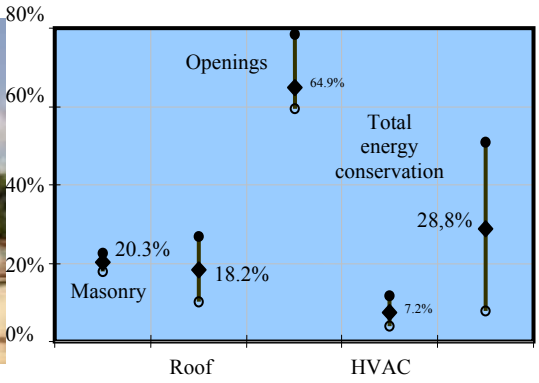

Energy conservation

City-Delta Phase II
A European Inter-Comparison Exercise of Long-Term Model Responses to Urban-Scale Emission-Reduction Scenarios

As a contribution to the modelling activities of the CAFE programme, an open model inter-comparison exercise was launched by the JRC-IES in collaboration with EMEP, IIASA and EUROTRAC to explore the changes in urban air quality predicted by different atmospheric chemistry-transport models (CTMs) in response to changes in urban emissions. The range of response resulting from this model inter-comparison was then used in the cost-effectiveness analysis of CAFE with the aim to balance Europe-wide emission controls against local measures. The model inter-comparison focused on ambient levels of particulate matter and ozone in urban areas by addressing health-relevant matrices of exposure (e.g., long-term concentrations).

The main objectives of the City-Delta exercise were:

- Model inter-comparisons in order to assess the performance of available models and compare them against available observational data
- To assist air-quality managers in quantifying the contribution of regional versus local sources and in identifying and assessing the most effective emission controls and
- To provide quantitative information in relation to legal obligations, e.g. whether a certain trend in emissions will achieve air quality limit values.

In City-Delta Phase II comparisons were conducted for four European cities, Berlin, Milan, Paris and Prague. Practical considerations included the availability of suitable models, of emission inventories for gaseous and particulate pollutants, of sufficient meteorological information, and monitoring data.

At the regional scale, revised emission fields were used, with validated gridded distributions of sectoral emissions scale. New IIASA 2010 projection factors, and updated height distribution and temporal repartition of these emissions were also provided for this second phase. At the urban scale, emissions were scaled to match the gridded values of the regional emissions to avoid inconsistencies between the local and regional emitted quantities. Background boundary conditions for 1999, also for the emission control scenarios provided by JRC-IES and meteorological data used originated from the ALADIN project. Regarding case studies scenarios, “base case” was 2000 and seven scenarios for 2010 were studied.

AUT/LHTEE participated in this inter-comparison exercise with the OFIS model. From the results, OFIS clearly achieved its goal, i.e., it succeeded in refining regional scale model results, while its effectiveness was highest near the city diminishing with distance. The performance of OFIS was comparable to that of complex 3D models. However, it proved to be by more than 1 order of magnitude faster. The combination of a regional scale model and OFIS was found to be an adequate tool for satisfying the needs of the EU Air Quality Framework Directive.

Generally, City-Delta conclusions provide guidance on how urban air-quality could be included in a Europe-wide evaluation of the cost-effectiveness of emission control strategies.

Project funded by the International Institute for Applied Systems Analysis (IIASA)

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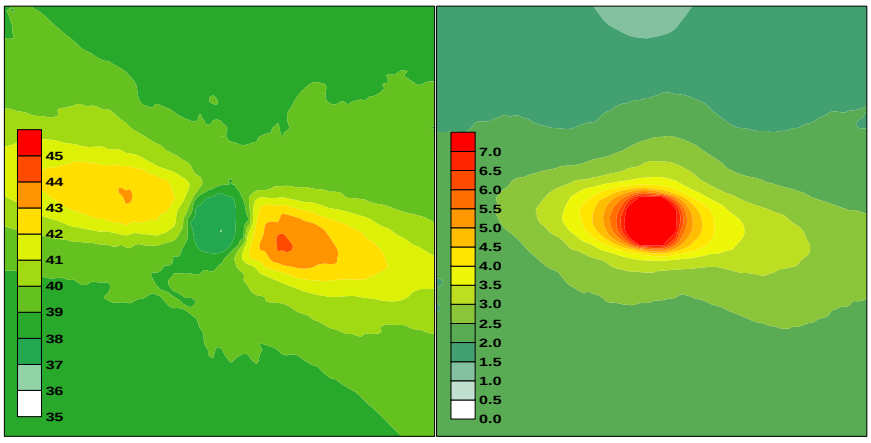

Spatial distribution of ozone concentrations, in μgm^{-3} (left) and particulate matter (right) in Milan.

Air Quality Assessment for Europe: from Local to Continental Scale Air4EU

Air4EU addressed the needs for policy-orientated research on integrated air quality (AQ) assessment by monitoring methods and modelling at different temporal and spatial scales for regulated pollutant components in Europe: PM_{10}, $PM_{2.5}$, NO_2, CO, SO_2, O_3 and benzene.

In respect to AQ assessment, Air4EU strengthened the links between research and policy, which has been recognised as a priority within the "Clean Air for Europe" (CAFE) programme. There is a wide variety of assessment methods to provide reliable and accurate AQ data, but the methods depend on the spatial and temporal scales, and are often not or only partially compatible. Monitoring and modelling methods are usually used separately and consequently yield results that are not mutually consistent. There is an obvious demand for scientific sound and practical recommendations on how to integrate measuring and modelling techniques into internally consistent, comprehensive and cost-effective assessment methods.

The aim of Air4EU was to provide recommendations on integrated AQ assessment for different temporal and spatial scales: ranging from hourly to annual and from "hotspot"/street to continental scale. This was considered to directly benefit EU stakeholders including policy makers and city, national and regional users. Research objectives in Air4EU were directed to review the benefits and drawbacks of existing modelling and monitoring methods for different spatial and temporal scales. Criteria for the review were parameters such as uncertainty and accuracy, costs, input requirements and representativeness of the data. These parameters were evaluated against the requirements for different policy purposes. This resulted in recommended methods for AQ assessment with emphasis on the combined use of monitoring and modelling. Air4EU prepared AQ maps at different scales in Europe based upon available data sets (monitoring, meteorology and emissions) and the recommended methods.

Air4EU brought together European top-scientists with complementary skills in the field of AQ assessment together with relevant stakeholders. The cooperation of researchers from six member states representing four universities and two research institutes, as well as eight user partners supported the establishment of the European Research Area. Authorities, practitioners and policy makers at urban, regional, national and European level are consulted, as well as a high level Expert Group. A vital aspect of Air4EU were 'case studies' to test and further develop the recommendations. Case studies, which addressed the "hotspot", urban and national scales, were implemented in Paris, Rome, Prague, London, Athens, Rotterdam and Oslo, in close cooperation with user partners and other interested parties.

Air4EU co-operated with on-going relevant projects (e.g. ENV-e-CITY; OSCAR; CLEAR; MERLIN) and networks (e.g. INTEGAIRE, City-Delta; POLIS), and specific liaison was established with the CAFE programme. Air4EU disseminated its results by a Website and through Newsletters and Workshops to the scientific community, environmental authorities, policy makers and other stakeholders in AQ in Europe.

LHTEE contribution focused in the review of modelling and monitoring methods for air quality assessment at the urban/ agglomerate scale, as well as the impact of scale interactions in the assessment process.

Project funded by CEC, Specific Targeted Project (2004-2006). Major partners: TNO, Apeldoorn, The Netherlands, NILU, Kjeller, Norway IER, University of Stuttgart, Germany, University of Hertfordshire, UK, University of Aveiro, Portugal.

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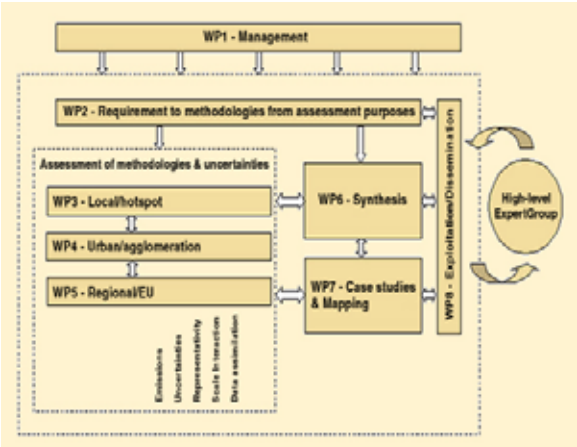
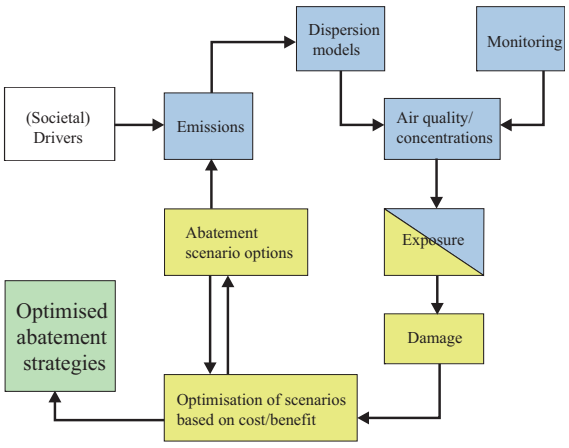


The structure of Air4EU



Functional structure of modules in an integrated Air Quality Management system

Social and Professional Reinstatement of Handicapped People and Gypsies through Reuse and Recycling of Waste Electric and Electronic Equipment in Greece – PRUWE

Main objective of this project is the development of social services for the reuse and recycling of Waste electrical and electronic equipment (WEEE) through the accession of people with disabilities and Gypsies in the corresponding market. This project has both an environmental and a social character and comprises 28 work packages LHTEE participating and contributing to most of them.

Initial goal is to contribute in developing procedures for the formulation of appropriate conditions, towards the development of social services for WEEE reuse and recycling, by the inclusion of people with disabilities and Gypsies in this evolving market. Application areas are the Hellenic regions of Thessaly and North Aegean, which show intense inequality problems for people with disabilities and Gypsies. Another major target of the project is to contribute to the reduction of occupational desegregation of the 2 aforementioned target groups, in parallel with the efforts for implementing related Hellenic and European legislation (Law 2939/6-8-2001; Directive 2002/96/EC and 2002/95/EC), in the frame of sustainable WEEE management. The compilation of standards and requirements for the development of social enterprises for WEEE recycling, another major project target, will also contribute significantly to the above framework. In this context, the following objectives have been formulated:

1. Creation of a social enterprise (SE) concerning recycling WEEE in Tyrnavos municipality (Thessaly). This SE will be staffed by Gypsies.
2. Upgrade of the two already existing SEs in North Aegean region, Mytilini municipality (Iliaxtida and Idallios Damos which are already involved in paper recycling) concerning WEEE recycling. These SEs will be staffed by people with disabilities.
3. Development of new educational tools on the WEEE recycling for people with disabilities and for Hellenic Gypsies.
4. Development and implementation of innovative training programs for the development of professions concerning the recycling of WEEE and the employment of people with disabilities and Hellenic Gypsies.
5. Participation of WEEE recycling managers and promotion of activities concerning the certification of WEEE recycling jobs.

For each SE a pilot preliminary stage and a business plan will be compiled and prepared. SEs will contribute towards the achievements of the targets of the corresponding Hellenic and European legislation.

PRUWE will also contribute in the configuration of the proposed alternative WEEE recycling system, which is now organised in Greece.

Project funded by European Social Fund (EQUAL program), Hellenic Ministry of Employment and Social Protection (2005 – 2007). Partners: Arvis S.A., University of Thessaly, TEI of Western Macedonia, Municipality of Tyrnavos, Municipality of Mytilini, Municipality of Samos, Samos Chamber of Commerce, Appliances Recycling S.A., Social Enterprises Iliaxtida and Idallios Damos.

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WEEE recycling

Manual WEEE dismantling

Sustainable Green Fleets – SU:GRE

SU:GRE is an accompanying measure that promotes alternative propulsion and mainly focuses on fleets, commercial/captive fleets and also private fleets. The main objective is to promote and support the conversion of fleets to alternative propulsion (ranging from bio-fuels, methane as fuel to hybrid systems comprised of combustion engines and electric propulsion systems) and the energy efficient usage of them. The project will foster a positive attitude towards alternative fuels and new power train concepts using captive fleets as forerunners and proof for the viability of alternative propulsion.

Site co-ordinators will organise the validation of the training/briefing materials, support the training/briefing and organise site visits for other fleet owners. It is assumed that two-way communication with fleet owners will greatly improve the efficacy of dissemination due to the higher quality of the materials and the possibility of face-to-face communication. As SU:GRE deals with fleet owners, the impact with regard to the vehicles to be converted is adequate to the effort. By using the results from fleet owners who have changed to alternative propulsion systems, partners involved will also gain good arguments for convincing individual car buyers. For air and water transport fleets are dominating over individual vehicles, so addressing fleets owners is the right way. A knowledge hub, implemented as an internet based communication and information platform, tools supporting the procurement and localisation of refuelling sites and a support desk will be implemented.

SU:GRE comprises of 6 work packages:

- WP1 project management will be responsible for managing dissemination actions, communication and contingency management, quality assurance procedures and financial administration.
- In WP2, an in-depth baseline analysis will ensure that the dissemination materials will not only contain/treat all practical aspects and collect the best cases, but also analyse existing campaigns and their effects.
- WP3 will synthesise the research into an implementation plan for the dissemination of the experiences and good practices and define the content for the three target groups (captive fleets, driving schools, teachers and other fleets).
- WP4 will validate the concept and further produce and assess the training materials with the help of the members who are fleet owners.
- WP5 will provide training/assistance and networking amongst captive and other fleet owners and will also address individuals via supporting driving schools and teachers with materials. For the show cases, real and virtual site visits will be organised/offered. The partners' many years of experience in networking and dissemination projects will help to offer both innovative dissemination approaches and high-quality dissemination products.
- WP6 will cover the general dissemination tasks (presentations, flyers, folders, newsletters, networking, and internet platform) and evaluate the content and the procedures based on a discussion of the experience of the workshops with regard to technological and economical aspects. A concise report will reveal preconditions for new alternative propulsion concepts and future campaigns.

LHTEE will contribute on the implementation of all 6 work packages. Firstly, it will analyse the country's conditions regarding the conversion of existing fleet types into green fleets in depth. Moreover, LHTEE will define and organise the main steps for the dissemination campaign and will contribute to the compilation of a dissemination handbook based on numerous examples of best practices. LHTEE will also support the dissemination activities and finally produce the project's evaluation handbook.

Project funded by EC-Intelligent Energy - Europe (2003-2008). Major partners: Austrian Mobility Research, Austria; City of Graz, Austria; Warsaw University of Technology, Poland.

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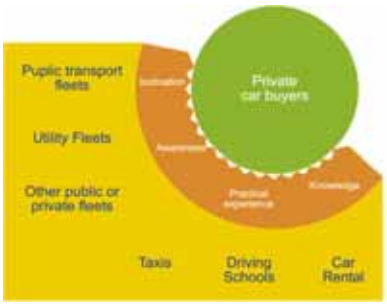


Levels of SU:GRE impact

Alternative fuels and propulsion promoted by SU:GRE

Research

Framework of indicators for the environment and sustainable development of the Greater Thessaloniki Area

Objective: To provide the necessary information for monitoring the status of the local environment, assess the compliance towards specific goals and assist local authorities and decision makers to develop strategic plans towards sustainable development and environmental quality.

LHTEE Contribution: Project co-ordination, assembly of indicators on the thematical areas: Demography, energy, transportation, industry, tourism, air quality, waste, climate change, education and R&D.

Funded by: Organisation for the Master Plan and Environmental Protection of Thessaloniki (2006-2008).

Investigation of the fire's impacts at Tagarades controlled waste area

Objective: Estimation of the atmospheric dispersion and deposition of PCDDs, PCDFs and Particular Matter emitted during the landfill fire of July 2006 at the 'Tagarades' waste disposal site, near Thessaloniki.

LHTEE Contribution: Meteorological measurements, PM_{10} observation, dispersion and deposition calculations using the MEMO/MARS-AERO mesoscale models.

Funded by: Association of Local Self-government Organization of major Thessaloniki area.

Developing practical guidelines for an observatory center on the progress of implementing projects on renewable and waste/wastewater (DEPOIR)

Objective: Integrated determination, classification and analysis of all procedures, milestones, problems, delays and red flags concerning the construction and operation of all types of related facilities.

LHTEE Contribution: Coordinator

Funded by: GSRT, Hellenic Ministry of Development, Operational Programme "Competitiveness" (2005-2008)

Network for energetic utilization and thermal treatment of solid and liquid wastes (NEUTRA)

Objective: To activate the critical research mass of AUTh on thermal processing and energy recovery technologies from several categories solid and liquid waste including biomass and municipal solid waste, as well as their pre/after-sorted fractions or other special categories suitable for incineration or pyrolysis-gasification either in special waste treatment facilities or in suitable industries.

LHTEE Contribution: Coordinator, expertise on solid and liquid waste management.

Funded by: AUTh Research Committee.

Energy Technology Network (ENTECH)

Objective: To mobilize and interconnect available knowledge and know-how of laboratory and research units within the Aristotle University in the fields of innovative energy technologies, in order to address related needs and respond to challenges appearing in the national and international energy market.

LHTEE contribution: Energetic aspects of waste management, logistics and related technology assessment.

Funded by: AUTh Research Committee.

Studying urban effects on mesoscale flows by Mesoscale-Microscale modeling coupling (MEMICO)

Objective: Development of an enhanced version of the mesoscale model MEMO, aiming to improve the accuracy of calculated meteorological fields in urban air quality simulations by incorporating a two-way coupling methodology between MEMO and the microscale model MIMO.

LHTEE Contribution: Design and implementation of the coupled model system, application and evaluation in select test cases.

Funded by: GSRT, Hellenic Ministry of Development, Operational Programme "Competitiveness" (2005-2008).

Services

During the year, the Laboratory provided consulting and other services in the following cases:

Preparation of national emission reduction and ambient air quality assessment programmes.

Market mapping and system analysis for the implementation of a new system for the alternative management of packaging waste at national level.

Feasibility study for a new photovoltaics facility in Sidirokastro, Serres.

Development of a software application for the calculation of thermal conductivity of buildings including thermal bridges, with the establishment of the methodology and algorithms, the layout and framework of the software and databases.

Papers in Journals.

Arvanitis A. and Moussiopoulos N. (2006) Estimating long term urban exposure to particulate matter and ozone in Europe, *Environmental Modelling & Software* **21**, 447-453.

Slini T., Kaprara A., Karatzas K. and Moussiopoulos N. (2006)
PM10 forecasting for Thessaloniki, Greece, *Environmental Modelling & Software***, 21,** 559-565.

Moussiopoulos N., Papalexiou S. and Sahm P. (2006)
Wind flow and photochemical air pollution in Thessaloniki, Greece. Part I: Simulations with the European Zooming Model, *Environmental Modelling & Software* **21***,* 1741-1751.

Moussiopoulos N. and Papalexiou S. (2006)
Wind flow and photochemical air pollution in Thessaloniki, Greece. Part II: Statistical evaluation of European Zooming Model's simulation results, *Environmental Modeling & Software* **21***,* 1752-1758.

Papadopoulos A. and Karagiannidis A. (2006) Application of the multicriteria analysis method Electre III for the optimisation of decentralised energy systems, *OMEGA Journal*, http://dx.doi.org/10.1016/j.omega 2006.01.004

Karagiannidis A., Xirogiannopoulou A. and Moussiopoulos N. (2006)
On the effect of demographic characteristics on the formulation of solid waste charging policy, *Waste Management,* **26**, 110-122.

Erkut E., Karagiannidis A., Perkoulidis G. and Tjandra S.A. (2006)
Multicriteria facility location model for municipal solid waste management in North Greece, *European Journal of Operational Research*, www.sciencedirect.com

Cadji M., Leverenz H., Tchobanoglous G., Karagiannidis A. and Antonopoulos I.-A. (2006)
Sustainable waste management at special events using reusable dishware: The example of whole earth festival at the University of California in Davis, *Fresenius Environmental Bulletin,* www.psp-parlar.de

Karagiannidis A., Moussiopoulos N., Samaras Z., Chrysochoou M. and Rakimbei P. (2006)
Solid waste analysis and characterisation in the frame of current European environmental legislation, *The Journal of Sustainable Planning and Development*, **1**, 464-475.

Papadopoulos A.M., Stylianou A., Oxizidis S. (2006)
Impact of energy pricing on buildings' energy design, *Management of Environ. Quality*, **17**, Nr.6, 753-762.

Koroneos C., Stylos N., Moussiopoulos N. (2006)
LCA of Multicrystaline Silicon Photovoltaic-part 1. Present and Future Perspectives, *The International Journal of Life Cycle Assessment, Ecomed Publishers,* **11**, Nr.2, 129-136.

Koroneos C., Stylos N., Moussiopoulos N. (2006)
LCA of Multycrystaline Silicon Photovoltaic – Part 2. Application on an island economy, *The International Journal of Life Cycle Assessment, Ecomed* Publishers, **11**, Nr. 3, 183-188.

Koroneos C., Dompros A., Roumbas G., Moussiopoulos N. (2006)
Life cycle assessment of kerosene, *International Journal of Life Cycle Assessment, Ecomed Publishers,* **10**, Nr. 6, 417-424.

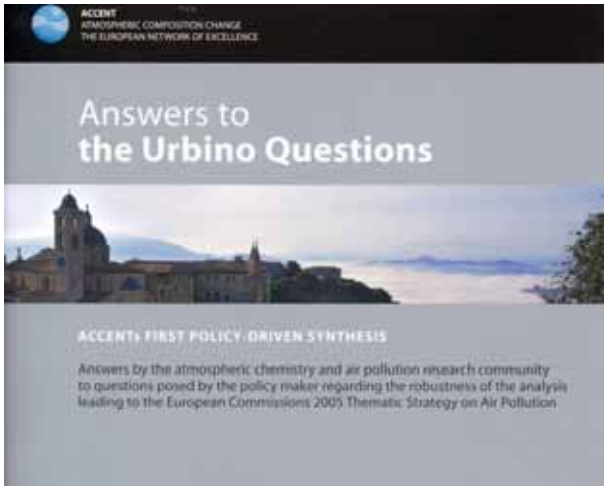
Articles in Books

Moussiopoulos N., Louka P., Finzi G., Volta M., Colbeck I., Diéguez J.J., Palau J.L., Pérez-Landa G., Salvador R. and Millán M.M. (2005)
Meteorological aspects of air pollution episodes in southern European cities, in **Meteorology applied to urban air pollution problems-Final Report Cost Action 715** (B. Fisher, S. Joffre, J. Kukkonen, M. Piringer, M. Rotach, M. Schatzmann eds.), Demetra Ltd Publishers, Bulgaria, 119-134.

Technical Reports

Moussiopoulos N., Samaras Z., Kalognomou L., Giannouli M., Eleftheriadou S. and Mellios G. (2006)
Air pollution at street level in European cities, EEA Technical report 1/2006, Copenhagen, 48 pp.

Contribution by Nicolas Moussiopoulos to ACCENT's first policy driven synthesis : **Answer to the Urbino Question** (F. Raes, J. Hjorth, eds).



Participation at Conferences

The list contains only the titles of papers given as oral presentations. In several conferences also poster presentations were made.

2nd National Conference and Exhibition of the Hellenic Solid Waste Management Association, Athens, Greece, 3-4 February

Humification of municipal sewage sludge: Results from a pilot project in Thessaloniki (M. Zygouras)

Optimum end of life management of "NetMod" ISDN network terminal as a case study of electrical and electronic product (H. Achillas)

Transportation cost analysis in the developing Hellenic WEEE management administrative system (N. Moussiopoulos)

Performance assessment of waste services by using benchmarking: The case of Nicosia Municipality in Cyprus (A. Xirogiannopoulou)

Investigating waste production and management in Thessaloniki dental units: preliminary results of Dentistry School (A. Xirogiannopoulou)

Full cost accounting as a tool for the financial assessment of "Pay-As-You-Throw" schemes: The case of Panorama (A. Xirogiannopoulou)

Exploration of market conditions for paper recycling in Greece (A. Xirogiannopoulou)

World Sustainable Energy Days, Wels, Austria, 1-3 March

(*4 posters were displayed*)

3rd International Conference of Katerini on "Sustainable Development: Theory and action", Katerini, Greece, 13-16 March

Solid waste management on small/rural communities and the prospective of processing the organic fraction. A case study for the prefecture of Pieria, Greece (A. Malamakis)

8th National Conference on Renewable Energy Sources, Institute of Solar Technology, Thessaloniki, Greece, 29-31 March

Economical and technical optimisation of industrial application insulation (A. Karamanos)

Generating synthetic weather years for Greek cities for energy calculations of buildings (A.M. Papadopoulos)

Waste and biomass-derived energy generation on remote and isolated communities. Examining the feasibility of similar projects based on the example of Phu Quoc island/Vietnam (A. Malamakis)

The influence of urban climate on the performance of solar collectors. The case of Lisbon (S. Oxizidis)

Indoor Environment and Energy Management Informatics System for school buildings (K. Karatzas)

International Conference on Improving Energy Efficiency in Commercial Buildings (IEECB), Frankfurt, Germany, 26-27 April

Integrated evaluation of buildings for energy efficiency: a case study in office buildings (E. Giama)

28th NATO/CCMS International Technical Meeting on Air Pollution Modelling and Its Application (ITM), Leipzig, Germany, 15-19 May

Modelling of aerosol composition using the MARS-MUSE dispersion model (I. Douros)

Conference of Aristotle University's Environmental Council, Thessaloniki, Greece, 1-4 June

Municipal solid waste collection optimization through GIS (G. Perkoulidis)

An intra-building information system for paper recycling in the campus of the Aristotle University (G. Perkoulidis)

Full-Cost-Accounting as a tool for the promotion of Pay-As-You-Throw schemes: The case of Panorama (A. Xirogiannopoulou)

Dump sites in Thessaloniki prefecture: Registration, classification and rehabilitation strategies (Th. Tsatsarelis)

Measures for the reduction of air pollution in Thessaloniki (N. Moussiopoulos)

Installation of a complete and reliable system of air pollution models to the organization for the master plan implementation and environmental protection in Thessaloniki (N. Moussiopoulos)

Turfgrass establishment for a dumpsite restoration in Efkarpia, Thessaloniki (P. Rakimbei)

8th International Conference on Energy-Efficient Healthy Buildings, Lisboa, Portugal, 4-8 June

Management tools and systems for the labelling of public buildings (E. Giama)

2nd Environment and Transport Conference (including 15th Transport and Air Pollution Conference), Reims, France, 12-14 June

Air pollution at street level in selected European cities (presented by a collaborating scientist)

6th International Conference on Urban Climate (ICUC), Goeteborg, Sweden, 12-16 June

Enhanced Mesoscale Meteorological Modeling for air quality Assessment (presented by a collaborating scientist)

Protection and Restoration of the Environment VIII, Chania, Crete, Greece, 3-7 July

Application of the MEMO and MM5 mesoscale models in the context of urban energy budget studies for the greater Athens area (N. Moussiopoulos)

Development of a methodology for the optimisation of industrial products' end of life management (H. Achillas)

Statistical analysis and risk assessment of open dumps in the Hellenic prefecture of Laconia (T. Tsatsarelis)

WEEE processing: perspectives of material recovery through disassembly in Greece (presented by a collaborating scientist)

Technologies of landfill gas management and utilization (T. Tsatsarelis)

Medical imaging wastes from health units: field survey and treatment options-a case study (A. Karagiannidis)

(1 poster was displayed)

Energy Performance and Environmental Quality of Buildings (EPEQUB 2006), Milos island, Greece, 6-7 July

Model analysis for existing buildings' efficient environmental evaluation (A.M. Papadopoulos)

Energy efficient solutions in buildings with the application of BEMS (A.M. Papadopoulos)

Integrated Photovoltaics as an Element of Building's Envelope (M. Karteris)

The importance of insulation materials in the reduction of the buildings' thermal losses (A.M . Papadopoulos)

1st International Conference on Environmental Toxicology 2006, Mykonos, Greece, 11-13 September

Investigating the waste production and management in dental units of Thessaloniki (A. Xirogiannopoulou)

Atmospheric Chemistry at the interfaces 2006- The 9th Scientific Conference of the IGAC Project, Cape Town, South Africa, 17-23 September

Long-term regional air quality modelling with an enseble of models in Europe: inter-comparison and uncertainty analysis from the CITYDELTA and EURODELTA experiment (presented by a collaborating scientist)

Fachtagung "Anaerobe biologische Abfallbehandlung", Dresden, Germany, 27-28 September

Estimation of methane potential from the biogas of the new Hellenic landfields (A. Karagiannidis)

21st European Conference for ESRI Users, Athens, Greece, 6-8 November 2006

Optimizing elements of urban solid waste collection through GIS: A pilot implementation for the Municipalities of Panorama and Sikies (I. Antonopoulos)

GIS inventory of uncontrolled landfills and prioritizing administrative plans for their restoration through coupled multicriterial analysis: A case study for the Prefecture of Chalkidiki in North Greece by using Analytic Hierarchy Process (I. Antonopoulos)

Going Green: Care Innovation 2006, Vienna, Austria, 13-16 November

Decision making on the alternatives for the end of life management of electrical and electronic equipment (Chr. Koroneos)

ECO-IMAGINE Thematic Conference "The waterfront management and GIS", Genoa, Italy, 14-18 November

(1 poster was displayed)

Recycling in Local Scale: Liquid and organics waste management, Volos, 28-29 November

Development of a methodology for the evaluation of different technologies for anaerobic fermentation of urban solid wastes (A. Karagiannidis)

Biomass and Waste-to-Energy Symposium, Venice, Italy, 29 November-1 December

Development of a methodology for the evaluation of different municipal solid waste anaerobic digestion technologies (A. Malamakis)

(2 posters were displayed)

Contribution to COST Actions

COST C23, "Strategies for a Low Carbon Urban Built Environment",

- Three interventions in Greece for the reduction of carbon emissions, Porto, Portugal, 11 January (C. Koroneos).

COST Action C24, "Analysis and Design of Innovative Systems for Low-EXergy in the Built Environment: COSTeXergy"

- Presentation of the Research Work, Brussels, Belgium, 17 November (C. Koroneos).

COST 530, "Sustainable Materials Technology, Life Cycle Inventories for Environmentally Conscious Manufacturing Processes",

- The Use of Exergy Analysis in the Implementation of IPP, Barcelona, Spain, 6 July (C. Koroneos).

COST 728 "Enhancing mesoscale meteorological modelling capabilities for air pollution and dispersion applications",

- Management Committee (MC) Meeting, Warsaw, Poland, 1-2 June (J. Douros)
- MC meeting Risoe, Denmark 15-17 November (N. Moussiopoulos)

COST 732, "Quality Assurance of Micro Scale Models",

- Short Scientific Mission, Hamburg, Germany, 25 November-9 December (Ph. Barmpas)
- MC meeting, Bratislava, Slovakia, 22-23 March (F. Barbas)
- MC meeting, Risoe, Denmark, 2-5 June (F. Barbas)
- MC meeting, Athens, Greece, 19-20 October; (N. Moussiopoulos)

Events

Members of the Laboratory held a series of speeches at important events during the academic year 2005-2006, including:

Prof. Nicolas Moussiopoulos at the Department of Physics on "Education & research in the Department of Mechanical Engineering of the Aristotle University Thessaloniki" (8 December 2005).

Prof. Nicolas Moussiopoulos at the Chemical Process Engineering Research Institute of the Centre for Research and Technology Hellas on "Air pollution levels at urban hotspot areas" (9 December 2005).

Ass. Prof. Agis Papadopoulos at the Cyprus Organization for Standardization, in Nicosia, Cyprus, on "The new EN standards accompanying the Energy Performance of Buildings Directive" (8 February 2006).

Prof. Nicolas Moussiopoulos at the Conference on Regional Innovation & Entrepreneurship organised by CERTH (Centre for Research and Technology), Conference Centre Thessaloniki, Technology Park (10 March 2006).

Ass. Prof. Agis Papadopoulos at the Event on Mankind and the Environment in the 21st century: The critical problems, organized by the Goulandris Physical History Museum, in Athens, on "Alternative energy sources for the 21st century" (22 March 2006).

Prof. Nicolas Moussiopoulos at a public dialog event on education, in Athens, on: "The engineers express their opinions concerning the given tertiary level education" (27 March 2006).

Ass. Prof. Agis Papadopoulos at an event organized by the Albanian Energy Agency, in Tirana, Albania, on: "The European Directive on the energy performance of buildings and the need for enhanced thermal insulation" (7 April 2006).

Ass. Prof. Agis Papadopoulos at the workshop organized by the Technical Chamber of Greece, in Thessaloniki, on: Environmental design of buildings" (15-16 April 2006).

Asst. Prof. Avraam Karagiannidis at the Workshop 'Minimization of environmental damage in case of oil spills' organized by the Institute for Circular Economy and BLG Consult, in Bremen, Germany on "The management of wastes from Mediterranean oil spills" (11 October 2006).

Asst. Prof. Avraam Karagiannidis at a workshop, organized by the Technical University of Crete, the Aristotle University of Thessaloniki and the Chemical Process Engineering Research Institute on 'Valorisation and thermal treatment of biomass and agricultural wastes' (24 November 2006).

Asst Prof. Avraam Karagiannidis at the LIFE Thematic Conference 'Local-level recycling of sewage and organic wastes', organized by the municipal tourist agency of Volos on "Anaerobic fermentation of organic solid wastes" (29 November 2006).

Ass. Prof. Agis Papadopoulos at an event organized by the Cypriot Technical and Scientific Chamber and the Frederick Institute of Technology, in Nicosia, Cyprus on: "The European Directive on the energy performance of buildings and its impact on their design" (30 November).

Asst Prof. Avraam Karagiannidis at the workshop on Commenting Waste Management from the Present to the Future, organized by the National Network for Environmental Education in Primary and Secondary schools, in Edessa, on "Energy recovery from wastes" (9 December 2006).

The Laboratory organized and hosted a series of scientific events:

Workshop on Sewage Sludge Management organized together with the NEUTRA Network, Aristotle University Thessaloniki, (31 January 2006).

ACCENT workshop on Model Benchmarking, Aristotle University Thessaloniki, (29-30 May 2006).

Workshop on Energy Performance of Buildings, Ventilation and Thermal Insulation, organized by LHTEE and GBES/University of Athens within the Vent-Discourse/SAPPEK projects, University of Athens, (3 October 2006).

ACCENT workshop on Interdisciplinary Training Workshop combined with the Hellenic ACCENT Day, Aristotle University Thessaloniki, (9-12 October 2006).

Workshop on state of the art thermal insulation materials, organized by LHTEE and the Scientific Park of Patras within the SAPPEK project, Patras (1 November 2006).

Workshop on the European Directive on the Energy Performance of Buildings and the need for enhanced Thermal Insulation organized by LHTEE and the Technical Chamber of Greece within the Pythagoras project, Museum of Byzantine Culture, Thessaloniki (10 November 2006).

Workshop on Energetic Utilization and Thermal Treatment of Solid and Liquid Wastes, organized together with the NEUTRA network, Aristotle University Thessaloniki (15 December 2006).

News

Seven previous staff members left our Laboratory in 2006: George Dombros, Natasa Dourala, Vasilena Mitsiadi, Dimitra Alexiou, Georgia Spyridou, Sofia Varnava and Anna Xirogiannopoulou. We wish them all the best for their professional career in the future. At the same time, seven new members joined us: Dimitrios Altinoglou, Stamatia Kontogianni, Ioannis-Sofoklis Antonopoulos, Vasileios-Ioannis Akylas, Marinos Karteris, Maria Zilou Kapaktsi and Konstantina Vretinari. Moreover, Eugenia Agorastoudi returned to our Laboratory. Christos Vlahocostas and Dimitrios Nerantzis had to leave us for serving their military duty. Ioannis Ossanlis and George Kotriklas returned to our Laboratory after their military service.

Ass. Prof. Agis Papadopoulos was appointed National Representative on Energy to the 7th FP of the EC.

Prof. Nicolas Moussiopoulos was nominated by the COST National Coordinator as the Greek representative in the Domain Committee on Earth System Science and Environmental Management.

Prof. Nicolas Moussiopoulos was a member of an evaluation Committee for the Cyprus University of Technology, Limasol.

On August 30th 2006 Prof. Nicolas Moussiopoulos was elected Dean of the School of Engineering, his term lasting until August 2010. It is the first time that a Mechanical Engineer holds this position.

Laboratory Personnel

Nicolas Moussiopoulos Professor, Dr.-Ing. habil (Director)

Agis Papadopoulos Associate Professor, Dr.-Eng., MSc
Avraam Karagiannidis Assistant Professor , Dr.-Eng., MSc
Afedo Koukounaris Administration Officer

Researchers with Co-ordinating Functions

Christopher Koroneos	PhD
Georgios Perkoulidis	Dr.-Eng
Ioannis Douros	Physicist, MSc
Evangelia-Anna Kalognomou	Physicist, MPhys

Researchers and PhD Students

Harisios Achillas	Mech. Engineer, MSc	Christos Naneris	Environmentalist
Vasilios-Ioannis Akylas	Mech. Engineer	Ioannis Ossanlis	Mech. Engineer, MSc
Dimitrios Anastaselos	Mech. Engineer	Symeon Oxizidis	Mech. Engineer
Ioannis-Sofoklis Antonopoulos	Mech. Engineer	Kostantinos Papageorgiou	Mech. Engineer
Aristotelis Avgelis	Mech. Engineer	Apostolos Papathanasiou	Physicist, MPhys
George Banias	Mech. Engineer	Panagiota Rakimbei	Environ. Engineer, MSc
Photios Barmpas	Aerosp. Engineer, MSc	Theodora Slini	Mathematician
Sofia-Natalia Boemi	Environmentalist	Dimitra Spiridi	Mech. Engineer
Lia Frangou	Biologist, Environm, PhD	Antis Stilianou	Mech. Engineer, MSc
Efrosini Giama	Mech. Engineer, MSc	Maria Theodoseli	Environ. Engineer, MSc
Konstantinos Kalogeropoulos	Environmentalist, MSc	George Theodosiou	Mech. Engineer
Anastasios Karamanos	Mech. Engineer	Thomas Tsatsarelis	Mech. Engineer
Marinos Karteris	Mech. Engineer	Georgios Tsegas	Physicist, PhD
Stamatia Kontogianni	Mech. Engineer	Christos Vlahocostas	Mech. Engineer, MSc
Apostolos Malamakis	Mech. Engineer		

Technical Staff and Secretariat

Georgios Kotriklas	System Administrator	Dimitrios Altinoglou	Administrative Support
Lazaros Sotiriadis	System Administrator	Konstantina Vretinari	Administrative Support
Eugenia Agorastoudi	Administrative Support	Maria Zilou-Kapaktsi	Administrative Support

Main Research Topics

Energy Systems and Technology
- -Process analysis and optimisation
- -Renewable energy sources
- -Rational energy use
- -Life Cycle Analysis
- -Sustainable production

Air Pollution
- -Transport and transformation of pollutants
- -Air quality assessment and management
- -Environmental impact assessment
- -Integrated environmental assessment

Waste Management
- -Sitting, logistics and recultivation issues
- -Recycling and energy recovery
- -Pricing schemes

Undergraduate Courses offered by Laboratory Members

1st Level:

Heat Transfer

2nd Level:

Business Finance
Heating-Refrigeration-Air Conditioning
Introduction to Environmental Engineering

3rd Level:

Extra Chapters on Heating and Refrigeration
Waste Management
Energy Designed Buildings
Examination of Environmental Impacts
Economic Analysis of Energy Systems
Atmospheric Pollution
Investment Analysis and Evaluation

ISO Certificate


TÜV CERT

CERTIFICATE

The TÜV CERT Certification Body of TÜV Saarland e.V.

certifies in accordance with TÜV CERT procedures that

LABORATORY OF HEAT TRANSFER AND ENVIRONMENTAL ENGINEERING
BOX 483 UNIVERSITY CAMPUS
ARISTOTLE UNIVERSITY THESSALONIKI
GR-54124 Thessaloniki, Greece

has established and applies a quality management system for

Energy Systems and Technology, Air Pollution, Waste Management, Integrated Environmental Management

An audit was performed, report No. B 524/06.
Proof has been furnished that the requirements according to

DIN EN ISO 9001: 2000

are fulfilled. The certificate is valid until 2009-05-03.
Certificate Registration No. 71 100 G 147

Sulzbach, 2006-05-04

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