Sustainability Dimensions

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

2004

The Laboratory of Heat Transfer and Environmental Engineering belongs to the Energy Section of the Mechanical Engineering Department of the Aristotle University Thessaloniki, Greece. Founded in 1990, the Laboratory is responsible for eleven pre-graduate courses in the Mechanical Engineering Department, while also supervising 19 doctoral candidates in the frame of their post-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 5 senior scientists, 26 young researchers and 8 technical and administrative members. Most of the research funds of the Laboratory originate from competitive programmes of the European Commission, although in 2004 we have been quite successful in achieving significant grants from national funding agencies. The total turnover for the year 2004 is of the order of 1 million €.

During 2004 our Laboratory intensified considerably its collaboration with the professional Associations of Mechanical Engineers, both at the national scale and in our area, the Region of Central Macedonia. We contributed to the success of workshops on technical regulations for natural gas and on safety and hygiene in school buildings. Furthermore, we participated at several meetings with the aim to streamline the interactions between academia and practice in the field of Mechanical Engineering.

Recent developments in waste management legislation will result in a substantial increase of the cost associated with both the collection and the final disposal of waste. Already for years, our Laboratory plays a leading role in Greece in all economics issues related to waste management. In 2004 we formulated proposals regarding the implementation of the “Pay As You Throw” concept in our country. Moreover, we continued our work towards optimising the recycling of waste from electric and electronic appliances.

Another important milestone for our work in 2004 was the start of operation of ACCENT, the European Network of Excellence on Atmospheric Composition Change. In view of our expertise, also in this framework we focus our attention on transport and transformation of air pollutants at the urban and local scales with emphasis on Quality Assurance in air pollution modelling. Furthermore, we contribute to ACCENT’s task on education and training, thus continuing our effort to combine research skills with improved practices in education and better training tools.

Apart from ACCENT, our Laboratory is already active in two other important Commission funded projects within EU’s 6th Framework Programme. One of these projects aims at evaluating the full costs and benefits (i.e. direct and external) of energy policies and of future energy systems, while the other has the objective to provide recommendations on integrated air quality assessments for different temporal and spatial scales, ranging from hourly to annual and from the hotspot to the continental scale.

Continuing the tradition of the last two years, we decided to produce also in 2004 a report summarising the scientific activities of our Laboratory. As in the last two years, the report starts with eight ‘research highlights’ revealing the span of our scientific work. The report contains also a list of our latest publications and information about the recently launched projects with our participation. Among the latter, the most exciting for us is undoubtedly the evaluation of indoor climate and air quality conditions in the White Tower, the trademark for our city, with Agis Papadopoulos as the scientist-in-charge. How could a project fascinate us more than this one dealing with the monument appearing in our logo?

Prof. Dr. Nicolas Moussiopoulos
Laboratory Director

Aristotle University Thessaloniki

Laboratory of Heat Transfer and Environmental Engineering (LHTEE)

December 2004

Multi-Pollutant, Multi-Effect Assessment of European Air Pollution Control Strategies: an Integrated Approach – MERLIN

MERLIN belongs to the EU 5th Framework Programme and is part of the Cluster of European Air Quality Research (CLEAR). The aim of the project is the development of a computer-based model system to determine the bundle of air pollution control measures that is capable of achieving compliance with air quality limit and target values (for emission, concentrations and deposition) for specific pollutants at least-costs. Furthermore, the model system will be used to calculate benefits, i.e. avoided damage costs by implementing air pollution control measures, first in a physical way, and in a second step – as far as possible – in monetary terms. Thus, costs and benefits of different bundles of measures can be estimated and cost-benefit analysis can be applied. In addition, macroeconomic effects and distributional impacts of pollution control strategies are determined.

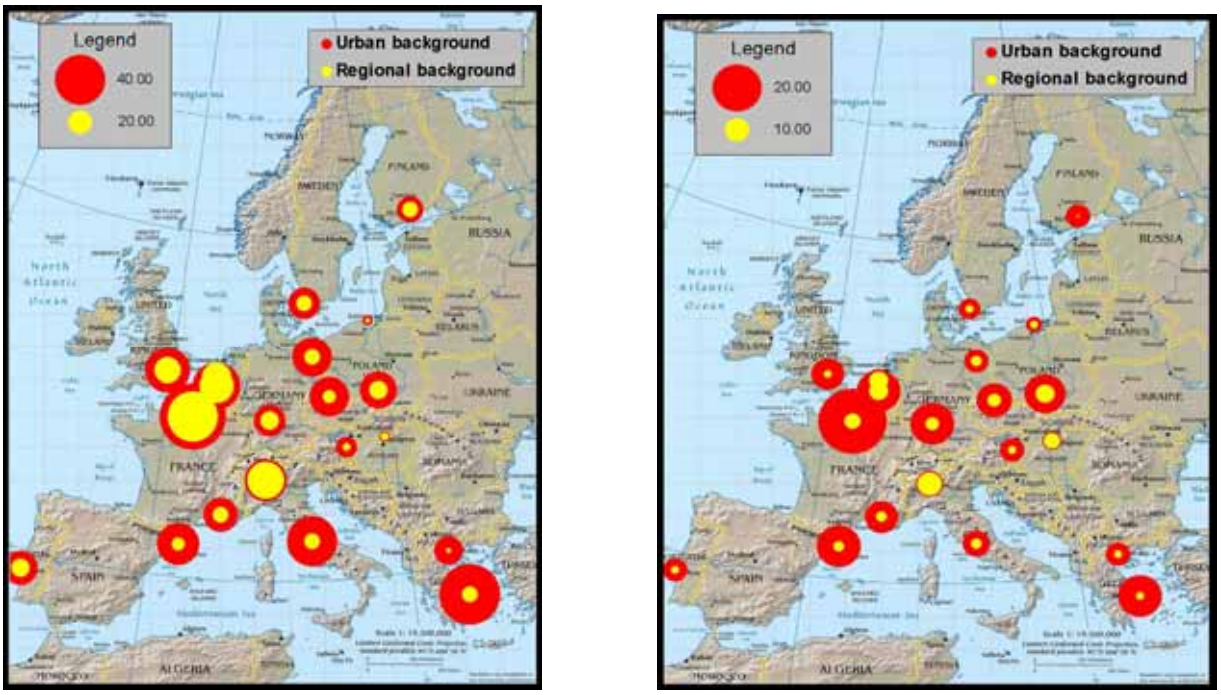
Within this multi-pollutant multi-effect framework, the reduction of ambient concentrations of tropospheric ozone, particulate matter, heavy metals, NO_x, the emissions of greenhouse gases, as well as acid deposition and eutrophication is being assessed. The instruments developed are applied and tested for compliance with the air quality limit values of the EC Air Quality Framework Directive (and its daughter directives), the EC National Emission Ceilings Directive, the UNECE critical loads for acid and nitrate deposition (e.g. using the gap-closure approach) and the reduction targets agreed upon the Kyoto Protocol.

Modelling and assessment is conducted at all necessary levels, from atmospheric dispersion modelling on European and urban scale to macroeconomic impact assessment of optimized control strategies for all relevant pollutants and the assessment of distributional effects and burden sharing issues. The instrument developed will be applied to a base case and two trend scenarios within the project, but also serve as a tool for policy support. Ultimate results of MERLIN will be tools and methods to assess European air pollution control strategies and their efficiency to achieve air quality targets and impacts on economic indicators.

Our Laboratory's contribution to MERLIN focuses on the urban scale simulation of air pollutant concentrations for several areas in Europe. More specifically, air quality levels in seven European cities (London, Milan, Athens, Katowice, Paris, Stuttgart and Barcelona) are described using both a comprehensive 3D approach (i.e. the MEMO/MUSE models) and the OFIS model (as a simpler approach). A larger number of cities is treated by using the OFIS approach only, taking advantage of the low computational cost of the model. These cities are Prague, Berlin, Copenhagen, Marseille, Gdansk, Lisbon, Helsinki, Rome, Budapest, Brussels, Antwerp, Graz and Thessaloniki. Both approaches cover a multi-month period and contribute to the assessment of the impact of regional air pollution control strategies to urban populations.

Project funded by CEC, Environment and Sustainable Development Programme (2001–2004). Major Partners: IER, University of Stuttgart, Germany (Co-ordinator), The Norwegian Meteorological Institute, Norway, ECOFYS Energy and the Environment, The Netherlands, Institute for Ecology of Industrial Areas, Poland, University College London, United Kingdom.

Contact: Prof. Nicolas Moussiopoulos, moussio@eng.auth.gr



Mean annual NO_2 (left) and PM_{10} (right) concentrations calculated for 20 European cities

Environmentally Viable Electronic City – ENV-e-CITY

The aim of this project was to create an on-line broker application for environmental information related services that could support the need for an efficient environmental assessment. This need has become more pressing by the enforcement of new EU environmental legislation like the "Framework Directive on ambient air quality assessment and management" (96/62/EC), which obliges Member States to assess air quality throughout their territory and to develop reduction plans and programmes for areas where air quality thresholds are exceeded.

Consortium partners envisaged ENV-e-CITY as a provider of valuable tools and applications targeted to 3 types of user groups: city authorities, consultants involved in environmental impact assessment (EIA) studies and citizens desiring valid information on the state of the environment. Ultimately, ENV-e-CITY should allow all users acquiring tailored environmental information and have easy access to data from measurements and models and data processing tools, for each of the four environmental domains covered by the project: Air Quality, Air Emissions, Meteorology and Topography.

The project was coordinated by our Laboratory and, as intended, produced the ENV-e-CITY Demonstrator, an online broker application for environmental information related services, extending over the four aforementioned environmental domains. The Demonstrator platform currently provides more than 20 services, with the possibility to extend to a larger number of services as well as to other domains.

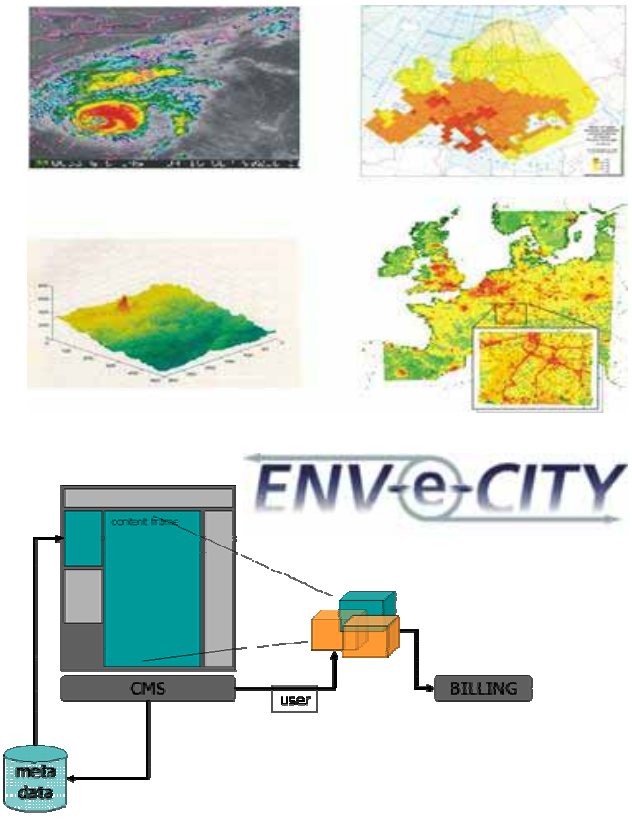
The project's final product was a platform comprising of advanced added value services, focusing on metadata. This product is in line with the e-Content programme's objectives by contributing to the professional development of citizens and promoting the exchange of knowledge between users and suppliers. The consortium thus succeeded to improve access to and expand use of public sector information thus promoting the implementation of the first action line of the e-Content programme.

Some of the concepts developed in ENV-e-CITY will be used in the context of ACCENT, the European Network of Excellence on Atmospheric Composition Change.

Project funded by CEC, e-Content Programme (2002–2004). Partners: Environmental Software and Services GmbH, Austria, Forschungsinstitut für anwendungsorientierte Wissensverarbeitung, Germany, Fraunhofer Institute for Applied Information Technology, Germany, Finnish Meteorological Institute, Finland, IER, University of Stuttgart, Germany, Ingenieurbüro Dr. Ing. Achim Lohmeyer, Germany, Norwegian Institute for Air Research, Norway, Interconsult Norgit AS, Norway, National Institute of Public Health and the Environment, Netherlands, Institute of Environmental Sciences, Energy Research and Process Innovation, Netherlands.

Contact: Prof. Nicolas Moussiopoulos, moussio@eng.auth.gr

The ENV-e-CITY Demonstrator homepage



The architecture of the ENV-e-CITY portal

Technology Foresight in the Region of Central Macedonia

The aim of this project was to identify the long term trends of various sectors in the Region of Central Macedonia and to provide a tool for developing a strategic vision of the region, which shall assist in the implementation of policies concerning the development of the region. This involved the timely identification of potential barriers, dangers and obstacles facing the Region of Central Macedonia, in order to be confronted successfully.

Within the project's framework, the following thematical areas were investigated: Information Science & Communications, Agrotechnology & Bioengineering, Environment, Industrial Engineering, Energy, Transportation, Financial Area of SE Europe and Human Resources. LHTEE was appointed to coordinate the working group "Environment".

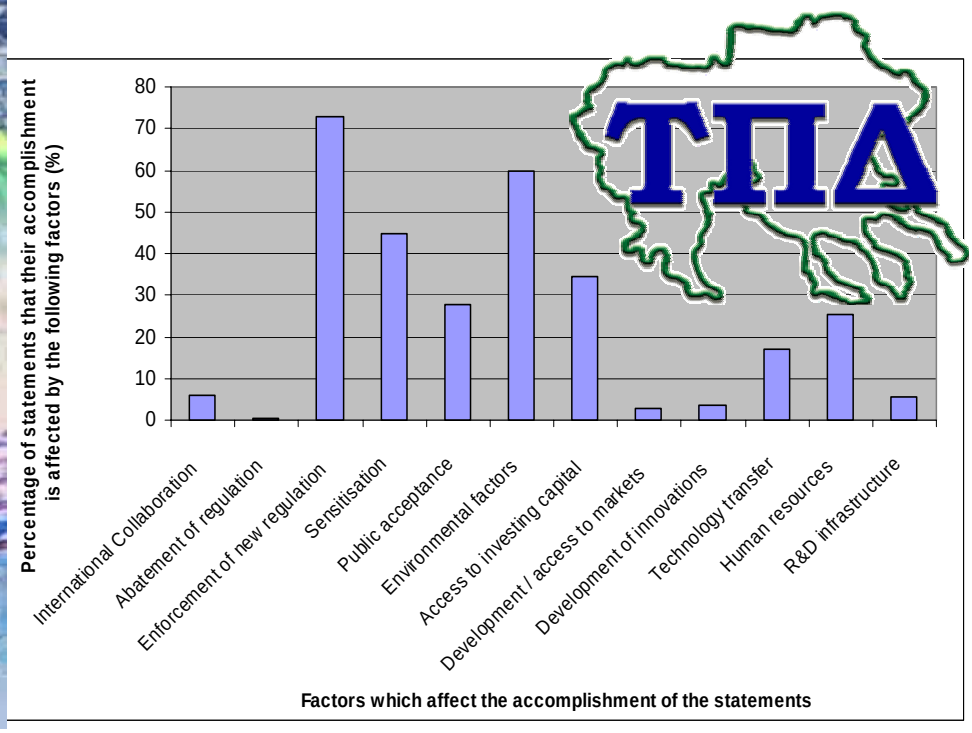
Environmental Technology Foresight in the Region of Central Macedonia was conducted in two rounds between November 2003 and February 2004, with the use of Delphi questionnaires. The statements which were included in the questionnaire were selected by the working group "Environment", based on a SWOT analysis of the region's present environmental status. The questionnaires were disseminated to 197 recipients from universities, industries, public sector and non governmental organisations. The participants were selected on the basis of their expertise and the need to achieve geographical dispersion inside the Region.

The questionnaire was divided into the following twelve distinctive topics: the statutory framework, atmosphere, waters, land, natural & anthropogenic disasters, natural environment & ecosystems, public health & nutrition, rural environment, fisheries, the urban environment, industry and tourism. The processing of the answers focused mostly on the public view regarding the importance of each questionnaire statement in combination with their public acceptance and the forecast realization timeframe. The questionnaire answers provided some very interesting findings regarding the region's technology foresight. Both the current status analysis of the region's environment and the analysis of the respondents' answers to the questionnaires concluded that Central Macedonia encounters major challenges, while it continues to have a natural environment that is rich both in resources and diversity. The way in which challenges shall be confronted and opportunities shall be exploited in the near future will heavily affect not only the region's natural environment but also its population's quality of life and the sustainability of the local economy.

More information on the findings and proposals of the technology foresight working groups for the region of Central Macedonia and the proposals of the working group "Environment" concerning future policies and strategies can be obtained from the project's website at: http://foresight.rc.auth.gr

Project funded by European Regional Development Fund (ERDF) Innovative Actions (2002–2004). Members of the Working Group "Environment": N. Moussiopoulos (coordinator), I. Krestenitis, A. Bais, A. Kamarianos, E. Sartzetakis, H. Achillas, N. Dourala.

Contact: Prof. Nicolas Moussiopoulos, moussio@eng.auth.gr



Digital Research Center for Cooperative Innovation

The Digital Research Center for Cooperative Innovation (DRC) in the Region of Central Macedonia aims to facilitate the access of public and private sector institutions to research project results and to contribute to the wider distribution and exploitation of products and services that are based on academic research that has been carried out by the Aristotle University of Thessaloniki, the University of Macedonia and other research and technology agencies in the Region of Central Macedonia.

The DRC consists of four components:

- On-line R&D database

The most important research outcomes, especially those that lead to the development of new products, new production processes and new services, are listed in a database, which companies and public organisations may access.

- On-line innovation support

A series of on-line roadmaps (guides) that support the further exploitation of the research results have been developed in order to help users (laboratories, companies and entrepreneurs, as well as public organisations) in accomplishing the following tasks:

a) Development of new product
b) Protection of intellectual property rights
c) Creation of spin-off company and
d) Quality management

- Communication between academia and business

Communication has been achieved through the

e) development of an on-line technology matching tool
f) the design of an on-line discussion forum
g) the creation of a printed guide and organisation of ten seminars and
h) the development of extensive, sustainable collaboration networks between research laboratories and enterprises.

- Pilot applications

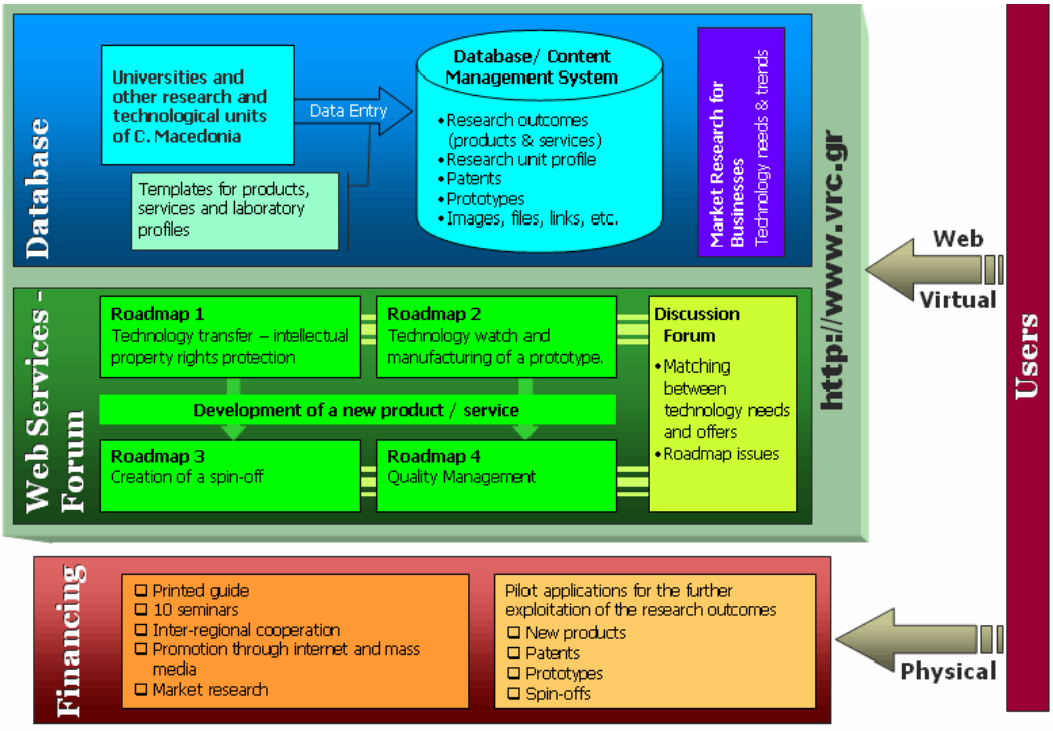
Collaboration efforts between the private sector and university laboratories concerning the development of commercial products or services based on R&D results have been co-financed.

The above components illustrate that the DRC has both digital and physical dimensions. The digital parts of the Center are built using standard web technologies and are accessible from the Center's website www.vrc.gr

LHTEE participated in the design and development of the DRC structure and content and carried out a market research study on demand for technologies. Furthermore, the Laboratory was involved in two pilot applications, one dealing with urban air quality assessment and one addressing the usefulness of CFD models in the context of microscale dispersion modelling.

Project funded by the European Regional Development Fund (ERDF), Innovative Action Programme (2000–2006). Major Partners: AUT Network of Innovation, Quality and Sustainable Development.

Contact: Prof. Nicolas Moussiopoulos, moussio@eng.auth.gr



The levels of the Digital Research Center

Design and Development of Innovative Stonewool Products for the Energy Upgrading of Existing and New Buildings – SAPPEK

Energy conservation in building sector is one of the most important EU priorities. Considering the fact that the greatest part of a building's energy consumption is devoted to heating and cooling, it is evident that the use of new, energy efficient insulation materials on the building's shell will reduce significantly its heating and cooling loads. SAPPEK fits entirely to EU's policy for energy conservation in buildings and is in accordance to all national programmes and actions related to the energy efficiency of buildings.

The overall aim of the project co-ordinated by our Laboratory is to obtain the technological know-how on improved and alternative thermal insulation solution concerning contemporary and older buildings, by developing a family of products based on stonewool applicable in existing and new buildings.

Goals set, in order to achieve this aim, are the research (theoretical, laboratory and applied industrial) for the determination of a new family of products of thermal insulating materials, the production of materials that will apply to certain specifications (physical properties, pollutants emission, environmental friendliness, low embodied energy), the lay-out of the production line according to certain specifications (flexible and easy production alterations and low production costs) and the dissemination and propagation of the new products and know-how on the market.

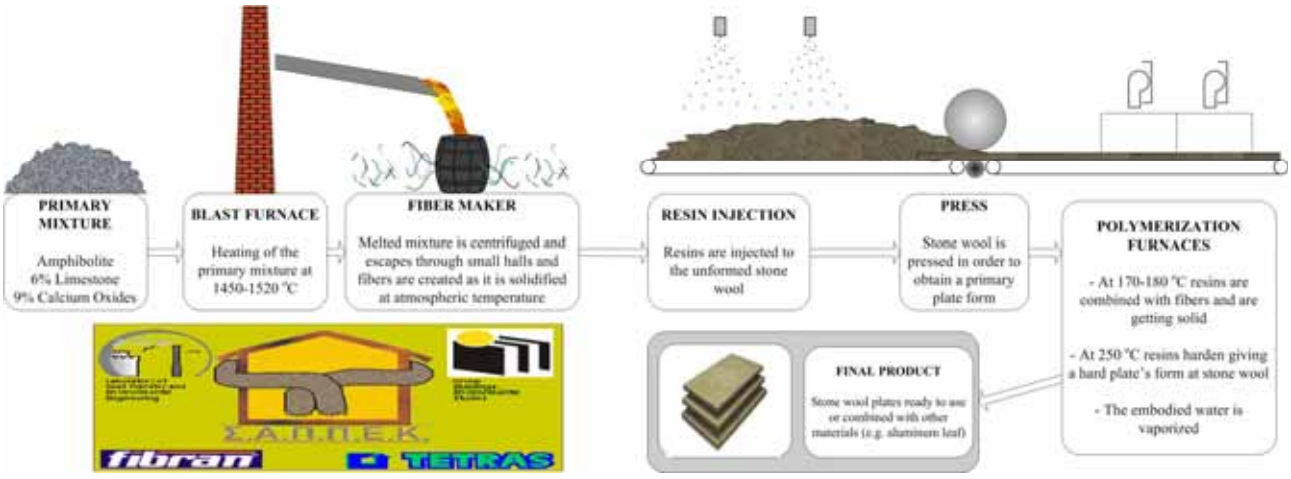
In detail, the final deliverables of the project will address the following issues:

- The market research analysis of the thermal insulation materials' branch in Greece, its perspective for the European market and the classification of the properties and application of stonewool produced materials
- The description of the design and technical details of the products and analytical description of their properties and application methods for the intended respective uses
- Life Cycle Analysis of the products
- The production planning, focused on features like the energy and economic efficiency, the environmental impact, the adoption of measures for the health and the safety of the workers
- The pilot production of the products
- The results and their analysis of the laboratory and field controls and measurements concerning the physical properties and the pollutant emissions of the produced materials
- The final technical documentation which will present the advantages, the construction methods and the spectrum of applications for all the new products
- The dissemination of the project's results, by means of an integrated action plan, including the setting up of a web-site, the implementation of workshops, seminars and presentations, the participation in conferences and exhibitions and the publication of scientific papers

So far the first two work packages (overall 5) have been completed and have successfully addressed the three initial deliverables.

Project funded by the Hellenic General Secretariat of Research and Technology (2003–2006). Partners: University of Athens, FIBRAN S.A., TETRAS O.E.

Contact: Agis Papadopoulos, agis@eng.auth.gr



Stonewool production process

Waste Management Based on Polluter-Pays Principles under Mediterranean Peculiarities – PAYTMED

A significant trend of solid waste management in the US, Europe, and elsewhere is the evolution of the conventional (flat rate) charging system for solid waste collection to the innovative "Pay-As-You-Throw" (PAYT) system. PAYT, also known as variable-rate pricing or unit pricing, is based on "polluter-pays" principles and it is mostly an alternative to financing municipal solid waste services. Its potential is verified by continuous developments and examples of implementation at several municipalities worldwide.

PAYTMED is focusing at the applicability of PAYT-programs implementation in Greece considering all those particular Mediterranean characteristics that may have impact at their success. PAYTMED aims firstly at the research of the implementation applicability of a waste management and pricing system based on PAYT in Mediterranean countries (focusing at the one of Greece) under the current peculiarities and conditions in the European-Mediterranean area. Furthermore, all parameters and factors that may influence the PAYT implementation are determined and analysed in order to identify and establish the proper PAYT subsystem.

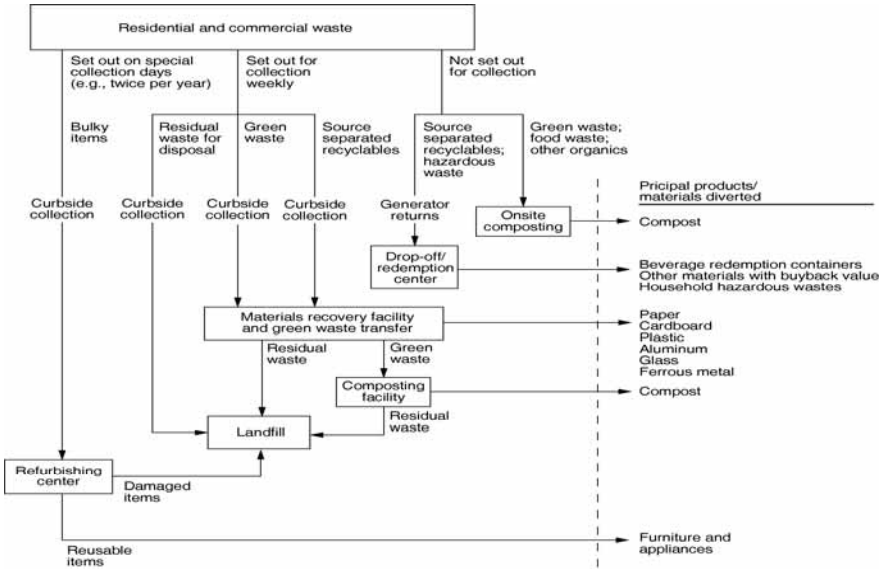
In detail, PAYTMED addresses the following issues:

- Need to increase our knowledge about the effectiveness of variable-rate pricing.
- Determination of the factors and drivers that may influence the introduction and the success of PAYT schemes in Greece.
- Recognition of the particular PAYT schemes which are suitable for the Mediterranean area and the development of possible scenarios of PAYT implementation in selected urban and rural Hellenic areas through "what-if" analysis.
- Compliance with the European regulation in relation with final disposal (EU 31/99) and waste recycling (EU 94/62), as well as the Hellenic Law 2939/2001.
- Economic analysis of the impact of PAYT on waste management and economic settings of selected areas.
- Analysis of the socio-economic impact of PAYT on the Hellenic/Mediterranean population.
- Proposal for suitable waste-charging schemes as public cleansing services' financing system.
- The applicability of a PAYT system is necessary to be investigated in detail, in order to avoid or minimise negative impacts, before it is implemented by a municipality. One of the most important components to be studied is the waste charging and billing system. In relation to waste charges, the following issues will finally be analysed: (a) charging scheme (rate-structure design), (b) calculation and billing system, (c) actual price level of charges.

Project funded by the Hellenic General Secretariat of Research and Technology (2004–2005). Partners: University of California, Davis (US), Department of Civil and Environmental Engineering (Prof. G. Tchobanoglous).

Contact: Avraam Karagiannidis, akarag@auth.gr

Davis' material recovery facility (May 2004 - internal view).



Generic structure of the urban solid waste management system of Davis (October 2004).

Integration of Solid Waste Management Tools into Specific Settings of European and Asian Communities – ISTEAC

Solid Waste Management (SWM) has been an important issue in European research and environmental policy in the last two decades. Considerable effort has been invested in Europe on the development of methods and policies in order to achieve waste minimisation, recycling and treatment in ways that protect resources, the human health and the environment. There is, however, still a long way for the integration of tools into the local infrastructure, especially in Mediterranean countries. On the other hand, Asian countries are also confronted with the issue of SWM, since the population and resource consumption increase rapidly, while the existing infrastructure does not keep up with the development in demands. ISTEAC will contribute to the integration of technological and administrative know-how, in order to achieve modernisation of SWM in a cost-effective manner. An overall objective of ISTEAC is also to strengthen the co-operation between European and Asian Universities on environmental protection and education.

ISTEAC's main objective is to study specific tools for reducing the amount of waste disposed of, such as composting and recycling, as well as to examine the local cultural and socio-economic characteristics that influence the application of these tools. Field tests and experiments on composting practices are set up in Vietnam and the Philippines, whereas composting and paper recycling schemes are compiled and assessed. ISTEAC will contribute, furthermore, to the information and education of the participating staff on a wide range of SWM issues and the exchange of cultural and scientific background. The knowledge gained will also be disseminated to SWM authorities and the local population.

ISTEAC main research activities include the following:

- Management scheme for used sanitary napkins in the campus of Miriam College, Philippines.
- Composting schemes for small and rural communities in Greece and Vietnam.
- Study of local cultural and socio-economic features that influence the structure of SWM in different settings.
- Exploration of recycling potential and recycling schemes for paper in different settings.

Workshops are organised at the participating countries aiming at the exchange of information within the project staff, as well as with the local stakeholders. Teaching missions are also taking place, where post-graduate students from Asian countries are trained. These activities provide a unique opportunity for Europeans and Asians to provide and receive feedback on SWM-related problems and approaches, an opportunity that is not often given due to the distance and costs it requires.

Project funded by the EU-AUNP University Network programme, (2002–2005). Major Partners: Dresden University of Technology, Germany; Hanoi University of Science, Vietnam; Miriam College, Philippines.

Contact: Avraam Karagiannidis, akarag@auth.gr

Monitoring of Hanoi composting facility (September 2004 – internal view).

Set-up of in-vessel composing in Miriam College (as of April 2004).

Renewable Energy Driven Desalination Systems - REDDES

Renewable energy sources for powering desalination processes is a very promising option especially in remote and arid regions where the use of conventional energy is costly or unavailable. Renewable energy driven desalination systems have been extensively discussed as an innovative approach to desalinate water economically and in an environmentally friendly manner. The stochastic nature of RES which result in the use of expensive energy storage systems usually limits the penetration of RES to the power generation system of a region. Desalination systems can utilise in a more economically efficient way the available RES potential. The energy produced is consumed for potable water production which can be stored economically for a large period of time before consumption.

An integrated model for the use of renewable energies in the desalination of seawater has been developed in the context of the REDDES (Renewable Energy Driven Desalination Systems) project. The model taking into account the available RES potential and the requested water demand can optimise the RES-desalination coupling configuration for maximum economic efficiency.

The overall objective of the project is the development and delivery of an integrated management and design tool for the use of renewables energies (wind, solar) in the desalination of seawater that will be implemented in arid remote and isolated communities. The tool will be applied, as a pilot project, in the small Greek islands of the Dodecanese in the south eastern Aegean. The results of the application of this tool will be elaborated together with the local authorities and will therefore be of direct use for them.

The case study will demonstrate and prove the feasibility of RES utilisation. It will be performed in order to find solutions to the fresh water supply problem of the arid islands of the Dodecanese by developing renewable energy driven desalination systems that are appropriate for each island. The eight small Greek islands that will be considered are Nisyros (population 800, area 41.40 km^2), Tilos (population 400, area 62.825 km^2), Symi (population 2700, area 58.10 km^2), Patmos (population 2700, area 34.05 km^2), Leros (population 2500, area 52.95 km^2), Kasos (population 1000, area 65.975 km^2), Astipalea (population 1000, area 96.85 km^2) and Kastelorizo (population 300, area 9.125 km^2).

The long term objectives of the project are:

- to prove the feasibility of RES utilisation for the production of fresh water;
- to provide information about technical issues on RES desalination coupling to industry entities;
- to provide a decision tool to policy makers for exploiting RES; and
- to prove to end-users how RES can contribute to regional development without severe environmental impact.

Project funded by CEC, Altener Programme (2002–2003). Major Partners: Regional Energy Agency of Dodecanese S.A., Greece, Region of Crete - Regional Energy Agency, Greece, Punto Energia Provincia di Sassari - Multi S.p.A., Italy, Gerling Sustainable Development Project Gmbh, Germany.

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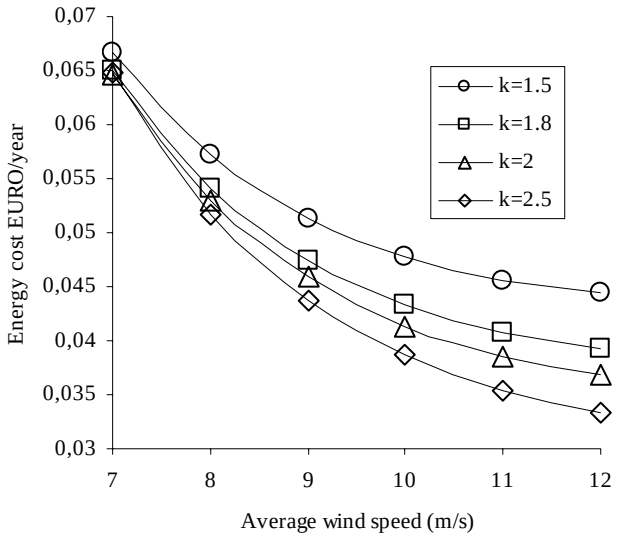

Energy production costs of a Bonus 300/33.4 Mk III wind turbine as function of average wind speed and shape factor, r=7% and n=15 years

Research

Atmospheric Composition Change: The European Network of Excellence (ACCENT)

Objective: To promote a common European strategy for research on atmospheric composition change, to develop and maintain durable means of communication and collaboration within the European scientific community, to facilitate this research and to optimise two-way interaction with policy-makers and the public.

LHTEE Contribution: Key role in the co-ordination of modelling activities with emphasis on Quality Assurance, contributions to steering research on transport and transformation of pollutants at the local scale, involvement in work related to education and training.

Funded by: CEC, 6th Framework Programme, Activity Area Sustainable Development, Global Change and Ecosystems (2004-2009).

New Energy Externalities Developments for Sustainability (NEEDS)

Objective: To evaluate the full costs and benefits (i.e. direct + external) of energy policies and of future energy systems, both at the level of individual countries and for the enlarged EU as a whole. In this context, monetary valuation of externalities associated to energy production, transport, conversion and use.

LHTEE Contribution: Atmospheric modelling at the urban and local scales, contributions to methodology improvement and application.

Funded by: CEC, 6th Framework Programme, Activity Area Sustainable Development, Global Change and Ecosystems (2004-2008).

Air Quality Assessment for Europe: From Local to Continental Scale (AIR4EU)

Objective: To provide recommendations on integrated air quality assessments for different temporal and spatial scales ranging from hourly to annual and from "hotspot" to continental scale. This will directly benefit EU stakeholders including policy makers and city, national and regional users.

LHTEE Contribution: Leading role regarding air quality assessment at the urban/agglomerate scale as well as the cross cutting issue of interactions between different scales.

Funded by: CEC, 6th Framework Programme, Activity Area Research for Policy Support (2004-2006).

Integrated Environmental Assessment and Management

Objective: The development of a business plan for a spin-off company that shall exploit the research results of LHTEE in the fields of air quality management, solid waste management and life cycle management. The aim is for the spin-off company to provide integrated environmental assessment and management services to the public and private sector.

LHTEE Contribution: Development of business plan.

Funded by: Hellenic General Secretariat of Research and Technology (2003-2004).

Integration of Solid Waste Management Tools into Specific Settings of European and Asian Communities (ISTEAC)

Objective: To study specific tools for reducing the amount of waste disposed of, with emphasis on composting and recycling, as well as to examine the local cultural and socio-economic characteristics that influence the application of these tools. Furthermore, the project will contribute to the information and education of the participating staff on a wide range of solid waste management issues.

LHTEE Contribution: Project management, field and socio-economic study, development and assessment of managerial and technological scenarios.

Funded by: CEC, ASEAN-EU University Network programme (2003-2005).

Waste Management Based on Polluter-Pays Principles under Mediterranean Peculiarities (PAYTMED)

Objective: To investigate the applicability of implementing a waste management and pricing system based on Pay-As-You-Throw (PAYT) in Mediterranean countries, at the example of Greece.

LHTEE Contribution: Project co-ordination, involvement in all WP.

Funded by: Hellenic General Secretariat of Research and Technology (2004-2006).

Optimum Management of Industrial Products at the End of their Useful Life (MIPEL)

Objective: To optimise the End of Life Management of electrical and electronic equipment by redesigning industrial products in order to decrease waste and hazardous materials, while enabling their reuse and environmentally sound disposal.

LHTEE Contribution: Project co-ordination, electrical and electronic equipment Life Cycle Analysis and waste management.

Funded by: Hellenic Ministry of National Education and Religious Affairs, Pythagoras programme (2004-2006).

Integrated Methodology for Monitoring, Decommission, Sanitation and Restoration of Uncontrolled Sites for Solid Waste Disposal (IDRUS)

Objective: To develop a methodological tool for managing wild waste disposal sites, in the frame of regional/local solid waste management and to formulate an integrated evaluation framework for assessing different intervention strategies (with the aim to facilitate the implementation of the selected scheme).

LHTEE Contribution: Project co-ordination, implementation of most WP.

Funded by: Hellenic Ministry of National Education and Religious Affairs, Pythagoras programme (2004-2006).

Development of an Educational Package for Indoor Environmental Quality

Objective: To evaluate and improve the environmental educational package given to undergraduate and postgraduate students by enlarging the scientific knowledge to the field of indoor environmental quality. The necessity of education in the particular sector is imposed by the so-called 'sick building syndrome'.

LHTEE Contribution: Involvement to educational package development on indoor environmental quality field.

Funded by: Hellenic Ministry of National Education and Religious Affairs, Pythagoras programme (2004-2006).

Resource Recovery from Waste Disposal Sites (REDIS)

Objective: To develop an aftercare methodology for waste disposal sites (from uncontrolled dumps to sanitary landfills), focusing on system analysis of selected examined sites and multiple resource (materials, energy and land area) recovery. Sampling, surveying and inventory of such sites is to be performed for various areas in Greece along with the compilation of a suitable guidebook.

LHTEE Contribution: Project co-ordination and implementation.

Funded by: Hellenic Ministry of National Education and Religious Affairs, Heraklitus programme (2003-2005).

Economical and Technical Optimization of Industrial Plants' Heat Insulation

Objective: To develop an analytical model that optimizes the energy behaviour of an industrial insulation application. In order to achieve that, the heat transfer through fibrous insulation and the heat balance in industrial insulation application are examined.

LHTEE Contribution: Project co-ordination.

Funded by: Hellenic Ministry of National Education and Religious Affairs, Heraklitus programme (2002-2005).

Ecodesign of Power Production Units

Objective: Application of the Life Cycle Analysis methodology for quantifying the environmental impacts of processes in power production units, subsequent use of process optimization tools and implementation of a waste production minimization tool in order to find the optimal feasible solution at the early stage of the design.

LHTEE Contribution: Project co-ordination.

Funded by: Hellenic Ministry of National Education and Religious Affairs, Heraklitus programme (2002-2005).

Integrated Product Policy in the Telecommunication Sector (IPP-TEL)

Objective: Application of Integrated Product Policy in the telecommunication sector by the Ecodesign and End of Life Management of an existing telecom device. Ecodesign aims at the development of a product with minimised environmental impacts during the whole life cycle. End of Life Management involves the development of economically efficient options for product reuse, disassembly, component reuse and recycling.

LHTEE Contribution: Life Cycle Analysis of a selected telecom device and investigation of Ecodesign and End of Life Management options.

Funded by: CEC, DG Environment, LIFE-Environment programme (2004-2007).

Monitoring and Evaluation of Indoor Climate and Air Quality Conditions in the White Tower, in order to Use it as a City Museum of Thessaloniki

Objective: To determine and evaluate the conditions prevailing in the historical building which is the trademark of the city and to elaborate the interventions necessary for its use as a City Museum, taking into consideration the restrictions imposed by its age, features and significance.

LHTEE Contribution: Co-ordination and scientific work.

Funded by: Thessaloniki Museum of Byzantine Culture (2004-2006).

Services

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

- Restoration of the Tagarades landfill, east sector, phase B: Concept of a technical offer.
- Investigation of the recycling fees for various categories of waste electric and electronic equipment (WEEE).

Books

N. Moussiopoulos, K. Karatzas, K. Nikolaou (2004)
Environmental planning and information on air pollution in Thessaloniki, Organisation for the Master Plan and Environmental Protection of Thessaloniki, Greece, 96 pp.

Tuinstra W., Eerens H.C., van Minnen J., Petroula D., Swart R., Brink C., Kalognomou E.-A., Moussiopoulos N., Amann M., Cofala J., Klimont Z., Dentener F., Raes F. (2004)
Air pollution and climate change policies in Europe: exploring linkages and the added value of an integrated approach, EEA Technical report 5/2004, Copenhagen, 94 pp.

Articles in Books

Moussiopoulos N. and Tourlou P.M. (2003)
Case studies – Air pollution modeling at local, regional, continental and global scales & Active groups in air pollution modeling, in **Air Quality Modeling – Theories, Methodologies, Computational Techniques and Available Databases and Software,** Vol. 1 – Fundamentals**,** Chapters 19 & 21 (P. Zanneti ed), published by the EnviroComp Institute (http://www.envirocomp.org/) and the Air & Waste Management Association (http://www.awma.org/), 313-323 and 355-362.

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Neue Wissenschaftliche Erkenntisse als Basis für die Bewertung der Luftqualität in Ballungsgebieten, in **Jahrbuch 2003 der Deutschen Akademie der Naturforscher Leopoldina (Halle/Saale),** (R. 3) 49, 555-567.

Karatzas K., Masouras A., Kaprara A., Bassoukos A., Papaioannou I., Slini Th. and Moussiopoulos N. (2004)
Environmental information systems and the concept of Environmental Informatics in **Environmental Online Communication, Advanced Information and Knowledge Processing Series** (A. Scharl ed.) published by Springer, London, ISBN: 1-85233-783-4, 3-10.

Papers in Journals

Karagiannidis A., Xirogiannopoulou A. and Moussiopoulos N. (2002)
Planning framework and case-study analyses from applying systems of variable-rate pricing in the collection services of urban wastes, *Technika Chronika, IV, issue 1-2*.

Koroneos C., Michailidis M. and Moussiopoulos N. (2003)
Multi-objective optimization in energy systems: The case study of Lesvos island, Greece, *Renewable and Sustainable Energy Reviews* **8,** 91-100.

Moussiopoulos N. and Douros I. (2003)
Evaluation and sensitivity tests of MEMO using the ESCOMPTE pre-campaign dataset, *International Journal of Environment and Pollution* **20,** 55-63.

Papadopoulos A.M. and Avgelis A. (2003)
Indoor environmental quality in naturally ventilated office buildings and its impact on their energy performance, *International Journal of Ventilation* **4,** 203-212.

Koroneos C., Haritakis I., Michaloglou K. and Moussiopoulos N. (2004)
Exergy analysis for power plant alternative designs-case study in Crete, Greece: Part I, *Energy Sources Journal* **26,** 1277-1285.

Koroneos C., Haritakis I., Michaloglou K. and Moussiopoulos N. (2004)
Exergy analysis for power plant alternative designs-case study in Crete, Greece: Part II, *Energy Sources Journal* **26,** 1287-1295.

Papadopoulos A.M. and Moussiopoulos N. (2004)
Towards a holistic approach of the urban environment and its impact on the buildings' energy behaviour: the ATREUS project, *Journal of Environmental Monitoring* **6,** 841-848.

Slini Th., Karatzas K. and Moussiopoulos N. (2004)
Correlation of air pollution and meteorological data using Neural Networks, *International Journal of Environment and Pollution* **20,** 218-229.

Karagiannidis A., Xirogiannopoulou A., Perkoulidis G. and Moussiopoulos N. (2004)
Assessing of the collection of urban solid wastes: a step towards municipality benchmarking, *Water, Air and Soil Pollution: Focus* **4 (4-5),** 397-409.

Karagiannidis A., Perkoulidis G., Moussiopoulos N. and Chrysochoou M. (2004)
Facility location for solid waste management through compilation and multicriterial ranking of optimal decentralised scenarios: a case study for the region of

Peloponesse in southern Greece, *The Journal of Engineering Research* **1,** 7-18.

Koroneos C., Dompros A., Roumbas G. and Moussiopoulos N. (2004)
Life cycle assessment of hydrogen fuel production processes, *International Journal of Hydrogen Energy* **29,** 1443-1450.

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Regression analysis and urban air quality forecasting for the city of Athens, *Global NEST: The International Journal* **4(2-3),** 153-162.

Papakostas K.T. and Papadopoulos A.M. (2004)
Energy requirements for the treatment of fresh air in HVAC systems: A case study for Athens and Thessaloniki, Greece, *International Journal of Ventilation* **3,** 33-40.

Karatzas K., Nikolaou K. and Moussiopoulos N. (2004)
Timely and valid air quality information: the APNEE-TU project, *Fresenious Environmental Bulletin (FEB)* **13,** 11.

A.M. Papadopoulos, S. Oxizidis, H. Doukas, I. Samlidis (2004)
Constrains and potential for the propagation of solar refrigeration in the building sector, *Energy and Building* **A-B**, 41-51.

Participation at Conferences

CORS/INFORMS Joint International Meeting, Banff, Canada, 16-19 May

Oral presentations

Optimizing the routing of collection trucks for urban solid wastes in a Greek Municipality (A. Karagiannidis)

Locational characteristics of wild landfills in the Prefecture of Thessaloniki, Greece (A. Karagiannidis)

Liberalization of the Greek electricity system: A system dynamics approach (A. Karagiannidis)

9th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes, Garmisch-Partenkirchen, Germany, 1-4 June

Oral presentations

A study of heat transfer effects on air quality in street canyons by numerical simulations (N. Moussiopoulos)

Application and development of the OFIS model within the framework of CityDelta
(N. Moussiopoulos)

Protection and Restoration of the Environment VII, Myconos, Greece, 28 June - 1 July

Oral presentations

Modelling the citizens' annoyance and convenience from urban solid waste collection bins (A. Xirogiannopoulou)

Infectious hospital waste management at the 2nd regional health and welfare authority of Central Macedonia (A. Xirogiannopoulou)

The multi-pollutant cost-effectiveness emission reduction problem (Ch. Vlahocostas)

Planning of interventions for the optimization of urban solid waste collection at municipal level (A. Karagiannidis)

What emission reductions are needed in Athens for attaining the EU air quality legislation? (Ch. Vlahocostas)

EURO XX, Rhodos, Greece, 4-7 July

Oral presentation

A multicriterial facility location model for municipal solid waste management (A. Karagiannidis)

WSEAS/IASME International Conference on Heat and Mass Transfer, Corfu, 17-19 August

Oral presentation:

Heat transfer phenomena in fibrous insulating materials (A. Karamanos)

RES & RUE for Islands Sustainable Energy Solutions-International Conference, Larnaca, Cyprus, 30-31 August

Oral presentation

Reducing air-conditioning demand in urban buildings and its impact in not interconnected electrical systems (A. Stilianou)

27th NATO/CCMS International Technical Meeting on Air Pollution Modelling and its Application, Banff, Canada, 25-29 October

Oral presentation

The effect of a street canyon length on the street scale flow field and air quality: A numerical study (Ph. Barmpas)

Conference Towards the "Smart" Hospital, Thessaloniki, Greece, 4-7 November

Oral presentations

Intra-hospital draft regulation for hazardous medical waste management (A. Karagiannidis)

Energy audits in hospital buildings and the potential for energy conservation (A. Avgelis)

Events

The Laboratory had major contributions to events organised in 2004 by Aristotle University's Environmental Council: On 31 March we discussed methodological aspects and current trends in urban air quality assessment on the occasion of the workshop on "Air Pollution and Health" co-organised by the Hellenic Association of Environmental Medicine. Moreover, we played a key role in this year's celebration of the Environmental Day on 4 June.

On 22 April the Laboratory participated at an event on "Recycling at the Aristotle University" organised by a group of undergraduate students of our Department.

Following an invitation by DG Environment, the Professor Nicolas Moussiopoulos presented on 5 May in Brussels the concept and the so far status of the "Street Emissions Ceilings" exercise, which represents a focus of our work for EEA's European Topic Centre on Air and Climate Change.

During this year we collaborated with various German institutions on the occasion of several scientific events. A first opportunity arose during the "German University Fair" on 9 March: Issues related to the European Research and Higher Education Areas were dealt with in a workshop of DAAD and Humboldt foundation alumni hosted at the Goethe Institute. In the same context, Aristotle University's School of Engineering and the Technical Chamber of Greece organised on 11 March a workshop on the equivalence of academic degrees and the professional rights with emphasis on the situation in Greece and in Germany. Events related to important environmental issues followed in September: Firstly, two round-table discussions at the Goethe Institute on urban air pollution abatement and the health impact of air pollution. Secondly, a major conference on waste management organised by the German-Greek Industry and Trade Chamber.

Two major seminars were organised within the framework of the SAPPEK project, one in Thessaloniki on 12 May and one in Athens on 18 October. In these seminars, which were attended by more than 340 architects, constructors and engineers, were discussed the results of the project and the scientific and professional state of the art in the field of buildings' energy behaviour and their thermal protection. The invited speakers included, amongst other, the deputy minister for energy Mr. G. Salagoudis, the General Secretary for Research and Technology Prof. I. Tsoukalas and leading architects and constructors such as A. Tombazis and J. Ventourakis and A. Alexopoulos and S. Kalitsantzis from Domotechniki and Helleniki Technodomiki respectively.

News

As in previous years, also in 2004 we had several staff changes. First of all, a new member has been added to our permanent staff: Mrs. Afedo Koukounaris, who is responsible for the co-ordination of the Laboratory secretariat. Moreover, six new co-workers joined the Laboratory: Antis Stilianou was recruited as a training and mobility researcher, whereas Thomas Tsatsarelis, Georgios Xidis, Stergios Kostidis, Avraam Avramidis were hired as young researchers and Sofia Varnava as secretariat support. As another training and mobility researcher, Giorgio Camilleri stayed with as for nine months in 2004, before joining ICAO in Montreal.

From our previous staff we had members that departed from our Laboratory to pursuit other personal interests or studies, among this group were Charoula Balla, Maria Chrissochoou, Despoina Papadopoulou, Sara Pardali and Giannis Papaioannou. Assistant Professor Kostas Karatzas, who also left the Laboratory in 2004, formed together with our former staff members Athina Kaprara, Asterios Masouras and Anastasios Basoukos an own research group within the Mechanical Engineering Department. Farewell to all!

Professor Nicolas Moussiopoulos was appointed Director of our Department's Energy Division. Furthermore, Agis Papadopoulos who in this year was promoted to the level of an Associate Professor, was appointed national expert on Research and Innovation to the European Commission. Dr. C.J. Koroneos joined the editorial board of the International Journal of Exergy. Finally, our former staff member Thanos Arvanitis, working now as a researcher at JRC, received from our Department his PhD degree with a thesis on aerosol dispersion modelling in urban areas.

Laboratory Personnel

Nicolas Moussiopoulos	Professor, Dr.-Ing. habil (Director)
Agis Papadopoulos	Associate Professor, Dr.-Eng., MSc
Avraam Karagiannidis	Assistant Professor , Dr.-Eng., MSc

Researchers with Co-ordinating Functions

Christopher Koroneos	PhD
Ioannis Douros	Physicist, MSc
Evangelia-Anna Kalognomou	Physicist, MPhys

Researchers and PhD Students

Georgios Perkoulidis	Dr.-Eng.	Symeon Oxizidis	Mech. Engineer
Harisios Achillas	Mech. Engineer, MSc	Panagiotis Panagiotidis	Mech. Engineer, MSc
Aristotelis Avgelis	Mech. Engineer	Kostas Papageorgiou	Mech. Engineer
Avraam Avramidis	Mech. Engineer	Apostolos Papathanasiou	Physicist, MPhys
Fotios Barbas	Aerosp. Engineer, MSc	Panagiota Rakimbei	Environ. Engineer, MSc
Aristidis Dobros	Chem. Engineer	Theodora Slini	Mathematician
Natasha Dourala	Economist, MA	Antis Stilianou	Mech. Engineer, MSc
Maria Frangou	Chemist, MSc	Maria Theodoseli	Environ. Engineer, MSc
Efrosini Giama	Mech. Engineer, MSc	Georgios Theodosiou	Mech. Engineer
Anastasios Karamanos	Mech. Engineer	Thomas Tsatsarelis	Mech. Engineer
Stergios Kostidis	Struct. Engineer, MSc	Christos Vlahocostas	Mech. Engineer, MSc
Christos Naneris	Environmentalist	Anna Xirogiannopoulou	Mech. Engineer
Ioannis Ossanlis	Mech. Engineer, MSc		

Technical Staff and Secretariat

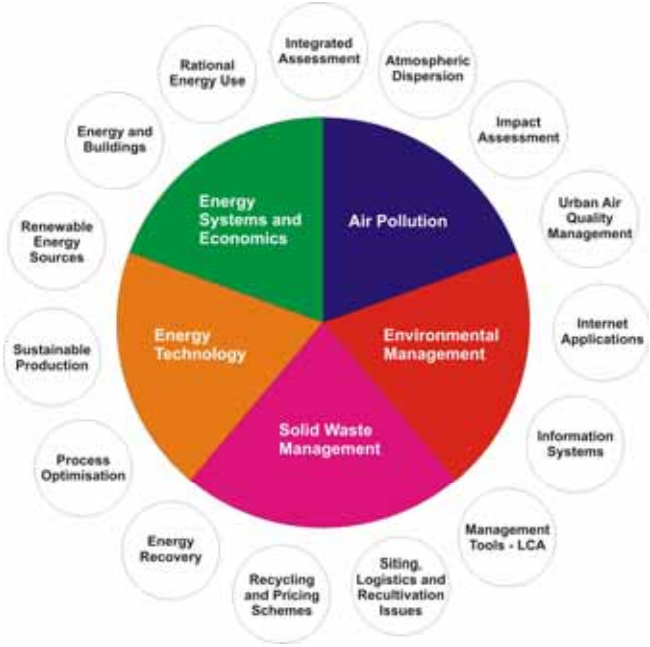
Lazaros Sotiriadis	System Administrator	Afedo Koukounaris	Administration Officer
Georgios Kotriklas	System Administrator	Dimitra Alexiou	Administrative Support
Dimitrios Nerantzis	System Administrator	Georgia Spiridou	Administrative Support
Sofia Eleftheriadou	Automation Engineer	Sofia Varnava	Administrative Support

Research fields of the Laboratory

The research work of the Laboratory focuses on:

Energy Systems: (a) Description, analysis and evaluation of energy technologies. (b) Rational use of energy in the industrial and domestic sectors. (c) Use of solid waste and biomass for energy production. (d) Renewable energy systems development. (e) Life Cycle Analysis applications for energy systems. (f) Analysis and implementation of alternative financing schemes in the energy sector.

Environmental Engineering: (a) Simulation of transport and chemical transformation of pollutants in the atmosphere with the use of advanced air quality models. (b) Assessment of measures for reducing air pollution levels. (c) Analysis of the impact of industrial activities and major public works on air quality. (d) Management and recycling of solid wastes. (e) Development and application of environmental management systems. (f) Integrated environmental assessment in urban areas.



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