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The demonstration component of the JOULE-THERMIE Programme

THERMIE

Urban Technologies

Sectoral Report 1995-97

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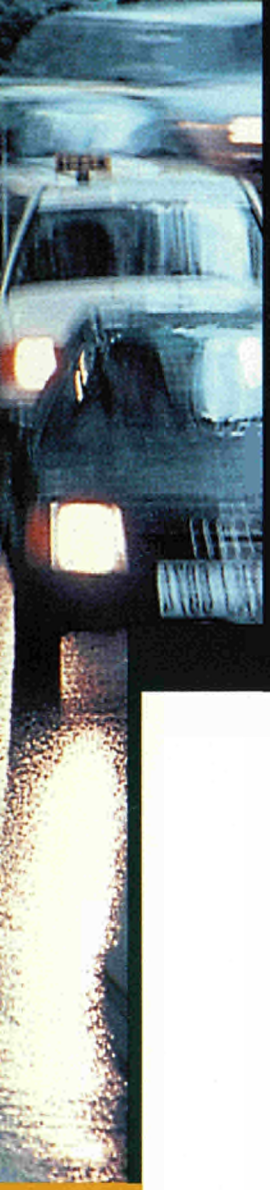
URBAN TECHNOLOGIES

THERMIE SECTORAL REPORT

Overview of THERMIE activities 1995-1997

CONTENTS



WHAT IS THERMIE?

JOULE-THERMIE was launched in 1995 as the European Union's first 'integrated' programme, bringing together the resources of the Directorates-General XII (Science, Research and Development) and XVII (Energy). The aim is to encourage the wider utilisation of non-nuclear energy technologies from research and development, through demonstration, towards the goal of the penetration of these systems into the marketplace. The programme runs until 1998 and has a total budget of 1,030 MECU.

Energy is fundamental to the existence of society, as without it industry, commerce and civil society cannot function. Fortunately, the earth is endowed with considerable energy-giving resources, mainly in the form of fossil fuels, such as oil, gas and coal. These are, however, unevenly distributed globally and are finite, so their use raises questions regarding security of supply and environmental sustainability. The JOULE-THERMIE programme supports research and technological development aimed at addressing these issues through the research, development and demonstration of technologies which enable us to reduce our energy demand, and to use what we need more cleanly and efficiently.

The THERMIE component of the programme focuses on the targeted demonstration of clean, efficient, cost-effective, and environmentally-friendly energy technologies. It participates in actions to prove the technological and economic viability of these technologies and promotes their wider replication and market penetration both within the EU and beyond, particularly in Central and Eastern Europe and the developing world. It promotes the application of a new energy infrastructure which fully utilises renewable energy sources, seeks to improve the efficiency of energy use and makes better use of fossil fuels. It also promotes improvements in the exploration, distribution and transport of hydrocarbons.

THERMIE aims to encourage the development and use of innovative energy technologies to meet EU aims and objectives across a wide spectrum of policy areas – energy, environment, economic, innovation, regional and social.

THERMIE promotes non-nuclear energy technologies through two types of actions. Demonstration projects help to prove the technical viability and economic advantages of new technologies by applying them on a sufficiently large scale for the first time. Associated measures help to prepare and implement the results of the programme by enhancing its impact on the market and its performance. These actions include activities related to strategy, dissemination and to encouraging and facilitating the participation of SMEs.

The final call for proposals under THERMIE was made at the end of 1997. The programme ends in 1998, after which a new programme will be developed as part of the Fifth Framework Programme.

Meeting the needs of the market

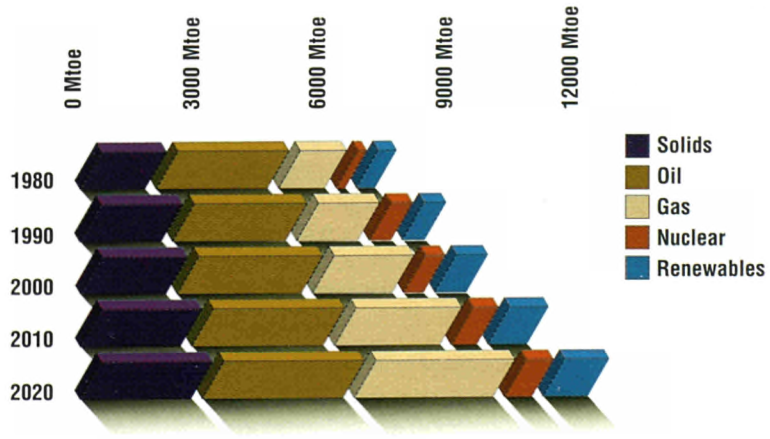
A key element of THERMIE today is that its activities must consider and respond to the real needs of market actors and the final consumer. It is not enough that technologies are developed and successfully demonstrated. A primary objective of the programme is to ensure that technological improvements are truly relevant to the needs of industrial, commercial and domestic society. This will help to ensure the availability of reliable, environmentally-acceptable and durable energy services (such as heating, lighting, transport or industrial processes) at affordable cost.

A sectoral approach

THERMIE is divided into three main sectors:

- Renewable Energy Sources
- Rational Use of Energy in Buildings, Industry and Transport
- Fossil Fuels (solid fuels and hydrocarbons).

This sectoral report provides a comprehensive overview of the activities carried out under THERMIE during 1995-1997 to promote the development and deployment of urban technologies.



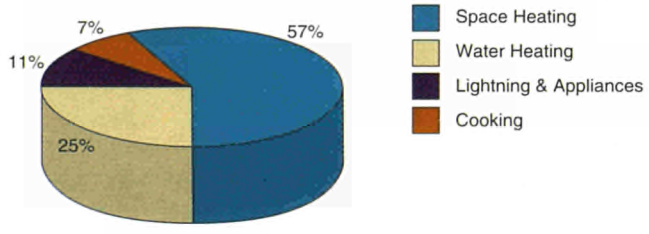
World energy consumption 1980-2020
From "Energy in Europe": European Energy to 2020,
(Conventional wisdom in case no additional policy measures are adopted).

RATIONALE FOR THE SECTOR - URBAN TECHNOLOGIES

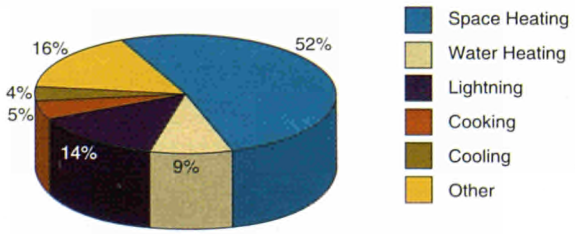
Today almost 85% of all European citizens live in towns and cities. Urban areas are the main consumers of energy, accounting for 75% of total EU final energy consumption, a large proportion of which is used for building comfort and transportation. The quality of life of urban citizens is largely dependant upon the state of the urban infrastructure, most importantly the built environment and the transport system. These two factors have the greatest impact upon the everyday lives of urban dwellers as they affect living and working conditions, personal mobility, access to services and the quality of the environment.

A fully integrated urban planning system is essential for the sustainable development of Cities of the Future. This will ensure the high quality, safe, secure, comfortable living and working environment and the efficient, cost-effective, transport systems which are essential to the well-being of Europe's urban citizens. These improvements to the urban system will require a variety of innovative 'urban technologies', which consider the rational use of energy in buildings and transport and the integration of renewables into buildings. These technologies can also minimise waste and pollution helping to improve the urban environment and contribute to global environmental protection.

Breakdown of energy consumption by end use in EU residential buildings



Breakdown of energy consumption by end use in EU commercial buildings



Buildings

The buildings sector in Europe accounts for approximately 40% of total energy consumption, around 70% of which is used in residential buildings. The breakdown of energy consumption in EU residential and commercial buildings is illustrated in the graphs on the previous page.

Total energy consumption in buildings is rising by approximately 1.5% per annum, which has serious implications for the environment. If the EU is to reach its Kyoto target of a 15% reduction on 1990 CO_2 emissions by 2010, then energy efficiency in the buildings sector must be increased. There has been a slow penetration of energy efficient technologies in buildings over the past 20 years, but energy saving potential remains huge. Even using current technology it is estimated that 16% and 25% energy saving potentials exist respectively for the residential and tertiary (commercial, recreational and public buildings etc.) sectors. This corresponds to a total CO_2 reduction of 340 Mtoe/yr.

Construction technologies, design techniques, materials and equipment have rapidly evolved in Europe, giving significant opportunity for energy efficient construction in new buildings. With only 1-2% of Europe's building stock being replaced annually, however, it is essential that energy efficiency problems are also addressed through retrofitting. Renovation offers the best opportunities for the rapid uptake of innovative, energy efficient technologies and should provide the focus for demonstration activities.

Building owners are often reluctant to invest in building integrated renewable energy systems, such as photovoltaics, or energy efficient technologies like lighting and control systems, when energy costs represent only a small fraction of total buildings running costs. Before they can be adopted widescale these technologies must be demonstrated, at full scale and in a real situation, to prove their cost-effectiveness. THERMIE has played an important role in this process. Through providing financial assistance for these activities, it helps to bridge the gap between Research and Technological Development (RTD) and the commercialisation of building integrated renewables and energy efficient technologies for buildings.

Technological demonstration is not only important with respect to single buildings, but also at the city scale. Combined Heat and Power (CHP) systems, for example, which have the potential to reach primary energy efficiencies of 80%, offer considerable scope for efficiency improvements, cost saving and emissions reductions in district heating and cooling systems. The full scale demonstration of such high efficiency systems is a very costly process and public funding, such as that provided under THERMIE, is important if such large scale demonstrations are to go ahead.

Europe's construction industry is a very important economic sector, but its contribution to GDP has been slowly declining in recent years. The increased adoption of renewable energy and energy efficient technologies in buildings can help to reverse this trend. Construction is a labour intensive industry, employing 25 – 30 million people in 2.7 million companies, the vast majority of which are small and medium-sized enterprises (SMEs). This large, fragmented, sector offers employment opportunities in a wide variety of enterprises. The majority of construction activity associated with energy efficiency involves the retrofitting of existing buildings, which can generate a significant number of local jobs. In terms of its economic growth potential and contribution to local employment opportunities the construction industry is of primary importance in the EU.

Despite its reputation as a traditional, conservative sector, the construction industry is generally open to technological developments, such as energy efficient and building integrated renewable energy technologies. These must be fully demonstrated, however, before they will be adopted into normal practice. The amount of demonstration carried out by companies is low, as full scale demonstration is expensive and risky and few small construction companies can afford to finance full scale demonstration alone. The assistance provided for such activities by THERMIE is essential if the technological solutions to the energy efficiency problem are to fully penetrate the industry.

Europe has the potential to establish itself as a world leader in the construction market. It has a strong reputation in many areas of the construction industry such as planning, design, engineering, project management and high quality product manufacture. Such technologies and skills can readily be exported to third countries. It is estimated that within 30 years two thirds of the world's population will live in cities and the market for energy efficient and building-integrated renewables technologies is thus poised to increase dramatically in the near future. The development of a strong domestic industry is the forerunner to the development of a strong export industry. This offers considerable economic growth and employment opportunities for the construction sector and the European economy. Demonstration projects are an ideal medium through which to publicise the achievements of the European building sector world-wide.

The adoption of advanced environmentally-conscious construction techniques and energy efficient technologies is essential to the creation of an urban infrastructure which offers a high quality of life to residents and workers alike. The development of a strong European industry which develops, manufactures, supplies and installs these technologies and applies novel construction techniques, also offers considerable opportunities for economic and employment growth within the sector.

Transport

Transport energy use in the EU has increased faster than that in any other economic sector, more than doubling between 1970 and the present day. Transport currently accounts for a third of final energy consumption and is on a rising trend, mainly due to the significant growth of road transport and particularly the use of the private car. A whole range of problems originate from increased transport use, including increases in congestion, travel times, deterioration of air quality, accidents, traffic noise and the depletion of hydrocarbon resources.

Despite fuel efficiency improvements in new vehicles, any benefits are outweighed by the fact that European citizens now have more and larger cars, with bigger engines and use them more frequently. The extension of urban residential areas and associated services has increased the frequency and length of trips necessary in an urban citizen's everyday life. This has made the private car highly desirable in the lifestyle of the modern European.

Public transport in most cities has lost significant market share recently to the private car. This trend has led to the displacement of less oil-dependent, less polluting modes of transport, such as buses, trains and trams. This has had a negative impact upon the urban environment and the quality of life of urban citizens overall. Traffic and parking capacities are now often exceeded, increasing journey times and causing energy over-consumption and high levels of urban pollution. Many European cities have now recognised the need to revive their urban transport systems, to provide alternatives to the private car.

Energy consumed in the transport sector is supplied almost exclusively from oil products. Considering the low potential for large scale fuel substitution in transport, the sector will remain dependent on oil for some years to come; a significant issue with regard to the security of energy supply in Europe. The development of transport technologies which can reduce the dependence of the EU on imported oil, through efficiency improvements and/or the development of alternative fuels, are particularly important in securing the EU energy supply.

The transport sector has a clear responsibility for environmental damage both locally, regionally and globally. Within the last 10 years photochemical pollution has increased 150%, while the contribution of transport to acid pollution is now 75% of total emissions for this pollutant type. Emissions of CO_2 are also increasing significantly, with implications for global warming. Action now needs to be taken to limit the environmental impact of the sector. This can only be achieved through the development of an environmentally-sustainable, energy efficient, cost-effective transport system. Such a system requires the development and adoption of a combination of innovative vehicle technologies, traffic management and public transport systems. Technology development and demonstration efforts must now be stepped up if the impacts of transport on the urban environment is to be minimised, particularly as emissions regulations and vehicle efficiency standards will become more stringent in future. The demonstration of innovative technologies is vital as a pre-requisite for them to gain a foothold in the market and the role of public funding programmes, such as THERMIE, in assisting technology developers with this process cannot be underestimated.

Public authorities are often responsible for the provision of public urban transport. Many of these are keen to adopt an energy efficient, low pollution urban public transport infrastructure, but will only commit to this high investment if it is proven to be cost effective and appropriate to the needs of their citizens. Transport projects are often best demonstrated by the public sector as this can provide good publicity and help to raise political awareness and widescale acceptance of innovative transport technologies. Neither the manufacturer nor the public authority can generally afford to finance such large scale demonstration projects alone, therefore public sector financing, such as that provided under THERMIE, can provide a valuable contribution which can allow these projects to go ahead.

The successful demonstration of advanced transport technologies can make a significant contribution to the strength of the European transport industry. Increasing the market penetration of European manufactured technologies will enable the industry to grow and compete more effectively in the marketplace. The global market for novel transport technologies is enormous and growing rapidly, but world-wide manufacturers are becoming increasingly aware of this and competition is intense. In some vehicle technologies the EU is at the forefront, while in others Japan and the USA lead the way. If Europe is to maintain and extend its competitive position, it must strive to continually develop, demonstrate and commercialise new technologies. Technology demonstration is particularly costly and a considerable financial risk for companies. Public support for such activities through programmes such as THERMIE is therefore essential if EU manufacturers are to establish and maintain a competitive position in this highly competitive world market. The development of a strong European transport industry helps to create considerable employment opportunities in Europe.

The financial assistance for demonstration projects and associated measures provided by THERMIE has made a significant contribution to helping the penetration of innovative urban technologies, such as energy efficient buildings and transport systems. Implementation of these technologies can significantly improve the quality of life for urban citizens by reducing pollution, providing a better local, regional and global environment and by improving living and working conditions. The penetration of such technologies into the marketplace in Europe and world-wide can also make a positive contribution to industrial development, economic growth and employment creation in the EU. All of these factors make a valuable contribution to an improved standard of living and quality of life for urban dwellers in the Cities of the Future.

OVERVIEW OF THERMIE ACTIVITIES DURING 1995-1997

The ultimate objective of THERMIE in the 'urban technologies' sector is to improve living and working conditions, and thereby quality of life, for Europe's urban citizens both now and in the Cities of the Future. Considerable progress has been made between 1995 and 1997 towards the technological demonstration and market penetration of technologies which can help to achieve this. This has been achieved through the combination of supported demonstration activities and associated measures.

With respect to buildings, THERMIE aims to achieve its objectives by demonstrating innovative technologies in the construction industry and the built environment. The use of advanced architectural concepts, building techniques and appropriate renewable energy and energy efficient technologies, can make a considerable contribution to enhancing the rational use of energy in urban buildings. This significantly reduces waste generation by the construction industry and enables considerable energy and cost savings to be made.

In the transport sector the ultimate objective of THERMIE is the same, but is to be achieved by assisting the demonstration and market penetration of innovative transport and vehicle technologies, which help to reduce fuel consumption and the emission of harmful pollutants within cities, while improving traffic conditions and mobility.

Before these technologies will be widely adopted, however, they must first be demonstrated at the full scale in a real application. Following this they also require rigorous promotion, to raise awareness of their benefits and launch them onto the market at home and abroad. Between 1995-1997 this process has been given significant assistance through the demonstration activities and associated measures supported under THERMIE.

In the buildings sector the demonstration projects supported have incorporated a wide range of innovative technologies. In the main they have focused upon technologies which lead to a substantial reduction in energy consumption and therefore environmental impact. These have been for either new build or retrofit in residential or tertiary sector buildings. Specifically such technologies have included: optimised building envelope materials and components, low energy design, integrated load management and controls for heating, cooling and electricity consumption, optimised lighting and heating, ventilation and air conditioning (HVAC) equipment, integrating natural light and the appropriate integration of renewable energy sources, in particular solar energy applications through active or passive solar systems.

In the transport sector demonstration projects supported between 1995 and 1997 have focused upon road transport and particularly public and urban transport. Projects have targeted the implementation of new vehicle technologies which can lead to clean, efficient transport systems, and traffic management technologies, such as fleet management and traffic control. They have also focused on the use of alternative, clean fuels, including fuel cells. Particular attention has been focused on actions which continue and progress actions already initiated concerning the promotion, organisation and diversification of Urban Public Transport (UPT).

Many of the associated measures supported by THERMIE in the buildings sector between 1995-1997 have involved the promotion of innovative energy technologies, such as energy efficient lighting, HVAC and low energy design. A number of these actions have targeted specific sectors such as hospitals, public buildings and hotels. Typical associated measures have included the organisation of networks to allow the horizontal exchange of information, the preparation and dissemination of awareness-raising documentation and studies to identify, and promote, the results of successful demonstration projects.

In the transport sector associated measures supported have mainly involved the promotion of new or innovative transport technologies to increase their market penetration. A number of these actions have been directly linked to demonstration projects, or are a concrete follow-up of previously supported activities. These activities have included the organisation of promotional workshops, conferences and training courses as well as the preparation of information dissemination publications and the conduct of studies. It has also included the establishment of information exchange networks, involving professional associations, to ensure wide dissemination of information.

The selection for urban technology projects in general has been based around the technical quality, cost-effectiveness, innovation, replication potential, relevance to the objectives of the programme in general and the publicised priorities for the sector for the year in view. So that effective work can be built upon, projects which are follow-on phases of existing projects or are associated measures to these projects have a high priority. Projects involving small and medium-sized enterprises (SMEs), extensive cross-border collaboration and the transfer of technology to third countries also have a high priority within the programme.

Cross-Border Collaboration-Targeted Projects

Cross-border collaboration in the urban technologies sector is particularly strong. One of the main objectives of THERMIE in this sector is to increase collaboration between cities in Member States. This is important to maximise information dissemination and shared experience when seeking to develop comprehensive construction, transport and energy solutions for the Cities of the Future.

This extensive collaboration has been achieved through the use of Targeted Projects and Integrated Quality Targeted Projects (IQTP), which involve consortia of cities from at least three Member or Associated States. These major European collaborative projects demonstrate best available technologies and best practice in the implementation of innovative energy technologies in urban areas, through the conduct of cross-national projects with common strategies in energy saving and rational use of energy.

In the buildings sector these targeted projects focus on the development and demonstration of technologies and construction practices which influence the social acceptance of low energy and consequently low CO_2 buildings. They also emphasise the incorporation of comprehensive urban planning as a powerful tool in influencing sustainable development.

In the transport sector these projects must improve the quality of current practice in urban transport and lead to a substantial technical and economic improvement in the overall energy efficiency of the urban and peri-urban transport system. This must be achieved using innovative technologies which, in addition, have to be integrated into coherent measures to better manage urban mobility of goods and/or people, with special emphasis on noise and pollution reduction.

SMEs

Due to the nature of the European construction sector, which is dominated by SMEs, their participation in THERMIE supported projects in the buildings sector is high. A significant proportion of projects incorporate SMEs into their consortia and a number of projects are even led by SMEs. Other organisations involved in building sector projects include local authorities, large manufacturing companies and universities. The level of participation of SMEs in transport projects, on the other hand, is very low, mainly due to the type of projects supported. In the main these are large scale demonstration projects involving the introduction of energy efficient transport systems into Europe's major cities. These projects, particularly the targeted projects, tend to involve mainly large consortia of municipal authorities and transport providers. Where SMEs are involved, these are usually small public organisations dealing with urban development issues. Participation from research organisations, universities and manufacturers in transport projects is also limited.

Third Countries

Between 1995 and 1997 third country projects supported by THERMIE have emphasised the development of market tools which help to promote EU expertise and technology in the international market. These actions have acted as catalysts in the opening up of new markets and have supported EU firms in the export of technologies and services. They also help EU companies develop business partnerships with companies abroad. With urban populations growing rapidly world-wide, the potential global market for urban technologies is enormous. A number of third country activities have therefore been supported in the urban technologies sector. The majority of these actions have involved an event combined with a study, publication, seminar/workshop, training initiative or business mission. Two of the most recent projects supported have involved the promotion of EU energy efficient transport equipment in the Ukraine and a training course in Russia promoting innovative EU technologies in public transport.

Highlights – Demonstration Project Success Stories: 1995-1997 (including Targeted and Integrated Quality Targeted Projects)

Projects supported during 1995-1997 in the urban technologies sector focused on the demonstration of innovative, energy saving technologies for transport and buildings which can contribute to the development of sustainable cities in Europe. Some of these projects are completed, whilst others are ongoing, or just beginning. The results produced by many of these projects to date are very promising and several which have made noteworthy progress are described here in more detail:

BUILDING TARGETED PROJECT 1996 – SHINE
Solar Housing Through Innovations for Natural Environment

The SHINE project involves a consortium of seven organisations who are aiming to make an energy saving of 60% against current consumption by applying retrofit measures to houses in six different European cities.

The consortium is committed to demonstrating the practicality of a series of technical measures to reduce CO_2 emissions, through the implementation of different renewable energy and rational use of energy (RES/RUE) techniques in 920 dwellings. The innovative energy saving equipment to be installed will include co-generation, parietodynamique insulated ventilation, optimised and controlled ventilation, solar energy (air systems, water systems and photovoltaics) and water savings using a new toilet system. These will use innovative and environmentally-friendly building materials

The main objective of the project is to give a strong lead in energy efficiency housing refurbishments with immediate energy saving and environmental impact, and to incorporate the results into general energy saving policies in the housing sector.

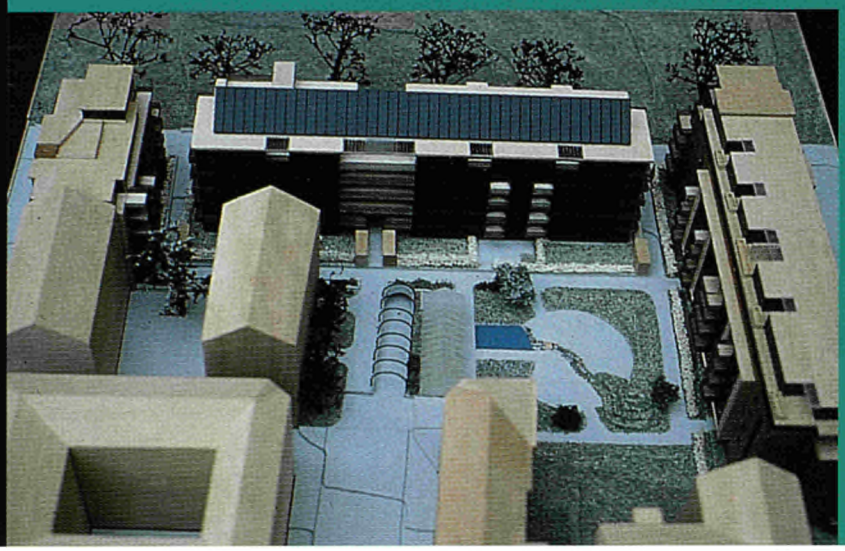
The project aims to achieve, for example, the following savings:

London Housing Association – UK
Energy savings – 200 tonnes of oil equivalent (toe) – 1,700,000 kWh
Environmental – 113 tonnes of CO_2, 177 kg NOx and 700 kg SO_2

Amsterdam City Area Housing Association – The Netherlands
Energy Savings – 206 toe – 2,298,221 kWh
Environmental – 993 tonnes CO_2, 2,247 kg NOx, 50kg SO_2

Other partners involved in the project:

Reading City	United Kingdom
Göteburg Housing Association	Sweden
Flensburg Housing Association	Denmark
Grenoble City	France



BUILDING TARGETED PROJECT – SUNH
Solar Urban New Housing

The SUNH project involves a consortia of 10 organisations in 8 different Member States. The aim of this project is to make energy savings of 50% against national standards, in new buildings which are to be erected in 12 different European cities. The project consists of 81 new houses, and 793 new flats.

The consortium is committed to demonstrating the relevance of a series of technical measures to reduce CO_2 emissions through the implementation of different RES/RUE techniques, using new, clean, building materials. The consortium will introduce into these new buildings: innovative energy and building technologies; advanced envelope materials, energy management systems, low electricity consumption from HVAC, solar energy (passive and active), natural lighting and water saving. It is expected that over 1,500 tonnes of CO_2 emissions and 880 kg and 2150 kg of SO_2 and NOx emissions respectively, will be saved annually from the energy saving of 620 toe which will result.

The objective of the SUNH project is to demonstrate the role that European cities could play, and the results that could be obtained, from the construction and operation of new dwellings where the integration of RES and RUE are the main philosophies behind the design. In addition, the consortium will also evaluate the success of the integration of solar active and passive systems. This will draw on the experience of expert architects and will compare the cost of the main solutions. It is envisaged that the municipalities will take the results of this evaluation into account in the future development of building sector regulations.

The cities involved in the SUHN project are:

Utrecht	The Netherlands
Rouen	France
Caen	France
Le Havre	France
Farum	Denmark
Oslo	Norway
Barcelona	Spain
Helsinki	Finland
Lisbon	Portugal
Reading	United Kingdom
Portsmouth	United Kingdom

BUILDING TARGETED PROJECT – MEDUCA
Model Educational Buildings for Integrated Energy Efficient Design

The MEDUCA project encompasses eight demonstration projects in seven countries. The aim of the project is to demonstrate the design and construction of energy efficient schools which stand out as exemplary models of optimised integrated energy efficient design in the region where they are located. This will involve both new construction and refurbishment projects combining conventional and innovative technologies.

The innovative energy concepts to be incorporated into these projects include, for energy efficiency: low energy windows, heat recovery, advanced energy management systems, advanced control systems, optimum daylight use and energy efficient lighting and fans. For integrated renewables the technologies include: photovoltaics, passive solar energy, active solar energy for swimming pool heating, the use of biomass pellets, geothermal energy and heat pumps.

It is expected that this collaborative project will have a significant impact on the general perception of energy efficient buildings and specifically serve as the basis for improved energy and comfort standards for educational buildings throughout Europe. This could lead to the adoption of an integrated technological approach to the energy efficient design of educational buildings as standard practice at both the local and national level in the countries involved.

The individual projects within MEDUCA will demonstrate energy savings and reduced emissions which are in the range of 50-60% for thermal and 30-50% for electricity.

The organisation involved in the MEDUCA projects are:

Ebeburg School	Denmark
Wittorfer School	Germany
Grong School	Norway
Höokegård School	Sweden
Environmental Education Centre	Italy
European Public Law Centre	Italy
University of Almeria	Spain

BUILDING TARGETED PROJECT – EXPOCITIES
Extensive Energy Planning of Cities

This project brings together four partners from around Europe who are planning the construction of large building projects of between 1,500 and 30,000 accommodation units.

All of these projects share commonalities in three respects; firstly, they are all part of urban development initiatives which include ecological and social aspects. Secondly, they all attach special importance to rational use of energy in the buildings, namely energy consumption of at least 40% lower than standards currently required. Finally they are all projects in prominent cosmopolitan cities which attract visitors from all over the world.

The four building projects consist of:

- A new area of expansion of **Palma de Mallorca**, the **Balearic Islands** capital, a coastal city dominated by tourism which has an enormous increase in energy demand during the tourist season. The development will be sustainable, yet attractive, to allow its full assimilation into the island.
- A renovation in the city of **Lisbon**, **Portugal**, accommodating the EXPO'98 exhibition which is to be converted into an urban expansion zone after the exhibition.
- A new housing district in the city of **Hanover**, **Germany** built in the area neighbouring the EXPO 2000. The development consists of 6,000 houses including a special 'EXPO-city' which emphasises sustainable urban development and energy optimisation.
- The development of a completely new district of 30,000 houses and 7,000 m^2 of offices near the city of **Utrecht**, **The Netherlands**. These will be compact, durable buildings which incorporate energy efficiency measures far beyond the national regulations. These will consume only half of the energy currently consumed by traditional buildings, significantly reducing CO_2 and NOx emissions. The new build area will serve as an international model in the field of sustainable urban development.

During the project there will be extensive exchange of the know-how which already exists within the four development teams. An Advisory Task Force will also be developed to review the details of each project and identify local problems. Solutions to these and implementation plans will then be proposed by the Task Force. A common strategy for innovative sustainable development solutions will also be developed. Common solutions will incorporate specific approaches to: urban energy planning, integration of renewables into the energy supply structure, efficient energy management, upgraded energy standards and cost reduction and optimised materials for building construction.

TRANSPORT TARGETED PROJECT – CENTAUR
Clean and Efficient New Transport Approach for Urban Rationalisation

Local authorities and transport operators from ten cities in eight European countries are involved in the CENTAUR project. The main driving force behind this project are the energy and pollution savings which can be achieved through the rational management of urban transport. The current project builds on the earlier ANTARES project.
If resource use for transport is to be optimised, then it is necessary for cities to promote the use of public transport and improve private car management. This requires that public transport is upgraded at both the vehicle service and planning level. Institutional collaboration is also required between transport operators, traffic authorities, parking and other service operators to ensure appropriate mobility management. In most cases this requires the introduction of innovative technologies and systems and the provision of new public transport systems.
CENTAUR's aim is to encourage the shift from private car use to public transport by introducing the use of more energy efficient vehicles and clean fuel technologies and optimising the use of the transport infrastructure. This is tackled at three levels; firstly, the implementation of technologies for more efficient vehicles and cleaner fuels, such as hybrid vehicles. Secondly, the implementation of the systems and equipment needed to serve the new mobility management approach, like multimodal traveller information systems and access control systems. Finally, through strategic studies, the planning of land-use and the provision of urban transport related infrastructures and awareness campaigns.
Each of the cities involved in CENTAUR have different objectives depending upon the prevalent land-use and mobility conditions. Barcelona provides a good example of the implementation of the CENTAUR project. The measures implemented in the city have included:

- Access control for car traffic, which has enhanced the environment in the historic centre and provided pedestrian priority.
- Integrated parking management systems, which have established car-parks as points of interchange where park and ride has been implemented.
- Improved public transport information at interchanges.
- A combined ticketing system which allows car drivers to take the train into the centre form interchange rail stations.

A variable message system for traffic control has been implemented: this consists of a real time control system that integrates camera detection, signals and variable message technology.
Secure cycle and motorcycle parking system and the possibility of introducing light-rail trams are also investigated in this project.

The cities involved in the CENTAUR project are:

Barcelona	Spain	Las Palmas	Gran Canaria
Leipzig	Germany	Bologna	Italy
Napoli	Italy	Bristol	UK
Dublin	Republic of Ireland	Graz	Austria

TRANSPORT TARGETED PROJECT – ZEUS
Zero and Low Emission Vehicles in Urban Society

ZEUS is a co-operative effort between eight European cities to create environmentally-viable and sustainable urban transport systems within Europe. Between them these cities have purchased and put into use over a thousand zero and low emission vehicles. A wide range of fuels and vehicle types, for both public and private transport, have been procured and introduced. In addition the project is studying the incentives and initiatives required to support the public use of more energy efficient transport.

The ZEUS project therefore demonstrates the opportunities to provide citizens with the option to use low energy, 'greener' transport, by running public transport systems on innovative fuels. It has also introduced advanced telematics for passenger information and generally improved public awareness of the links between transport, energy and the environment.

This project is helping to remove the market obstacles such as the high cost of current vehicles, the lack of infrastructure for fuel and maintenance and absence of incentives to boost market penetration, which are currently hindering the widespread development of zero and low emission vehicles.

The city of Palermo provides a good example of the ZEUS project. Here 25 buses, 10 taxis and 210 cars powered by compressed natural gas have been introduced alongside 10 electric freight vehicles and 100 electric cars. Some of the electricity required to power the vehicles is provided by photovoltaics. The city has also introduced the associated infrastructure for gas and electric fuelling. Four interchange parking centres have also been introduced where the general public can access electric cars using smart cards. A car sharing system has also been established, as has a system of access for low energy cars to the city centre.

The cities involved in the ZEUS project are:

Athens	Greece
Bremen	Germany
Copenhagen	Denmark
Helsinki	Finland
London/Coventry	UK
Luxembourg	Luxembourg
Palermo	Sicily
Stockholm	Sweden

TRANSPORT TARGETED PROJECT – SAGITTAIRE
Hybrid Electric Buses

The SAGITTAIRE project involves co-operation between the organisations responsible for operating public transport in nine towns in eight different European countries.

The project aims to demonstrate user acceptance of the first hybrid electric buses, which combine energy efficiency with low or zero emissions, in the urban public transport system of these towns. It also applies rationalisation and planning measures for motorised transport in order to achieve fossil fuel savings, improvements in air quality and noise reduction.

SAGITTAIRE aims to encourage passengers to move away from the use of the private car and towards public transport by installing an attractive service which can help to overcome the problems of congestion, energy overconsumption, pollutant emissions and noise, currently caused by the use of private transport in urban areas. To make public transport efficient, attractive and secure it has introduced intermodality, and efficient timetabling which ensures the frequency and speed of transport and reduces waiting times. The project will also demonstrates, on a large scale, that hybrid electric bus technology is viable under ordinary operating conditions and has positive effects on urban public transport in technical, economic, social, energy and environmental terms. Finally it is producing guidelines and formulating recommendations for a widescale market penetration of hybrid electric bus technology.

The cities involved in the SAGITTAIRE project are:

Stavanger	Norway
Brugge	Belgium
Luxembourg	Luxembourg
Sintra	Portugal
Alicante	Spain
Athens	Greece
Trento	Italy
Savona	Italy
Besançon	France

TRANSPORT TARGETED PROJECT – JUPITER-2
Joint Urban Project in Transport Energy Reduction

JUPITER-2 is a consortium of seven cities across the European Union. The project involves the demonstration of rational transport and energy policies. This follow-on project involves completely new schemes in order to develop further the concept of the energy efficient city.

The projects in the seven cities involved in the project are accompanied by a series of horizontal tasks focused on project evaluation and comparison. Each of these focuses on a single aspect of the overall JUPITER-2 programme, either vehicles and fuels, transport management and land-use or mobility planning, but are linked to provide an overall evaluation. Individual cities will be used as case studies to illustrate particular issues.

The vehicles and fuels task involves an overall appraisal of the various innovative vehicles and fuels. The appraisal focuses on such issues as emissions and energy consumption, but will also consider operational performance in order to assess the attractiveness of each vehicle to public and commercial operators. The transport management task involves the evaluation of measures such as information systems and infrastructure improvements, which complement the vehicle technologies implemented. This will enable guidelines summarising approaches to transport management to be produced. The land-use and mobility planning tasks explores the relationship between land-use planning and transport. This will consist of an assessment of transport implications of land-use measures looking at the various short-term measures implemented within JUPITER-2. Additional research into the experience of various cities with respect to this will enable the development of general guidelines.

The city of Gent provides an example of the type of demonstration projects introduced under JUPITER-2. The city has implemented technologies, strategies and measures which form the kernel for sustainable mobility in the city. Several innovative vehicle technologies have been introduced, including the introduction of energy reduction technologies into existing trams. Electric service vehicles have also been introduced to reduce pollution in the city. In addition new low floor buses with cleaner, diesel motors have been introduced to encourage the use of public transport. Measures are also being taken to improve accessibility to public transport within the city centre, through the provision of real-time information at major stops. Public transport vehicles will also be given priority at junctions. Finally, the inner city will be renovated to provide a car free pedestrian area.

The cities participating in the JUPITER-2 project are:

Merseyside	UK	Florence	Italy
Nantes	France	Aalborg	Denmark
Bilbao	Spain	Heidelberg	Germany
Gent	Belgium		

Riga, the capital of Latvia is a JUPITER-2 follower city which will benefit from the technical advances made in the project.

Highlights – Associated Measure Success Stories

Associated measures supported by THERMIE during 1995-1997 have focused on the dissemination of information on urban technologies to market actors within the sector. This has stimulated interest in these technologies and contributed to an increase in their market penetration. Activities have included organisation of exhibitions and conferences, training courses, workshops/seminars and the preparation of associated publications.

URBAN TECHNOLOGIES EUROPEAN FORUM TASK I Identification and Analysis of the State-of-the-Art in Urban Technologies. STR-0636-1995-ES

The objective of this project was the preparation of the necessary documentation for discussion at the Urban Technologies Forum. This documentation identified and described the growing number of urban technologies which have entered the market in recent years.

This comprehensive set of documents was prepared to provide background information for discussion at the Urban Technologies Forum. The information presented described the main energy related urban technologies, and gave details of the state-of-the-art in each of these. These documents also included more general information on the principal energy issues which affect the urban sector. Particular emphasis was given to those issues which have implications for the application of energy efficient technologies in buildings and for street lighting and transport. The urban technologies considered in the report all demonstrate the influence that energy consumption has over municipal services and urban inhabitants.

The main points from the technology analysis have been used to develop an integrated global strategy for each municipal sector.

Project Co-ordinator	ICAEN
Participants	ENERGIE-CITIES
	European Federation of Regional Energy and Environmental Agencies
	Fundacio Privada Institut Ildefons Cerdas

URBAN TECHNOLOGIES EUROPEAN FORUM TASK II
Organisation of the European Forum on Urban Technologies. STR-0637-1995-ES

The main objective of this project was to promote energy efficiency technologies and activities and develop a programme for the implementation at the urban and regional level. This was achieved through a conference Forum. This Forum has led to an improved knowledge and increased awareness of energy management as an important issue which should be integrated into urban policy within local authorities. This Forum has assisted in the wide dissemination of information on demonstrated urban technologies and their integration into the urban system to the relevant market actors.

The Forum was a multi-sectoral meeting of experts and representatives from different organisations involved in urban technologies and urban management/ development. The objective of the Forum was to analyse the state-of-the-art of energy efficient technologies for urban areas mainly in two sectors, the public sector and the service sector. The documentation prepared in the associated THERMIE project, STR-0636-1995-ES, was presented at the Forum and provided the main background information for discussion.

Several topics were identified at the Forum as of primary importance, the most important issue being the new economic, social and environmental sustainability challenges that urban area have to face. The Forum established that European city authorities feel that their cities need substantial changes in order to improve the quality of life of their inhabitants. The management of cities therefore requires a broad interaction of all urban actors, a common knowledge of all the facts, and a shared comprehension of the issues and mechanisms and calls for innovation.

Project Co-ordinator	ICAEN
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A VIEW TO THE FUTURE

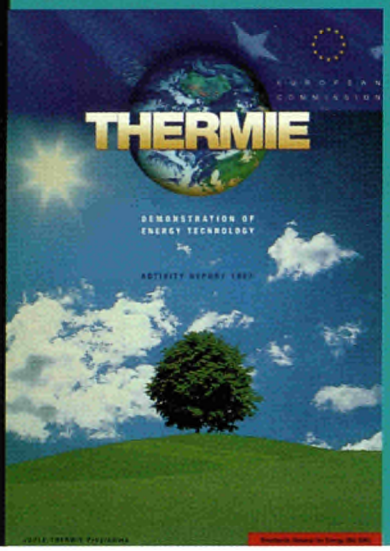
The development of towns and cities now requires extensive planning, to ensure the current and future well-being of this growing number of urban citizens. This should consider infrastructural development in a comprehensive, integrated way and from an environmentally-sustainable perspective. This is particularly important with respect to the built environment and the transportation system as these have a significant influence over resource use and pollution generation. Improving the efficiency with which this infrastructure operates will make a positive contribution to the urban environment, improving living and working conditions and raising the overall quality of life for urban citizens. Technological development and demonstration should not therefore be looked at as a goal in itself, but rather as providing tools to help shape the complex reality of the City of the Future.

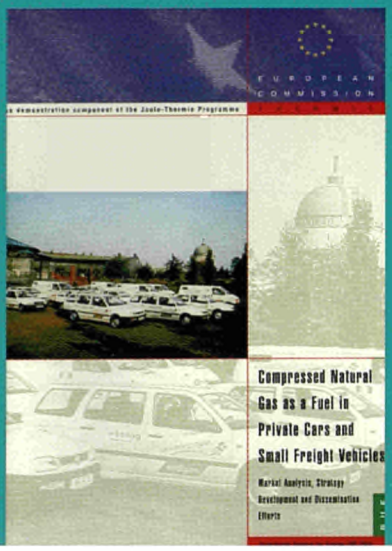
Buildings

Despite the fact that there is a single primary goal in this sector – to reduce energy consumption in buildings and thereby reduce the overall emission of environmentally-damaging pollutants – there is no single technology or approach which can even come close to achieving this. Local authorities emphasise the importance of urban planning to develop 'energy conscious settlements', architects focus on the potential of design concepts and builders stress the need for new materials and/or technologies. In fact, a contribution from each of these actors is required to achieve the most effective package of technologies and techniques.

If the quality of life for urban citizens is to be improved in the future then technologies which aim to increase the efficiency of energy use in buildings must now be developed and widely adopted. The following areas have been identified as priorities for the demonstration of suitable technologies/techniques:

- **Innovative or recyclable building materials which are energy efficient in their manufacture:** The use of these materials should be demonstrated considering their impact upon energy consumption and waste generation over the lifetime of buildings;
- **Construction processes integrating low energy features:** Construction processes should be improved to lower energy consumption. Best practice should be encouraged throughout the EU;
- **Large and small scale integrated solutions to satisfying heat and cooling requirements:** Integrated Urban Energy Systems, providing city scale energy distribution and management should be developed and demonstrated alongside individual buildings successfully integrating innovative energy technologies. Both of these offer a promising solution towards the rational use of energy in urban areas;





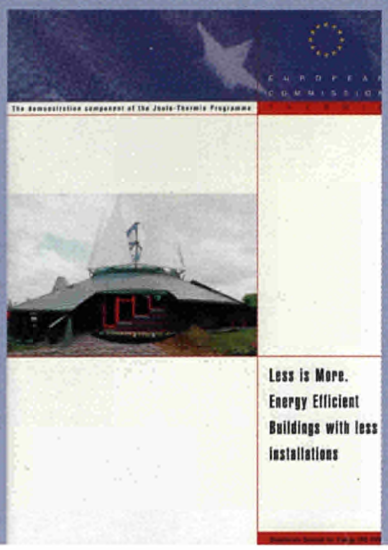
- **Economically competitive control and management solutions:** The wider adoption of energy management systems at both city and building scales is an appropriate way to improve the economic effectiveness of building management. These should take advantage of new information technologies to achieve minimum energy consumption, and to reduce pollution and waste;
- **Competitive low energy/high comfort standards providing high quality living and working environments:** The development and promotion of standards and rating systems at EU level is deemed highly important as a way of fostering the adoption of energy saving and environmentally-conscious technologies in the buildings sector.

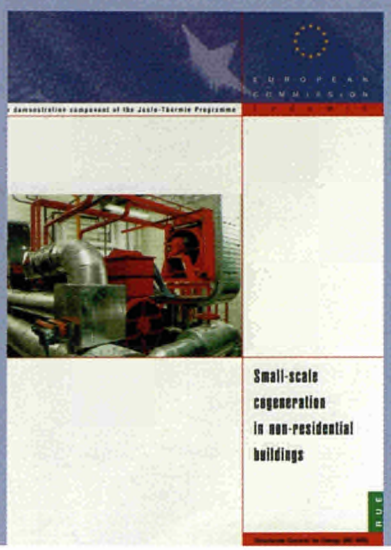
The box below illustrates the technologies which have the capability of reaching the above aims and should therefore be prioritised for demonstration.

Building Technology Demonstration Priorities

- Envelope and passive solar components, such as insulation materials, vacuum insulation, substitute foaming agents and the development of radiation and convection barriers.
- Glazing, including advanced glazing systems and transparent insulation.
- Ventilation, including heat recovery systems, efficient devices, dynamic insulation.
- Passive hybrid and low energy cooling techniques.
- Ventilation, including heat recovery systems and air flow control systems.
- Lighting, including General Service Halogen with IR coating, coated filament incandescent, radio frequency induced fluorescence and light transport systems.
- Daylighting, including new, more efficient glazing or glass coating, daylight distributing hardware (optical fibres, light pipes etc).
- Energy Management Systems and Controls, particularly with respect to improved ability to interface with common domestic appliances.
- Domestic Hot Water Systems.
- CHP and fuel cells.
- Thermal storage.
- Heat and cool generation.

Considering the current and potential future size of the construction technology market and the capacity of the construction sector to contribute to employment and economic growth within the EU economy, it is important that innovation and demonstration efforts continue. Only in this way can the EU industry remain competitive in the face of strong competition and grow in technology areas where it already dominates the global market.





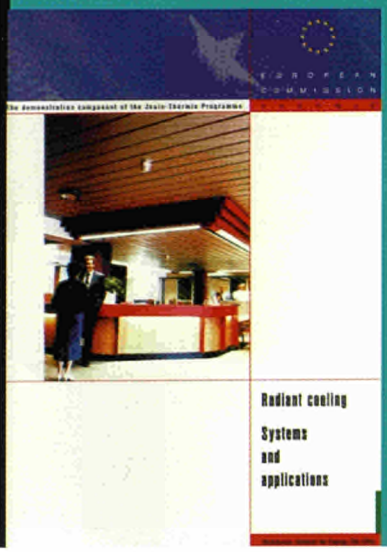
Once the technical potential of innovative energy saving technologies/techniques have been translated into real economic, social and environmental benefits, then the decision makers in the building sector will start to adopt them. Market demand will then reduce costs, further increasing sales. The full scale demonstration of these technologies is a pre-requisite to this process and the role of pre-competitive support should not therefore be underestimated. Targeted, focused public sector support for demonstration should therefore continue as the fragmented, conservative building industry cannot afford to support demonstration activities alone. Only in this way can the energy saving, environmental protection and economic growth benefits of the adoption of such technologies, with the associated improvement to the quality of urban life, be realised.

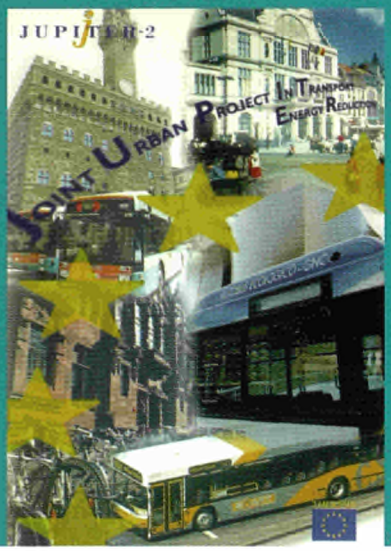
Transport

Transport is of primary importance to the European economy. It is in itself one of Europe's key economic sectors, and an efficient transport network is essential to the functioning of industry, commerce and civil society. Transport is, however, the fastest growing consumer of energy and particularly oil derived products. This is creating increasing problems with respect to its environmental impact, particularly climate change and the security of European energy supply. Given this, technological innovation towards the development of an energy efficient, sustainable transport system is imperative if the quality of life of European citizens is to be maintained and improved.

Efficiency improvements through technological developments in transport to date have been offset by factors such as increased vehicle size and power, reduced tonnage per mile for trucks, urban traffic congestion and increased road speeds. To further improve efficiency and thereby achieve a reduction in environmental impact, will require not only the development, demonstration and adoption of innovative vehicle technologies and alternative fuels, but also the establishment of road management systems and the promotion of alternative transport modes to displace road freight and the private car. The following technology areas have been identified as particularly appropriate for demonstration in the short to medium term:

- Alternative vehicles and fuels, natural gas, electric/hybrid fuel cell vehicles etc.
- Urban traffic control.
- Public transport priority.
- Information systems and telematics.





Alternative fuels, such as natural gas, methanol, hydrogen, fuel cells or electricity propulsion systems, should be a priority demonstration area in the future due to their positive contribution to both environment and security of supply. However, the cost of these technologies must be considerably reduced if they are to be adopted widescale. It is also necessary to demonstrate such vehicle fleets at the full scale to establish their reliability and operating costs under realistic conditions. The efficiency and performance characteristics of these technologies must be proven to be comparable with diesel engines, before these technologies will become mainstream. Alternative fuels offer particular benefits in urban public transport systems and may see widespread penetration here first.

Travel management initiatives should be a priority demonstration area in the future. Advanced Transport Telematics (ATT) offer significant potential here. Management systems for urban public transport are significantly developed, but require further demonstration if they are to be widely adopted. The extended use of transport pricing, should also be promoted, using economic incentives and regulations to stimulate citizens to use transport more rationally, and use alternatives to the private car where possible. Associated technologies, such as those which link road pricing schemes to energy use, emissions reductions and congestion, must be developed and demonstrated in order to ensure fair and efficient charging. Several such technologies, such as automatic vehicle identification and control are already developed but can only be adopted widescale once their suitability has been fully demonstrated.

More efficient and cleaner transport modes and technologies are currently being developed in Europe. Potential still exists for improvements in internal combustion engines that can reduce fuel consumption by up to 15% in the diesel cycle and improve transmission efficiency by 10-20%. The development and demonstration of these technologies therefore needs to be a priority for the future.

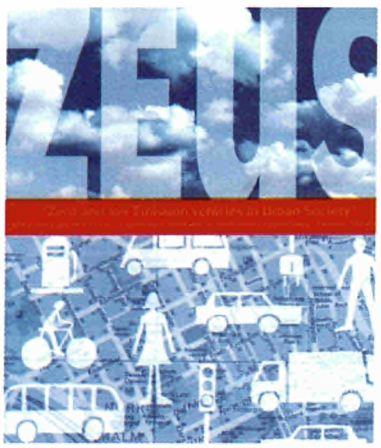
European industry must continue to innovate and build on its current strength in transport technologies if it is to maintain and increase its market share in the face of strong competition from the USA and Japan in this global market. The transport technology market is huge, but highly competitive and the rapid demonstration and commercialisation of innovative technologies is vital if European industry is to win a significant market share. This has significant implications for the economic development of the EU in terms of industrial and economic growth and the number of jobs retained or generated in this sector. Pre-competitive support is therefore vital in ensuring that technologies enter the market rapidly, ensuring maximum benefit for European industry.

All innovative technologies must be effectively demonstrated at the full scale to prove that they are cost-effective and comparable in convenience and performance to conventional transport technologies, before they penetrate the market. If real progress is to be made in improving Europe's urban transport systems, then

extensive co-operation is required between vehicle manufacturers, research centres and public authorities to ensure the development, successful demonstration and subsequent adoption of innovative technologies. Only then can a real improvement be made to the quality of life of Europe's urban citizens. The ultimate adoption of clean, efficient transport technologies which optimise energy use, reduce pollution and provide a reliable, appropriate transport system to allow urban dwellers the mobility they require to conduct their everyday lives, should be the ultimate aim of any future technological demonstration.

If Europe's vision of the City of the Future, where all urban citizens enjoy a good urban environment and a high quality of life, is to be achieved, then the adoption of state-of-the-art, urban technologies, which significantly reduce the emission of harmful pollutants and increase the security of Europe's energy supply in the long term, is essential. Their uptake will also assist in the establishment of a strong European manufacturing industry, which is able to trade effectively within the EU and export world-wide.

Before such technologies can successfully penetrate the market they require extensive full scale demonstration in real situations. This must take place rapidly if technologies are to be launched onto the global market ahead of international competition, providing a competitive advantage to European industry. Demonstration is a costly and risky exercise for manufacturers and many, particularly SMEs, are unable to finance such projects alone. THERMIE, through its provision of public sector finance for the demonstration of technologies, has added significant momentum to the product development process allowing these technologies to be brought to the market quickly. This has allowed the many benefits of these technologies to be rapidly realised, improving the quality of the urban environment now. Pre-competitive support must continue if the Cities of the Future are, as is Europe's aim, to provide a pleasant environment in which to live and work.



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