

Chapter 2

THE RESOURCEFUL CITY AND THE ENERGY CRITERION

This chapter focuses on key elements of the urban environment and principles and actions inaugurating new models and patterns. The world momentum of local agendas 21, charters and declarations brought to the forefront eco-principles and eco-actions for the improvement of the urban metabolism. Resource and waste management, transport of citizens and goods, quality of air and global warming are of extreme importance to cities that become laboratories of ecological innovation and provide inspiring examples. Energy is the common denominator of most actions.

1. THE ECOLOGICAL CITY

Cities are open, complex and dynamic human ecosystems, which require a remarkable array of material and labour inputs and produce an equally remarkable array of outputs and outcomes. They have most complex metabolisms and mobilise tremendous flows of people, resources, energy, products, waste and emissions. The sustainability journey demands from cities the improvement of their performance and, especially in developed countries, the disassociation of the economic activity from resource use and pollutant release. The design of urban policies should be preceded by material and energy flow analyses and followed by continuous impact monitoring.

Cities are the main contributors to and victims of planetary and local environmental problems. At each stage of urbanisation, environmental conditions in cities were improved dramatically. The supply of clean water, the removal of waste and the rise of standards of comfort and cleanliness needed radical innovations, which have long become common practice. Cities confront now a range of problems, like urban sprawl, high car dependency, the loss of green spaces, the development of brownfields, growth of distressed urban areas, and lack of dynamism in city centres that are not addressed by conventional policies. The result is the accumulation of problems and the search of new strategies reinforcing the capacity of cities to offer the quality of life expected by their citizens.

A sustainable city respects the geophysical and cultural local limits, mobilises invisible economic and social structures and seeks synergy and symbiosis with the bioregion. Sustainability demands moves towards life-cycle approaches and strategic long-term efforts to tackle the underlying causes of environmental damage. Urban environmental planning for sustainability requires a comprehensive interdisciplinary assessment of urban assets, a natural resource information system and an identification and analysis of the policy distortions and bottlenecks. All approaches to the environment, as one of the three pillars of sustainability, have to be adapted in the urban context. Prevention should be considered an investment and not expenditure.

The precautionary principle is subject to much debate and sometimes contradictory views. In the USA, the approach is more focused on significant risks and regulation is based on scientific evaluation. An EC Communication issued in 2000 suggests a structured decision-making process to ensure the correct balance between the freedom of individual organisations and the need to protect the environment and public health. The approach aims at building a common basis for assessing, managing and communicating risks that science is not yet able to determine with sufficient certainty. The acceptable level of risk is an eminent political responsibility. Respecting the principle should lead to transparent, coherent, proportionate and non-discriminatory actions and at the same time avoid unwarranted recourse to the principle as a disguised form of protectionism.

Environmental deterioration is due to the incapacity of public policy and the market to properly manage environmental resources. The passage from the “Command and Control” regulatory approaches to the polluter pays, complemented by the user pays principle has been a significant step in Europe. The absence of markets for air or water is linked to the absence of property fees for these goods. The lack of a price of access is at the origin of their unlimited use. Economic instruments act like substitutes of markets that are costly and difficult to organise. The advantage of economic instruments is that they can be applied using the fiscal infrastructure of a city. Their success depends on the meta-policy and the institutional context.

Economic instruments impact on the energy and innovation which markets can unleash and may induce polluters to choose the most efficient and effective pattern of abatement in response to the price signal they receive. They promise reduced bureaucracy, incentives to improve over time, better environmental performance and generation of funds to finance sustainability policy measures. Subsidy reform, especially for energy, can have significant economic and environmental benefits. The use of charges and taxes has to reflect scarcity value as a powerful tool for sending signals to producers and consumers. Taxation is, however, always unpopular and revenue-neutral tax reform including tax shifts (e.g. from labour towards natural capital) constitutes a key way to ease green taxes.

Other economic instruments include the assignment of property rights, liability systems and performance bonds, pending satisfactory environment performance, and transferable development rights, when the landowners in sending areas are given development units, to be exercised exclusively in the receiving zone. All economic instruments should be integral parts of efficient, effective and equitable policy portfolios. Information and awareness are organic part of these portfolios. The UNECE convention on Access to Information, Public Participation in Decision making and access to justice in environmental matters (Aarhus 1998) has marked an important step forward.

Industrialised cities and regions consume too many valuable resources and produce too much waste and emissions. They have enormous ecological footprints, estimated after the evaluation and aggregation of the biophysical capacity of land needed to produce the necessary resources and to absorb the territorial waste. The ecological

debt of the industrialised countries gets accumulated. Over the thirty last years, the global ecological footprint increased by 70% (while the population increased by 65%).

In 1961, the global community needed half of the biological capacity of Earth. Forty years later, humanity needs 1.2 planets to survive! The average surface needed by world citizen today amounts to 20.2 hectares. It ranges from 0.3 hectares in Afghanistan to 9.5 hectare in the USA (wwf 2004).

London's ecological footprint is estimated to occupy an area one hundred and twenty five times greater than administrative London, even if assessment is limited to the consumption of food and forest products and the capacity to generate emissions of carbon dioxide. Its life has to be supported by an area equivalent to 94% of Britain's productive land area. The ecological footprint of the Netherlands is evaluated to equal 14-15 times its national territory (Girardet 1992).

Some years ago, the European Environment Agency had estimated that a European city of one million inhabitants consumes every day, on average, 11,500 tonnes of fossil fuels, 320,000 tonnes of water and 2,000 tonnes of food (EEA 1995a). Stabilising consumption is a major issue today and an important objective, close to the heart of the Charter of European Sustainable Cities and Towns, which recognises that decreasing consumption levels may be an over-ambitious aim impossible to achieve.

Consuming better goods instead of more goods could be a devise for sustainable consumption. Improved technology and increased efficiency have contributed to lowering the levels of pollution, but increased consumer demand has often more than offset these benefits. The citizens of the industrialised countries represent 20% of the world population but consume 80% of resources and contribute to an ecological footprint six times heavier than the developing world citizens. If the latter were to increase their consumption by 50%, the former would have to decrease its consumption by 15%, which would imply a drastic change of habits in the industrialised countries.

Agenda 21 identified unsustainable patterns of production and consumption, particularly in industrialised countries, as a major cause of environmental deterioration. The Johannesburg Plan set out a range of

actions that countries should take to influence consumption patterns. Policies to influence production patterns, like cleaner production and eco-efficiency, are in general, better developed and understood than demand-side policies, where progress depends on all consumers and citizens.

Actions to influence consumption patterns include regulation, economic instruments, social instruments and other government and NGO actions. Regulation measures range from the insulation of new buildings to the mandatory installation of water-saving systems. Economic instruments try to ensure that the price of household energy, road fuels, water and waste, fully reflects the associated environmental and social externalities. They range from differential taxes to encourage the use of environment friendly fuels to taxes on municipal water supplies and eco-taxes for waste. Social instruments comprise a series of means to raise consumers' awareness about the adoption of more sustainable lifestyles. They range from cartoons, comic strips and Internet services to junior eco-clubs, touring exhibitions and eco-labelling, like the flower, white swans or blue angels.

The flower is the symbol of the European Eco-label, part of a broader strategy aimed at promoting sustainable consumption and production. It is a voluntary scheme designed to encourage businesses to market products and services that are more environment and consumer friendly. A flower offers a sign which is easy to identify for public and private purchasers. It has the ambition to serve as a guide to greener products and services and can be found throughout the European Union and the countries of the European Economic Area / European Free Trade Association (Iceland, Liechtenstein, and Norway).

Green public and private procurement is of key importance for creating new market niches and improving production and consumption patterns. The European LEAP project brings together eleven local authorities to prepare and test a strategy on joint procurement of green products. The EcoProcura conferences, held every two years, bring together purchasers, suppliers, decision-makers and regulators to share the latest developments in the field of eco-procurement. The Dutch 3P (people, planet, profit) approach is exemplary (EC 2004e).

Environmental and consumer organisations are often the source of innovative action to improve consumption patterns. The Global Action Plan (GAP) is based on the principle that individual action can make a

difference and that people should be provided proper support structures. It addresses especially those who are willing to do something about the environment, but are not quite sure about what to do. GAP collaborates with households and communities on action concerning natural resource use, water quality, CO₂ emissions and waste production and disposal. Teams of four to five households meet regularly for six to eight months on a specific theme: household energy use, household waste management, water consumption, transport and shopping. The participation of children is highly welcome. Action already taken is being evaluated and next steps are being determined. Results in the UK, where the Plan is supported by companies such as British Gas and Groundwork Trusts, highlight an annual reduction of waste by 35%, CO₂ emissions by 9%, petrol consumption by 10% and water use by 13% (EFILWC 1996a).

Many European cities are in search of ecological models. The medium-sized cities of the metropolitan district of the central UK experienced both the decline of their textile and engineering base, and industrial air and water pollution and traffic exhaust emissions. Kirklees was the first local authority in the UK to produce a "State of the Environment report". The local commitment to environmental matters led to a happy partnership with the Friends of the Earth looking for a pilot authority to take on board their environmental Charter for Local Government. The "Friends of the Earth Charter for Local Government" set out key recommendations for action. They include provisions on making environmental requirements part of purchasing and procurement policy, encouraging and enabling public participation, implementing environmental criteria in grant-aid conditions and contract and tender specifications and greening land use and development plans.

Since the 1970s and especially after the Rio Summit, cities are striving to gain environmental credentials and urban ecology offers them new visions. Awareness of environmental quality is increasingly regarded as a new civic value and more and more cities strive to adopt proactive policies leading to the conception of new systems of production and consumption. New environment friendly lifestyles cannot be imposed from governments. They are developed through innovative partnerships rooted in the local culture. "Green City" does not simply mean green spaces, grass roofs, timber frame constructions, improved energy systems and water cycles. A cultural reform is needed to give meaning to all technical achievements. A wide urban consensus is a necessary precondition.

From Lahti, Finland, to Lavrion, Greece, European cities were among the first to adopt local plans 21, many of them providing international models of excellence. All Swedish local authorities had adopted local agendas and plans 21 by the targeted deadline in Rio (1996). The plans include comprehensive actions on resource and waste management, transport, consumption patterns and environmental education. They are essential for cities trying to create an eco-culture and conceive, introduce and manage new systems of supply and demand, founded on active citizen participation. Stockholm (Figure 13) developed a comprehensive eco-cycle balancing strategy, in which waste from some activities become precious input to other productive activities. A new culture of co-operation has been introduced among the energy organisations, the water company and the waste management agency (Beatley 2000).



Figure 13. A Representation of Stockholm. Source: The author's exhibition of Artworks on Siren cities, European Parliament 2004

Environmental charters have been prepared by many European cities in the 1990s. In France, environmental charters constitute contracts between the State and each city. The Charter of Mulhouse is a clear example of the strong will to improve the environment and public health. In Italy, the University of Naples prepared a Charter for the sustainable development of Naples and through a large consultation process with citizens associations. The Local Environmental Charter has been shaped through well attended seminars which challenged ecological urban practices in Naples and examined new opportunities stemming from sustainable development (Gillo et al. 1997).

Integrating ecological concern in all urban policies has been a key condition for the concept of the "Ecological city" in the framework of the eponymous OECD project (OECD 1996). The process could be described as an essential bridge between the macro-level concept of sustainable development and the micro-level of everyday local performance. In The Netherlands, the vision for the city of the future is centered on the interrelated concepts of the liveable city, the well-ordered city, the affordable city and the sustainable city.

The Tokyo government promotes the creation of an eco-society in order to advance towards a clean, sound and citizen-friendly metropolis. The action plan includes comprehensive actions on resource management, water recycling, energy, transportation demand management and promotion of environmental education and awareness (UN/Tokyo Metropolitan Government 1998).

In Germany, environmental awareness has often been linked to socio-economic change, first and foremost in the cities which have been the scene of socio-political transformation. With the reunification, the ecological restructuring concept came into prominence. It advocates a new sustainable symbiosis between economy and ecology in the urban landscape and places the emphasis on environmental preventive policies to tackle the anthropological origins of problems. A European model project linking ecological urban restructuring with Local Agenda 21 was implemented in Leipzig (Hahn 1997). The concept has many points in common with the research programme on "Man and the Biosphere" of UNESCO, the first international organisation to use the term "sustainable city" (UNESCO 1988).

Urban ecology has been an important element for the “renaissance” of Berlin, after the fall of the wall during a night of celebration on 9 November 1989. Some projects from the years of euphoria that followed reunification provide convincing examples. In Kreuzberg, the renovation of Block 103 highlighted links between social well being and environmental upgrading. Former squatters of the block have been given the opportunity to own the space they occupied, if successfully trained in converting the houses into environment-friendly and resource-saving buildings. Another complex, Block 6, has been the field of innovation for alternative water systems. The project provided tenants with the possibility to monitor their hydraulic resources and take good care of their rain and grey waters. The process emphasised communication and learning and resulted in fifty per cent savings on water. Eco-stations have been created in many neighbourhoods to promote awareness raising, training and counselling.

Many cities become ecological laboratories and experiment with new concepts, products and processes. Schwabach, a small self-sufficient German city, offers an example for the elaboration of an urban ecology planning strategy. The city has been selected by the Federal Ministry because of its unified, dynamic local government and its ecological achievements to date, especially in waste management. The driving principle is that nothing is impossible and everybody has to participate. The pilot study aimed at introducing ecological concepts and actions to a normal city, under ordinary conditions. They have been translated into a concrete 1993-2003 Model Urban Development Strategy, leading to Schwabach Ecological City (Schmidt-Eichstaedt 1993).

Tourists constitute a special population target for sustainability. Many hotel chains worldwide associate residents in the prevention of water consumption. Special ecological and waste programmes in Mediterranean tourist destinations try to promote sustainability concepts and actions. In the over constructed tourist destination of Marbella, ecological actions comprise reforestation, the paint your tree campaign, and even a programme for the environmental awareness of dogs.

Ecological innovations and best practices come not only from the environment conscious cities but also stem from crises. In Huelva, one of the most polluted Spanish cities, an area of 400 hectares previously used as a deposit site for industrial waste, has been thoroughly rehabilitated.

Community protests and the subsequent social dialogue in search of viable alternatives have been decisive to the success of the project.

In old industrial cities, many environmental problems are linked to the decline of industrial industries. In cities of the former East Germany, like Dessau, ecology was an organic part of the radical upheaval during the 1990s. Eighty-four per cent of the city was destroyed during the Second World War and reconstruction often made things even worse. The collapsed old industry had to innovate in order to survive and develop. A new land-use plan is favouring mixed uses and promoting civic participation. But in 2004, unemployment in former East Germany is still ten points higher than in West Germany (18.5% versus 8.3%) and this has serious consequences for the advance of ecological projects.

The energy balance of cities depends on the urban and energy policy and planning, the urban infrastructures, transport patterns and citizen lifestyles. City structures and policies can contribute immensely towards minimising the material and energy intensity of goods and services, reducing toxic dispersion, enhancing material reuse and maximising the use of renewable resources. Sustainable urban policies should be carried out with respect to the carrying capacity and the equilibrium of the urban and sub-urban ecosystems and with regard to the availability and the distribution of resources. Energy flow analyses and impact monitoring are crucial.

Sustainable development asks for circular rather than linear urban metabolisms and improved energy stocks and flows throughout cities. More efficient and environment-friendly energy systems, gradually integrating new and renewable energy forms, become features of the European urban landscapes. Cities try to improve technologies and demand patterns, optimise production and distribution networks, including decentralised combined heat and power systems, and enhance synergies of excellence. Renewable energy forms become increasingly attractive. The EU-supported SIREN project tries to address barriers to the integration of renewable energy systems at the municipal level and raise awareness of the socio-economic benefits among stakeholders.

Leicester, the first city to be awarded the status of "Environment City" in the UK, offers a plethora of ideas. The city has been assisted by the Business Sector Network to bring together ideas from the city's commercial sector and provide assistance to businesses, and Environ, a

non-profit-making company, helping local organisations with environmental audits and advice. The energy efficiency centre promotes action for improving the efficiency standards for buildings and schools, introduces an energy education package for teachers and invites students to contribute to the energy monitoring of their schools. The energy efficiency bus, equipped with solar panels and connected to the Internet, visits schools and enterprises to promote consciousness about renewable energy. Energy passes to optimise the energy conditions of houses is a common measure in the German Länder (Energie-Cités 2001).

In Germany, Freiburg is a pioneer city in the use of renewable energies and bio-climatic architecture, enhancing physical and climatic factors for optimal design and planning. The political and public support created favourable conditions for the city to be the centre of two national and international renewable energy research Institutes, the *Oko-Institute* and the *Fraunhofer Institute*. Developments, such as the *Heliotrope* constructed in 1985, exhibit the advantages of optimised passive solar compact buildings. The tariff structure of the Freiburg utilities offers more favourable rates for photovoltaic energy users. The virtuous circle of technical demonstration, awareness raising and participation is established, thanks to the commitment of the city and its citizens.

The Kronsberg development in Hanover uses some of the latest energy technologies, while the city of Malmö invests in energy innovation. Barcelona confers a prime example in promoting energy efficiency in buildings. The Municipal Action Plan included the replacement of incandescent lighting by low-energy lighting, improvement of air-conditioning devices, installation of solar heat collectors in educational buildings, office premises and sport complexes and of photovoltaic panels in university and office buildings. A range of improvements was introduced to save energy in municipal buildings. These activities have brought savings of 1,700,000 kWh per year, translating into 243,500 € per year.

Renewable energy options become increasingly popular among cities and citizens. Barcelona has given an exemplary boost to the promotion of thermal solar energy. The *BARNAMIL* project, conceived by the Barcelona City Council has involved many local organisations and groups, together with the local energy agency *BARNAGEL* and the Catalan business association *APERCA*. The adoption of the *Thermal Solar Municipal Ordinance*, which encourages the installation of solar

heat collectors in buildings, marked an important step forward. The ordinance defined the rules and conditions for the installation of solar collectors in all new and renovated public and private buildings.

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The city of Mataro, North of Barcelona, took advantage of the construction of a new library to experiment with photovoltaics and to create a prototype building to demonstrate that the use of solar energy is not only feasible but also profitable. A computerised monitoring system enables the photovoltaic installation to operate at 62% efficiency. The project has been well received by citizens and the city promotes it, through the dissemination of leaflets and brochures explaining the advantages of solar energy (Energie-Cités 2001).

Symbolic events hold much potential for introducing innovations and influencing everyday decisions. The 2004 edition of “Green Week”, celebrated by some one hundred and sixty cities and towns in the 25 EU countries in June 2004, under the banner of “Urban Green Days” offered a greenhouse of ideas and actions. The event focused on four essential themes: green travel, green homes, green neighbourhoods and green reporting. Participating cities often went beyond the state of the art.

Modena presented the co-action of two companies introducing a free bus service for the commuting of their staff, which constitutes a novel car-pooling experience. In Orléans, a 300m² replica house demonstrated the impact of lifestyle choices. The living room focused on energy consumption, the kitchen on fair trade, labelling and recycling, the bathroom on the water cycle and cleaning chemical products and the office on the use of paper and electronic appliances. At the level of the neighbourhood, London’s Lewisham Borough opened a new park on previously industrial wasteland named Ferranti park after the designer of the world’s first large-scale power scale in 1890, built in the area. On green reporting, London used the Urban Green Days to launch a new website www.london-green-map.org, mapping community-based environmental events across the city.

2. ECOEFFICIENCY, ECODESIGN, ECOAUDITING

Improving eco-efficiency (economic and ecological) is a promising path for visionary and committed cities, governments, industry and citizens willing to advance towards sustainable development. The

Business Council for Sustainable Development (later WBCSD) adopted eco-efficiency as a business concept in 1992, in its report to the Rio Summit. Eco-efficiency demands more and better with less impact on the environment. It is achieved by the delivery of competitively priced goods and services that satisfy quality of life, while progressively reducing resource intensity and ecological impact throughout the life cycle. Energy intensity, material minimisation, service intensity of goods, minimisation of the toxic dispersion, enhancement of the life cycle and maximisation of the use of renewable resources are key criteria for eco-efficiency (Fussler 1996; WBCSD 1997).

Traditionally, the noblest aim for businesses and cities was to provide good products and services and meet the needs of citizens with worthy returns to shareholders and satisfying working and living environments. With advancing globalisation, growing importance of corporate governance, emergence of ethical consumers and rising of green and pressure groups, industry has to satisfy an increasing number of stakeholders, including all those potentially impacted by products and services. Legislation and enforcement are quoted as powerful drivers of corporate environmental performance, together with business values, corporate image and reputation, agreements between government, trade associations, cost of waste disposal, customer and citizen participation (WBCSD 1999).

Studies have revealed important improvements in eco-efficiency over the last years. However, the increasing demand for resources outweighs the eco-efficiency gains. Improving eco-efficiency throughout the economy demands actions such as the adoption of eco-efficiency input and output indicators at national level and the promotion of eco-efficiency economy-wide. Strategies for social innovation include efforts for sounder household and mobility consumption patterns, eco-education, information and communication. Adoption of best practices can improve environmental performance and increase benefits or reduce costs.

Sustainable eco-consumption is the main driving force for eco-developments. Eco-innovation can be supported by various instruments. New types of voluntary agreements and approaches, such as extended producer responsibility, disclosure requirements and environmental management systems, encourage changes in resource inputs and the complete remodelling of products and processes. Eco-design, design for the environment and the economy, takes into account environmental

considerations into product and process engineering and marketing procedures. Eco-companies and enlightened businesses aim at reducing the impact of processes and products throughout their life cycles.

It is estimated that 80% of all product-related environmental impacts are determined during the product design phase. An EU framework directive on eco-design requirements for energy-using products, issued in 2003, promotes the integration of environmental considerations as early as possible into the product development process. The directive is a fine demonstration of the integration of life-cycle thinking in European decision-making. The reduction of the energy consumption of products benefits the economy, the environment and the society. A number of studies have demonstrated that regulation is a motor for eco-design.

Values relating to fair trade gain ground. Green, ethical and vigilant consumers call for cities and companies to design and prove their contribution to sustainable development. Citizen associations and the media tend to create a climate of trust, surrounding sustainable cities and businesses. Companies and municipalities without a declared commitment to sustainable development may face consumer boycotts, attacks on fixed assets, failure to attract good stakeholders, residents and employees, expenses to remedy past mistakes, restrictions on operations and obstacles in raising finance and insurance. Pro-action is a must, since damaged reputation, impaired licenses, disillusioned shareholders and disappointed citizens may impose a disproportionate a-posteriori cost. The ERICA sea accident in 1999 and the way that TotalFinaElf tried to restore trust provide a prime example.

A growing number of cities and companies are preparing for zero emissions. Pioneer businesses adopted the concept of sustainable development as a central corporate value and try to integrate socio-environmental objectives in the overall business principles. Business groups encourage their member companies to align corporate and societal values and simultaneously consider both shareholder and societal added value. Declarations and codes of ethics introduced a new era of corporate social responsibility. At the international inter-governmental forefront, Agenda 21, seen as the highest value reference for sustainable development, included guidelines for local authorities and businesses (Mega 2000a).

Like urban declarations, corporate codes of conduct gain momentum. Their effectiveness is however hard to evaluate. Assessment and public reporting is a necessary complementary component of the whole process. The voluntary non-binding nature of most codes is often related to the absence of any form of independent auditing, even if codes spell out the necessity for monitoring, assessment and reporting. Businesses adopt a broad range of approaches, from non-reporting to social reporting (SustainAbility/UNEP 1998, 1999). The EU Strategy on Sustainable Development invited all publicly-quoted companies with at least five hundred staff to publish a triple bottom-line report and present their performance against economic, social and economic criteria.

The principles suggested by CERES, a leading US coalition of environmental investor and advocacy groups, seem to be the highest watermark in terms of commitment to monitoring and publicly reporting on progress. Endorsers commit to annually complete a report, to assess opportunities and weaknesses. Such reports help stakeholders and investors to get more fully involved in the process of corporate goal setting and evaluate adherence to the principles. The global reporting initiative, launched in 1997, proposed a harmonized public disclosure to deliver a steady flow of consistent, comparable and verifiable information (CERES 1998a, b, 2002).

Local clusters of excellence are essential in promoting shared responsibility and new approaches. They often forge strong links between research and production. In Ireland, the Clean Technology Centre, established in 1991 as a partnership venture among the Cork Regional Technical College and ten leading companies in the chemical and pharmaceutical industry, is regarded as a pole of eco-innovation in one of the most contentious environmental management areas. Environmental pressures impacting on industry include licensing, regulations and voluntary initiatives. The Clean Technology Centre aims at promoting waste minimization techniques, clean technologies and cleaner production. The project bridges the concern for the environment and the need to produce well-equipped graduates for industry. Industry improved access to information and skills and the community established confidence in environmental management in the region.

Eco-auditing constitutes a valuable instrument on the road towards sustainability. Eco-auditing schemes have first been adopted by private sector organizations as management tools in order to assess,

report on and improve environmental performance. Their backbone is a systematic environmental monitoring considering all aspects of an organization's activities and services, products and processes. Environmental auditing in the public sector and especially among local authorities is a rapidly expanding instrument for challenging urban performances. The field is still in a state of flux and it is difficult to provide a well-defined paradigm out of hybrid methodologies. A good example is provided by the EU Eco-Management and Audit Scheme (EMAS).

The EMAS aims at recognizing and rewarding organizations that go beyond minimum legal compliance and continuously improve their performance. It is an instrument available to companies since 1995. Originally restricted to industrial sectors, it has been open to all economic sectors since 2001. Participation is voluntary and open to all public and private organizations operating in the EU and the EEA. To receive EMAS registration and signal it to the outside world with an attractive logo, an organization must conduct a thorough environmental review and consequently establish an effective environmental management system, with requirements equivalent to international standards ISO 14001. The organisation has to carry out an environmental audit, assess the system in place and provide a statement of its environmental performance. All above four stages have to be approved by an accredited EMAS verifier. External, independent third party verification plays a key role for the credibility, reliability and transparency of the scheme. Integration of energy efficiency in EMAS led to the E2MAS scheme.

Transparency, credibility, accountability are the three key components of auditing schemes. Cities and enterprises often adopt parallel paths when conducting their environmental auditing. It is essential to have the rigour associated with financial auditing in the process. Diagnosis should be followed by prognosis of trends and adequate design of policies. The environmental balance sheet of Sundsvall, in Sweden, including the accounts of stocks and flows of environmental resources, can provide a model. In the periphery of Barcelona, Igualada undertakes the auditing of all urban activities, while in the UK, the richness of the components of environmental auditing in Kirklees offers a horizon of lessons. From the internal auditing of the municipality to the external auditing of the community, urban eco-auditing practices can inspire many cities (EFILWC 1995a).

3. ENERGY AND THE BUILT ENVIRONMENT

Environmental concerns are increasingly embraced by the EU citizens. They are often linked to damage caused by energy supply systems, e.g. oil slicks, nuclear accidents and methane leaks, but also to the inherent inefficiencies of the combustion systems. Climate change, a long-term battle for the world community is inextricably related to energy. The European Union has 5% of the world population but produces 14% of the global emissions. Improving energy efficiency across sectors and throughout activities is a key factor for meeting the challenges towards sustainable energy.

The Action Plan to improve energy efficiency in the European Community estimates a potential for energy efficiency improvement of more than 18% of present energy consumption. It is equivalent to over 160 Mtoe or 1,900 TWh, and it is not yet realized partly due to impediments which prevent the adequate diffusion of energy-efficient technologies and the resourceful use of energy. The Action Plan includes policies and instruments for overcoming obstacles and enhancing opportunities (EC 2000d).

Buildings account for 45% of total energy consumption in the EU, mainly for heating, lighting, appliances and equipment. Increasing living space per capita and higher levels of comfort and equipment for homes and offices lead to rising energy consumption. The impact of energy use in buildings is pervasive, since it is estimated that Europeans spend 90% of their time indoors. Studies demonstrate that there is a large potential for cost-effective energy savings in this field, probably larger than in any other sector. Buildings in Europe have lifetimes of between fifty and one hundred years or more. Given the low turnover of buildings, the largest potential for improving energy performance, in the short-term, is in the existing building stock.

New ethics are increasingly reflected in new building regulations. An EU Directive, issued in 2002, on the energy performance of buildings, suggested a common framework of harmonized measures for the development of integrated energy performance standards, to be applied to new and existing buildings when renovated. Energy performance

standards should lead to certification schemes for buildings, which would be presented to the public. Especially for public buildings, standards would recommend the optimal climatic conditions for energy efficiency. Last but not least, the directive highlights the importance of the inspection of boilers and other heating and cooling systems for energy efficiency. A total energy saving of 22% could be achieved by 2010 with these measures.

The proposed common approach to energy performance standards covers efficiency aspects ranging from clean and efficient energy generation to insulation and installed equipment. An integrated method addressing all energy aspects would facilitate the most effective and efficient combination of measures. To some extent, this method has already been applied in Finland, Germany, Ireland, the Netherlands and the United Kingdom. Expanding this approach for the EU would not only increase energy savings, but also provide a basis for designers and builders to be able to recognize and utilize high standards across different member States.

The certification schemes founded on the above methodology would be applied to buildings and dwellings when they are built, sold or rented. They should not be over five years old, and should include guidance on how to increase energy efficiency. The specific inclusion with the rental of buildings could counteract any negative aspects of the different interests of the building owner and tenant. As owners are not responsible for the energy bills, they are often less motivated to improve the energy efficiency of the buildings and are unlikely to invest in energy saving features such as insulation. However, if tenants are authorized and exhorted to view the energy efficiency standards when choosing a property to rent, there are incentives for owners to invest in improvements.

Certification schemes are currently mandatory in new buildings in Denmark, Germany and the United Kingdom. Some member States operate a voluntary certification scheme for existing buildings, which is mandatory only in Denmark. Estimations in Denmark that included the certification of 160,000 houses over three and a half years achieved energy savings of 125 million €. This is extremely encouraging for the promotion of energy efficiency in buildings, particularly when compared with the cost of 25 million € for certification for the same period. Overall,

this practice produced a return of over thirteen per cent on investments, demonstrating the scheme's cost-effectiveness.

Finally, the EU framework highlights the importance of the inspection and assessment of heating and cooling systems. The examination and subsequent maintenance of such systems is now acknowledged as a key method for upholding energy efficiency. The frequency of inspections should correspond to the range of the particular installation. For example, with the range of 10 kW and 100 kW that is shown by boilers in small residences to those in blocks of flats or offices, these installations should be examined at least every four years. However, a frequency of inspection of up to two years is necessary for boilers that have an output higher than 100 kW. In the situation where the boiler is over fifteen years old, it is recommended that the whole heating system should be inspected in order to determine which measures are most appropriate to improve its energy performance. Within the European Union, the inspection of boilers is already mandatory in some member States, with the remainder following voluntary and information programmes.

Public buildings and privately owned buildings that are used by the public can act as pioneers and serve as models for intelligent resource-saving buildings. The display of energy performance certificates and recommended optimal climatic conditions, e.g. the most favourable indoor temperatures, in all buildings frequented by the public can promote awareness. Symbols are important, such as the buildings hosting the Danish and Dutch ministries of Environment.

4. THE BATTLE OF CLIMATE CHANGE

Climate change is a multi-faceted phenomenon and the most prominent issue of sustainable development agendas. Its primary indicator is air surface temperature. Average global annual air temperatures have risen by 0.6°C since the late 1800s, and the Intergovernmental Panel on Climate Change (IPCC), created in 1988 by two United Nations organisations (WMO and UNEP), foresees a considerable increase of 1.4 to 5.8 degrees Celsius by 2100. Sea level rise is also most often associated with climate change and if present trends continue, projections suggest an increase of 9 to 88 cm by 2100, a rapid

and profound change. Temperature change may also cause extreme weather events, such as storms, floods, hurricanes, heat waves and droughts. Evidence of climate change is growing, both on land and in the oceans, with receding glaciers and disturbed marine species (IPCC 2001).

Scientific evidence highlights that emissions of greenhouse gases (GHG), including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and the three main fluorinated gases, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆), are causing a rise in air temperatures. The Greenhouse Effect is a natural phenomenon, without which the earth would have temperatures around 33°C lower. However, the unnatural rise in greenhouse gases, which have increased seven fold during the twentieth century, has led to what is known as the Enhanced Greenhouse Effect, causing global warming. The origins of climate change are very diverse, stemming from a multitude of natural and human activities. Energy production and consumption have an enormous contribution. Power supply is the single most important contributor to GHG emissions. Deforestation contributes to releasing CO₂ and conversely geological sequestration helps to diminish CO₂ into the atmosphere (IPCC 1996).

Climate politics is high on the global agenda, attracting significant attention from scientists, policy makers and citizens, but still clouded by uncertainty on the impacts, costs and benefits of action. It is a planetary challenge with important intra- and inter-generation equity dimensions, since action is needed now to alter long-term trends affecting future generations and to prevent change, which is not expected to be uniform across the globe. Countries that have caused the bulk of emissions (USA, China and the EU are causing 21%, 15% and 14% respectively) are not those most likely to suffer its worst impact. The most severe harmful impacts are expected to occur in the developing world, further aggravating poverty and socio-economic disparities. Low land populations, such as those in Bangladesh, seem particularly vulnerable, due to flooding. Industrialised countries have a responsibility for leadership in addressing emissions. A global participation, with common but differentiated responsibilities, is required for a lasting solution (OECD 2003).

The key starting point for action against global climate change is the United Nations Framework Convention on Climate Change (UNFCCC), issued during the 1992 Rio conference. The Framework

Convention on Climate Change, ratified now by one hundred and eighty nine nations legally bound by it, recognized the challenges posed by climate change, and set an ultimate objective of stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. According to the convention, industrialised countries should aim to reduce their GHG emissions, report on relevant policies and present emission projections. The Conference of Parties to the Climate Convention would meet periodically to review commitments and bring possible amendments to the Convention.

At the Third Conference of the signatories in Kyoto in 1997, the Kyoto Protocol to the UNFCCC, marked an important milestone. It constituted a major pact among industrialised countries, committing them to clear emission reduction and unambiguous targets for GHG emissions. The protocol introduced three new flexible instruments, including emission trading, joint implementation and the clean development mechanism. At the forefront of international efforts, the European Union committed itself to reducing its greenhouse gas emissions to 8% below 1990 levels by 2008-2012.

The United States withdrew from the Kyoto Protocol in 2001. All EU member States ratified the Kyoto Protocol in 2002. Russia joined on 18 November 2004. Russia's support brought the number of countries and CO₂ emissions they account for over the limit to make the protocol legally binding. This fact marked the start of the ninety day count down to the entry into force of the protocol on 16 February 2005 adopted by 141 countries. The Kyoto Protocol is considered to be the first step in a long struggle to tame global climate with concerted efforts by all nations. There is however increasing evidence that climate change cannot be prevented and adaptation measures are also crucial (OECD 1999a, 2000c).

Global change and energy are among of the cornerstones of the EU Strategy on Sustainable Development. Long-term visions, systematic research and comprehensive policies are vital for moving effectively towards low emission pathways. Emission patterns are influenced by long-lived investments in energy supply, transport infrastructure, housing and industrial installations, which impact consumption patterns at a long time horizon. Instant change is impossible and the need for technological, socio-economic and institutional innovation is sharper (EC 2001b).

Global warming is partially the end product of millions of individual decisions made by the world's residents within their immediate environments. The contribution of each city to global warming depends on its environmental and economic performance, social well-being and awareness about its impact on the global environment. A network of global-minded cities, the Alliance of European Cities for the Climate, brings together hundreds of communities in Germany and the rest of Europe, all of them dedicated in achieving 50% reduction in CO₂ emissions by 2010 as compared to 1987.

Carbon dioxide, the dominant greenhouse gas accounting for 78% of emissions, is primarily generated by the energy system, responsible for 95% of the total CO₂ emissions. As the efficiency of the combustion process is low, there are many carbon dioxide emissions in comparison to the actual value of energy created. There is a huge potential for research and technological innovation to dramatically reduce carbon dioxide emissions by improving efficiency or by switching to fuels with low or zero carbon content.

Methane, the second most important greenhouse gas, accounting for around 9% in GHGs, is a powerful gas; each tonne of methane is equivalent, in global warming terms, to twenty one tonnes of CO₂, over a time span of one hundred years. The contribution of the energy system to total methane emissions fell from 23% in 1990 to 20%. The main sources of energy-related methane are coal mining and the production and transmission of natural gas. Natural gas is typically composed of between 85% and 95% methane, and, when natural gas is released during the extraction of coal and oil, a significant amount of CH₄ emissions are also generated. Nitrous oxide is a very powerful GHG, with each tonne equivalent to three hundred and ten tonnes of CO₂, over a time span of one hundred years. The main sources of N₂O are industrial processes, agriculture and fuel combustion. The contribution of the energy system is about 16% (EEA 2002).

From 1990 to 2001, the European Union marked an overall 2.3% reduction in GHG emissions. CO₂ emissions had increased by 1.6% above 1990 levels, while CH₄ and N₂O had decreased by 21% and 16% respectively. In 2002, emissions were 2.9% below 1990 levels. Achieving the target on a linear path, emissions should have fallen by 4.8%. This means that the EU has only made the third of the way towards meeting

the Kyoto objectives. More worrying are the trends in Ireland, Portugal which exceeded their target paths by 20% (EEA 2003).

Progress resulted from an amalgamation of developments in most sectors (energy supply, industry, agriculture, waste management), some of which cannot be repeated, such as the introduction of technical measures to decrease nitrous oxide emissions in plants in France and the UK. In the UK, the achieved reduction of 14% in GHG emissions is primarily due to the shift from the use of coal to the use of natural gas in power generation. Trends in emission reductions could change very swiftly, as in the UK, where due to a slight increase in coal use in 2000, carbon dioxide emissions for this year have marked an increase of 2% above their 1999 levels (EEA 2003).

The transport sector represents the main obstacle to progress. Emissions originated from transport increased by 21% during the period 1990-2001. Increased transport demand has largely outstripped gains from technological improvement and fuel efficiency. The automobile industry, under its voluntary agreement with the European Commission, has multiplied its efforts to reduce CO₂ emissions from passenger cars. Even if a reduction in emissions from new cars was achieved, all three manufacturing associations (Europe, Japan and Korea) must intensify their efforts in order to meet their longer term objectives.

Based on scientific evidence, the EU has reached political consensus that + 2 °C above pre-industrial levels is the maximum safe level taking into account the pre-cautionary principle. The latest projections highlight that the European Union will be unable to meet the Kyoto objectives in the absence of intense efforts and stringent measures (Figure 14). All new member States, except Slovenia, are on track to meet their reduction targets, mainly because of the economic transition and the consequent restructuring or closure of heavily polluting industries. Projections for the EU-25 expect emissions to be only 3.8% below 1990 levels by 2010.

The European Climate Change Programme (ECCP) set up by the European Commission in 2000, aims at identifying the most environmentally beneficial and cost-effective additional measures as a means of enabling the EU to meet its target, complementing the efforts of member States. In 2003, the second ECCP progress report provided an overview of the results including the status of implementation of the

range of measures and suggests further actions in the most promising directions. The policies and measures included in the ECCP report have a total emission reduction potential of 578 - 696 million tonnes of CO₂ equivalent emissions. This meant, for the EU of the fifteen member States, a capacity for emission reduction twice as required (336), confirming the EU ability to meet its target if the appropriate measures are put in place (EC 2003c).

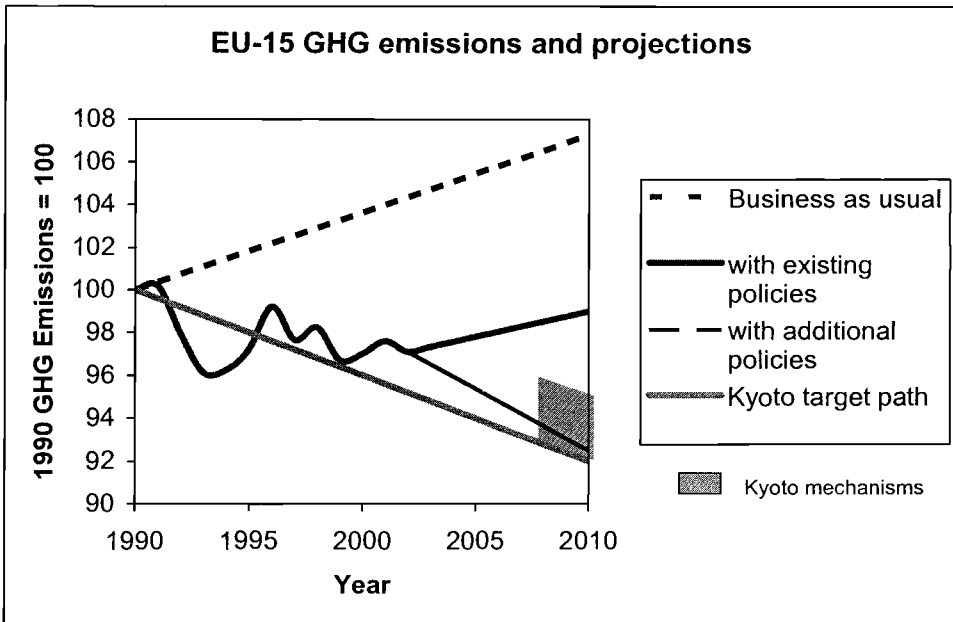


Figure 14. EU-15 Greenhouse emissions and projections 1990-2010.

Source: EC 2004

The cost-effectiveness of policies to fulfill the Kyoto commitments is an important element of the EU strategy. Cost estimates of the different combinations of emission abatement measures exhibit considerable variation between studies. The most cost-effective methods are expected to achieve a cost of between 0-50 € per tonne CO₂ equivalent reduction, including savings that offset the cost of the measure (e.g. avoided fuel costs). Cost-effective measures may be straightforward, such as reducing the leakage of natural gas from pipelines, which is economically attractive as it decreases fuel losses while dropping emissions.

Emission trading is a flexible mechanism, which is increasingly attractive for EU member States wishing to reach their targets at significantly lower costs (EC 2001e). The EU framework for emission trading confers more flexibility and cost-efficiency than direct regulation and may offer higher degree of effectiveness regarding the fulfillment of the commitments than other economic instruments, such as taxation or voluntary agreements. Model simulations developed in various EU research projects demonstrate that EU-wide emission trading would reduce the cost of meeting the EU Kyoto objectives by 25% or more. In July 2004, the European Commission has accepted the first eight national allocation plans, which define the number of CO₂ emission allowances that member States intend to allocate to energy-intensive industrial plants so that they can participate in emissions trading from January 2005. The scheme is expected to cover some 12,000 industrial and energy production plants across the EU.

5. URBAN SOIL, WATER AND AIR

Land is the essential ingredient in any urban growth. Urbanisation increases the demand for land and the pressure on wild land. Forests are being changed to agricultural land or urban areas. Urbanisation is likely to lead to a doubling in size of built-up areas in most developing countries over the next fifteen to twenty years. Coastal cities and zones, which attract a high percentage of the world population are under increased stress. The retreat of the shoreline affects many coastal regions. Biological diversity is ever more threatened. Devising efficient, effective and equitable land development policies, incorporating environmental imperatives, is a major challenge facing decision-makers and planners.

The latest report on environmental signals issued by the European Environment Agency highlights that the area of built-up land in Europe is growing much faster than the population and that social pressures are driving a trend towards more and smaller households, which use resources less efficiently than large ones. Urban sprawl may have disastrous effects on the environment. Agricultural land is being abandoned or intensely exploited while new forms of rural development may bring additional pressures on the environment (EEA 2004).

In the European Union, concerns about the degradation of soil led the European Commission to take the initiative of a strategy to protect soils as one of seven thematic strategies foreseen under the Sixth Environment Action Programme (EC 2001a). Soil is a vital and largely non-renewable resource. Soil erosion, the decline in soil quality and the sealing of soil are major and often irreparable problems across the EU. They have crucial urban dimensions.

Fresh water is a vital and scarce natural resource. In Europe, many cities experience water shortages or are supplied with ground water, the quality of which is seriously threatened. Maintenance of distribution networks remains a major concern. Leakage and risk detection are increasingly parts of integrated management and early warning systems. Renovation of networks and surveillance systems in order to limit leakage, which often reaches 30%, is under way or planned in many cities. In Tokyo, the set up of a system for identifying leaks has reduced losses to nine per cent.

At the global scene, more than half of the world population has no access to safe drinking water. Water is a potential source of conflict, but it can also be an effective means for dialogue to build trust and co-operation among countries. Good water governance is essential to prevent a global water crisis. Water management strategies have to halt the unsustainable exploitation of water resources and promote both equitable access and adequate supplies. The International Year of Freshwater 2003 shed ample light to the sustainable use of global hydrological resources and the ethical and socio-economic principles to guide water management and development practices. The Water Campaign, launched by the International Council of Local Environmental Initiatives (ICLEI) in June 2000, aims at building a worldwide movement of local governments committed to achieving tangible improvements in the sustainable use of fresh water resources by protecting and enhancing local watersheds, reducing water pollution, and improving the availability and efficiency of water services.

Water management reflects economic, social, environmental and cultural values. Sound water management requires the consideration of the entire water cycle, including its natural phase (rain, water tables, rivers) and the phase linked to human activity (from collecting water to purification of polluted water), and sheds light on the importance of innovation, policy integration strategies and monitoring. Water

observatories allow the meeting of quantitative and qualitative demands for drinking water, the evaluation of risks related to water pollutants and flooding and the elaboration of a meaningful water management policy. A strong institutional framework, incremental rates systems that penalise the largest customers, improved information and awareness and active participation of stakeholders are key elements of efficient and effective policy portfolios.

The EU Initiative “Water for Life” launched at the Johannesburg Summit as a comprehensive partnership designed to help countries achieve water and sanitation targets, progressed with the conclusion of specific agreements between Africa, Eastern Europe, the Caucasus and Central Asia. It constitutes a multi-stakeholder process involving greatly the partner regions, the business world and the civil society. The Third World Water Forum (Kyoto, March 2003) offered a unique platform for exchanging ideas and experiences, and discussing the global water crisis. The European Commission confirmed its commitment to cutting by half the number of people living without drinking water and basic sanitation. During a special Europe Day in Kyoto, delegates had the opportunity to learn about progress in implementing the Water Initiative and problems experienced in partner regions (Africa, Newly Independent States and Mediterranean).

Air pollution critically affects human health and may also damage ecosystems, buildings and monuments. It results from the combination of gases that are emitted into the air. The most significant of these include sulphur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), suspended particles, and certain metals. The primary source of air pollution is the combustion of fossil fuel in energy generation, industrial processes and transport (EEA 1997). During the last ten years there has been significant success in reducing certain pollutants through source control and abatement strategies and fiscal measures. Lead concentrations dropped sharply. However, guideline thresholds issued by the WHO for sulphur dioxide, carbon monoxide, nitrogen oxides and particular matter are still exceeded in a great number of European cities.

Reports from the European Environmental Agency highlight that as many as sixty thousand deaths per year in large European cities are caused by long-term exposure to air pollution. Children are increasingly exposed to environmental risks than adults. One child in seven is affected

by asthma. Air pollution indices developed for forty five European cities, with a total population of eighty million, highlight that 35% of the inhabitants are exposed to concentration levels that exceed the short-term air quality guidelines for SO₂ and/or winter smog conditions. Even higher percentages of citizens are exposed to ozone-related summer smog conditions, due primarily to NO_x concentrations. Studies indicate that life expectancy in polluted urban areas in Poland and the Czech Republic is significantly below average for these countries as a whole. Apart from local air pollution, the combustion of fossil fuels causes important problems on a regional scale, notably acid rain (EEA 1995a, 1997, 1998, 1999, 2002).

In European cities, the dominant sources of atmospheric pollution are shifting from the combustion of high sulphur fuels linked to energy and industrial processes to the combustion of gaseous fuels for motorised traffic. Nitrogen oxides, particularly nitrogen dioxide, are known to cause specific damage to lung tissues and to contribute to acidification, eutrophication and photochemical smog. The great majority of NO_x emissions (98%) are produced by energy production and consumption. Over the period 1990 to 1998, total NO_x emissions fell by 20%; the same decrease was achieved in energy-related NO_x emissions.

Sulphur dioxide emissions contribute to acidification and the production of fine particular matter, which can have major health effects. The great majority of SO₂ emissions (94% in 1998) come from the energy system. Fossil fuels contain varying levels of sulphur. The utmost source of EU SO₂ emissions is electricity production by conventional power stations. Due to technological progress in electricity generation, strict SO₂ emission abatement measures, changes in the sulphur content of fuels and the introduction of differential tax levels, EU emissions have substantially decreased. Over the period from 1990 to 1998, total SO₂ emissions decreased by 52%. The same drop was registered for energy-related SO₂ (EC 1999c).

The energy sector is responsible for three extremely important air pollutants, particularly with regard to human health: arsenic, cadmium and nickel. Within the EU, the greatest source of arsenic (87%) and nickel (59%) is stationary combustion, including public power generation, co-generation and district heating, domestic burning of solid fuels, and industrial combustion. Heavy metals occur naturally in fossil fuels, in particular solid fuels and oil. These fuels burn with a high ash

residue (hence their high production of suspended particulates), onto which the heavy metal compounds attach themselves in the flue gas. The level of heavy metal emissions is also greatly affected by the actual combustion process itself, including the conditions, temperatures and secondary emission abatement systems.

There is a large array of factors that impact air pollution. They include the type and the location of the pollution source, the type and concentration of emissions, the time of year (warmer temperatures increase chemical reaction rates), and the geomorphology of the region, since valleys tend to trap air pollution. Similarly, the extent to which air pollution affects human health also depends on numerous parameters, the most significant of these being the level and length of time of exposure, individual susceptibility and age.

For several years high ozone concentrations have been reported in the air in Europe between May and August. In the higher layers of the atmosphere (stratosphere), ozone shields the planet from damaging UV radiation; in the lower atmosphere it is an aggressive gas, which alters cellular function particularly in the ocular and pulmonary mucous membranes. Epidemiological studies have shown that peaks in ozone concentration cause irritation of the eyes and of the respiratory tracts, coughs, headaches and disturbances in respiratory function particularly in children and asthmatics. Since 1994, an EU Directive on air pollution aims at informing and alerting the population when the permissible thresholds of air pollution are exceeded. Tropospheric ozone develops from compounds such as nitrogen oxides (NO_x) and organic volatile compounds in the presence of solar rays. These component parts are emitted into the atmosphere through human activities, mainly transport, and from natural sources.

Air pollution is rarely caused by a single pollutant and the effects of exposure to a cocktail of pollutants can either be multiple, or amplified if different pollutants cause similar impacts. The heavy metals produced during energy generation by fossil fuels can cause various cancers, digestive and nervous problems. Similarly, particulates can be carcinogenic, but they also cause cardiac problems, respiratory diseases, and increase the risk of infant mortality. Since these pollutants often occur together as the particulates are a vector for heavy metal compounds, they may intensify mutually carcinogenic properties and cause a range of serious health problems (EC 1999c).

6. SUSTAINABLE WASTE MANAGEMENT

Sound waste management is inextricably linked to sound resource management. Any paradigm shift concerning waste starts by its consideration as a precious resource. But if the rest of resources should not be depleted, waste should not be generated. Integrated product policies shed light on the life-cycle of products from the extraction of natural resources, through their design, manufacture, assembly, marketing, distribution, sale and use to their eventual disposal as waste. Eco-efficiency and eco-labelling are crucial for the prevention of waste generation. Packaging waste has to be given particular attention.

Reconsideration of the urban metabolism insists on waste prevention, action before the waste is generated, even if investments still concentrate on the recycling end. However, municipal waste still increases in line with GDP. The costs for disposing of urban waste are very high and reach 30% of the total environmental expenditure. Zero waste seems a utopian slogan. However, throughout Europe, many cities abandon conventional waste disposal policies and adopt innovative waste management.

Regulation obliging waste generators to separate all waste at source has been the common element of many waste management programmes. Source separation is conducted in co-operation with the treatment facilities. It is normally preceded by introduction of technology or practices to prevent and reduce waste. Household waste is in general collected at three levels: residue, organic and bulky waste. Glass and paper waste are usually collected in neighbourhood containers. Enterprises sort waste into many more different fractions. Hazardous waste is usually subject to more research and treatment.

The Danish waste management system can provide insight into comprehensive waste management. Thirty years ago the main question was to optimise infrastructure and logistics. Municipalities came voluntarily together to form inter-communal partnerships and optimise the size of waste processing facilities. In the mid-1980s, municipalities obtained the authority to regulate all waste generated by the local residential, commercial, construction and industrial sectors. Throughout

the 1980s, a national law obliged waste generators to pay a tax for the disposal of waste for landfilling and incineration. The Copenhagen City Council adopted a comprehensive urban waste regulatory system in 1991. In 2001, the objectives of the waste regulatory system were for 58% of the urban solid waste to be recycled, 24% to be incinerated and 18% to be landfilled.

From the recycling of hi-tech electronic material to the composting of organic waste, European experiences are multiple and diverse. In Bolzano, a project to verify and compare measurement methods of urban waste is aiming to support for change in financing from tax to tariff for waste produced. The Clean City Awards Scheme, set up by the Corporation of London was designed to develop a partnership with businesses to achieve a clean environment through sound waste management.

A project set up by the Municipality of Oeiras, in the metropolitan area of Lisbon, for the backyard composting of organic waste led to the dramatic reduction of the volume of waste the municipal services collect, transport, treat and dispose of. The project had a great impact in increasing public awareness of urban environmental problems and offered inhabitants the possibility to produce a high quality fertiliser for their gardens. In Rimini, a medium-sized city with a double population during the summer months, the municipality decided to unify waste management, summer-intense activity with garden maintenance, conducted especially during the winter months. The public company created for this two-season activity promoted diversified collections, mainly for paper derived from domestic use and organic waste collection from hotels. The first collection was based on the stimulation of public participation through the exchange of used paper for a plant. The collected paper was transported and recycled in a paper-mill near the city, which was entrusted to a centre for the rehabilitation of drug addicts.

In Parma, the public company for waste collection has always been active in organising diversified collections, mainly paper and glass in the 1970s, aluminium cans and batteries in the 1980s. Creative advertising has been used to create awareness and encourage civic participation. "We will build a kindergarten with the profits received from the sale of used paper" was the major slogan of a paper recycling campaign. In the 1990s, its project "Friendly Plastic" aimed at transforming plastic waste into building material. A company for the

recycling of heterogeneous plastics was founded and produced recycled plastic, but the new material was not easily accepted by the market and its competitive forces (EFILWC 1993).

New urban neighbourhoods offer ample opportunities for innovative resource and waste management. According to Aristotle “habits are being formed the first day.” The Understenshöjden ecological village in Stockholm is a good example of improving urban metabolism with ecological self-building and user participation in the design. In Kronsberg, a new quarter of seventy hectares, built in Hanover for the EXPO 2000 and hosting seven thousand residents by the end of 2001, the Waste Management Concept initiated preventative waste management planning instead of conventional waste disposal.

The design and construction of the Kronsberg district incorporated all currently available know-how on ecological aspects of construction. This extended from energy-saving construction methods for all buildings to rainwater management and ecological management of excavated soil to the exemplary waste concept. The model includes the building waste concept, the commercial and domestic waste idea and communication. Within the construction waste concept, the city of Hanover reached a contractual agreement with developers to use exclusively environmentally compatible and healthy building materials. Construction waste was reduced by 80% through sorting and recycling measures. Waste at Kronsberg could be reduced by 30% to 154 Kg per resident and year, compared to the Hanover average of 219 Kg per person and year.

To promote communication, the City of Hanover and the institutions concerned by the creation of Kronsberg, created KUKA, Kronsberg’s Environmental Liaison Agency. KUKA played an important role in advising and training local residents on waste sorting (glass, waste paper, organic waste, packaging and the rest) and disposal at nearby collection points. Special attention was given to the awareness raising of immigrants and children. One of the most interesting concepts was the low-waste breakfasts. The project won the Barcelona Royal innovation award, a bi-annual award that recompensed in 2002 best practices in waste management.

7. MOBILITY AND ACCESSIBILITY

Environmental problems in urban areas do not arise mainly as a result of production. They essentially result from consumption and, in particular, from traffic. Traffic infrastructure covers 10% to 15% of the urban space in the EU and is source of many concerns. The road network should facilitate traffic flows and not dominate the body of the city. The vehicle stock grew by 50% in the period between 1980 and 1995 (while vehicle occupancy rates declined) and kilometres travelled by 65% (compared to a population growth of 13% and a growth of GDP of 44%). Inland transport costs, in terms of accidents and environmental impact, may represent 5% of GDP. In urban areas, the high cost of congestion could further increase this figure. In cities like Athens more than 80% of air pollution is attributable to traffic.

Transport is the fastest growing source of greenhouse gas emissions. At the global level, road transport has become the largest single most intractable anthropogenic source of CO₂ emissions. It seems that current policies cannot prevent problems from getting worse and that a drastic overall reduction in travel is necessary. Addressing greenhouse gas emissions from transport requires a fundamentally novel approach with the public engaged in policy development and debate. Technological, social and political innovation should be promoted, together with demand-side management and governance. The EU White Paper on Transport insists that pricing infrastructure should reflect real transport costs. The ECMT work on the socio-environmental externalities of transport proposed a common basis for the costs and the mix of policy instruments (EC 2001f).

Mobility has long been regarded as a cardinal urban value. The private car is a supreme symbol of freedom for urban dwellers. Mobility patterns depend on both the supply of transport infrastructure and the increasingly complex and unsystematic mobility demand. Demand is impacted by the largely unconstrained location decisions of firms, developers and households. Sub-urbanisation has always been inextricably linked to transport infrastructure. Many metropolitan areas suffer from a vicious circle of road construction and further sub-urbanisation. Commuting times show an extraordinary stability through

time, in all territorial systems, and experts suggest that there is an anthropologic constant in the form of a fixed time budget (EC 1992).

Economic growth has been a major factor for increased car ownership and transport waves. After the “Celtic tiger” phenomenon in Ireland, during the 1990s, Dublin experiences unprecedented rise in private car ownership and use, approaching the European average of one car per two citizens. The level of demand for transport increased at almost double the rate originally predicted by the Dublin Transportation Office in 1994. In 1998, the tonnage of freight going through Dublin port was almost double than what was predicted for 2001, passenger numbers in Dublin airport reached those predicted for 2001 and travel by private car rose by 38% more than the one forecast for 2001. The city was facing gridlocks particularly during peak hours. To respond to this a number of new measures were introduced. These included expanded bus lanes into the city centre, a new tram system which began in 2004 and the construction of a Dublin port tunnel to keep all the heavy goods freight traffic out of the city centre. However, traffic congestion remains one of the major headaches for the city.

Sustainable mobility is about minimizing the negative effect of transport on the environment. All European sustainable transport approaches aim at achieving a significant switch from the use of private cars to public transport, cycling and walking in cities and their commuter belts. Complementary policies are also put forward, such as increasing benefit-in-kind taxation to make company cars less attractive, imposing tax on free off-street parking spaces and considering road pricing.

The experience of Oslo and London with urban tolls offers many lessons. The limitation of cars entering the twenty two Km² central area of the British capital by tolls has been introduced in February 2003. The congestion charging scheme represented an investment of one hundred million £ in electronic equipment. The number of cars entering the City centre has been reduced by seventy thousand. The annual revenues are estimated 20% higher than the annual cost of the system (80M£). Complementary measures to provide for citizens who chose to leave their private cars included reinforcement of the bus fleet and improvement of the frequency, with waiting time in stations reduced by 35%.

The doctrine of “mobility at any price” has no meaning in the era of sustainability. Redirecting the focus onto accessibility seems a

plausible alternative. The distinction between access and mobility is not a trivial one (ALFOZ 1995). Unlike sheer mobility, access means not only getting people where they need to go, but also getting to them what they need, and new information technologies may play a major role in that process. The role of cities in assembling as opposed to dividing may be reinforced by the removal of architectonic barriers, in particular those relics of heavy transport infrastructure that blight so many European cities. Elimination of these barriers and designation of the recovered space for public use represents an action that is both exemplary and transferable. Integral urban accessibility programmes developed in the Spanish cities of El Ferrol and Salamanca took away the obstacles that hinder mobility and facilitated access to central poles, public transport, pedestrian crossings, etc. Accessibility is linked to proximity, however, physical proximity does not necessarily eradicate social distance (EFILWC 1993).

The human leg is the only truly sustainable transport means. A pedestrian-friendly city is more human. Copenhagen has been a pioneer city in recognising the social value of pedestrian streets. When the central street Strøget, became pedestrian in 1962, as one of the very early such systems in Europe there was a heated discussion. Detractors of the project suggested that the scheme was contrary to Nordic mentality and culture, but success came almost right away. The creation of pedestrian precincts continued in coordination with the downtown parking policy and the elimination of 2% to 3% of the parking spaces per year. The public transport system was improved and the bicycle network enlarged. More and more space has been taken away from traffic and given to citizens, who started leaving behind anonymous peripheries and coming back to the city centre. Stroget hosts now civic architecture, sculptures, fountains, concerts and many visual delights.

Civilised pedestrian streets expand throughout Europe. Vienna's pedestrian center is one of the most interesting in Europe. Oulu, in Finland, is extending its pedestrian zone, which is proving to be very successful, despite temperatures that can reach as low as -30°C. The Italian cities have been pioneers in closing the historic centres to private cars and introducing park and ride systems. Rome (Figure 15), Milan, Florence, Bologna, Bolzano experimented with various scales of car restrictions. Venice remains always the archetype of a car-free city par excellence, but it is Zurich and Basle that register the higher public

transport use, around five hundred in terms of trips per inhabitant per public transport means per year.

Perugia, one of the first Italian streets to restrict the use of private cars in the historic centre, created not just a passage to link the pedestrian area to the parking spaces, but a gallery of urban archaeology. In Evora, one of the World Heritage cities, the municipality prepared a plan to deal with the excess traffic in the historic centre, surrounded by an ancient wall, the chaotic parking situation, and the quality of life of citizens and tourists. The project includes the creation of large car parks outside the city walls, a high-quality public transport system, with mini- and minibuses adapted to the narrow medieval streets, park-and-ride and the creation of agreeable pedestrian streets and cycle tracks (EFILWC 1993).



Figure 15. Rome, Historic centre. Source: The author's exhibition of Artworks on Siren cities, European Parliament 2004

In Orvieto, the alternative mobility system has been created out of the need to improve urban quality life threatened from tourist pressure. Tourist buses were driving in the historic town on top of the hill causing much damage to the fragile rocky morphology. The city revitalised the

old funicular railway and asked all visitors to leave their cars in large car parking spaces at the foot of the Orvieto hills. The funicular railway is taking all passengers to the top of the hill, where they can use the network of minibuses take them around the city. A single authority for public transport and private car parking could internalise more equitably the environmental costs of private motoring and improve public transport.

The role of the street is exalted in the European Urban Charter issued by the Council of Europe in 1992 (CoE 1992). The “Code of the street: streets for all” introduced in 2004 in Belgium, asks for more attention to be paid to the rights of the pedestrians, cyclists, children, the elderly and the handicapped. The code requires drivers to respect one meter minimum distance from pedestrians when the latter are allowed to cross streets. It also reinforces repression measures. The concept of crossing curbs is being introduced to promote safe crossing and incite drivers to reduce speed.

Bicycles are the only other sustainable transport means, second to walking. Is it a paradox that both walking and cycling have been developed in northern, rather than in southern cities where climate allows more outdoor activities? Nurture seems stronger than nature. Denmark has already a bicycle network of more than 10.000 Km long. Amsterdam and Copenhagen are the capitals with the most elaborate bicycle network, complementing the road and canal routes. Both cities developed successful public “City Bikes” programmes. Amsterdam also has the higher rate of stolen bicycles, one stolen bicycle per inhabitant per year!

Thanks to the development of policies and infrastructure to promote cycling, the bike has become a useful means of transport in many European cities. In Münster and Erlangen, 35% of all transport needs are satisfied by bicycle. Cities like Basle can be crossed and enjoyed by bicycle. The “Velo-city” conferences promote new alliances between the bicycle and the city. The cities of Zurich and La Rochelle lend bicycles free of charge to residents and visitors. In Leipzig, local authorities encourage the 500,000 inhabitants to use their bicycles to connect to the public transport network, to which they are offered access for free if they parked their bicycle in a bicycle park next to a network. This “Bike and Ride” system is enhancing the 200 Km bicycle network, which offers the basis for 13% of all urban trips.

The irresistible rise of the private car has not yet been tamed. Motorised traffic is considered to be the single most destructive enemy of European cities. The study undertaken by the European Commission on "A Car-Free City" suggested redesigning cities in pedestrian terms. A city without cars could be composed of autonomous units, fully accessible on foot from one end to the other, separated by green spaces and united by high-speed public transport. The car-free city seems to be not only ecologically effective, but appears to be even economically efficient. It is estimated that it can be two to five times less costly, depending on urban population density (EC 1992; EFILWC 1995c).

Most cities try to quell the surging number of cars and encourage people to relinquish their private vehicles. Bologna was the first city to organise in 1985 a referendum on the restriction of the private car in its city-centre. Amsterdam, which had also gone through a recent referendum on the restriction of the private car, in early 1990s, organised in 1994 the conference "Car-Free Cities?" The question mark is significant, as it expresses reactions and inhibitions. On that occasion, cities committed to promoting policies discouraging the use of private cars launched the Car-Free Cities Club. The passage from car-occupied spaces into noble citizen-occupied spaces represents a major challenge for European cities (Municipality of Amsterdam 1994; Car-free Cities Club 1994).

Safe, clean, reliable, fast, frequent, noiseless, flexible, easily accessible, well-designed, environment friendly and economically viable public transport is a precondition for combating dependence from private cars. Even if Europe seems far away from places like Tokyo, where only one per cent of commuters use their private car, there are many innovations in upgrading public transport. Zurich is one of the few cities that developed a coherent solution to a problem of traffic build-up at intersections. Preserving and upgrading the tram system and rearranging the bus lines were the key elements of the improvement of the public network. The particularity of the system is its ability to deal with each public transport vehicle individually, allowing it to cross intersections without stopping.

Innovative practices in the limelight expand and transform urban landscapes. In Germany, the concept of short distances gains ground. Heidelberg, Freiburg and Basle have been pioneers in introducing low-noise vehicles in noise protection districts and eco-tickets for public

transport. Tramways are returning in European cities. Nantes, Grenoble and Strasbourg introduced from 1985 onwards, three technological generations of tramway. In Valencia, the new tramway is advertised as a tramway named desire. The tram, abolished in 1960 in Athens, returned back in August 2004. Equipped with the latest technology, it offers the city the possibility of a valuable alternative mobility and the capacity to transport eighty thousand passengers per day.

Innovative combinations among tram and train/metro systems are not new in cities. In Brussels, the network links the efficiencies of metro, pre-metro and tramway systems. Saarbrücken's new tram-train system shares existing tracks with the national railway, making infrastructures more efficient. National-municipal co-operation is reflected on the co-operation between the four municipalities of the Helsinki metropolitan region and the railways. Inter-region rail traffic is increasing and rail functions, in some parts, as a metro.

The socio-cultural aspects of the transport systems deserve much attention. Major stations of the new metropolitan system in Athens host archaeological galleries which exhibit also the findings during the excavations for the creation of the underground. In Budapest, the administration of the metro, around a hundred years old, is still seen as embodying arbitrary features of the old regime. A young cineaste has devoted a film to the metro controllers. The film was recompensed by the administration which was criticised.

Perugia carried out innovative experiments for reorganising the bus network, especially for peripheral zones and better adapting supply to the changing demand patterns. The telebus service, introduced in 1985, runs along a principal route, and can serve additional secondary routes only by request. This is enabled by a magnetic card distributed to the user and a communication centre. The system has proved very efficient and it is particularly useful for areas with sparse settlement and for access to transport for people with reduced mobility.

Electric, bio-buses and hybrid cars develop and intelligent transport management systems permeate many transport policies. Car-pooling and car-sharing schemes expand with mixed results. Green lanes exclusively reserved to public transport are now a common feature in cities. Smart transport passes, often linking transport to other public services, and eco-tickets are also in continuous progress. In Toulouse, the

municipality, the semi-public enterprise for public transport and the company which has created a smart-pass, worked together for the readjustment of the transport services to public needs.

The creation of pedestrian paths and careful articulation of transport means offer new possibilities for partnerships. The AUTOPLUS system in La Rochelle created new synergies between bus companies, taxis, boats and hotels. The pilot park-and-ride project "De Slinge" in Rotterdam offers an interesting example of multiple benefits. The car park had become an arena for vandalism. No enterprise was attracted to undertake its rehabilitation and its management, nor did the municipality have the means. An autonomous structure was created with the help of European funds, and not only renewed the car-park but it installed there a workshop for bicycle repair, some small shops and containers for waste recycling. Twenty-one new jobs have been created.

Bangkok, one of the world's most asphyxiated cities by private cars, has also marked important steps over the last ten years. The creation of the Mass Rapid Transit Authority in 1992 led to the construction of a long discussed elevated light train in the city centre and linked to the underground to serve peripheral areas. The aerial train Bangkok Mass Transit System, inaugurated in 1999, added an important dimension to the common transport landscape of the Thai capital. Each train has a capacity of one thousand passengers and stands as the equivalent of eight hundred cars. Quick, secure, environment and citizen-friendly, the skytrain has been easily adopted by inhabitants and tourists. During its first four years, it provided a service to more than 320 million passengers. Each working day, it transports more than 330,000 passengers. The observed punctuality is 99.94 per cent and the recorded clients' satisfaction is 82%. The 2003 annual security inspection, done in collaboration with American maintenance teams, gave satisfactory results. Multiple social and cultural activities are being organised on the skytrain to promote its use as an integrated public service.

Freight transport accounts for about 10-12% of vehicle traffic in cities. It is essential for the economic functioning of cities and has significant effects on congestion and the environment. Construction works and retail are responsible for much of the goods traffic. Commercial vehicles vary largely from dirty, noisy and intrusive trucks to smart electric cars. Many cities impose vehicle size or weight restrictions, or limit access in certain areas. A balance has to be struck

between access requirements, essential to a city's vitality and transport and environmental objectives. Policy responses include the German model, based on private transport companies coming together to serve and the Dutch model based on licences provided by authorities to transport companies.

OECD-ECMT studies highlight the importance of integrated transport and land-use policies for improving mobility patterns. Reconciling and mixing land uses is often necessary, but rarely a sufficient condition for reducing traffic flows. Density may be inversely related to travel demand and energy consumption. The strength of the land use/transport inter-relationship depends on assumptions about mobility and cultural behaviour. High mobility leads to travel patterns that may not be very sensitive to land use patterns. Optimal transport/land use interventions depend highly on the context. The search of efficiency, accessibility and choice has to take into account many parameters, such as the size and structure of the city, the location of other activities, the distribution of the employment, public transport alternatives and the parking policy (OECD-ECMT 1994).

Optimal policy portfolios include the promotion of lower-consumption vehicles and new propulsion technologies, demand-management schemes, such as parking controls and access restrictions, information and communication, fair and efficient pricing regimes and land-use and planning. Noteworthy European initiatives include ELTIS (European Local Transport Information Service), jointly funded by the EC and the International Union of Public Transport, the citizens' network benchmarking initiative and the European platform on mobility management. The European CIVITAS initiative, launched in 2000, aims at introducing a radical strategy for Clean Urban Transport. The participating EU cities deploy exemplary efforts in developing attractive alternatives to the use of private cars.

The European JUPITER initiative and other targeted transport projects try to demonstrate innovative urban transport measures to improve the environment. The JUPITER II project achieved reduction in energy consumption of 20% and emissions of harmful air pollutants of between 16% and 25%. The strategic assessment of the project highlights that modal split has significantly improved in most cities, with a 12% increase in public transport. A more extensive implementation could double this figure. A substantial reduction of 4% in CO₂ emissions and

20% in particulate emissions was recorded and demonstrated the potential of innovative energy and environmental technologies.

Biogas fuels give new opportunities to cities which strive to lower vehicle emission and dependence on petroleum. Stockholm developed, in collaboration with other European cities, the project ZEUS (zero and low emission vehicles in urban society). One of the ZEUS sub-projects is the introduction of vehicles fuelled by biogas, originating from recycled liquid organic waste. A pilot station for biogas production has been constructed and hybrid vehicles functioning with petrol and/or biogas were gradually introduced. A fleet of two hundred vehicles, lorries and private cars, has been the result of the co-operation among the municipal enterprise for waste water management, fuel companies and city infrastructure services. A biogas-fuelled lorry ensures the transport of biogas to the filling station (EC 2000g).

Symbols are powerful. From the 16th to 22nd September 2004, European citizens had again the opportunity to enjoy a full week of events dedicated to sustainable mobility. A wide range of initiatives tackling different aspects of urban mobility were carried out by local authorities on each day of the week and in partnership with local organisations and associations, NGOs and businesses. The Car Free Day on Wednesday, 22 September 2004 was the highlight of the week, with the challenge of organising “In town without my car” on a working day!

The European Mobility Week represented a platform for local authorities as well as organisations and associations from all over Europe to promote their existing policies, initiatives and best practices on sustainable urban mobility, launch new policies and initiatives and raise citizens' awareness on the damages that current urban mobility trends generate on the environment and the quality of life. Safe streets for children was the central focus of the European Mobility Week 2004. Many events highlighted the importance of the safest possible mobility patterns for children.



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