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The information society and the environment

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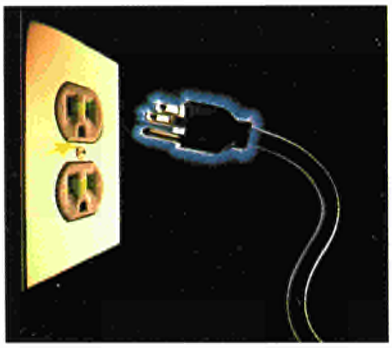

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Editorial

Robert Verrue

NOW IN THE LATE 20TH CENTURY, the arbitrary approaches of the past to agricultural, industrial and urban development are increasingly shunned. A transformation of attitudes and activities is coming about, helped by the new age of information – the information society. Telecommunications, satellite technology, telematics, and information technology, combined with global environmental expertise, are the powerful instruments at our disposal for putting this transformation into practice.

Just as mechanisation and the power of steam, gas and electricity revolutionised the 19th century, and then the internal combustion engine, advances in physics, medicine, materials science and countless other technologies brought about the modern 20th century era, so telecommunications and the new electronic tools of the information society are the agents of previously unimaginable change as the millenium approaches. Indeed, they play an even more vital part in the world's future development, because they enable us at last to take the long view.

Thanks to their speed, accuracy and storage capacity, we are more and more comprehensively informed. We can now observe, measure, analyse, and evaluate the natural and man-made world, the rural and the urban environment better than ever before.

The indirect effects of information and communications technologies on the environment are crucial. They form the invisible backbone of all 'remote' activities which can help conserve valuable energy resources depleted by constant business travel. They also reduce the detrimental impact on the environment of such travel, let alone its human costs in terms of money, time and unnecessary stress.

Audio and videoconferencing links and the near instantaneous on-screen delivery of documents through electronic mail and modems are diminishing the need for commuting, and making telework a welcome contribution to many people's lives, especially in remoter areas. Additionally, such areas can benefit not only from increased employment possibilities but also from advances in telelearning and telemedicine, which enable information rather than people to travel swiftly over great distances.

Through such varied telematics technologies we are therefore able to balance current industrial, agricultural and commercial trends with the need for future development that is both environmentally-friendly and sustainable, in Europe as elsewhere in the world, and in this the European Commission is taking a strong lead.

A variety of European Union programmes now link the environment with industry and research projects. Their aim is to respond to the growing demand for improved environmental care and awareness, enhancing people's working and living environments, their daily lives, health and wellbeing, but also to increase Europe's competitiveness, – essential if both the environment and the economy are to benefit.

Stricter environmental controls on both products and manufacturing processes are a challenge to industry but they also represent an expanding market for environmentally and ecologically sound technologies, processes, products and services. The 'green' industry is thriving and has excellent prospects for growth.

Within the Telematics Applications of the European Commission's Fourth Framework Programme 1994-98, a new exploratory action was introduced to assess the potential of innovative applications for the protection of the environment.

Indeed, one of the chief aims of this Telematics for the Environment action is to encourage the sharing of environmental information systems between disciplines and across international boundaries, which will create environmental management concepts for use by industry and governments across Europe, fostering the cross-fertilisation of ideas and demonstrating the added value offered by truly global cooperation action.

In addition, the Group of Seven (G-7), founded by the governments of the world's seven most industrialised countries in association with the European Commission, has several pilot projects on environmental topics of global concern and relevance making imaginative use of the World Wide Web.

In this environmental issue of the magazine we aim to demonstrate that the information society is not only essential for business, industry, and research, but also has a vital role to play in ordinary people's daily lives, wherever they live and whatever they do.

Its tools enable us to manage and protect the world's physical environment: the land, its crops and natural resources, the rivers and oceans, our cities and our countryside, the water we drink and the air we breathe.

The message is clear: the information society can be a beneficial force working for the environment on which our future depends. ■

Robert Verrue
Director-General, DGXIII


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Sustainability in an information society

THE POTENTIAL CONTRIBUTION which a rapid transition to an information society can make to sustainable employment and growth has been extensively rehearsed in the Commission's *White Paper on Growth, Competitiveness and Employment*[1] of 1993. There is less discussion and understanding about the contribution that can be made to sustainability in environmental impact, materials use, energy use and transport, but the potential is no less important.

Two recent initiatives at European level will help to raise the issues in policy debate and research:

- the Information Society Forum,[2] set up as an independent advisory body, has chosen to focus on "sustainable development, infrastructures and technology" as one of the six themes of its first report;
- building on exploratory research in 1994 and 1995, DGXIII of the European Commission will support an expert "working circle," with the task of clarifying the potential contribution of advanced communications to sustainability. An attempt is also being made to explore the degree of common interest in industry and sustainability lobbies to work together towards a common agenda and common goals.

The background against which these groups must work is one of growing public and political awareness that our economic prosperity and growth is unsustainable, even though we are not hitting limits to growth in resource depletion, – which was the major concern of the 1970s.

Energy resources are not infinite, but neither are they running out. In addition, our energy use affects the overall energy balance of the planet by less than 1%.

The new constraints are environmental, and associated with material use and transfers. We have increased natural material transfers in the environment by over 100%, and released into it tens of thousands of new chemical and biochemical products, with often surprising results.

For example, ozone layer depletion is an artefact of industrial chemical use and release; greenhouse gas accumulation is a "material transfer" problem more than an "energy use" problem; dioxin and DDT legislations are responses to industrial and medico/agro-industrial material use.

'Dematerialisation' is now the key to longer-term sustainability. This means reducing the amount of material which is daily extracted from the environment, processed, synthesised, and dispersed into the environment during the modern manufacturing and marketing cycle.

An example from daily life: improved technology in the production of domestic appliances, like refrigerators, and a change in working and housekeeping patterns has changed them from an expensive luxury to an affordable household necessity. Accordingly sales have increased enormously. At the same time fridges are less durable than their expensive predecessors, so are more likely to be replaced every few years, rather than be repaired.

The consequent proliferation not only of new fridges bought, but of old ones thrown away, entails a continuing consumption of materials, energy and services in many sectors: redesigning, manufacturing, marketing, displaying, selling, delivering, running, and also disposal and destruction of the obsolete items. The same applies to cookers, washing machines, tv sets, hi-fi sets, radios. Marketing techniques have their predictable effect, and once the cost of repair becomes higher than that of replacement, or even before that, most appliances are eventually jettisoned, and new, updated models purchased.

Their 'dematerialisation' would require a fundamental restructuring in the provision of everyday consumer goods and services: one that neither deprives the consumer of the services, nor industry of its creation, but instead makes the product become a service. For example, the fridge would be replaced simply by the service of refrigeration, which would be **automatically built into the fabric** of every domestic kitchen, as is already the case with plumbing, main drainage, electrical wiring and heating in the vast majority of modern housing. This is the 'product to service conversion,' and it requires a radical shift of philosophy both in industry and the public to become the norm.

Dematerialisation and the information society

As suggested above, dematerialisation can be realised by process improvement, product improvement, product to service conversion and structural change. All can be influenced by the information and communication revolution, but in different ways and to different degrees.

Process re-engineering management has been given a major stimulus by the emergence of multi-media information infrastructures. All the 500 multinational companies cited by *Fortune* magazine as having the world's highest-turnovers have been through at least one "re-engineering" exercise in the last 5 years, under competitive pressures to improve their use of skills and resources. While de-materialisation and energy saving have not been goals, benefits have been realised, and the business benefits and methodologies of re-engineering have been recognised and tested. If these proven techniques can now be applied with the goal of reducing material use and transport, further incidental business benefits will almost certainly emerge.

Product improvement has been driven by market forces and material technology: new materials, better suited to the product's function. However, the

"information content" of products in terms of their market value has risen faster than their material content has fallen.

Over 50% of the market value of a car is related to its "information content" – through research, design, production and retail management. Even for a packet of pasta, most of its retail value is information-related. In terms of their market value, most products can be substantially de-materialised.

With advanced communications, other products become services. A newspaper becomes an on-line news service; an instruction manual becomes an interactive technical advice service; cinema film reproduction and cinema chain management becomes a "video-on-demand" service in the home; a post-operation recuperation institution becomes a medical surveillance service in the home. The de-materialisation is evident.

Structural changes in the way markets are organised, in the way our transport infrastructures are organised and used, in the way we work and live: these are the hardest changes to stimulate. But it is here that the greatest benefits in sustainability are to be realised. The emergence of information infrastructures as the new element in economic and social development changes all the ground rules of an industrialised materialist society.

Information management

In the 1990s, most people work in information management: bankers, business executives, accountants, salesmen, secretaries, graphic designers, researchers.

Of all activities, information services ought to be the easiest to de-materialise – but we tend to see only the tip of the iceberg: the piles of paper on desks. The bulk of the material iceberg is made up of the office desk, the PC, photocopying machines and photocopies, archives, the office building itself, with its marble hall, its restaurants, parking, the executive cars...

It's no good simply trying to get rid of the paper. It's not enough to de-materialise the French telephone directory through Minitel. Any real de-materialisation must also cut into the bulk of the iceberg: it must "de-materialise" the office – at least per unit of business turnover.

This may sound an incredible goal, but it can be done, and has been done – teleworking and "hot desking;" the office as a meeting place and occasional base for a nomadic and decentralised workforce is both an attractive business proposition and real de-materialisation.

The champions of this idea are of course the IT companies: Digital, Apple, IBM, and others: Digital has pioneered the flexible office concept; IBM has saved millions of dollars in city-centre office rentals.[3]

The insurance companies and the retail banks show another approach. The move to replace local branch offices with a larger network of automatic telling machines is already a substantial de-materialisation of the retail branch network. The move to direct banking over the phone or Internet takes the process even further – here you already have a "Factor of 10" in de-materialisation of a business process.

The retail sector

If information management is an easy case, let's look at some tougher problems. The "end-point" of material production is retailing – buying food, cleaning products, clothes, shoes, and "do-it-yourself" products account for over 90% of everyday purchases. Again, we tend to see only the tip of the material iceberg – the food itself or the pair of shoes, and since you can't de-materialise food or shoes, the immediate reaction is that there are no opportunities for de-materialisation. However, this isn't true for the bulk of the iceberg.

Recent trends in shopping have increased the material iceberg of retailing: large hypermarkets, with large car parks have considerably increased the traffic associated with shopping – people commute to hypermarkets in the same way they commute to work. The stores themselves, with their car-parks, restaurants and access roads, use more materials (building, plumbing, wiring and packaging) per unit sold than ever before.

Even worse, this has not been associated with any reduction in traffic and infrastructure associated with provisioning the stores. Global provisioning, with over 10,000 separate items, has increased customer choice, but has also increased material use and the environmental impact of the production, wholesale and retailing process.

How can information infrastructures reverse this trend? Are we addicted to ever-widening global choice? Are there ways to de-materialise some of the retailing iceberg?

Better organisation of provisioning chains is one: it makes no economic sense to truck potatoes from Germany to Italy, and then to truck them back as crisps and chips. It makes no sense to fly fresh flowers from Israel to Amsterdam auctions, to fly the flowers back to Italy, or even back to Tel Aviv for sale.

Video auctions and better logistical management, through better information to all parties concerned, can catalyse a considerable rationalisation. *(See **I&T Magazine** issue no.17, p.22 on electronic auctions).* At the customer end, tele-shopping can preserve or expand choice. It can substitute delivery of a 20 kg part-load to a home for a 20 km round trip of one or two people in a 1000 kg vehicle, with all the parking and building space implications that go with it. Of course, tele-shopping may never substitute for the social experience of "entertainment shopping," but it is already making big inroads into "chore shopping" in California.

Transport

The second most important purchase people make in life is a car (or a sequence of cars). Can you de-materialise a car with information and telecommunications? Better design can help – lighter bodies, more efficient engines, but the gains are more than off-set by the still growing level of car-ownership – technological progress has made cars more affordable faster than it has de-materialised them.

Perhaps more radical progress can be made by concept changes: new types of vehicle that fill the gap between the car and the bicycle. There can be new ideas for resource-sharing that fill the gap between ownership and rental – perhaps smart cards to allow self-drive of mini-cabs in cities; that fill the gap between public and private transport. However, no single organisation, whether a vehicle manufacturer or a city transport authority, can act alone to make these concept changes viable. Collective and co-operative action by public and private-sector bodies is the only way to structural and conceptual change.

Shared-use may be the single most effective way to de-materialise personal transport, but it still presumes that physical transport of goods and people is necessary.

Virtual presence at a distant location, with high-resolution colour, and 3D imaging, CD-quality sound and even manipulative remote control is within our technological grasp, but will be expensive for many years to come – but no more expensive than buying and running a car.

Can people and businesses be persuaded that high-quality and high-functionality virtual presence is as much or more a status symbol and expression of their individuality as owning a 3-ton Mercedes? Video-conferencing will not eliminate use of a car; but it can dramatically reduce it.

But beware: not all uses of informatics and telecommunications will contribute to sustainable development. The transition to an "information society" may well offer new opportunities for de-materialisation in the transport sector, but it can also make things worse.

If telematic systems for route guidance and anti-collision assistance only result in more cars on roads, if better designed and cheaper cars make individual car ownership viable for more of the world's population, the net effect will be to accelerate our rush to a precipice of social and environmental crisis.

Concerted actions: the way forward?

Achievement of sustainability cannot be imposed on our societies by Government decree. We are all familiar with the political difficulties of following up the Rio Earth Summit through supplementary energy taxation and legislation on recycling and waste. Genuine and substantial progress towards sustainability requires that all major interests push in the same direction. We all "own" the problems of unsustainable use of materials and abuse of our environment. We must all contribute to the solutions.

No one individual organisation can act alone: no individual or retailer can decide to introduce tele-shopping; no flower producer in Israel can decide to offer his products in video-auction rather than in Amsterdam; no individual or company alone can make any impact on congestion in city traffic by telecommuting. Only collective commitment and action by substantial groups of organisations – in both the public and private sectors – can be effective.

And everyone must benefit, not just in the longer term through a better preserved environment, but in the short-term in business efficiency, competitiveness and in individuals' "quality of life."

This was the goal behind the consultation by DGXIII on a draft "Memorandum of Understanding": can we find a set of common principles and goals, which businesses, public authorities, non-government organisations, and even influential individuals can sign up to – voluntarily? This is a framework for co-operation that reflects their own short-term interests, as well as longer-term social interests.

The essence of European action is co-operation: common objectives and a framework in which diverse interests can pursue their own interests in the common good. The frameworks of European research and technology development, and the Information Society Forum are there to be used.

However, these frameworks must be filled by concrete proposals from the "champions" of new ideas. The Commission itself cannot be the driving force, except in very specific areas such as the single market, or European Monetary Union, where all Member States agree on the goal and it can only be achieved by coherent legislative and policy action at EU level.

Sustainability will not be achieved by Government-led legislative action alone, nor by European-level action alone. A much broader commitment to a common purpose is necessary. Perhaps co-operation for a "global information society" is the context we need. ■

Peter Johnston and Robert Pestel
DGXIII-B

(1) *White Paper: Growth, competitiveness and employment: the challenge and ways forward into the 21st century.* Bulletin of the European Communities, Supplement 6/93; December 1993.

(2) A forum of 128 people from all walks of life, called together by the European Commission in July 1995 to advise the European Parliament, the Council of Ministers and the Commission.

(3) *Telework '94 – New Ways to Work,* Berlin, November 3-4, 1994. Proceedings of the European Assembly on Teleworking and New Ways of Working.

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Building a new environmental infobahn

the European Environment Agency and EIONET get into full swing

MOST EUROPEANS live in a complex environment characterised by a mosaic of natural and man-made habitats. The environment changes constantly. There are daily patterns driven by light conditions, weather, and traffic. Seasonal patterns are driven by climate. Long-term trends in environmental change are caused by the development of vegetation, human society and macro-climate, and are being recognised as increasingly important.

Environmental disturbances, which are events beyond the usual range of variation, such as forest fires or chemical spills, can also modify all the above patterns.

Environmental information is therefore inherently complex. Variables change spontaneously and must be monitored. Environmental systems are not like those keeping track of human activities, because even as the data is being recorded, the subjects of it naturally shift, change and age.

Most environmental information should also be spatially referenced. This is a big advantage, as nature thus provides an automatic indexing key which can be used to integrate different data sources.

Measuring environmental variables is often complicated as the attributes of interest cannot always be measured directly. Indicators are therefore used frequently. Discrete and subjective classifications are in widespread use. Standardisation and harmonisation of data collection is therefore of paramount importance.

In this context, the concept of an environmental data bank can be dangerous. You can put money in a bank account, and there is only one interpretation of the sum. (We ignore money-laundering issues here). Environmental data always comes with several attributes about how it was collected, processed, and interpreted. Those meanings must be carried on with the data element as meta-data through all further processing.

Origins of the EEA

The regulation about the European Environment Agency was laid down in 1990, and the Agency started operating in 1992. Its purpose is to organise, harmonise, and collate the multitude of environmental information collected all over Europe, including countries outside the EU, both in order to produce objective and reliable data to help EU policy makers and also to keep the public properly informed.

Based in Copenhagen, the EEA has now been fully staffed and equipped. Headed by an executive director, it has a management board with a representative from each of the member states, plus two from the European Commission and two scientists designated by the European Parliament. It is assisted by a scientific committee of nine environmental experts, has a staff of over 50 and a 1996 budget of 14.5 million ECU.

The main product of the EEA for 1995 was a major analysis and an encyclopaedia about the state of the environment in Europe entitled: *Europe's Environment: the Dobris Assessment.* A similar report has to be produced every three years.

The EEA also hosts CORINE, (Coordination of Information on the Environment) which is a set of detailed databases on specific topical areas, such as biotopes, land cover, air quality, etc.

The EEA is the nucleus of a wider network of agencies and institutions that form the European Environment Information and Observation Network (EIONET). This consists of:

- national focal points which co-ordinate the activities in the member countries;
- topic centres which provide thematic information about important subjects such as water, air, biodiversity, etc;
- main component elements which collect the bulk of information in the member countries; and
- national reference centres which provide specific services.

No less than 450 potential partners have been identified for EIONET.

EIONET requirements and solutions

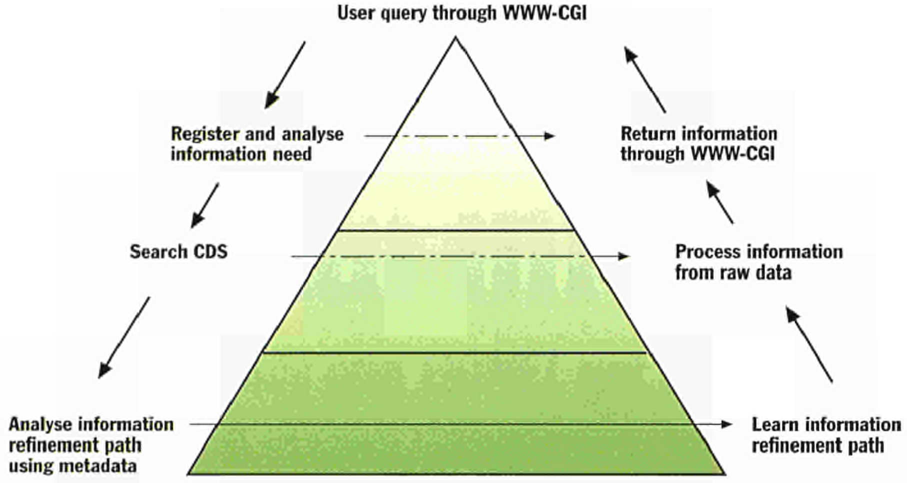
EIONET functionalities are gradually being built up. Its communication needs go beyond ordinary e-mail and file transfers. The most notable extra requirements include the following:

- *Meta-databases*

In essence, these are data about data, such as definitions of concepts and descriptions of rules and restrictions in the applicability of data. In fact, a meta-database is a repository of object definitions in the same sense as repositories are used in Computer-Assisted Software Engineering (CASE).

Environmental information is inherently complex. Variables change spontaneously and must be monitored. With environmental systems, even as the data is being recorded, the subjects of it naturally shift, change and age.

Figure 1: ***The planned adaptive information hierarchy in EIONET.*** **User queries to databases are received via the Common Gateway Interface (CGI) of the World-Wide Web. If the information is "off-the-shelf," it is returned immediately. Otherwise, the Catalogue of Data Sources is consulted, and data is found somewhere in EIONET. If data still remains unavailable, meta-databases will be consulted, and the possible pathways of producing the data can be investigated and learned.**



The difference between these and CASE is the need to store the object definitions into a multi-user database. Several meta-database standards exist which are being studied at the EEA.

■ *Catalogues of data sources (CDS)*
These are often confused with meta-databases. However, a CDS is less abstract, describing which organisations hold what data. Nevertheless, a CDS must be linked closely with a meta-database. The main challenge is to bring the concepts and terminologies in line with core business activities, libraries, IT development, and project management.

■ *Groupware*
The next major step, after sending files through e-mail and sharing them via a file server, is organising the work flows on documents and replicating them on a number of file servers. These are some of the functionalities found in groupware packages such as Lotus Notes, ICL TeamWare, and several web-based systems. There is considerable interest within EIONET in implementing some groupware functionality. The EEA has recently installed Digital Web Forum products for test use.

■ *Structured, portable document management*
This reads the Standard General Mark-up Language or SGML. When 450 collaborators are sharing files and producing reports that maintain the same encyclopaedia-like structure from one release to another, there must be a machine-independent way of sharing and managing the documents. It must be possible to derive multiple end products such as web pages, CD-ROM and various printed versions from same-source files with as little hand coding as possible. Only SGML can provide this functionality. However, implementing it will be a long process.

■ *On-line databases*
All environmental institutions hold unique data sets that are potentially interesting to the EEA, other EIONET members, the scientific community, and to the general public. There is no better way to make these data available than building an on-line World-Wide Web gateway to them.

In fact, the Common Gateway Interface on the web is becoming a universal front-end to almost all kinds of programmes in these days. This is a key technology for EIONET that has already been exploited by our sister organisations such as the Australian Environmental Resources Information Network (ERIN).

■ *Information dissemination to the general public*
This is becoming more and more important. Using the web is again perhaps the most effective technological solution. Today 25-35% of homes in Scandinavia have a PC. Sales of PCs have already exceeded sales of tele-visions, for instance, and in five years, the majority of homes will boast a PC. Today, most PCs still represent lonely islands, but with the present boom in the Internet, most of those PCs will be connected in the foreseeable future. This will mean a huge need for simple information about the environment, because it is interesting for everyone. CDS and search tools are essential for making information accessible.

■ *Adaptive queries and information hierarchies*
It is impossible to foresee all the potential needs for environmental information. An information architecture capable of learning must therefore be devised. This means creating an hierarchical information model which registers user needs. A particular piece of information may not be available when it is requested, but the raw data to produce it could well be somewhere in the EIONET. A meta-database must contain the rules of how the data can be refined and processed into fulfilling the user needs. In the beginning there will be lots of hand-coding to make this work, but as meta-databases and CDS become more available, this process can perhaps be automated to some extent. *(See figure 1)* Also intelligent agents that retrieve information in a networked environment must be studied.

■ *Clearing-houses and special interest networks*
A clearing-house is the term for an independent service that works for a common good, facilitating co-operation, sharing information, providing directory services, solving copyright issues on information and building up its partners' capacities. Clearing-houses have been requested for various environmental processes such as the Convention for Biological Diversity. A modern way to implement a clearing-house is to operate it virtually on the Internet as a Special

Interest Network (SIN). SINs are being promoted for the various topical networks on the EIONET.

Current IT activities within EEA

The annual work programme of EEA specifies several areas for IT development in 1996. These are steps towards implementing some of the above functionalities.

The major project will be installation of a Wide Area Network (WAN) for EIONET. The aim of this project is to connect all national focal points of EIONET with a network. It is important that each node has a minimum level of connectivity so that applications can be built on top of that network.

The EIONET WAN will be funded through DG III's IDA Programme (Interchange of Data between Administrations) up to a total of 2 million ECU. The architecture of EIONET conforms to the conceptual approach of IDA.

Because of the wide-open nature of EIONET, an Internet-based implementation has been chosen. The EIONET will be using virtual private networks over the public Internet where existing connections are good. For most sites a dedicated router and a server computer will be installed for an Intranet connection. The EIONET telematics network is to serve the partners' internal needs, but also forms the basis for a broader outside connectivity. *(See figure 2)*

On the occasion of its second birthday on 13 November 1995, the EEA launched its web site at http:/www.eea.dk/. President Santer honoured the anniversary with his presence and was on hand to open the service officially. Currently, we are writing guidelines for the EEA about what information should be posted on the web and what the necessary work processes are. The goals are to integrate electronic and paper publishing as much as possible, and get everyone involved. Similar guidelines for the EIONET will follow. There are now about 800 documents on the EEA web site.

Catalogues of Data Sources (CDS) are moving swiftly forward under the lead of the topic centre for CDS. The topic centre has been awarded to the Ministry of Environment in Lower Saxony, Germany, and a team of ten other agencies. The topic centre for CDS will also develop a multilingual thesaurus for environmental concepts, which is a basis for many other activities.

Benefits awaited

It should also be realised that there is no other way to make EIONET work and implement the above functionalities than by building on top of existing and operational networks. Internet is the main vehicle here. When there are 450 collaborators and millions of customers, the only standards that can be utilised are those that are already in use and adopted by the partners.

This new reality can be disquieting too: sometimes certain things really do not exist if they are not on the web. Success and failure can now be measured in very simple quantitative terms such as the number of hits on a web site. Currently we run at about 60,000 file retrievals/month, but we expect a correspondingly greater order of magnitude when in a year's time the IDA-EIONET project is completed.

The above approaches and technologies will be studied and implemented for EIONET gradually. This will be a long process, and we are learning as we go along. The result will be a new environmental infobahn that provides better access for Europeans to the information about our environment.

The information society will become reality only when its citizens find information relevant to them more easily, and when they can better participate in the decision-making that affects them. EEA and EIONET are working to make it happen. ■

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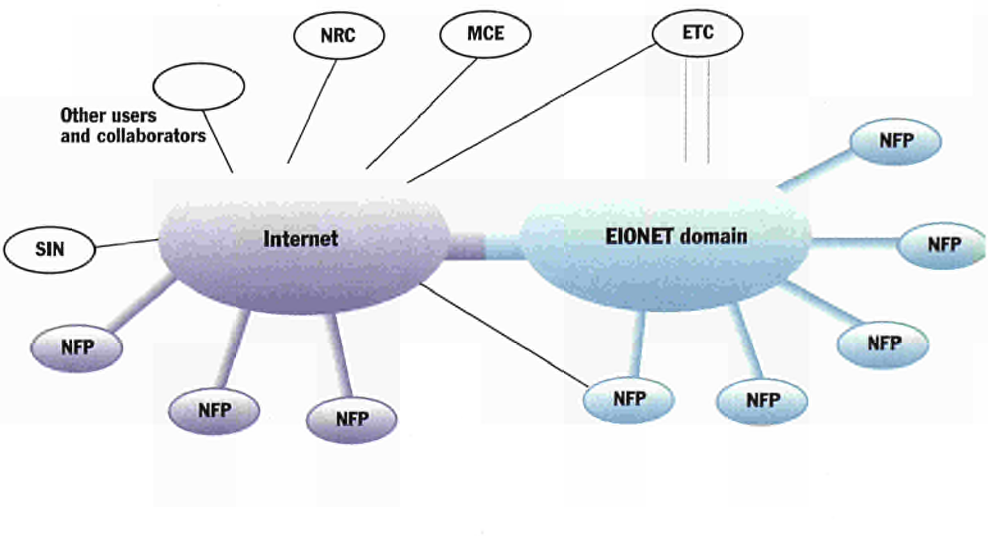

Figure 2: ***The EIONET domain and its connectivity.***
NFP: National Focal Points in 15 member countries included in the current IDA-EIONET project. (Most of them connect through the EIONET domain, but existing Internet connections will also be used).
ETC: European Topic Centres
MCE: Main Component Elements
NRC: National Reference Centres
SIN: Special Interest Networks

Telematics for improving air quality

AIR IS ESSENTIAL for life itself. The quality of the air we breathe is vital to our own health and wellbeing, but also to the whole environment which sustains us. Indeed, 'sustainable development' is increasingly recognised as the only viable option for the future of man and the planet. 'Sustainable development' is therefore a major goal for Europe's economy. This calls for a steady and continual growth and competitiveness of European products and services in the world market – and a parallel improvement in the environmental quality of our industries and cities.

Throughout Europe, especially amongst the people and politicians of the European Union, awareness is growing that this goal can only be achieved through better control and management of the environment. Air quality issues now form an integral part of this process.

Telematics for the environment

Advanced Telematics (information and telecommunications) offer new applications which can help manage the environment and control air quality, and at the same time enable the public to be both well-informed and actively involved. Telematics for the Environment is the name of a new sector in the Research and Development Programme 'Telematics Applications of Common Interest' within the Fourth Framework for Research, Technological Development and Demonstration Activities (1994-98) of the European Union. This new sector, Environment Telematics, has funding of 21 million ECU.

Adding value to quality of life

In the short term, the exploratory action on the environment will investigate how multimedia telematics solutions can add value to improving environmental management, and support other corresponding elements of EU policy: job creation, promoting new forms of work organisation, improving people's quality of life and the quality of the environment, and improving the efficiency and cost-effectiveness of public services.

In the medium and long term, the action aims to contribute to the development of a competitive European market for telematics applications and services in the field of environmental management, and thereby to better the quality of life for the people of Europe by increasing levels of environmental protection, reducing the impact of environmental disasters, and reducing and preventing pollution.

Work in environment telematics concentrates on automatic warning and integrated monitoring systems concerning pollution levels in the atmosphere, rivers or sea. Applications and services will be developed to monitor environmental categories such as urban areas, industrial plants, coastal areas or river basins. Research and demonstration will concentrate on the development and interconnection of information networks and centres, based on existing information and telecommunication technologies.

Wide-ranging projects

As a result of the first call of proposals which closed on 15 March 1995, 18 projects were retained and included in the Commission Decision of 26 July 1995. The twelve demonstrator projects which will be implemented started their work in January 1996. They address a number of environmental applications: integrated air quality control, water quality monitoring, public environmental information services, catalogue of data sources, eco-auditing, and forest fire management. These applications are based on existing technologies: Geographical Information Systems, Data Base Management Systems, Multimedia Graphical Interfaces, Client Server Systems, Remote Sensing, Satellite Communication, ISDN, World Wide Web/Internet, etc.

The 4th Framework Programme: Telematics Applications Projects on urban air quality

Project Acronym/N°	Main objectives	Pollutants concerned	Cities/Regions involved
EMMA EN 1005 *(Environmental monitoring in metropolitan areas)*	Environmental monitoring, forecasting and warning system in metropolitan areas, focusing on urban pollution control (air quality).	CO, NO_x, SO_2, O_3, VOCs, (volatile organic compounds), noise	Athens (GR), Stockholm (SE), Genova (IT), Madrid (ES) and Leicester (UK)
ECOSIM EN 1006 *(Ecological and environmental monitoring and simulation system for management decision support in urban areas)*	Develops and validates a demonstrator for an integrated environmental monitoring and modelling system, for management decision support in environmental planning in urban and industrial areas. The applications and monitoring networks address air pollution, ground and surface water, coastal water and transport emissions.	CO, NOx, SO_2, O_3, PM10	Berlin (DE), Greek Ministry of Environment, Environmental Authorities of the Region of Athens (GR), City of Gdansk (PL)
EFFECT EN 1007 *(Environmental forecasting for the effective control of traffic)*	Environmental forecasting & management for the effective control of traffic in urban areas, and to create awareness of road traffic pollution effects.	CO_2, NO_2, SO_2	Leicester (UK), Gothenburg (SE), Maidstone (UK) and Volos (GR)
ENVIROCITY EN 1008 *(Public environmental information services for European cities)*	Demonstrates and disseminates user-oriented environmental information on cities' environmental operation and management, through the use of telematics (multimedia & via the WWW-Internet).	pollutants in air, climate, water, land-use, vegetation, waste, noise	Munich (DE), Antwerp (BE), Lamia (GR), Vitoria (ES)
TEMSIS EN 1015 *(Transnational environmental management support and information system)*	Transnational environment management support and information systems for authorities and the general public using distributed systems and info-kiosks.	pollutants in air, water, soil, waste	Saar-Moselle Region (DE, FR)
KITE[1] V 2063 *(Kernel project on impact of transport telematics on the environment)*	Development of a methodological framework and a toolkit for assessing the impact of transport telematics technologies and strategies on air pollution; application of the toolkit in case studies for each of the cities involved.	CO, CO_2, NO_x, HC	Athens (GR), Piraeus (GR), Birmingham (UK), Cologne (DE), Southampton (UK), Torino (IT)

[1] Project under 3rd FP implemented in Telematics applied to Transport

The applications mostly belong to two major environmental domains:

- environmental monitoring, information and control systems for the purpose of improved reporting, planning, forecasting, and decision making;
- global emergency management systems to improve prevention, risk assessment, risk analysis and crisis management for time-critical events, in the case of man-made and natural disasters.

Furthermore, European environment information services and applications are being pursued in support of the objectives of the European Environment Agency (EEA) and the Centre of Earth Observation (CEO).

Environmental managers from public authorities from more than 25 European regions and 20 European cities are involved in the projects in the form of public-private cooperation or partnerships, ensuring an efficient implementation of the 'user-driven-approach,' stipulated as one of key objectives of the Telematics Applications Programme. Air quality issues play a prominent role, and several projects will support local authorities in implementing their Local Agenda 21, following the resolutions from the Earth Summit Meeting and conference in Rio during 1992.

Urban user-involvement

Urban air quality and traffic-related emissions, and their impact on the environment, are the themes of the projects described below, which will be implemented and validated as demonstrator prototypes. A special characteristic of all projects is the strong user involvement (e.g. traffic authorities, environmental authorities, environmental consultative groups, the general public) at every development phase of the project. (See table on page 12 for brief summaries).

EFFECT aims to set up an environmental forecasting and management system for predicting poor local air quality in real time and then to instigate effective traffic demand management measures to reduce pollution levels in particular problem areas. The EFFECT system will thus facilitate the integration of air quality models with real-time information on traffic flows, information from local air quality sensors and meteorological sensors, thereby enabling the prediction of pollution 'hot spots.' The traffic demand management system will enable interactive management of traffic conditions and optimisation of the road network operation, based on environmental criteria.

At the heart of the EFFECT environmental management system will be an on-line Air Quality Monitoring and Measurement System with a graphical user interface. A range of demand management tools will be demonstrated at various sites in the cities of Leicester and Maidstone (UK), Gothenburg (Sweden), and Volos (Greece). These include: variable message signs, RDS-TMC (a driver information system, using the 'radio data system – traffic message channel'), PROMISE terminals (mobile traffic information system), SOCRATES vehicles (on-board traffic information based on GSM) and variable urban traffic control strategies.

Increasing public awareness

The traffic information systems utilised in EFFECT have been demonstrated in previous transport telematics projects like the CITIES, SOCRATES, PROMISE and ATT-ALERT projects. Through public information systems such as these, public awareness of traffic-generated pollution effects will be increased. The real-time approach taken in EFFECT is expected to become a valuable tool, also supplementing more strategic and long-term approaches, such as in transport and land-use planning.

The EMMA project (Environmental Monitoring in Metropolitan Areas) focuses on setting up an environmental monitoring and forecasting, information and warning system in metropolitan areas, with special emphasis on urban pollution control, particularly on forecasting pollution levels for a 24-and 48-hour time horizon, and on information to the general public.

Consistent with the proposed directive of the European Commission on Ambient Air Quality Assessment (94/0106), the project will pay particular attention to the development of global air quality indicators. A user reference group with representatives of local, regional and national environment agencies, transport and health organisations will be set up to establish recommendations for such indicators and foster the harmonisation of national and European approaches.

An open system architecture concept will be developed to support a set of generic system functions which are common to all test sites and site-specific functions (e.g. distribution of information to the general public). Demonstrators of the system will be tested and validated in the cities of Genova (Italy), Madrid (Spain), Stockholm (Sweden) and Leicester (UK). The demonstrators will monitor, analyse and distribute environmental data and information in various user-friendly ways, eg utilising Geographical Information Systems (GIS), and information networks such as the Internet or Local Area Networks.

Sophisticated models

The objectives of the project ECOSIM are to develop and validate a demonstrator for an integrated environmental monitoring and modelling system, to support decisions on environmental planning in urban and industrial areas.

The ECOSIM system will be implemented in a client-server architecture with high-performance computing (HPC) where necessary, to run sophisticated models (e.g. atmospheric models, air dispersion and chemistry models, traffic, ground water, and coastal water models) which will allow the prediction of ozone levels to be calculated from road traffic emissions.

A distributed information server will be developed that integrates a broad range of information sources, such as data acquisition systems based on existing monitoring networks, central and distributed databases and GIS components including pre- and post-processing, multimedia information (hypertext, images, maps, animation) and numerical simulation models, partly implemented with HPC technology.

The applications and monitoring networks in ECOSIM address air pollution, ground and surface water, coastal water and transport emissions. The project will target its validation activities through the definition of a number of scenarios, each of which defines specific objectives for the use of ECOSIM at one of the validation sites.

Telematics projects will be a powerful enabling tool for environmental managers and decision-makers, giving them greater power to assess, control and limit damage to the environment.

The principal scenarios demonstrated and analysed will address the following:

- the influence of traffic control measures on regional ozone concentration based on on-line traffic emission data;
- the influence of the sea breeze phenomenon on regional ozone concentration;
- the interplay between pollution in ground water, surface and coastal water.

The scenarios will be tested in the cities of Berlin (Germany), Gdansk (Poland) and the region of Athens (Greece).

Better accessibility

Other projects like TEMSIS and ENVIROCITY will focus on improving the accessibility of environmental information, for the general public, including air quality information. Interactive info-kiosks will not only allow access to environmental information, but also allow people to forward specific requests to the relevant administrations and authorities. Multimedia telematics systems will be implemented to support the requirements of other users as well, such as city planners, local environmental experts or traffic control experts.

The ENVIROCITY project specifically is based on an existing Geographical Information System, database query technologies and the Internet-WWW. Work will include the standardisation of meta-data, and improving access for any international user to existing data, meta-data and information sources on planning, reporting and the general public's decision-making. The information sources will encompass information on air, climate, soil, surface and ground water, also socio-economic environment data and biotic (fauna & flora) information.

Similarly to ENVIROCITY, the project TEMSIS will inform people on the day-to-day changes on air quality in their local environment. Environmental information will be disseminated in central places such as city halls, or to private homes via access to Internet. Furthermore, local authorities will inform the general public living in their area about the potential environmental effects of new planned industrial developments or about the impact when enhancing or changing the transport infrastructure.

Apart from the objectives and the scope of the above projects which will be implemented under the 4th Framework Programme, projects like KITE were implemented in the 3rd Framework Programme.

KITE developed a consistent methodology for air pollution emission impact assessment, i.e. guidelines and recommendations on how to assess environmental impacts of transport telematics strategies.

Empowerment through information

In short, through the exploitation of advanced telematics technologies and applications and the opportunities offered by rapid developments towards a modern information society, projects such as those under the Telematics Applications Programme will empower both the general public and environmental managers.

They will keep the general public better informed on the state of the environment and allow them to be more involved in the process.

Above all, irrespective of whether vehicle emissions or industrial activities are the culprits, the projects will be a powerful enabling tool for environmental managers and decision-makers, giving them greater power to assess, control and limit damage to the environment. ■

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Improving electrical energy efficiency in the home

EU warms to the latest technologies

THE OIL CRISES of 1973 and 1980 had a profound and lasting effect on the economies of Europe and demonstrated the macro-economic impact which a hike in energy prices could have on business development. Industry woke up to the importance of energy charges for production costs and competitiveness.

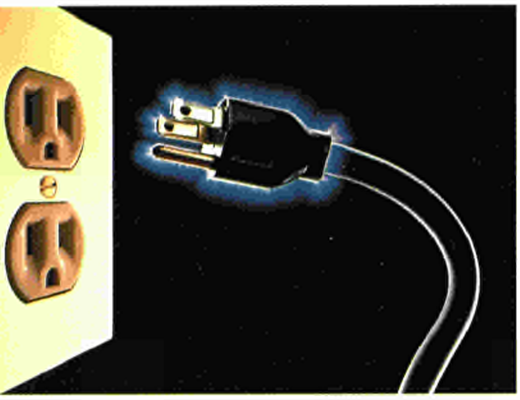
For electricity generators and distributors, the environment has not been the same since. High-quality energy supplies at low prices have come to be seen as an urgent necessity. But the debate has long since broadened beyond purely economic considerations to the issue of environmental protection.

In the late 1960s, the Club of Rome (an influential international group of economists, researchers, scientists, politicians and philosophers) was advocating a slow-down in growth to secure a sustainable pace of development. In the 1990s, reconciling environmental protection with economic development and industrial competitiveness has become one of the primary concerns of advocates of sustainable growth at national and European policy level. The aim of the European Commission's energy policy is to find the cheapest way, consistent with reliable supply and environmental safeguards, of managing the needs of private and industrial consumers.

At the time of the first oil crisis, in 1973, a handful of initiates were witnessing the emergence of the first microprocessors, which have gained considerably in importance over the past 20 years. Since then, research has brought energy savings and more efficient use of electricity.

The advantages of home systems

At present, a number of technological developments specifically concerning the living environment are contributing to the emergence of home systems.



In the 1990s, reconciling environmental protection with economic development and industrial competitiveness has become one of the primary concerns for advocates of sustainable growth at national and European policy level.

A range of applications which will soon be available demonstrate the advantages and economic viability of home systems technology, not just for industry and the electricity distributors but also for the consumer. One of its most promising uses is for managing electricity distribution. The fall in the price of oil (it is now lower in real terms than it was in 1973) and the decline in the price of fossil fuels generally have made electricity prices become less competitive.

Optimising domestic electricity consumption would allow electricity companies to keep a tighter rein on investment, and the consumer would benefit in terms of lower bills and increased comfort.

What the future holds

In the very near future, a simple, user-friendly interface will enable full remote control of the home environment. Press the "night" button and the temperature will fall, doors will lock automatically, lights will turn off and the central heating will switch to standby. In addition, signals sent by the energy distributor to the meter, which in turn sends information through the house's electrical circuits, will enable appliances such as dishwashers, washing machines, tumble dryers and storage heaters to switch on automatically during cheap-rate hours. Home systems technology is palpably making it into the home. The abstract, experimental concept is becoming reality.

Straightening out the consumption curve

European electricity companies today are faced with the problem of optimising household consumption. In the past, they successfully concentrated their efforts on the electrical energy consumed by industry. Today's priority is more efficient management of domestic consumption.

The market for energy savings is influenced by private consumer behaviour. A review of energy issues and public opinion in Europe published by the European Commission in September 1993[1] indicates that European citizens are very aware of the need to reduce the risk of pollution and cut back on energy consumption, with 82% stating it as a priority goal.

In 1994, households accounted for some 30% of total electricity consumption in Europe. The Commission's Green Paper[2] forecasts growth in electricity consumption in the European Union of 2% a year from 1995 to 2000. Annual growth in domestic and tertiary energy consumption could be around 1% up to 2005.

Energy consumption in the course of a day is far from constant. A typical graph would show a curve in the shape of a camel's hump. There is a great surge in demand in the mornings, followed by a slight upturn at midday and another strong burst in the evening, after which demand tails off for the night. The result is that electricity distributors are obliged to invest in expensive supply networks with the capacity to meet peak demand. The oversizing this entails is a real headache for electricity suppliers.

In a bid to encourage energy efficiency, the electricity distributors have taken steps to offer their domestic customers new energy management systems which will allow them to optimise consumption. One option is flexible charge bands. Suppliers have found that, if customers are to adapt their electricity use to charge rates without having to watch the clock, they have to be provided with equipment that automatically takes account of the current charge rate. With these energy managers, consumers can alter their use of electrical installations such as heating systems, and run domestic appliances – washing machines, dishwashers, etc. – during off-peak periods, to achieve the best possible trade-off between comfort and price.

Increasingly, domestic appliances are equipped with "chips" or microprocessors to control a range of settings such as power supply, temperature and cycle duration. Consumers are given detailed information on their energy consumption and the lower-cost off-peak periods. A user-friendly interface enables automated programming of domestic energy management and displays the benefits to be gained from the flexible rate system.

Environmental advantages

Over and above their economic impact, energy management systems of this kind have environmental and social advantages for the community as a whole, in that widespread use would reduce the need for new power stations to cope with surges in demand. This is a particularly pressing problem, as many obsolete sites are due to be decommissioned in the near future.

Optimal management of electrical energy is also of particular interest to European electricity companies in an increasingly deregulated and thus open and competitive market. In the United Kingdom, recently privatised electricity companies have faced major restructuring and the problem of obtaining a return on investment.

In the continuing move towards an internal market in energy, the European Commission proposes action in three areas:

- establishing a transparent and non-discriminatory licensing system for electricity generation and power line construction;
- ensuring operational transparency by unbundling the management and accounts functions from energy production, transport and distribution within vertically integrated companies;
- introducing limited third-party access.

Esprit energy projects

In the field of optimising domestic energy consumption, research teams are studying the options for the practical and appropriate installation of energy managers and monitors and "intelligent" electrical appliances.

With that goal in mind, EDF in France, Iberdrola in Spain, Manweb in the United Kingdom, ENEL in Italy, etc. have formed European consortia to develop systems for domestic consumers which will reduce electricity consumption and enable more efficient use of flexible rates.

Within the Esprit programme, the main impetus for implementing such solutions comes from three European projects for advanced technology transfer:

- HS-COMPOSANTS (EP-6782)
- OPENMAN (EP-7061)
- IDEM (EP-6092)

The key aim of the HS-COMPOSANTS project is to produce components to EHS (European Home System) specifications. These were drawn up under the Eureka and Esprit programmes to ensure that products from different manufacturers are compatible, with a view to harmonising the development of supply. The electricity company EDF (France) is the project coordinator. The other participants are the industrial concerns SGS Thomson (France), Schneider (France), Landis & Gyr (Switzerland), Schlumberger (France), Daimler Benz, AEG (Germany), Philips (Netherlands), Thorn EMI (UK), Thomson Multimedia (France) and the associations ORPHELEC (France) and EHSA (Belgium). The European Home Systems Association (EHSA) also makes a vital contribution by promoting the development of a European standard based on the EHS specifications.

Alternative energy's role

The IDEM project (Integrated Domestic Energy Management) aims to use alternative energy sources such as solar and wind power to complement the national grid, as a solution to the problem of supplying energy to isolated areas and customers. These forms of energy, produced at the point of consumption, will enable regions where supply is poor, such as islands and rural and mountain areas, to meet their own electricity needs and sell any surplus on to distributors. The programme partners belong to a European consortium comprising the companies ENEL and Zeltron in Italy, the Electrolux group's research laboratory, Landis & Gyr in Switzerland, MARI Computer Systems and NADA in the UK, Helgeco in Greece, and the University of Linköping, Sweden.

The ENEL electricity company has carried out experiments in Italy on photovoltaic generators for isolated houses under the European Commission's VALOREN programme. The IDEM project will also extend the television communication interface developed under the Esprit project IDEA-TV (EP-7525) to energy management for isolated houses, with special secondary stations using photovoltaic generators controlled by cellular radio. The system carries out such energy control functions as automatic readings, load and rate management, alarm monitoring, etc. Domestic functions are to be incorporated into pilot installations in Italy and will then be extended to other European Union countries.

Inbuilt intelligence

Zeltron – part of the Electrolux group – is responsible for the introduction of new intelligent domestic appliances. Under the IDEM project, priority was given to the development of "intelligent" plugs, an interim solution pending the advent of washing machines with in-built intelligent systems. The target is for energy management and domestic automation components to be incorporated in domestic appliances for the consumer market at the start of the next decade.

The brief for the OPENMAN project (Optimal Energy Management Configurable System) is to optimise energy management in the home with a view to achieving:

- the long-term optimisation of the energy supply system and the levelling of peak periods,
- energy savings through improved domestic energy efficiency,
- the standardisation of energy management systems and the promotion of such systems in the domestic sector.

OPENMAN is developing a coherent platform comprising an advice and configuration tool (based on an expert system) and an energy manager. The configurator, installed in electricity distributors' sales offices, will tailor applications to individual customer needs. Once the energy manager and intelligent plugs are installed in the customer's home, the various pre-programmed energy management applications can be operated transparently. The companies taking part in this European project are Iberdrola and Keon (Spain), EDF and Schlumberger (France). In the final phase of the project, the platform was piloted on selected sites in France and Spain in late 1995.

Manufacturers will have to bear in mind that, while information technology helps improve control of electricity consumption, it is also a new sector of demand. It is in offices, for example, that the rate of growth in electricity consumption is at its highest, doubling every three years.

The impact of the information society

The advent of the information society and one or more personal computers per household will inevitably generate an increase in electricity consumption. Up to now, information technology take-up has largely been confined to the business sector, but by the end of the decade the market for domestic PCs in various guises (conventional PCs, intelligent communication terminals, games consoles, CD-ROM drives, etc). will have far outstripped demand from industry.

According to a study by Professor Jacques Roturier (University of Bordeaux), the IT equipment used in office buildings in the tertiary sector consumes between 50 and 100 kWh per m2 annually – some 25% of total electricity consumption. The report estimated the electric power needed to operate the 34 million microcomputers in use in the European Union in 1991 at between 7 and 10 GW, or the equivalent of 10 or more 1,000 MVA generating units.

To reduce the electricity consumption resulting from the rise in the number of microcomputers in use, manufacturers have developed systems and procedures whereby the screen display shuts off fully or in part after a set period when the computer is not in use. Automatic screen savers cut energy consumption by between 60% and 70% compared with conventional hardware. The industry has also succeeded in optimising the electricity consumption of components, both through technological advance and by adapting the concepts developed for portable and mobile computing.

Any attempt to limit the consumption of electronic appliances must involve an overall improvement in current quality and thus a reduction in electricity loss on the part of energy producers and distributors. We need to move swiftly beyond the present stage of introducing standby modes and on to devices designed with an architecture based on the dynamic management of electricity demand, thereby allowing systems to manage their own electricity consumption according to actual use.

Sophistication through symbiosis

The advent of the information society will probably require symbiosis and complementarity between communication systems, in the bid to achieve an ever greater degree of sophistication. Electricity distributors plan to supply high value-added multimedia services. The 3-year Esprit project ETHOS (EP-20304) will involve more than 1,000 pilot tests in Denmark, France, Italy and the United Kingdom to develop an optimum solution for domestic energy management to EHS specifications and supply value-added multimedia services.

The consortium comprises a number of electricity companies – Midlands Electricity (UK), SWALEC (UK), London Electricity (UK), Eastern Group (UK), EDF (France), DEFU (Denmark) and ENEL (Italy) – centred on the EA Technology research centre (UK), Bristol University (UK), SGS Thomson (France) and Schneider Electric (France).

Electricity distributors are set to play an increasingly active part in the development of multimedia services in the near future. They also have a significant contribution to make towards promoting the information society. ■

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White Paper: *An energy policy for the European Union* COM (95) 682 final, January 1996.

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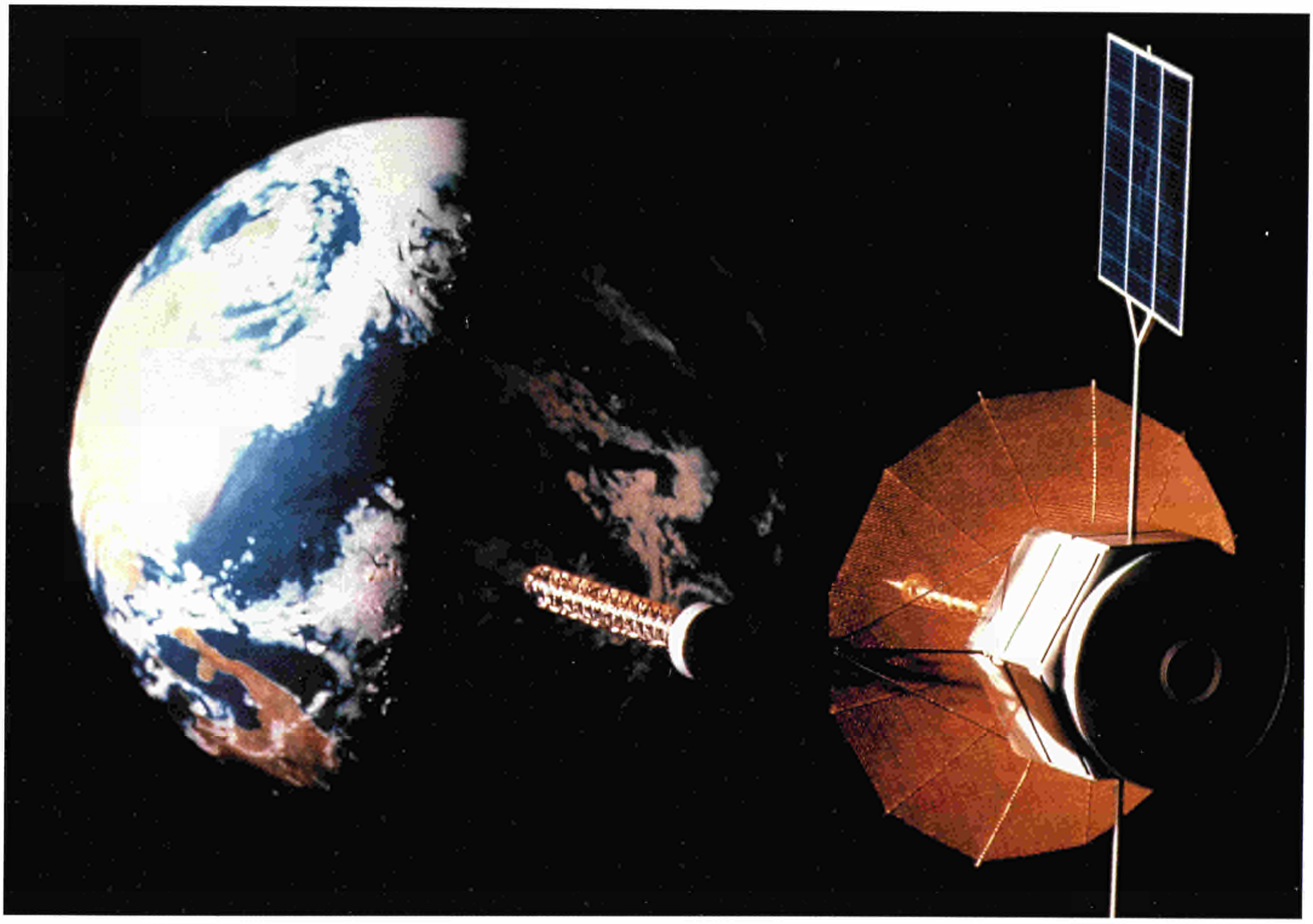
Girdling the earth

Earth observation data distribution via satellite



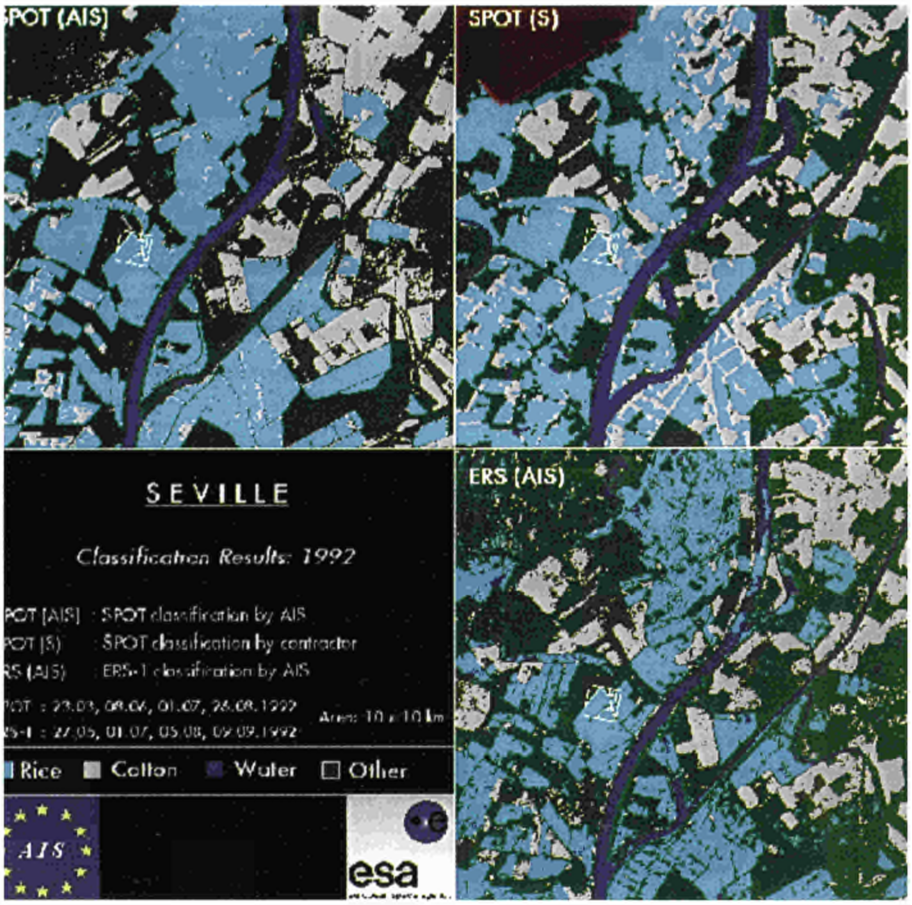
Eerily beautiful images of the earth, taken by remote sensing satellites girdling the planet, have already become familiar to us through television and magazine pictures. The information provided by these as they cover the earth's surface, including the remotest and most inaccessible places in the world, is reliable, continuous, repetitive, non-invasive and non-destructive, as well as rapid, accurate and cost-effective. These features are of crucial importance to environmental management, in which earth observation data via satellite now plays a key role.

Remote sensing satellites help measure and monitor the earth's climate and environment, including changes in the weather, sea and land temperatures, winds, ocean currents, volcanic and seismic activity. They can also track the influence of man on the environment, both urban and agricultural, observing crop growth, pollution of land, rivers, lakes and seas, and spotting potential disasters caused by fires or flooding.

"I'll put a girdle round the earth in 40 minutes!" *(**A Midsummer Night's Dream**, Shakespeare)*

The images they produce are being increasingly used for a variety of applications which support the policies of the European Commission, including environmental monitoring, land use control, mapping, flooding surveillance and prevention, etc. Indeed, the Commission is the largest consumer of earth observation satellite data in Europe. But just how is the data that produces the image actually distributed?

First, of course, there is the reception of the raw data from the satellite itself. As an example, let us consider the reception and distribution of high-rate data from the ERS-1 satellite[1] of the European Space Agency (ESA). This satellite carries a very powerful instrument, SAR[2], which is an advanced microwave radar, and has the advantage, particularily for Europe, of being able to 'see through' clouds, thus providing imagery on a 24-hour a day basis. This instrument produces data at a very high rate – up to 105 Mbps.



Estimating crop coverage in Europe.

The three main stations which receive data direct from the satellite are at Kiruna (in Northern Sweden), Fucino (inland from Rome), and at Mas Palomas (in the Canaries). There is a first processing of the raw data at these stations, and then dissemination via the so-called Broadband Data Dissemination Network, which allows the transmission of 'Fast Delivery' images from Kiruna or Fucino, nominally within 24 hours of data sensing, to designated centres in Europe (one per country in Europe), using a Eutelsat satellite for image transmission. The nominated centres then distribute the data to end-users.

What this means is that a user can now have in his hands data only 24 hours old – essential for monitoring oil slicks, routing ships, or monitoring ice movements in, for example, the Baltic – and remember, until recently, the user had to wait weeks or even months to receive such information. The use of the communication satellite links to distribute data direct from the initial earth observation receiving stations has thereby opened up the possibility of a whole range of 'near real-time' applications that would have been inconceivable until now.

The Kiruna and Fucino stations also distribute data over the same satellite link to the European Space Agency's ESRIN[3] site at Frascati, just to the south of Rome. This houses the EARTHNET facility, which forms the main European data archive centre for a range of earth observation satellites – not just European, but American and Japanese also.

Nowadays small VSAT[4] terminals on the roofs of many office blocks and business centres are a familiar sight. However, it is worth looking back to 1982, when the ESRIN computer building had a small antenna on its roof for links to the OTS[5] demonstration satellite which preceded the Eutelsat system – and for the first time the Italian authorities had to confront the regulatory problems of small terminal communication satellite systems.

The solution initially proposed was to install the 1.5 metre antenna at the main Italian ground station site at Fucino, 120 km from Frascati, then install a dedicated microwave link to carry the signal between the two locations. However, logic finally won and the antenna duly arrived on the computer building roof.

We have seen above how satellites can be used to speed up the distribution of data from the point of reception from the earth observation satellite to national centres. Next comes the distribution of data throughout Europe to users. In the past this has been called the 'black hole' of earth observation in Europe – lots of data going in and none coming out.

To overcome this problem, a joint action is being undertaken by the Commission and the ESA known as the European Earth Observation System (EEOS). The Commission element is the Centre for Earth Observation, funded under the Fourth Framework Programme.These partners are complemented by national activities, industry elements, intergovernmental agencies and European parts of international organisations. EEOS aims to:

- provide a framework within which all relevant elements within Europe may come together to form a coherent whole, making it easier to access and use the wealth of data and information available;
- encourage users to develop applications that incorporate information derived from earth observation data;
- establish services that will make data available to the widest possible user community;
- provide a distributed decentralised network – both a physical network of facilities across Europe, and at the same time a human network of suppliers and users.

However, EEOS will not have its own network, but will rely on the developing Trans-European Network infrastructure that is being stimulated by Commission activities.

Of course, satellite systems will only be an element of the infrastructure, but there is a clear role for VSAT systems with their capability of connecting widely dispersed points, quickly establishing broad-band links, or providing links to areas of difficult geographical access. Examples of this may be found in two projects in the ACTS programme (Advanced Communications Technologies and Services):

- SUNRISE, which uses VSAT technology to link up some of the less-favoured regions of Greece, Italy, Portugal and Ireland. This project can be used to implement the EEOS access links from these countries;
- STEN (Scientific Trans-European Net) to interconnect different locations in Portugal, Spain and Switzerland using satellite links, which could give EEOS an extra set of access points and user interconnections from these countries via a separate non-terrestrial means.

Finally, there is the possible use, for certain requirements, of direct broadcast satellite (DBS) techniques. We are all now familiar with small dish antennas mounted on rooftops, but there is no reason why they could not be used for data reception – in this case earth observation data – rather than entertainment television.

An example of this is the MAXICAST system, which has been tested between ESRIN and sites in Belgium and the Netherlands. During the trials, ESRIN operates the local transmit front end and server for correct scheduling and forwarding of transmission requests originating from local data sources to two different data broadcast facilities, located in Belgium and the Netherlands.

Four stations are located at ESRIN and two in Brussels, with antenna diameters ranging from 90 to 120 centimeters, acting as transmit (data server) or receive terminals. The trials exceeded expectations, and it is now envisaged to operate the system on a full-scale basis.

Thus we see applied to the distribution of earth observation data the gamut of satellite communication systems – bulk transfer of data from the main receive stations to national centres using comparatively large antenna dishes; the use of VSAT systems as an element of a pan-European data distribution network; and finally the use of direct broadcast techniques to get data to end-users. This amply demonstrates the synergy between the two main satellite applications areas: earth observation and communications. ■

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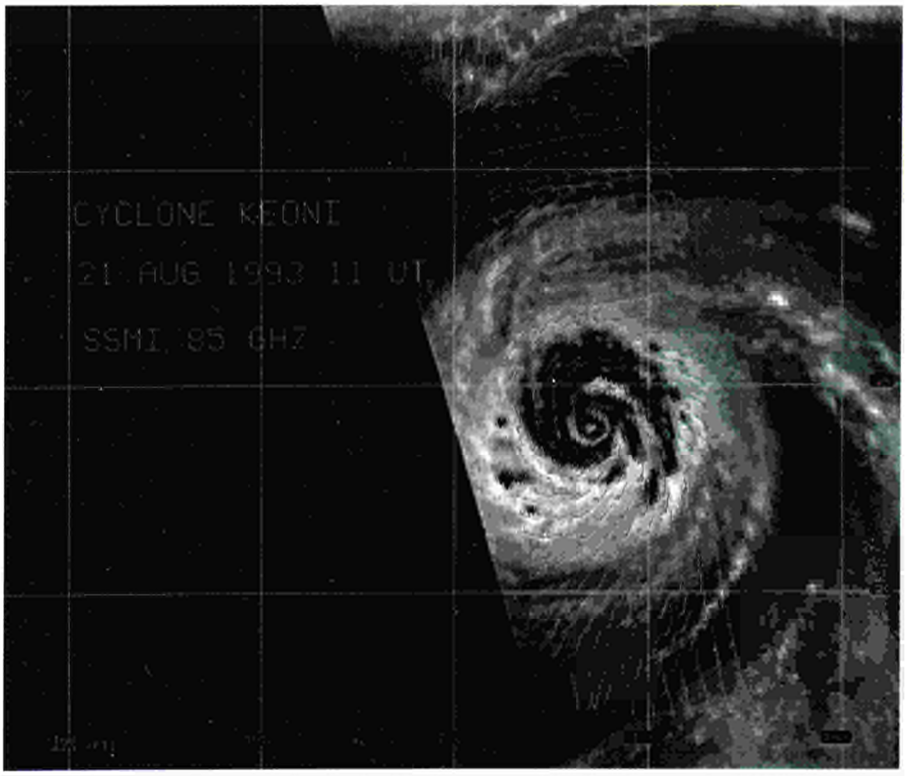
Key to acronyms:
[1] ERS-1: European Remote Sensing Satellite –1
[2] SAR: Synthetic Aperture Radar
[3] ESRIN: European Space Research Institute
[4] VSAT: Very Small Aperture Terminal
[5] OTS: Orbital Test Satellite



Forecasting at the European Centre for Medium-range Weather Forecasts (ECMWF)

European process industries – turning environmental adversity into business opportunities

PROCESS INDUSTRIES underpin the wealth of European manufacturing industry. A wide variety of processes provide raw materials and intermediate products which are ultimately used by consumers in Europe and across the globe.

However, this material conversion brings the accompanying problems of emissions and unwanted by-products. Moreover, many production plants are relatively old, yet cannot be economically replaced in the near future.

Historically, industry has been accused of at worst ignoring environmental consequences, and at best of reacting grudgingly to governmental legislation on the environment. Whilst an adversarial relationship has at times existed between industry and the public, there are indications of industry mounting a concerted campaign to address long-term environmental issues.

The key enabler for widespread, systematic environmental improvement is information technology (IT). The advent of reliable IT offers new and exciting ways to control and contain environmental performance. For many years it has been applied in product design to ensure safe handling and to reduce waste, in process design to minimise emissions and reduce inventories. Now the capacity of modern high-performance IT to handle and analyse massive data flows extends this potential still further.

Several industrial initiatives are taking practical steps towards better environmental management. In particular, the Esprit programme is already making an important contribution towards shaping new environmental management tools.

Towards better environmental care

A first step in the environmental arena was the voluntary "Responsible Care" programme. This is an international voluntary initiative which aims for continuous improvement in all aspects of health, safety and environmental protection. Initiated in 1984, it now involves 36 countries, including all those in Europe. Amongst its guiding principles are requirements to:

- operate to the best practices of the industry
- assess the actual and potential health, safety and environmental impacts of company activities
- work closely with authorities and the community to achieve the required levels of performance.

The next step is the pro-active use of an environmental focus to unlock better business performance. A combination of collaborative teamwork and innovative application of technology is now demonstrating solutions to existing problems. This constitutes good news for Europe's process industries – it gives an additional impetus towards profitability and competitiveness and creates new business opportunities.

The Intelligent Manufacturing Systems (IMS) initiative is another example of high-level international collaboration on working towards clean manufacturing. Prominent technologists from the European Union, EFTA, Japan and the USA have met and developed an outline programme for research into new sustainable process technologies.

Up-rating existing assets with IT

Industry is now well aware of the need for sustainable use of technology in order to survive. Process designers are now focused on trying to achieve "zero emissions" plants.

Whilst it is possible to 'design out' the effluents and emissions on new process plants, this option is not readily available for many existing plants. At first sight, some of Europe's older assets seem doomed to be phased out by advancing legislation.

The operations manager on a plant is constantly confronted with problems of where to allocate funding in order to obtain maximum impact on environmental issues. Typical questions faced on industrial sites include:

- How can I get information on what is really in that drain?
- What is the average composition of that stream?
- If I want to be ahead of the game, how can I measure concentrations at very low levels?
- How can I tell where a gas leak is occurring on my plant?
- How do I know whether I am within my constraint limits?
- The latest batch of feed stock is of pure quality. How should we run our reaction unit to avoid a smoke plume?
- A temperature inversion weather condition has been predicted. How should we amend our plant operation so that we do not exceed the compliance limits?
- We have tightened up our process but how can we prove to interested parties that we are inside our compliance limits?
- I am measuring information from all sorts of analysers and sensors, how do I make sense of it all?

The approaches discussed below demonstrate how collaborative IT projects are improving the quality of the information available for decision making.

A collaborative approach

The operational problems outlined above are faced by most process manufacturing companies, whether large or small. The technical complexities required to achieve suitable solutions are often unaffordable for many companies. Recent de-layering of organisations in Europe has meant that most companies are unable to provide in-house resources to design and apply technology to solving these problems. Consequently there is now a growing awareness that a "go it alone" approach is simply not viable.

The Research and Technology Development programmes funded by the European Commission have been encouraging targeted R&D by supporting multi-national industrial collaboration teams. Projects are aimed at pre-competitive research and development work. This means that companies may work with other potential competitors, safe in the knowledge that their joint output will ultimately provide usable infrastructural solutions.

Environmental issues, at one time seen as "grudge spending," can now be viewed as a opportunity to pool problems and potential solutions and then share development risk. A collaborative approach also has the advantage of wider industrial applicability and acceptability.

The complementary environmental Esprit projects, PRIMA, TESS, EMS and TENPRO, outlined below, demonstrate this collaborative approach.

Working out industries' future needs

PRIMA (Process Industries Manufacturing Advantage through IT) is a new initiative launched in fifteen major EU producer companies, which coordinates process industry users to establish and codify future information technology needs. These will be posted to the IT vendor community in order to prioritise and stimulate innovative and appropriate industrial solutions to process industry problems.

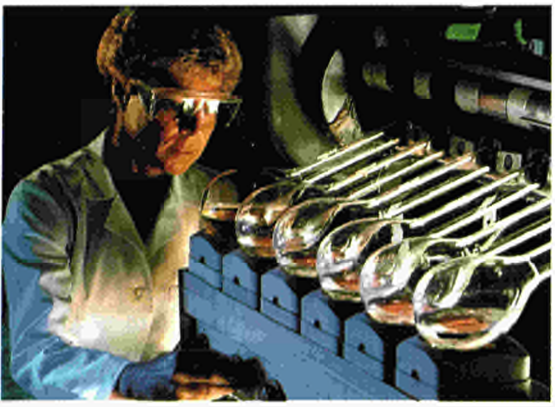
One of the issues to be addressed by PRIMA working groups is how IT can be used to coordinate diverse, distributed decision-making about environmental management. The PRIMA group expects to cross-fertilise a number of recent and current initiatives on this issue.

Smart sensors at the sharp end

TESS (Total Environmental Sensors and Surveillance) tackles the well-known difficulties of measuring complex open gas streams in an industrial environment. Currently measurements are usually taken using expensive analysers in off-line laboratories. The sensors and their associated equipment are often unreliable and produce results a long time after the event. These sampled measurements also suffer from being only single "snap shots," only repeated some time afterwards. Even when reliable, constant and regular measurements are available, the manager is often not presented with sufficient data to pinpoint where the problems are.

The TESS project aims to analyse the composition of gases in open air and vents at the low concentrations which could occur when a leak happens on a plant. Advanced microelectronic technology is used to construct photo-acoustic sensors and gas cloud imaging devices.

Arrays of these detectors are deployed on the boundaries of a production plant. Because the detectors are passive, the system does not require careful alignment and so can be used to sweep the area. A single instrument will



> **"Good environmental performance and business objectives go hand in hand. It is not something extra which companies need to do for moral or corporate responsibility reasons. It is an integral part of ICI's business strategy to achieve a sustainable future."**
> **Charles Miller-Smith**
> **(Chief Executive Officer, ICI)**

detect and track volumes of gas over kilometre distances.

A TV camera is mounted coaxially with the gas cloud imager so as to provide a background image of the instrument's field of view. These signals allow a spatial image of the air purity to be constructed on the associated computer. The display shows a colour-contoured image, which can then be combined with video camera images. This functions in a similar way to a medical body scanner so that operations personnel may detect where on the "body" of the plant the malfunction has occurred.

The TESS project points the way to future applications where operations managers will be able to tackle environmental problems systematically, assisted by spatial computer diagnostics.

EMS (Environmental Management System), piloted on the River Seine in France, is aimed at assuring regional water quality. Whilst multiple sensors are used to monitor water quality, it is impossible to place sensors on every meter of the river. Instead sensor data is augmented by laboratory samples plus reports from physical observations by water police, firemen, fishermen and members of the public. This information arrives at different times in differing ways. The challenge is therefore to fuse together all the measurement, sample and report information so that an overall picture can be painted and used to understand the sources of spillages. Once the data has been amalgamated, the system provides information and reports for a variety of end-user groups.

Real-time site environmental management

TENPRO – (Total Environmental Protection Project) aims for a comprehensive solution across large-scale sites. The problems of measurement, detection and information fusion are often compounded on a major chemical site. Here multiple plants utilise share facilities. Legislation requires managerial control at individual plant and site levels. It is not possible to predict when plant incidents or breakdowns could occur simultaneously. The problem facing the operations manager is how to achieve total environmental accountability at all times across the whole site.

This requires a rapid assessment and signalling of impending consent violations. In addition, whilst the gaseous emissions may under normal weather conditions be well within consent limits, some weather conditions can cause abnormally high concentrations of chemicals.

In the early 1990s, there was no IT tool available for the continuous monitoring and quantifying of an industrial process's environmental performance and impact. Recognising this, ICI, the chemical manufacturer, and EDP, the Portuguese electrical utility, together with SEMA, a major European software house, formed a partnership to submit a proposal to the European Commission to develop such a tool. As a result the TENPRO project was set up to address these site environment management issues.

A TENPRO system utilises a real-time measurement plus keyed-in observations to warn of impending problem conditions and produce statistical reports. On-line computer models allow the system to give early warning. This type of approach is expected to supersede paper-based compliance records in future, and the project should provide a model for managing environmental issues on production sites.

Prototype installations are being tested on a Portuguese power generation site and at a major chemical complex in Northwest England.

Competitiveness and employment

A policy of pollution prevention, in particular through a generalised development of clean products and processes, will not only avoid rapidly increasing clean-up costs but also stimulate a faster diffusion of R&D results. The resulting 'first-mover advantage' will contribute to strengthening the overall competitiveness of European industry.

A new set of business-minded environmental instruments is to be exploited in industry. A start has already been made through eco-auditing, eco-labelling, voluntary agreements, liability schemes etc. Some of these instruments will create new job opportunities, particularly in environmental services, which is definitely a growing market. New jobs could be created in the following fields:

- Maintenance of natural areas and public areas (local waste recycling);
- Water purification and the cleaning-up of polluted areas;
- Monitoring of quality standards;
- Energy-saving equipment, particularly in housing.

Environment-friendly processes

In the present context of global competition, the technologies in environment-friendly processes and the organisational requirements for introducing them must fit with the concept of lean manufacturing (e.g. less energy, fewer raw materials). They constitute a significant improvement and also foster competitiveness. According to Charles Miller-Smith, Chief Executive Officer of ICI:

"Good environmental performance and business objectives go hand in hand. It is not something extra which companies need to do for moral or corporate responsibility reasons. It is an integral part of ICI's business strategy to achieve a sustainable future."

Moving beyond production processes to product markets provides an additional dimension for industrial competitiveness. Markets for environmentally-sound products provide an incentive for firms since they represent an added source of potential profits. As stricter environmental requirements are imposed on export markets, the application of clean technologies becomes a condition of access to these markets.

The 'eco-industry' is now widely accepted as a quickly expanding industrial market, and according to OECD studies will expand considerably in this decade. It covers not only the supply of goods and services to firms for the control or abatement of pollution, but also the expenditure on improved production methods or products, as well as the markets for environmentally-sound or 'green' products.

New environmental opportunities

Environmental monitoring and management systems represent but one example of new eco-industry opportunities. The initial research activities of these projects can be expected to provide "first mover advantage" into eco-services. Emerging products and services will be applicable to wider world markets.

On the basis of the latest estimates, the world market in environmental products and services is now worth some 100 billion ECU per year. This could reach 270 billion ECU by the year 2000. The market for environmental protection products is growing rapidly, especially in the industrialised countries, with an estimated average rate of growth of between 5% and 6% a year. In the year 2000, the largest national market is expected to be the United States, accounting for 38% of the total. Europe is expected to account for 26%.

European process industries are entering a new era of environmental management which goes beyond rhetoric and philosophy. The initiatives described demonstrate an emerging ethos of self-help in industry, thanks to technology and collaborative cooperation. ■

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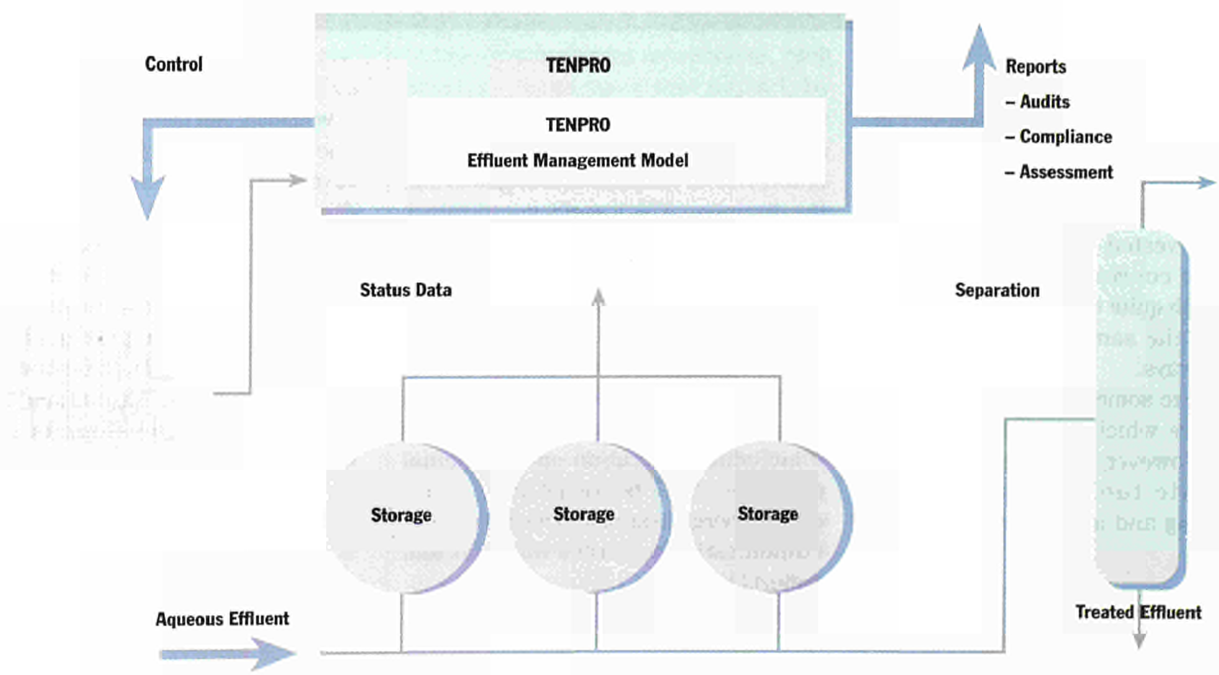
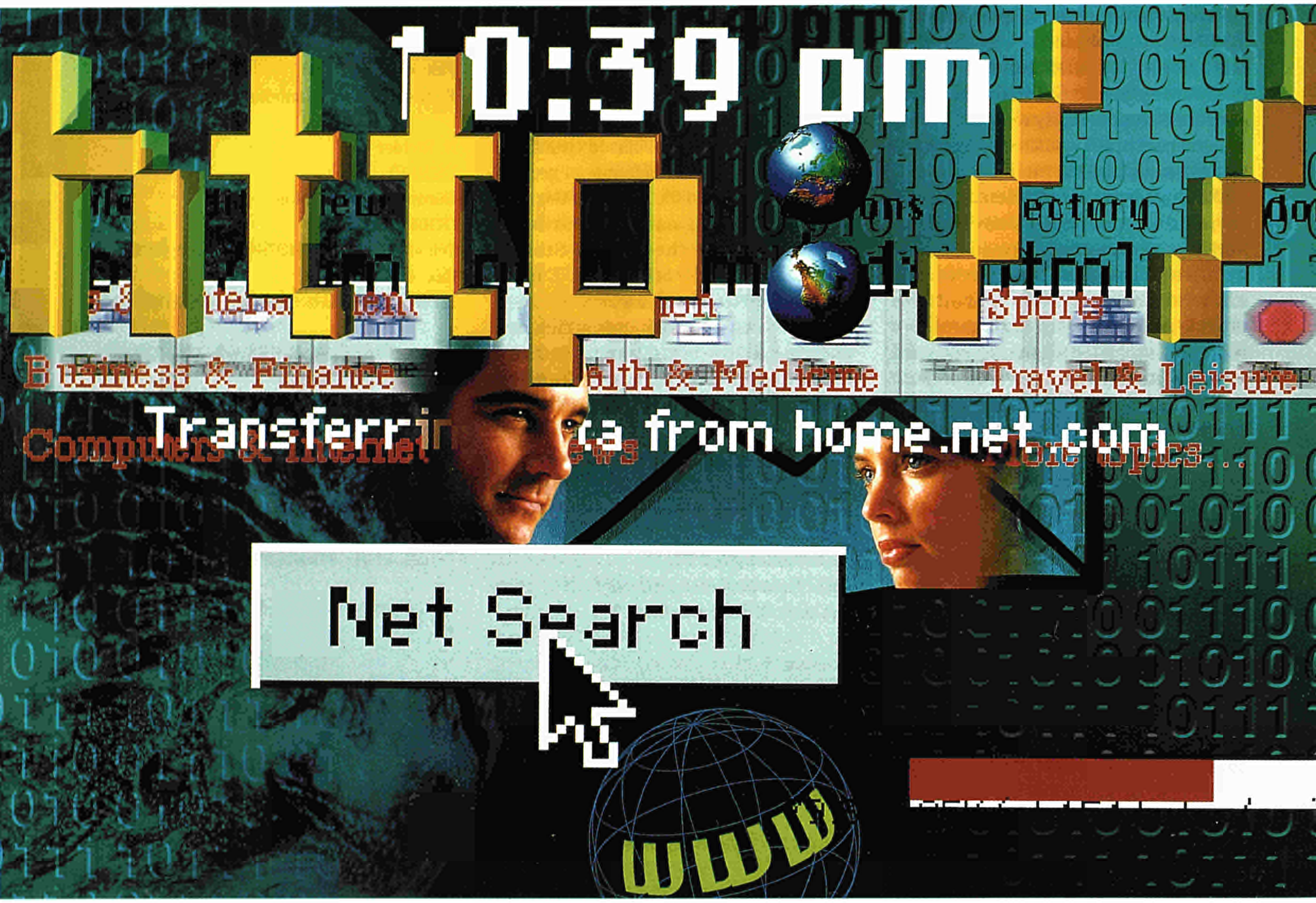
Total environmental protection project



Information engineering and environmental change



INFORMATION IS AN ESSENTIAL COMMODITY in the struggle to contain the world's environmental problems and find new ways of conserving limited resources. Not least, vested interests have often sought to control information, and parties with quite different agendas can interpret the same data in radically different ways.

There are some fundamental human issues here which no technology can resolve. However, a new generation of electronic tools for gathering, distributing and analysing data could make more information more widely available to more people. The key to this enterprise is information engineering, the discipline which seeks not to gather or create new data, but to develop new ways of finding and using information which may now be difficult to identify, collate or manipulate.

Through the Information Engineering programme, the European Commission is now supporting a number of projects – including several on environmental themes – which are helping quite different organisations to work together collaboratively, across national and cultural borders.

New models and methods

The TWENTY-ONE project, for example, is developing a model for the distribution of large multimedia documents through channels including the Internet, the World Wide Web and CD-ROM. One document in particular provides the exemplar in this pilot project – Agenda 21, the statement of goals and potential programmes relating to sustainable development which emerged from the 'Rio Summit' of June 1992.

Agenda 21 has already been published on the World Wide Web, and its address is: http://www.ciesin.org/datasets/unced/unced.html. – However, even in this format it would more accessible if it enjoyed better facilities for identifying, analysing and utilising the information which it contains. Through Agenda 21, the TWENTY-ONE project is developing resources not only to improve access to this seminal publication, but for use with similarly challenging documents of many kinds.

The TWENTY-ONE project represents a consortium of eleven organizations from five countries, including Climate Alliance (Germany), Environ Trust Limited (UK), Friends of the Earth Europe and VODO (Belgium), the MOOI Foundation and TNO TPD (Netherlands), together with the universities of Twente and Tübingen, the Rank Xerox Research Centre (France), DFKI (Germany) and Eolas (UK), under the co-ordination of Getronics Software (Netherlands). In this collaboration, both environmentalists and technologists stand to benefit from a project which enhances the electronic publication of complex text files and multimedia resources.

A related project, GEOMED (Geographical Mediation Systems), is experimenting with the use of electronic networks to distribute geographic information (GI), and support 'shared workspaces' on the computer screen. GEOMED brings together ten organisations from five countries, in three pilot applications.

In the urban planning departments of Tilburg and Bonn, GEOMED will support collaborative working with geographic information. In Tuscany, planners at three levels of government (municipal, provincial and regional) will use GEOMED to assess the potential environmental impact of large public works such as a proposed high-speed train route. Through GEOMED, architectural and engineering companies in Greece will experiment with the exchange of geographic information over local and wide area networks (LAN/WAN).

The common objective of these quite different projects is to make information more accessible, without demanding a new order of computing skills from users whose knowledge and aptitude may lie elsewhere. The ultimate combination of these new resources with the power and potential of the Internet and World Wide Web could considerably influence developments, public and private, in many sectors.

ProNet, another Information Engineering project, is looking at ways of conveying information which will facilitate recycling at an industrial level. This is essentially a feasibility study which focuses on the electronics industry, where many complex products contain components which could be profitably recycled if the right information were available to everyone in the supply chain from manufacturer to recycler. ProNet is being developed by a consortium of nine organisations from four countries, in an alliance of industrialists, technologists and environmentalists ranging from Sony Deutschland to the Netherlands' Institute for Applied Environmental Economics.

None of these three projects is inherently environmental: rather, all three are primarily concerned with making complex information of various kinds easier to find and to use. However, in the environmental arena alone, such services could have real impact, by helping more people to find and use information which is now too much the preserve of the select few with the tools (or patience) to exploit it.

What is Information Engineering?

'Information Engineering' may sound like something from the pages of speculative fiction – a good name, perhaps, for one of those shadowy corporations whose dabblings in weird science propel the plots of so many high-tech Hollywood blockbusters.

In fact, information engineering is simply a new term for the old business of transforming information into products and services which people can

Both environmentalists and technologists stand to benefit from a project which enhances the electronic publication of environmental information.

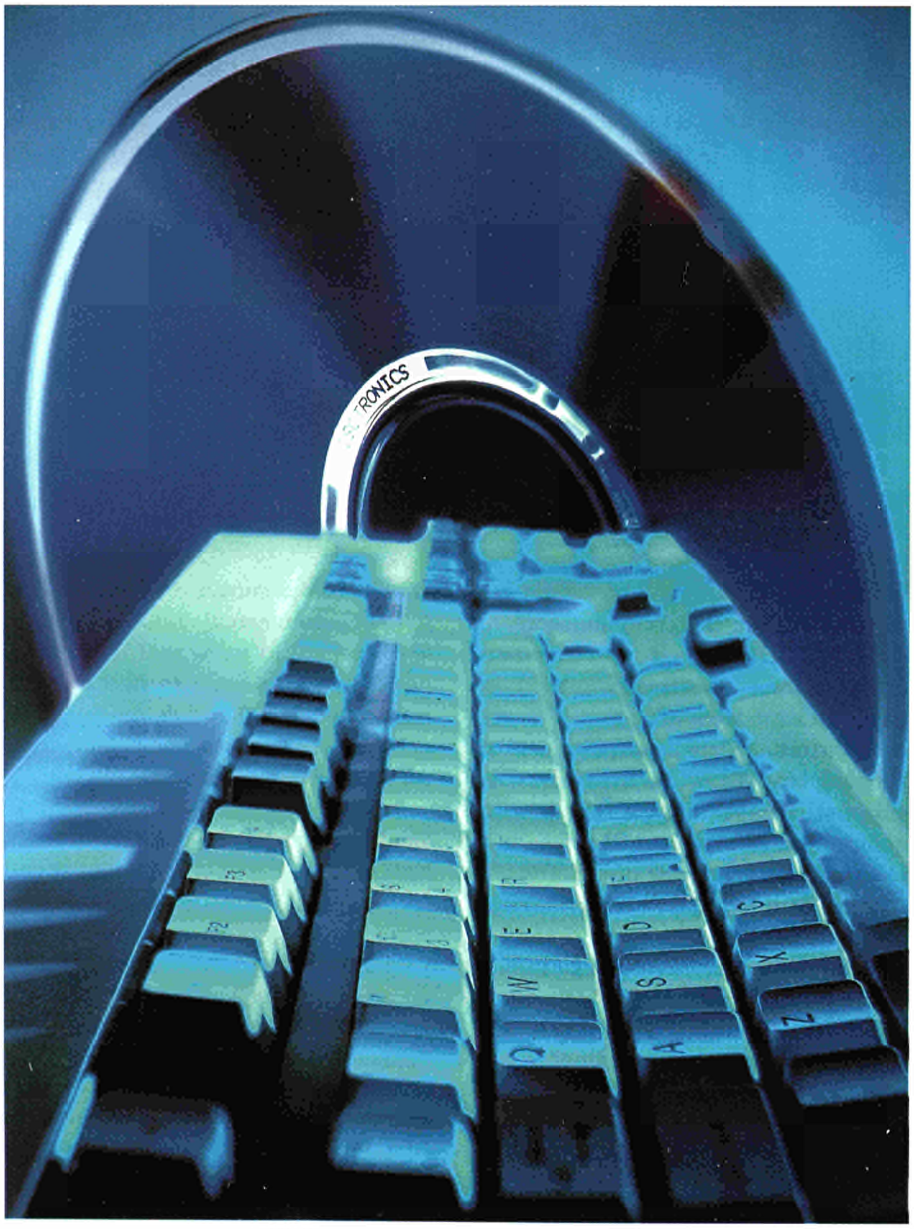
actually use. The fundamental process is common to engineering of all kinds, from the ancient skills of civil engineering to the modern innovations of aeronautic engineering: the application of scientific principles and manufactured components to the design, construction and maintenance of objects and systems. But where the familiar achievements of engineering are manifestly physical – roads and bridges, fortifications and machines – information engineering trades on the new frontier between the tangible tools of data collection and processing, and the essentially intangible resources of intellectual property and electronic information systems.

There is obviously common ground between information engineering and electronic publishing, that dynamic new sector which now broadly embraces distribution channels from teletext and video games through computer software and compact discs to the Internet and World Wide Web. Information engineering also addresses the challenge of multimedia, which incorporates text and data, still and moving images, animation and sound in a variety of electronic formats and systems.

The Information Engineering Programme

Information Engineering forms one of the twelve strands in the European Commission's Telematics Applications Programme. The Information Engineering programme is currently part-funding nine pilot applications, together with ten smaller 'preliminary phase pilots' (PPPs), and a handful of other activities. The I*M Europe Web site provides a comprehensive introduction to the programme at http://www.echo.lu.

The object of these projects is not to develop new content, but to exploit existing resources which have yet to realize their full potential in interactive electronic formats. (For those engaged in creating resources, the Commission's INFO2000 programme, which began



last year, is exclusively concerned with content).

Some of the other nine main pilot applications are specifically developing new information systems for niche markets. AQUARELLE is creating a network of databases, research papers and multimedia resources in the field of cultural heritage, while MAID is establishing electronic Design Information and Design Service Centres for industrial designers and their suppliers. MAGICA is developing information resources for business-to-business and business-to-consumer services.

New aspects of electronic publishing take these concepts a step further. EUROPE-MMM explores ways to distribute text-based and audio-visual resources selectively so that, for example, a college lecturer could cost-effectively assemble a tailormade package of learning materials for any one course or topic.

MBLN enhances the potential of local newspapers to provide new electronic publishing and advertising services in the communities which they serve.

Multimedia Broker is assembling a suite of support tools, guidelines and procedures to help publishers and other content owners to develop new multimedia products incorporating resources already to hand.

WATIS aims to make job-hunting easier by posting vacancies from employers and resumés from job-seekers in public kiosks which could also include information about employment opportunities in other parts of Europe.

If projects such as TWENTY-ONE, GEOMED and ProNet could be extended beyond the environmental sector to provide new models in other markets, it is not difficult to see how these other Information Engineering projects could similarly be applied to information services and electronic publishing on environmental themes. Not least, by making information about research, products and services more easily available, such projects could encourage end-users in many sectors to make positive environmental changes in their own working practices.

Building on experience

A number of these Information Engineering projects are based on successful earlier work by key members of the consortia. For example, TWENTY-ONE builds on a model for electronic document distribution from MOOI, ProNet draws on a recycling scheme supported by Sony, and WATIS is based on a Work Information System which has already helped to fill over 100,000 jobs in Belgium.

At every level in the Information Engineering programme, there is a strong emphasis on measured progress, building on past experience. During 1994/95, the Information Engineering programme supported 22 feasibility projects and nine other studies, and current activity includes four 'support issues' designed to help the consortia gain from one another's expertise.

The new buzzword here is 'concertation', an old word recoined to distinguish this frank exchange of experience from more familiar concepts of harmonisation or integration. Concertation recognises that different approaches to a common problem may yield equally valid or appropriate solutions: the aim is not to find a single answer to a complex question, but to pool resources so that more options are easily available in the future. This is the essence of Information Engineering.

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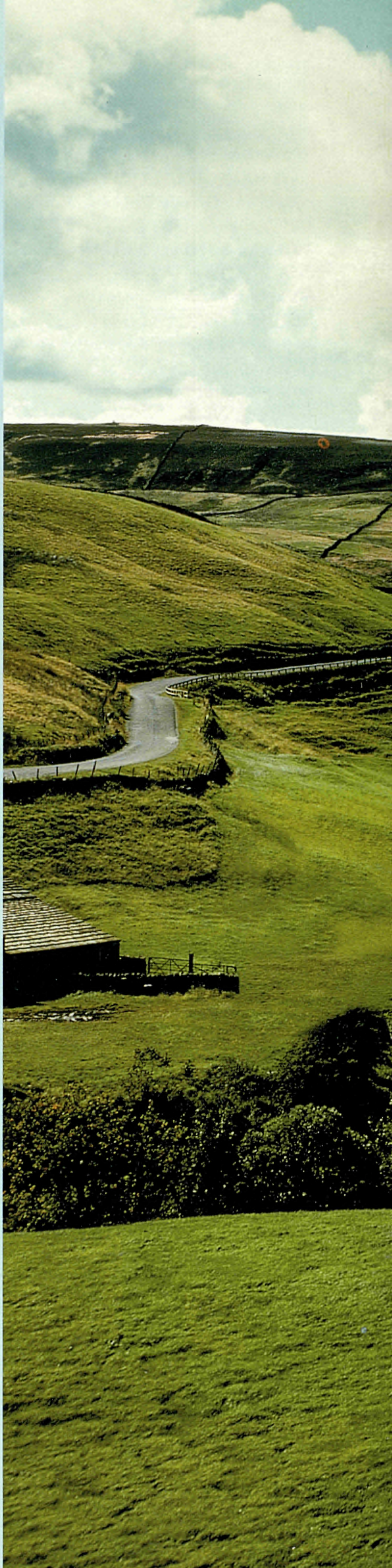

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