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Technological Studies

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Introduction and executive summary

The Institute for Prospective Technological Studies (IPTS) is one of the seven research institutes of the European Commission Joint Research Centre. It was created to help exploit technological change, in the broad policy sense, through a better understanding of the links between technology, economy and society. The IPTS supports public policy making in those areas that have a Science and Technology component and it analyses, interprets and communicates the implications for Europe of changes in technology taking place world-wide.

In July, 1995 Edith Cresson, Commissioner for Research, Education and Training set out the threefold mission of the Institute for Prospective Technological Studies:

- to ensure a constant technology watch activity within the European Union;
- to undertake research focusing on technology-employment-competitiveness;
- to carry out work on request to meet the needs of other Commission or European Parliament services.

In order to enable the IPTS to fulfil its mission it was restructured into two operational units:

- Technology Watch (TW) - The aim of the TW unit is to detect scientific breakthroughs, events and trends that might lead to technological innovation at an early stage, and to alert European decision makers as to their implications and consequences, especially when there is a need for action at European level.
- Technology-Employment-Competitiveness (TEC) - This unit deals with economic sustainability issues related to firms' business practices in particular regarding their competitiveness; economic and social sustainability issues related to work/wealth distribution; and the role of innovation in regional development and the management of resources.

At this stage the challenge of launching the European Science and Technology Observatory network has been met successfully. The fourteen organisations behind this network have broadened the scope of expertise which backs up the IPTS's knowledge base.

As most of the IPTS's work is highly relevant to the European decision making process, the Commission Directorates General and the European Parliament constitute the Institute's principal 'clientele'. Four internal administrative agreements were concluded for IPTS's work supporting the Forward Studies Unit, DG III, DG XI and DG XVI of the European Commission in 1996. Further support activities were carried out outside bilateral institutional agreements, in particular in cases where the work to be performed was relevant to more than one Directorate General or to other European institutions¹.

Among the IPTS's competitive activities, the Institute ran eight Shared-Cost Action projects in 1996. Three of those projects concern the energy sector and were signed at the end of 1995. Among those projects signed in 1996, three concentrate on environmental issues, one on agriculture and one on transport. The setting up of the Integrated Pollution Prevention and Control Bureau within the Technology Watch Unit on behalf of DG XI is another example of a successful competitive activity.

The Institute also started two projects for third parties: a peer review of a major German Life Cycle Assessment study undertaken to compare various options for recycling plastic packaging waste; and, a project on the technical and legal barriers which represent obstacles for the penetration of renewable energies into energy markets.

Given the IPTS's location in Seville part of its research effort addresses issues with a regional dimension, particularly those focusing on the needs of the Mediterranean countries.

The 'IPTS Report' has become the flagship of the Institute in terms of disseminating IPTS's achievements. During its first year of publication the number of subscribers has increased from 3.500 to nearly 6.000 world-wide.

To conclude, 1996 may be regarded as a crucial year for the IPTS in terms of the consolidation of its structure, activities and projection.

1996 IPTS Highlights:

- *issuing the 'IPTS Report' on a monthly basis,*
- *launching the European Science and Technology Observatory network,*
- *establishing the Integrated Pollution Prevention and Control Bureau within the Technology-Watch unit.*

¹ See annex I for a detailed list of IPTS 1996 projects.

..... The Institute for Prospective Technological Studies

director: herbert.allgeier@jrc.es²

The IPTS observes, analyses and communicates the implications of technological developments in terms of social, economic and political issues in which technology plays a significant role. This is the central brief of the IPTS' mission, defined by Commissioner Edith Cresson in September 1995.

In order to meet its objectives the IPTS, has established a set of capabilities including: the means of gathering information, the observation or input of information; the capability of prospective analysis and foresight capabilities. These are based on and supported by the IPTS's own research programme and a number of modern communication techniques but in particular extense dialogue with the user -e.g. policy makers. In addition, in-house research allows the Institute to keep abreast of the latest developments and form credible partnerships with other leading Institutes.

The ESTO network: Observation

The European Science and Technology Observatory (ESTO), a network of 14 European organisations created by the IPTS, aims to integrate existing Technology Watch capacity while ensuring the necessary quality control and broad scope needed for activities of this nature. The broad coverage given by the ESTO-network ensures that the most significant technology-driven developments are identified and their implications understood.

The ESTO-network collects, processes and classifies information on S&T events and developments and thus is able to deliver important and relevant information, which can then be used to provide an early warning to European decision-makers.

The smooth running of the observation and internal communication process of the ESTO network is achieved through the IPTS World Wide Web site. It is envisaged that in due course this form of communication may evolve into a 'virtual technology watch network'.

The ESTO-network avoids becoming a closed 'club' by its flexible management structure, which allows other institutions to become associated with the network.

In-house Research: Analysis

Analysis and interpretation of raw ESTO data is the first stage of 'adding value'. The IPTS not only needs to have a broad understanding of the technological trajectories and the social and economic forces driving them, but also possess in-house excellence in

² Mr. Herbert J. Allgeier was Director of the IPTS between August 1994 and December 1996.

selected key fields. This wide understanding is indispensable in order to be able to appreciate S&T trends in areas where complex technological developments overlap and influence each other.

Expertise is developed along thematic lines, but foresight and prospective studies are themes underlying all activities. The evaluation of prospective methods is necessarily a part of the analysis of information at the IPTS and contributes to the development of the in-house 'tool-kit'. It is also a way of enhancing the value of foresight and technology watch activities performed by Member States for their own purposes which would otherwise not reach European policy-makers.

***From the World Wide Web to the 'IPTS Report':
Communication***

For an institute whose clients are mostly decision-makers, information must be timely, must address current or anticipated problems and must be perceived as objective. It must reach minority as well as majority policy groups and be relevant to the policy-making debate. Above all the IPTS must understand and signal issues even before they are on the policy agenda, and in many cases, it plays a role in helping the decision-making process. Communication, and the way in which it takes place, is as important as the generation of prospective knowledge.



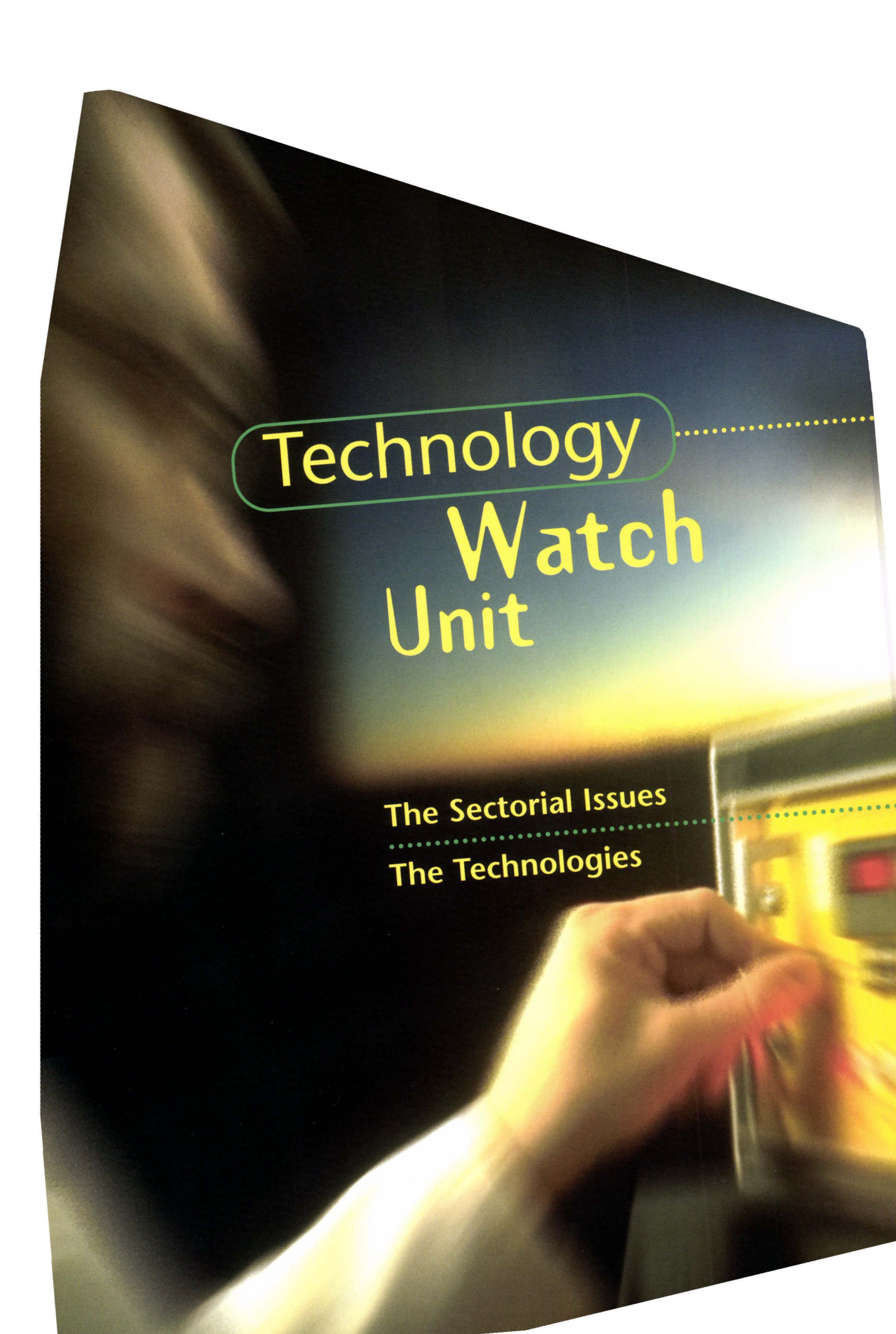
To meet these needs, the IPTS has developed both broadcast and targeted communication processes. Broadcast communication is achieved through the IPTS Web site³ and the 'IPTS Report'.

The 'IPTS Report' is the most challenging of the different means of communication set up by the IPTS so far. Launched in December 1995, the report has become one of the Institute's main tools for broad communication. It is a scientific journal published in four languages, which addresses a very diverse readership, although it is primarily targeted at decision-makers. Its distribution stands at nearly 6.000 copies per issue.

Working Papers, Final Reports, Prospective Notes and articles in journals, are equally important⁴. These are by their nature targeted forms of communication. The IPTS has also contributed to the organization of specific workshops and seminars, not only for Commission Directorates General, but also for the European Parliament and the Council of Europe (hearings, public meetings, etc.).

³<http://www.jrc.es>

⁴See annex II for the IPTS 1996 List of Publications.



Technology Watch Unit

The Sectorial Issues
The Technologies

head of unit: claude.tahir@jrc.es

The Technology Watch Unit (TW) is underpinned by two principal objectives:

- to detect scientific breakthroughs, trends and events that might lead to technological innovation at an early stage, and
- to alert EU decision makers about their implications and consequences, particularly when action at European level would be justified.

The Technology Watch Unit's work programme looks at the development of technological trajectories from the point of view of sectorial issues -necessary for both economic and social development- and from the perspective of a selected number of technologies which effect the life of citizens today -e.g. information and communication technologies, biotechnology, industrial technologies.

As has been mentioned, the main mechanism for achieving this is the ESTO network.

During 1996, the IPTS worked on the development of a methodology covering different technological fields starting from topics in which the IPTS already has a comparative advantage (environment, energy, transport, information technology, etc.). At present, for the IPTS, this involves channelling and exploiting available information (often from Commission services, the OECD, national centres, etc.) on the situation in the Member States and their main industrial competitors.

I. The sectorial issues

Energy

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Energy supply and related services constitute one of the biggest markets within the global economy and an efficient energy supply system is a prerequisite for economic prosperity. Hence, continued access to energy resources and related services at a reasonable price, and under conditions that are acceptable to all, has traditionally been a major concern of policy makers.

Whilst in the past dependence on uncertain resources or the absence of national stocks have lead to the setting up of large-scale programmes -whether coal, hydro or nuclear energy- today the paradigm for the energy sector is very different. The driving force for change is now a growing potential conflict between the advantages of, and the need for, abundant energy consumption on the one hand, and the real, or perceived, disadvantages of excessive energy use on the other.

High on the list of disadvantages is the negative impact on the environment, and this is likely to be a major factor well into the future. Among the environmental problems associated with energy consumption the perceived threat of global warming is perhaps the most pressing. This problem is likely to be the focal point of the energy policy debate in coming years, triggering political initiatives which will take shape in the context of relations between countries and blocks (North/South), the global economy, and technology (advanced fossil fuel cycles and renewable energy programmes).

In order to manage these changes, whilst paying due attention to market forces, within the scope of the overall aim of achieving an acceptable degree of sustainability in economic growth, it is first necessary to understand the vast multidimensional scientific and technological problems involved. This may imply Community actions at several levels and include technological and economic as well as regional and international initiatives.

The IPTS seeks to contribute to the establishment of a common knowledge-base to enhance the understanding of the consequences of the use of energy and energy technologies in the world. An outstanding example is the problem of global warming. Work in this area has been organised along two lines:

1. The emerging technologies
2. The economic and social implications

1.The emerging energy technologies

The goal of the overall project is to provide an adequate characterisation of technology data collection (i.e. cost, efficiency, market competitiveness, environmental-related data) as a basis for the development of long-term scenarios. The collection and analysis of information about current RD&D programmes is also considered, in order to provide an in-depth support to decision-makers on future RD&D planning.

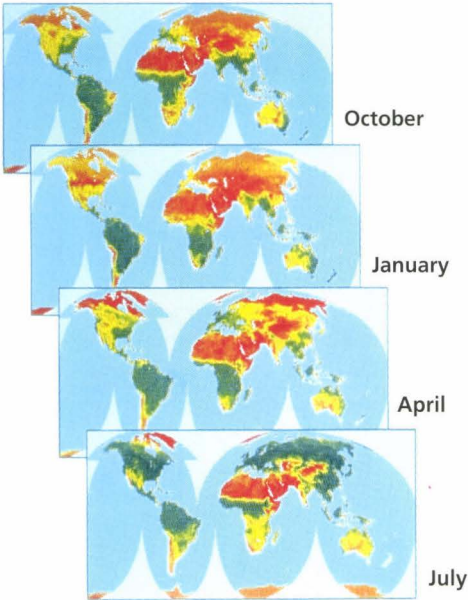
To establish a sound scientific and technological background, it is necessary to carry out accompanying prospective technological assessment activities. These technological bases are important to understand the development of energy technologies. The main bottlenecks must be identified in order to be able to forecast the development of these technologies. This activity aims not only to explore the trends in emerging technologies, but also to make this information available to potential users (analysts, decision-makers, consumers, manufacturers). There are five major areas of interest within this line of activity:

a) **Global warming data collection.** Observations on Green House Gases (GHG) emissions, temperature records, as well as data derived from sedimentary units and ice cores could be the key to a more accurate understanding of the natural variability of climate, and help answer questions about future climate changes and their impact on life. Within this project, the most recent research results on global climate sensitivity in the past have been collected and summarised. An updating report is produced twice a year, including the latest news on the GHG problem, mitigation aspects, new technological options and advanced climate indicators.

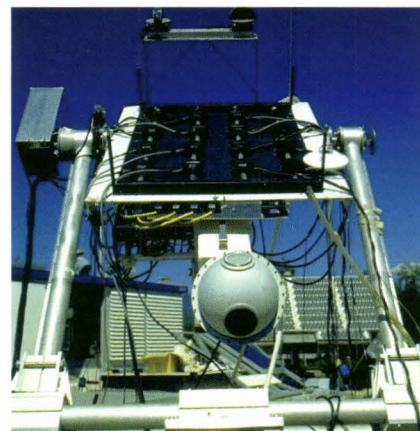
b) **Trends in renewable energy technologies.** Some of these technologies are close to the commercialisation threshold. To date, global prospective analysis of the photovoltaic technology and the potential of biomass for Europe have been performed. The approach followed consists of surveys of the state-of-the-art of the renewable technology under analysis, or, alternatively, consulting experts in the elaboration of strategic, long-term studies regarding the potential of the technology considered.

c) **New and advanced fuel cycles.** Developments of technologies for traditional fuels are being monitored. Improvements in conversion efficiencies and environmental effects are being collected and reported. Fuel cells (both for transport and for electricity production) have been analysed, as have some of the emerging clean coal technologies. The task is carried out continuously through a systematic screening of the most relevant information sources. In addition, some expert studies are periodically delivered, according to any priorities detected. Particular emphasis is put on advanced coal cycles.

d) **Dissemination of information concerning environmental costs of energy transformation and use.** This task is being implemented through participation in the 'Externe' JOULE programme. The IPTS is currently building Internet access to the databank on external costs for several fuel cycles compiled within this project.



e) Specific applications. The IPTS participates in modelling exercises that require an agreed common set of technology data. The Institute takes an active part in the construction (and update) of such technological databases. This task is part of the JOULE project 'Newgics', analysing the new generation of energy models developed under the auspices of DGXII. The IPTS is a member of the technology working group charged with the development of a commonly agreed technology data base to be supplied to the relevant energy models.



2. Economic and Social Implications

The objective of this project is to assess the development of energy systems and their related effects on the environment and economy. It focuses not only on global trends (GHG emissions, global warming, effects on the world economy), but also on local aspects that may be induced by the changes that take place in the regional energy systems. The ultimate goal is to make available the techno-economic knowledge required to manage the changes taking place in the energy sector efficiently. These changes concern not only security of supply and fuel shifting, but also environmental effects and socio-economic implications. The impact of different policy options, such as energy / carbon taxes, subsidies to renewables, potential joint implementation schemes, etc., are being evaluated. The effectiveness of such policies is being assessed in terms of market penetration speed of new technologies, environmental benefit achieved, as well as its monetary counterpart.

This cluster of activities groups several sub-projects concerning renewable energy issues, as well as analyses on traditional fuel cycles and the characteristics of energy markets:

a) Socio-economic impact of renewable energy (RE) projects in Southern Mediterranean Countries: recent studies carried out have highlighted the challenge of social and economic development in these developing countries. The elaboration of an action plan to promote the use of renewable energies for electricity supply in the southern Mediterranean countries has been agreed upon as an efficient way to promote collaboration between the EU and those countries with the goal of achieving higher levels of welfare and development.

This is a sub-project of the JOULE project 'Medenergy' which aims to analyse and evaluate the potential for renewable energy production. This requires the development of future scenarios for several economic and social variables in the concerned countries. **The IPTS is developing estimates of the socio-economic impact of the implementation of such RE schemes.**

b) Market penetration mechanisms of renewable energy technologies.

Understanding the dynamics of technology innovation within the energy field is a requisite for designing an adequate energy policy. The focus of this activity is put on the economic aspects of R&D and innovation, with particular emphasis on RE.

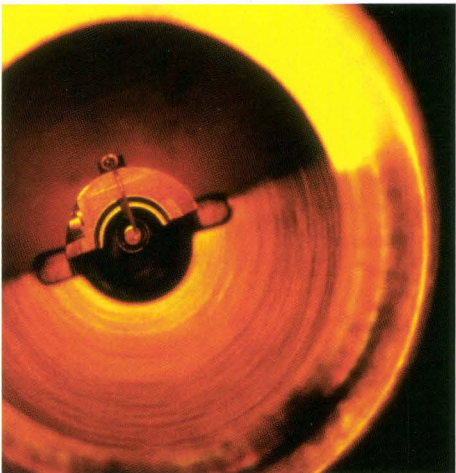
This activity is part of the JOULE project 'Newgics'. **The IPTS contribution aims at improving the module of the POLES model describing the dynamics of RE market penetration.**

c) Feasibility study of a biomass research centre in Spain (as a branch of CIEMAT) **and a renewable energy and water agency in Sicily (TERA).** It is widely acknowledged that biomass has a role to play in the energy system, in particular with respect to security of supply and prevention of climate change. **The efforts of national research institutes in promoting biomass as well as other RE technologies are supported by the IPTS by elaborating feasibility and implementation plans.**

These studies are accomplished by reviewing the principal bio-energy activities in Europe and world-wide, identifying the main obstacles against the penetration of bio-energy in the energy systems, and setting up a strategic frame for the technological development of bio-energy in the EU.

d) Energy market studies. Energy markets are the basic interface between the energy and the economic systems. **The IPTS aims to maintain an ongoing survey of the trends concerning the changes to the structure and characteristics of these markets.**

Legal and technical barriers hindering the penetration of renewable technologies have been explored via a THERMIE project. Future activities will focus on the effects of the liberalisation and deregulation of electricity markets.



Sample Publications

(see annex II)

- *'Climate Change: Analysis of causes, impacts and options'* EUR 16402
- *'Strategy for Solar-Thermal Energy Research, Development and Industrial Application'* EUR 17276
- *'Prospectives de la biomasse pour l'énergie dans l'Union Européenne'* EUR 17260
- *'Energy Demand and CO2 Emissions from the World Transport Sector: Past Evidence and Forecasts'* EUR 17256

Environment

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Over the past twenty years, a general awareness about the need to protect the environment has grown substantially, fuelled by a number of major ecological catastrophes such as Bhopal, Seveso and Chernobyl.



Doubts have been raised about the sustainability of economic growth as generally understood by industry. Demand for clean air, water and food have put increasing pressure on politicians to adopt new legislation and drive Industry towards improved processes, a move sometimes resisted as long as the overall benefits of the exercise were not understood.

The change, as a whole, is a very complex process, in which technology, often considered as the origin of the problem, can contribute to the solution. There is no single solution to a particular problem: it will vary from region to region, depend on local environmental sensitivity, and require fine-tuning as technologies emerge and evolve. Even if everybody in industry, environmentalists and legislators were able to agree that the process of greening is here to stay, and in the end that it is beneficial in every way, there will be winners and losers.

Beyond taking part in the dialogue between the different parties concerned, **the strategic line followed by the IPTS is to analyse and understand the impact of the technological changes on major socio-economic factors like employment and competitiveness and to develop its activities around and in support of the EU legislative process**, e.g. the Integrated Pollution Prevention and Control Directive.

Lines of action:

1. Integrated Pollution Prevention and Control
2. Clean Technologies and the Greening of Industry
3. Green Accounting: monitoring progress towards sustainable development

1. Integrated Pollution Prevention and Control (IPPC)

The IPPC Directive foresees the implementation of a harmonised enabling framework for industrial activities in the EU that will consider the environment as a whole (an integrated approach, taking into account air, water, soil etc.). These procedures will be based on 'integrated' Best Available Techniques (BAT) Reference Documents reflecting the results of an information exchange between Member States, Industries and Environmental NGOs co-ordinated by the Commission.

Following an agreement between DG XI and the JRC signed in 1996, the IPTS has become the operating agent of the European IPPC Bureau (EIPPCB), as from January 1997.

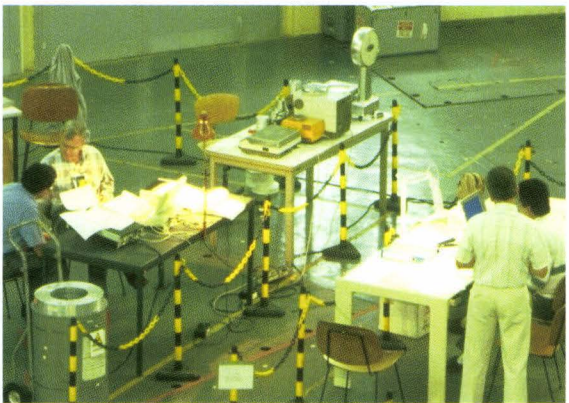
2. Clean Technologies and the greening of industry

Conforming to the previous line of activity, IPTS's work was addressed at **assessing the dynamics and socio-economic impact of emerging clean technologies**. The relevance of this trend is being analysed for areas selected in the context of sustainable development. In this sense, several specific projects are being undertaken under various headings: recycling, reduction of emissions and case studies in the greening of industry.

a) Recycling. The IPTS is monitoring the development of the European strategy for waste management and of the implementation of the European Packaging Directive. The overall goal is to determine the barriers preventing the development of recycling in Europe, through both a general cross-sectoral analysis and other specific case studies. The aim of the work developed for the Association of Plastics Manufacturers in Europe (APME) is to organise an international peer review of a major German Life Cycle Assessment (LCA) study comparing various options for recycling plastics packaging waste.

b) Identification of Nitrogen Oxides (NOX) and Non-Methane Volatile Organic Compounds (NMVOC) emission reduction measures: The IPTS is participating in the project 'Assessment of Policy Instruments for Efficient Ozone Abatement Strategies in Europe'. The IPTS task in the project is to characterise NOx and NMVOC (ozone precursors) emission reduction measures. This project is under development and it will be concluded in 1998.

c) Case studies on the greening of industry: The projects under this heading focus study on the conditions under which innovations penetrate industry and contribute to the improvement of its environmental performance. More specifically, these projects look at the transition to a sustainable transportation system, the role of biotechnology in the greening of industry, and various other topics. This project will be finished in 1998.



3. Green Accounting: The tools for assessing progress towards sustainable development at government and enterprise levels

New integrated indicators ('Green Accounting') are desirable to assess progress towards sustainable development. Such indicators should incorporate environmental as well as economic and societal performance (e.g. employment). The Commission has recently adopted a 5-year programme for the identification of such indicators. The programme is being co-ordinated by the Forward Studies Unit of the Commission (FSU), and is of interest also to the European Parliament. **The IPTS is providing critical briefings of various aspects of the development.**

'Green Accounting' is being examined at national and at private enterprise levels. At national level, the IPTS is focusing its work on providing the EP (Environment Committee) with briefs on the issue. At the private enterprise level, the IPTS supports

the FSU with the development of studies on the use of environmental assessment methodologies and how they relate to EU initiatives in the field. In this sense, a specific study on the use of Life Cycle Assessment (LCA) in Business Management is being developed.

Sample Publications

(see annex II)

■ „The recycling industry in the European Union: Impediments and prospects’ EUR 17271

■ „Survey on current legislative activity in plastic waste management’ EUR 16467

Mobility and the means of Transport

Sector co-ordinator: jochen.naegele@jrc.es⁵

Mobility and the quality of the transport system are of crucial importance for contemporary society from both economic and social points of view. However, transport is double-edged; its beneficial impact on wealth and employment creation is counteracted by serious side effects: congestion, pollution, resource consumption and concerns about safety. Thus a conflict needs to be resolved in the future: namely to maintain the high-quality level of mobility and transport services necessary to fulfil the needs of society and to reduce the negative externalities in terms of the environment, resources and safety.

Mobility is a complex research topic, which can only be addressed on an interdisciplinary basis. It needs to be examined at the intersection of economics, infrastructures, vehicles and individual behaviour. Other activities, like the supply of technical systems, regulation, and the organisation of means of achieving mobility also have direct bearing upon it.

The IPTS is contributing to this area in two ways:

- As part of its Technology Watch function, the detection and prospective assessment of new transport technology options.
- By using an integrated perspective on the future development of transport and mobility patterns in extended urban areas.

These two issues are interrelated. On the one hand, the technology assessment and prospective results feed into the analysis of actor strategies associated with urban mobility (such as individuals, transport system operators, policy-makers, and manufacturers). On the other hand, interaction with the actors is needed in order to detect emerging technological trends as well as new needs to which technological change should respond.

⁵ Mr. Jochen Naegele was the Transport sector co-ordinator between November 1994 and April 1997

The transport line of action reflects the considerations above, while keeping options open for responding to new requests (e.g. from the Task Force 'Car of Tomorrow') and for exploring new emerging developments.

Technologies, strategies and driving forces for sustainable transport in extended urban areas

Transport in extended urban areas is facing three major challenges, namely congestion, pollution and the limitations of natural resources. In this context, policy-makers at European level need to provide the right framing conditions, which allow reconciliation of these challenges along a sustainable path, and they need to direct RTD-resources in a consistent way.

The interdependencies in this area are highly complex and are affected by new technological options, mobility needs, economic constraints and organisational factors.

Building, on the one hand, on the observation, assessment and foresight of these trends, and on the other hand on a formalized modelling approach, the IPTS has developed some scenarios which make it possible to consider the strategic decisions and reactions of the main actors in extended urban transport.

IPTS work in this field can be outlined briefly in the following five points:

- a) Technology watch and comparative assessment of new technological options in (urban) transport (for the Scientific and Technological Options Assessment of the EP -STOA- and the Task Force 'Car of Tomorrow'). The main areas of research cover new materials, propulsion systems, fuels, telematics, 'virtual' transport, new urban mobility concepts and intermodality.
- b) Technology Foresight methods applied to advanced transport telematics .
- c) Analysis of social, economic and political driving forces and strategies for change in urban transport.
- d) Improvement of the existing strategic modelling approach using fuzzy logic.
- e) Development of scenarios as decision support for Commission services and other European institutions.



Sample Publications

(see annex II)

- 'The Method of Fuzzy Scenarios: Principle and Application to the Future of Congestion in Urban Centres' EUR 16444
- 'The Car of the Future, the Future of the Car' EUR 17277
- 'Future of Transport Telematics Technologies: Results of a SMIC inquiry'EUR 17311

II. The technologies

Information and Communication Technologies

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In just a few years, a quantum leap in the capabilities and performance of computer and telecommunications hardware and software for a given unit cost has triggered vast and sudden changes in business, manufacturing, employment, environmental monitoring, etc. These changes are so pervasive that a whole new society, the so-called Information Society, is being born.

It is mainly for these reasons that the IPTS considers the field of information and telecommunications technologies (ICT) to be sufficiently relevant to be included in its Technology Watch work programme. However, there is so much expertise in this field that a sharp focus is essential.

The approach taken by the IPTS in this area is from a global perspective. The IPTS focuses on the Multimedia Information Society (MIS), taken as a whole. By means of appropriated models a better understanding is obtained of the intricate impacts of MIS upon citizens, content providers, content packagers, distributors, gatekeepers, equipment manufacturers, and traditional telecommunications operators. Direct and indirect effects upon competition, productivity, employment, education and social exclusion must also be taken into account.

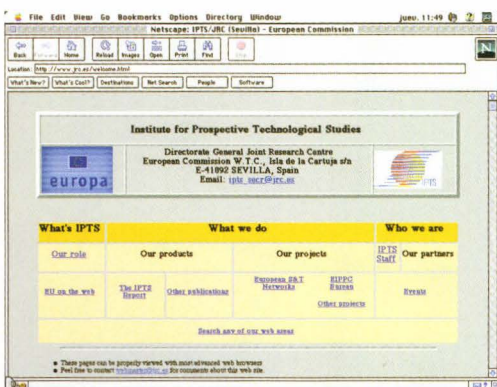
Multimedia Information Society (MIS)

The main task of this project is to perform Technology Watch, that is utilising the networks of experts formed around the IPTS in order to:

- map the major actors and their respective positions;
- explore the competitive position of European industry; and
- study the impacts and implications on employment, the organisation of enterprises and regional development.

Three themes have been chosen to accomplish this project that will be concluded at the end of 1997:

- Information & Communication Technologies and Regional Development
- Information & Communication Technologies and the Financial Sector
- Information & Communication Technologies and Enterprises.



Life Sciences and Biotechnology

Sector co-ordinator: kay.beese@jrc.es

The impact of technological development in the life sciences is two-fold:

- Increasing understanding of natural systems is making possible shifts in health care, agriculture and industry.
- Rising concern about the increasing potential to interfere with and modify nature. Objections have been expressed on ethical grounds.

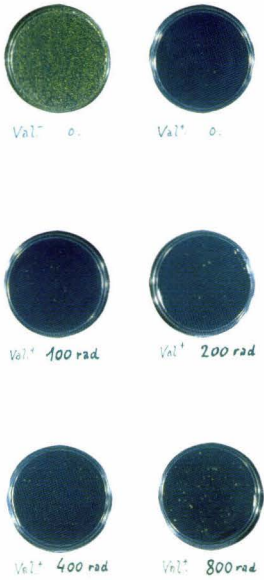
IPTS activities focus on the impact of these new technologies-genetic engineering, protein design, rapid synthesis of molecular diversity, genetic characterisation and gene therapy- on health care and the health care industry, taking into account the particularly complex relationship between health care and governmental policies on the one hand and public acceptance of new technologies on the other.

1.The impact of the new biotechnology on the health-care industry

Although the pharmaceutical industry is one of the best performing industries in Europe, changing health care priorities from disease treatment to disease prediction and prevention, technological developments (genetic analysis, combinatorial chemistry) and political changes (national sovereignty over natural resources for drug development) make it necessary to reassess its needs and opportunities. The evolution of clinical genetics and competition for natural products from synthetic molecular diversity are likely to have major impacts on this sector. European competitiveness will, to a large extent, depend on the legal environment within which it has to operate.

The main aims of this project to be completed in 1997 are:

- To assess the importance of drug extracts of tropical wild species for drug development compared to synthetic molecular diversity created by new technologies.
- To examine the prospects for European biomedical industry in the field of clinical genetic services based on the amount of genomic data, the efficiency of DNA testing technology and social or ethical limits to genetic profiling.
- To assess regulatory and legal aspects of the pharmaceutical industry, ethical considerations and public perception related to the application of new biomolecular technologies.



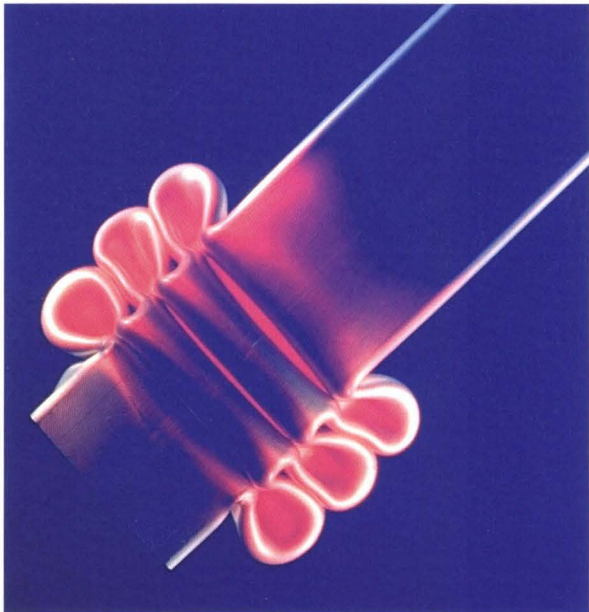
2. A prospective Analysis of European Pharmaceutical Research, Development and Innovation

This project was launched following a request by the STOA Programme (Scientific and Technological Options Assessment) of the European Parliament. Its main objective was to inform decision makers and stimulate further reflection and debate on the future of pharmaceutical research in Europe beyond the year 2000. The outcome of the project provides a baseline understanding against which it will be possible for the different actors to work on the sustainable development of a complex system integrating European values.

Industrial Processes and Materials

Sector co-ordinator: jochen.naegele@jrc.es⁶

Industrial processes and materials occupy a key position in European society. Our present level of wealth creation can only be maintained by developing new technologies, products and the necessary production processes for them. The assessment of new technologies, including their underlying scientific basis, should not just focus on



technological aspects, but equally, or more so, on related socio-economic issues. New technologies have to address and solve problems arising from conflicts between the quality of life, environment and employment, in the new context of global competitiveness.

It is therefore essential to detect new technological breakthroughs and market opportunities as well as bottlenecks as they appear. But more importantly, potential benefits and risks for society should be identified at an early stage in technology development, so as to enable decision makers to devise a guiding policy framework.

The IPTS has identified two main areas of work within this line of action:

1. Nanotechnology: Innovation Potential & Societal Aspects,
2. Advanced Materials.

⁶ Mr. Jochen Naegele was the Industrial Processes and Materials sector co-ordinator between November 1994 and April 1997.

1. Nanotechnology: Innovation Potential & Societal Aspects

Nanotechnology is considered by both policy-makers concerned with innovation and leading scientists to be a promising area of high tech research, utilising available highly advanced European scientific and technological resources.

Nanotechnology has shown up in a number of recent foresight exercises in European member states as well as the USA and Japan and it is expected to lead to a wide range of innovations affecting many areas of social life, including IT, biomedical technology, materials, industrial production, environmental and energy applications.

There is a need for interdisciplinary collaboration between the distinct disciplines involved in nanotechnology, for which the opportunities have not been developed to the full.

This project aims to explore nanotechnology developments, commercial applications, market demand and acceptance, in order to advise policy-makers how to use its full potential and to minimise the risks. This project will be completed by the end of 1998.

2. Advanced materials

This project aims to identify common bottlenecks in the transfer of high technology materials to other large-scale markets, including low technology sectors. During this process it will be possible to identify some generally applicable mechanisms to stimulate the technology transfer action - as well as providing some comparison of similar approaches made outside of the EU.

This project will be finalised in the autumn of 1997.

Sample Publications

(see annex II)

- 'Overview of Activities on Nanotechnology and Related Technologies' EUR 16461
- 'The Increasing Use of Aluminium: Prospects and Implications' EUR 17284



Technology- Employment- Competitiveness Unit

Competitiveness
Employment and Technology
Regional aspects and resources



unit co-ordinator: gustavo.fahrenkrog@jrc.es

In the context of the economic and social changes taking place in society, new technologies are often blamed for many of the unbalancing effects of these changes and in particular concerning unemployment. This is in itself not a new phenomenon; the relationship between technological change and employment was already a topic of controversy in the nineteenth century and, since then, has returned time and time again to the forefront of the economic debate whenever the problem of structural unemployment sets the political agenda.

The challenge of creating a stable and sustainable society for ourselves and coming generations, revolves around three types of conflict:

1. The need to maintain and improve the quality of life (economic sustainability) which will continue to challenge policy makers (competitiveness focus).
2. The need to adapt social organisations - i.e. the means by which to ensure a fair distribution of wealth and of work and the way society is governed in the search for social sustainability (employment focus).
3. The role of innovation in regional development and the management resources (a regional focus).

Against this background, the main objective of the IPTS's programme is to provide insight, from the science and technology perspective, into current shifts in the socio-economic paradigm thereby improving the policy-makers response to the socio-economic expectations of European citizens. The IPTS's Technology-Employment-Competitiveness unit looks at the development of technological trajectories from the social and economic conflict orientation, and from the point of view of technology's impact on employment and competitiveness.

In recent years, 'competitiveness' has become a central concern for decision-makers due to the need for all countries to contend with the rising standards of economic and industrial efficiency, which result from the globalisation of markets and factors of production. It also stems in part from the difficulty of coming to terms with the changes in the nature of competition using traditional methods for analysing international economic relations. The underlying desire is to move government action from a 'comparative advantage' type basis to one better suited to the evolving context of globalisation, thereby enabling links to be envisaged between corporate competitiveness and national/supra-national economic performance.

Given the complexity of the issue, and considering that much of the debate has been focused on the competitiveness of nations and regions, **the IPTS is shifting attention, in the first instance, to some aspects of the competitive strength of individual enterprises.** It is the strength or weakness of firms, which determines the competitiveness of regions or nations. At the level of firms it is the organisational change brought about by the introduction of new technologies or the need to adapt technologies to the requirements of the new organisational paradigms, which will determine their competitiveness.

The IPTS is concentrating on three different lines of action:

1. Firms' organisational practices;
2. The organisation of systems of innovation;
3. Technologies' Foresight.

1. Competitiveness and the organisational practices of firms

At the level of individual firms, competitive advantage seems to be ever more a function of the internal efficiency and effectiveness of business practices, in so far as the level of the playing field for competitors is concerned (i.e. with regard to the cost and availability of inputs and production factors, on one hand, and, with regard to the quality/ performance of goods and services at the output side on the other hand). This has been brought on by globalisation, the accelerating pace of technological development and the supplier-user driven customisation of markets.

The aim of this project is to focus on understanding the 'innovation dynamics' of this on-going process, in particular the way in which technical R&D and innovation activities have become intertwined with organisational innovation and a 'business process' mentality. Attention is paid to the different ways firms are evolving in this regard, depending on their size, sector, technological intensity, market location and maturity, and operating environment.

The IPTS is monitoring and analysing developments in this field from an EU perspective (e.g. Agile enterprises; Information Technology and the productivity paradox; Bridging the efficiency gap: is down-sizing the way?; Bench-marking of best practices) which will be finished at the end of 1998.

2. Systems of innovation and economic webs

No firm or individual innovates in isolation, but always in a way which is dependent on the motivation to do so provided by the environment of which it (he/she) forms part. Critical to this is the depth and extent of the linkages between actors as well as careful regulation of the reward system - to businesses in open competitive markets, as well as to individual initiative, either within firms or as entrepreneurs.

The aim of this project is to develop this systemic perspective of how innovation 'happens' in the economy, in particular 'technological' innovation, and how new technologies are diffused. Central to the study is the development of an understanding of who the key actors are and what vectors are involved in articulating, perceiving and relaying those signals (market or otherwise) that trigger industrial innovation, and what paths these signals follow. In so doing, the project aims to develop descriptions of coherent techno-economic systems that are characterised by their 'socio-economic' rather than 'sector' dimensions, thereby reflecting the economic reality of the symbiosis between industry, services, consumers and public authorities.

From an EU point of view, the aim is to enrich the various policy debates with information and insight on the actual state and development dynamics, of industrial innovation in Europe, reflecting how EU policy may bear upon different 'systems', the dimensions of which vary from the local to the global level. This project will be integrated into a new initiative called 'Made in Europe' in 1997.

3. Technologies' Foresight

Technology Foresight, meaning the systematic collection and assessment of information about future technological developments and their socio-economic impact, is increasingly used by governments to inform the decision-making process of the options available for strategic choices. This recent tendency in Europe is driven by the necessity - in terms of economic, industrial and societal needs - to



make a more effective allocation of resources, concentrating when necessary on clear, consensual priorities.

The objectives of this project are:

- to analyse the results and to follow-up completed and currently running foresight exercises in the EU and elsewhere,
- to monitor the development and implementation of new national foresight exercises, and
- to participate in the policy debate and experimentation regarding the design, content and possible implementation modalities of a continuous foresight process and capability at European level.

This project, which will run until the end of 1998, is structured around the following tasks:

- a) Technology foresight and prospective studies - identify key technology trends & their impact on competitiveness, innovation and society (employment, the information revolution, etc.)
- b) Foresight Watch, focusing on technology and the firm - industrial and materials technologies' trends, developments and their deployment and utilisation within firms - (DG XII)
- c) Conduct a number of thematic foresight/ prospective exercises built around structured seminars

Sample Publications

(see annex II)

■ 'AGILE Manufacturing - A scooping Study' EUR 16469

■ 'Industrial Efficiency - A literature Synthesis' EUR 16447

The IPTS Report

No. 03 - April 1996

Agile Enterprises

Martin T Harvey & James P Gavigan

Issue: During this century, the basis of manufacturing has progressed from Craftsmanship, through Mass Production, to Lean and Flexible Manufacturing, and presently continues to evolve at an ever increasing rate. The only certainty is change, and pressure is building for that to be a step change. The newly emerging paradigm may turn out to be the so-called "Agile (Manufacturing) Enterprise"

Relevance: The Agility drive is inextricably linked to science and technology, both in the way it builds on existing technological capabilities and in helping to drive new technological trajectories. It predicts a total re-invention of the organisation of manufacturing, through realignment of business processes, relationships, and contractual arrangements. It conjures up notions of "virtual companies", raising fundamental socio-economic issues around employment, skills, and lifetime finances, which are important for individuals, families, industry, and society at large.

Employment and Technology

sector co-ordinator: gustavo.fahrenkrog@jrc.es

Unemployment is possibly the biggest challenge to achieving complete sustainability, which the EU and many other developed countries are currently facing. New technologies are often blamed for the disturbing effects of social and economic changes and in particular for unemployment. The introduction of new technologies, and in particular their massive diffusion, has radically changed social relations, the organization of work and production, and often even the organisation of political institutions.

Today, information and communication technologies (ICT) are the new dominant drivers of change in many social, economic and cultural processes. Societies are adapting to them by trial and error, searching for new institutions better able to address the challenges. ICT is radically changing the way in which people communicate over time and space and through this process ICT is altering the organisation of work, the workplace and the skills which are required. By using these technologies, people are also redefining leisure and the form and place of consumption. The way in which physical goods are moved is being changed, and knowledge is becoming increasingly mobile.

Up until now unemployment has been the most visible effect, but it is also a critical period for those who have jobs and need to adapt to new functions and forms of work. It is provoking a crisis in the educational system and the partial collapse of the means of providing minimum welfare, etc.

Since the issue has been extensively researched in recent years the IPTS concentrates on the one hand on distilling information and presenting options to policy-makers, and on the other, on some less well-explored policy options. In addition, the IPTS will progressively include employment consequences in its analysis of the development of certain technologies. Two lines of action have emerged:

1. Employment and Technology: being competitive in Europe
2. Industrial clusters, networks of firms and the creation of employment

1. Employment and Technology: being competitive in Europe

The employment debate is very much characterised by schools of thought, which assume the existence of certain main mechanisms as determinants of employment patterns. They build, to a large extent, on the labour costs' argument, but neglects many other important mechanisms. This one-sided view has tended to be very influential in recent debates on economic and employment policies.

In order to identify alternatives for tackling the employment issue it is first of all necessary to build up a knowledge base of the variety of existing approaches to be analysed and confront them with empirical information and thereby check the reliability

of existing policy strategies. So far this project has focused on producing a basic overview of the employment and technology debate. The next step will focus on exploring models of competitiveness which have been successful in Europe, in understanding the issues which make those cases work and outlining policy alternatives which have played a role in them. Given the complexity of the task, the IPTS will tackle these issues with other European Research institutes. In preliminary discussions these institutes have agreed to set up a joint project called: 'Made In Europe'.



2. Industrial clusters, networks and districts for employment

The analysis of market relations and the study of firms' performance and practices in such market environments have dominated recent research on employment as well as the policy debate. But market relations alone cannot characterise the intermediate or meso-level. Especially in countries like Japan and most European countries, non-market relations in the form of networks and clusters represent an important principle of interaction in techno-economic systems. These clusters fulfil an important function for the maintenance of employment by providing synergetic mechanisms of information and knowledge transfer, co-operation, finance, pooling of infrastructure services, cultural affinity, and facilitation of innovation and diffusion of technologies. They establish a 'social contract' of trusting informal relationships and services, which balances disadvantages in terms of size and labour costs. This enables the SMEs (which are the typical members of such clusters) to maintain a high level of flexibility and employment.

Despite the many success stories of clusters, they have been challenged recently by the globalisation of production, ever-fiercer competition and the rapid introduction of new technologies. Clusters can react very flexibly to incremental changes, but the recent technological and economic revolutions have gone beyond the adaptation capacity of their institutions and structures, i.e. their main stabilising elements. The crucial question the IPTS seeks to raise is how to deal with the new techno-economic challenges while maintaining the benefits of existing clusters and stimulating the emergence of new ones.

There is still a lack of knowledge about the key mechanisms for the successful operation of clusters, their creation, the way they absorb and implement new technologies, and their ability to generate employment. But clusters are also of particular interest for another reason: the prominent role of trust and of negotiation processes could facilitate the reconciliation of environmental, economic and social elements of the sustainability concept in their development pathways - a result which appears to be difficult to achieve in a pure market environment.

Sample Publications

(see annex II)

'New technologies and employment:
Highlights of an ongoing Debate' EUR 16458

Regional aspects and resources

sector co-ordinator: patrice.laget@jrc.es⁷

Persistent and often widening discrepancies between richest and poorest economies and regions are motivating policy-makers to re-examine the question of economic development.

Meanwhile, in response to the limitations of general economic theories, academics have been paying ever-increasing attention to 'local elements'. Regional approaches have emerged as a way of avoiding the impasse in which general perspectives seem to be blocked. Local factors are being reconsidered. Regional approaches correspond to an intermediate level for diagnosis between the micro and the global scale.

From a thematic point of view, the regional approach implies a 'disciplinary enlargement' from 'pure' economics to other social sciences as well as to natural sciences and technology.

From a methodological point of view, regional approaches are systemic. They go beyond the elements in themselves and take into consideration the relationships between the constituent elements of a region in order to explain which mechanisms regulate its functioning. The regional approach takes into consideration the systemic relationships between the economic, social and environmental spheres. Regions are sustainable systems if they are viable in the long term from an economic, social and environmental point of view.

Geographically a region may correspond to any of a wide range of entities situated between two extremes: the Meso-Regions (such as the Baltic, South East Asia or Mediterranean) and the Administrative Regions composed of many of the existing National States (e.g. Objective 1 Regions of the EU).

The objective of this programme is to advise/support policy-makers and those concerned with regional questions and to encourage a sharing of knowledge and expertise in order to contribute to the construction of sustainable development.

Four priority lines of action have currently been identified:

1. The Mediterranean Meso-Region;
2. Innovation for Regional Development;
3. Agro-Food;
4. Water.

Two underlying approaches have been implemented: i.e. a horizontal approach, which aims to compare meso-regional socio-economies, and a vertical one, which looks at specific questions such as natural resources, e.g. water and renewable energy sources.

⁷Mr. Patrice Laget was the Regional sector co-ordinator between February 1995 and November 1996.

1. The Mediterranean Meso-Region

The objective of this project is to identify and analyse the effects of the know-how transferred into Third Mediterranean Countries' (TMC) economies and its societal impact.

The IPTS provides S&T background information to support the Euro-Mediterranean Monitoring Committee which was proposed by the Council and established in the framework of the Barcelona Conference (November 1995).

In close co-ordination with DG XII-B, the IPTS has started a series of studies covering all twelve TMCs, trying to identify the potential competitive advantages of these countries and the main obstacles to be overcome.

At the same time, the 'Impact of Technological Change on Population migration' (with reference to Maghreb Countries) is being studied to acquire knowledge on the links between technology transfer and the Maghreb societies.

The project will conclude in 1998.

2. Potentials of Science & Technology, Innovation (STI) for Regional Development

The objective of this project is to analyse the impact of S&T and innovation instruments in the less favoured or peripheral regions of the EU (Structural Funds' Objective 1 Regions). The research extrapolates the best practices in the field, incorporating the analysis of technological change and innovation from a regional perspective. At the same time, it analyses its impacts in terms of regional growth and social welfare.

This project will conclude in 1997.

3. Agro-food industry in the Mediterranean Area

The agro-food industry is a key industry for the sustainable development of Southern Mediterranean countries. Traditionally a polluting industry, over the last 20 years, the European food industry has embarked on a steep technological development curve to improve energy and water efficiency, food quality and safety, food innovation and environmental impacts. This development has had only marginal impact in the South of the Mediterranean.

It is therefore now opportune to survey the technological state-of-the-art and trends in the food industry, identify the needs of Southern Mediterranean countries and explore the potential for agro-food technology transfer from Europe. This survey will also seek to identify commercial opportunities for European suppliers in the Southern Mediterranean while also providing opportunities for these countries to assure their subsistence, contribute to their sustainable development and enable them to better compete in the world of the agro-food market.

This project allows the IPTS to enlarge its technology watch, participate in the sustainability debate and contribute to the development of trans-Mediterranean co-operation. Emphasis is being placed on the Maghreb, Egypt and Turkey.

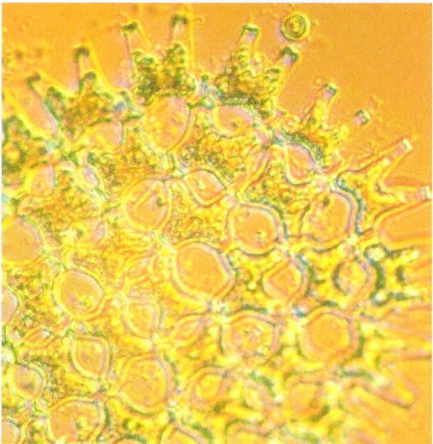
So far, most of the project has been developed around the olive oil industry. However, until its conclusion in 1998, the sugar and the dairy industries are two sectors likely to be studied.

4. Water Management in the Mediterranean

Water is a fundamental element of all aspects of life including most economic activities. In a growing number of areas, however, supplies of water are limited and its wise management is of critical importance for enabling sustainable development. The solution clearly lies in an appropriate combination of technological, economic, administrative, and educational tools, adapted to particular geographical conditions.

IPTS activity is focused on helping decision makers to find the correct balance, in the Mediterranean context, through:

- a) the identification of methodology to assess the full societal (direct/indirect, monetary/non-economic) value of water in its different uses. Case study on Andalusia;
- b) the profile of water research and water industry in Portugal, Spain, Italy and Greece;
- c) the evaluation of present water resource policies and orientations towards the future, for Portugal, Spain, France, Italy, Greece, Malta and Cyprus: 'Vers une Gestion Soutenable/Strategique des Ressources Hydriques';
- d) a Prospective Assessment of Desalination Technology.



Sample Publications

(see annex II)

- 'Technology Gaps and Sustainable Regional Development: an explanatory study - case of the agri-food sector in Andalusia, Ireland, South Brandenburg and Central Macedonia' EUR 17278
- 'Politiques de développement territorial et investissements étrangers dans les pays du Maghreb' EUR 16419
- 'Desalination Technology: Survey and Prospects' EUR 16434



Annex I

List of IPTS 1996 Projects

NOTE:

The list of IPTS projects has been created according to ‘customer’ criteria. Projects developed for more than one Institution are mentioned in each of the respective tables for those ‘customers’. An asterisk marks such projects wherever they are repeated.

COMMISSION DIRECTORATES GENERAL

During 1996, the IPTS has worked on several projects for various Commission Directorates General. In general, one of the following procedures is applied before the development of those projects:

- a) An ‘Institutional Agreement’ is usually signed by the Directors General (JRC and DG concerned) when the project is in the interest of both services. The ‘agreement’ could be developed by one or more projects.
- b) The IPTS can bid in a DG’s call for tender.

TITLE OF THE PROJECT	CUSTOMERS (AND SERVICES POTENTIALLY INTERESTED)	IPTS PARTNERS
Competitiveness and the organisational practices of firms	DG III, DG XII*	
Systems of innovation and economic webs	DG III, DG XII, DG XIII	
Technologies’ Foresight	DG III, DG XII	
The Mediterranean Meso- Region	DG XII-B, DG I-B	
Potentials of Science & Technology, Innovation (STI) for Regional Development	DG XVI	Universidade Nova de Lisboa (Portugal), FEDEA (Spain), DIW (Germany), CIRCA (Ireland), CERES (Greece)
Agro-food industry in the Mediterranean area	DG I-B, DG III, DG VI, DG XVI	

Water Management in the Mediterranean	DG III, the Water Task Force, DG XVI	Ambiente Italia, Planistat, INYPSA, National Technical University of Athens, ECON, C.A.C. Konteatis Ltd., Blue Plan RAC, Hidrotecnica Portuguesa, CENTA
The Emerging Energy Technologies	The Forward Studies Unit (FSU), DG XVII, DG XII (JOULE)	Sociedad para el desarrollo Energético de Andalucía (SODEAN), UNESCO, ESD, BESEL, EUFORES, IDAE, CIEMAT, ETSU, NTUA, IEPE
Energy Technologies: The Economic and Social Implications	DG XII (JOULE), DG XVII*	Observatoire Meditteranean de l'energie (OME), Ente Nazionale dell'Energia Alternativa (ENEA) Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT)
Integrated Pollution Prevention and Control	DG XI	
Clean Technologies and the greening of industry	DG III, DG XI, DG XII, FSU*	University of Twente (The Netherlands), University of West England (United Kingdom), Mr. Harro Van Lente (private Consultant NL)
Green accounting: The tools for assessing progress towards sustainable development at government level as well as the level of the enterprise	FSU, DG XII*	COWI Consult
Technologies, strategies and driving forces for sustainable transport in extended urban areas	DF XII, Task Force Car of Tomorrow (TFCOT)*	The University of Twente (The Netherlands), MERIT (The Netherlands)
The impact of new technologies on the health-care industry	DG XI	Biotics Ltd.
Nanotechnology: Innovation potential and societal aspects	DG XII C, DG III F*	Mr. Budworth, (private consultant).

EUROPEAN PARLIAMENT (EP)

EP Committees or individual MEPs can request that the IPTS undertake a project for them via the JRC Commissioner.

TITLE OF THE PROJECT	CUSTOMERS	IPTS PARTNERS
Employment and Technology: being competitive in Europe	European Parliament- Committee on Research, Technological Development and Energy*	
Cliamte change: causes, impact and options	European Parliament -Committee on the Environment, Public Health and Consumer Protection	
Clean Technologies and the greening of industry	European Parliament - Committee on the Environment, Public Health and Consumer Protection*	The University of Twente (The Netherlands), The University of West England (United Kingdom), Mr. Harro Van Lente, a private Consultant from the Netherlands.
Green Accounting: The tools for assessing progress towards sustainable development at government level as well as at the level of the enterprise	European Parliament - Committee on the Environment, Public Health and Consumer Protection*	COWI Consult
Information Society: competitiveness and employment	European Parliament - Scientific and Technological Option Assessments (STOA)	
A Prospective Analysis of European Pharmaceutical Research, Development and Innovation	European Parliament - Scientific and Technological Option Assessments (STOA)	London School of Economics, and EURO-CASE
Technologies, strategies and driving forces for sustainable transport in extended urban areas	European Parliament - Scientific and Technological Option Assessments (STOA)*	
Research and Sustainable development (hearing)	European Parliament - Committee on Research, Technological Development and Energy	
European Research in the perspective of the XXlst Century	European Parliament - Committee on Research, Technological Development and Energy	
The Aging of Society and Technology (workshop)	European Parliament - Committee on Research, Technological Development and Energy	

OTHER CUSTOMERS

The IPTS can reply positively to a request addressed directly to it if it falls within its work programme and it has the necessary resources to undertake it successfully. The IPTS can also bid in open calls for tenders.

TITLE OF THE PROJECT	CUSTOMERS	IPTS PARTNERS
Competitiveness and the organisational practices of firms	IRDAC*	IPC
Employment and Technology: being competitive in Europe	Council of Europe*	ESTO Network
Technical-Juridical European Forum on Renewable Energy	SODEAN (Sociedad para el desarrollo Energético de Andalucía)	
Clean Technologies and the greening of industry	APME (Association of Plastics Manufacturers in Europe)*	The University of Twente (The Netherlands), The University of West England (United Kingdom), Mr Harro Van Lente (private consultant NL)

IN-HOUSE RESEARCH

When the IPTS identifies a trend that is worthwhile investigating, it can put its own resources into it.

TITLE OF THE PROJECT	CUSTOMERS	IPTS PARTNERS
Industrial clusters, networks and districts for employment	IPTS	
Agile Enterprises	IPTS	CEST
Energy Technologies: The Economic and Social Implications	IPTS*	NTUA, IEPE, ESD, SODEAN
Multimedia Information Society	IPTS	ESTO
Nanotechnology: Innovation potential and societal aspects	IPTS*	Mr. Budworth, (private consultant)
Advanced Materials	IPTS	
Value of Water	IPTS	University of Seville

GRANTHOLDER PROJECTS

The IPTS has among its staff several grant holders currently working on a PhD thesis.

TITLE OF THE PROJECT	ACADEMIC HOSTS AND COLLABORATORS
Innovation diffusion and political control of energy technologies: a comparative case-study on cogeneration (combined heat and power)	Stuttgart University, PREST
Impact of technological change on population migration	DG I, Brussels University
Economic Growth and Technological Change	Seville University, ETIC
Sustainable olive oil technological change and transfers for regional development in the Mediterranean	Research Inst. in Es, It, Gr, UK, NL; DG XVI, DG VI

Annex II

List of IPTS 1996 Publications

<i>Date</i>	<i>Author</i>	<i>EUR</i>	<i>Title</i>
Jan-96	P. Canarelli	EUR 16444 EN	The Method of Fuzzy Scenarios: Principle and Application to the Future of Congestion in Urban Centres
Jan-96	P. Canarelli	EUR 16445 EN	Neural Networks: a Tool for Analysing Real World Complex Systems
Jan-96	P. Canarelli	EUR 16446 EN	Knowledge Extraction from Data Using Genetic Algorithms
Feb-96	M. Aguado	EUR 16391 EN	Status and Prospective Analysis of the Photovoltaic Technology
Mar-96	C. Gómez*, M. Aguado (eds.) M.L.	EUR 16390 EN	Conclusions of the Forum 'European Enterprises facing technical and legal barriers to renewable energy, Seville, 23 and 24 November 1995 (Organised by SODEAN, UNESCO, IPTS, ECD, BESEL -Collaborators: EUFORES, IDAE)
Mar-96	E. Cahill	EUR 16447 EN	Industrial Efficiency - A Literature Synthesis
Mar-96	L. Bontoux	EUR 16459 EN	Survey of current projects for plastics recycling by chemolysis: Prospective technological study on materials/chemical-feedstock recycling and energy recovery from municipal plastics waste - Project i.1.a
Apr-96	P. Hardy	EUR 16419 FR	Politiques de développement territorial et investissements étrangers dans les pays du Maghreb
Apr-96	L. Bontoux, D. Papameletiou (eds.)	EUR 16460 EN	Technology options for plastics waste management: Proceedings, Seville 20-21 November 1995
Apr-96	Dr. D. W. Budworth	EUR 16461	Overview of Activities on Nanotechnology and Related Technologies
May-96	A. Zwick	EUR 16402 EN	Climate change - Analysis of causes, impacts and options
May-96	G. Fahrenkrog, D. Kyriakou	EUR 16458 EN	New technologies and employment: Highlights of an ongoing Debate

VAR - Various

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<i>IPTS Inter. no</i>	<i>Date</i>	<i>Author</i>	<i>ORA/ART/PRO</i>	<i>Title</i>
SP96/02	Aug-96	S. Gomez y Paloma Co-author: Group of Bertino	ART 43171	'East-West Agro-Food Systems Toward the Third Millennium', 'Memorandum on East-West Agro-Food Systems Toward the Third Millennium', SER INAR Publisher, p. 1-30 Cesena, Italy, July 1996
AR96/01	Aug-96	G. Mezelas	ART 43172	'Quand les bactéries font de la résistance' Biofutur, p. 31-34, September 1996
SP96/04	Oct-96	M. Bonazzi	ORA 40238	'Sustainable Olive Oil Technology Transfer for Regional Development in the Mediterranean Basin'; 'Intellectual Agenda on Environmental Strategy', Centre for Environmental Strategy, Univ. of Surrey, 15 October 1996, Guildford UK
SP96/03	Oct-96	M. Bonazzi	ORA 40239	'Evolución tecnológica y estrategias integradas de desarrollo sostenible para el sector del aceite de oliva en el Mediterráneo'; 'International Conference on Olive Oil', Institute of Fats, 10 October 1996, Seville, Spain
AR96/02	Oct-96	A. Zwick, P. Canarelli	ART 43210	'Climate sensitivity analysis using neural networks', Fresenius Environmental Bulletin, n° 5, p.700-705, November 1996
SP96/06	Nov-96	A. Burrill	ORA/PRO 40167	'Assessing the role of water in the regional development of the lower Guadalquivir basin'; 'The Environment in the XXI Century: Environment, long-term Governance and Democracy' Centre de Prospective et de Veille Scientifique, Fontvraud, France, September
SP96/05	Nov-96	J. Stamm'ler Jaliff, C.A. Jonsson, A. Ljungblad	ORA/PRO 40168	'Introduction of Modern Software Technology: a Case from Swedish Industry'; 'INSPIRE'96' (International Conference on Software Process Improvement-Research into Education & Training), Bilbao, 26-28 September 1996, British Computer Society/ European Software Institute
SP96/08	Dec-96	M. Demicheli, L. Bontoux	ORA 40280	'Current Activity on the Valorization of By-Products from the Olive Oil Industry', Hotel Príncipe de Asturias, Seville 7 December 1996
SP96/07	Dec-96	M. Bonazzi	ORA/PRO 40279	'Which Environment for the XXI Century? Environment, long-term Governance and Democracy'; 'Euro-Mediterranean policies for Olive Oil', Centre de Prospective et de Veille Scientifique, Fontvraud, France 9/11 September 1996



Annex III

Who does what at the IPTS

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