

**The Research Councils' response to the recommendations of the
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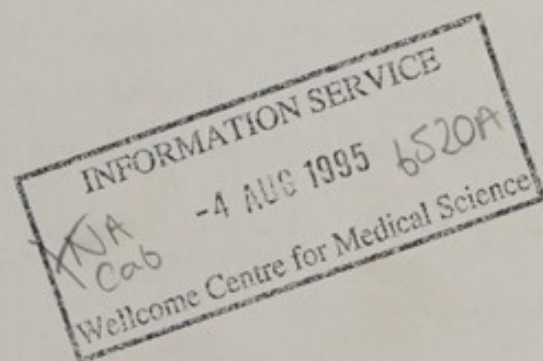
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CABINET OFFICE
OFFICE OF PUBLIC SERVICE AND SCIENCE

THE RESEARCH COUNCILS' RESPONSE
TO THE RECOMMENDATIONS OF
THE TECHNOLOGY FORESIGHT INITIATIVE

DG Research Councils
Office of Science and Technology
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INTRODUCTION

1. The report of the Technology Foresight Steering Group, *Progress Through Partnership*, was published in May 1995. The 15 Technology Foresight Panels published their individual reports during April and May 1995. In anticipation of the publication of the reports the Research Councils began preparing their responses during 1994.
2. The following is a summary of each Council's proposed plan of action to take forward the Foresight findings now that all the reports have been published.
3. Annex A shows how these programmes map onto the eleven key topics described in *Progress Through Partnership* for each of the seven Research Councils.

BIOTECHNOLOGY AND BIOLOGICAL SCIENCES RESEARCH COUNCIL (BBSRC)

4. Following its establishment in April 1994, BBSRC adopted a working structure which reflected the call in the Government's White Paper, *Realising Our Potential* [Cm 2250], for the Council to be responsive to the needs of its users. The Council established three Directorates with the specific aim of developing and implementing policy to meet the needs of its three principal user communities: chemicals and pharmaceuticals; food; and agriculture.
5. For each of these Directorates the BBSRC established an Advisory Committee, chaired by an industrialist, with at least 50% user representation on the Committee. Over the past year, these Directorate Advisory Committees have set out to identify those areas where research is required to underpin the needs of the user community by conducting an extensive consultation with the user base, and through

INTRODUCTION

The report of the Technology Foresight Steering Group, *Project Through Foresight*, was published in May 1992. The 12 Technology Foresight Panels published their individual reports during April and May 1993. In anticipation of the publication of the report the Research Councils began preparing their responses during 1994.

The following is a summary of each Council's proposed plan of action to take forward the Foresight findings now that all the reports have been published.

Annex A shows how these programmes map onto the eleven key topics described in *Project Through Foresight* for each of the seven Research Councils.

BIOTECHNOLOGY AND BIOLOGICAL SCIENCES RESEARCH COUNCIL (BBSRC)

Following its establishment in April 1992, BBSRC adopted a working strategy which reflected the call in the Government's White Paper, *Realising Our Potential* (1990), for the Council to be responsive to the needs of its users. The Council established three Directorates with the specific aim of developing and implementing policy to meet the needs of its three principal user communities: clinicians and pharmaceuticals; food and agriculture.

For each of these Directorates the BBSRC established an Advisory Committee chaired by an independent, well known and respected member of the community. Over the past year, these BBSRC Advisory Committees have met to discuss those areas where research is required to address the needs of the user community by co-ordinating an extensive consultation with the user base and through

correspondence and workshops. Throughout this period there has been a good interaction with the Technology Foresight Initiative, assisted by the extensive cross-membership between the Directorate Advisory Committees and Technology Foresight Sector Panels. For example, four members of the Food Directorate Advisory Committee are also members of the Food and Drink Sector Panel.

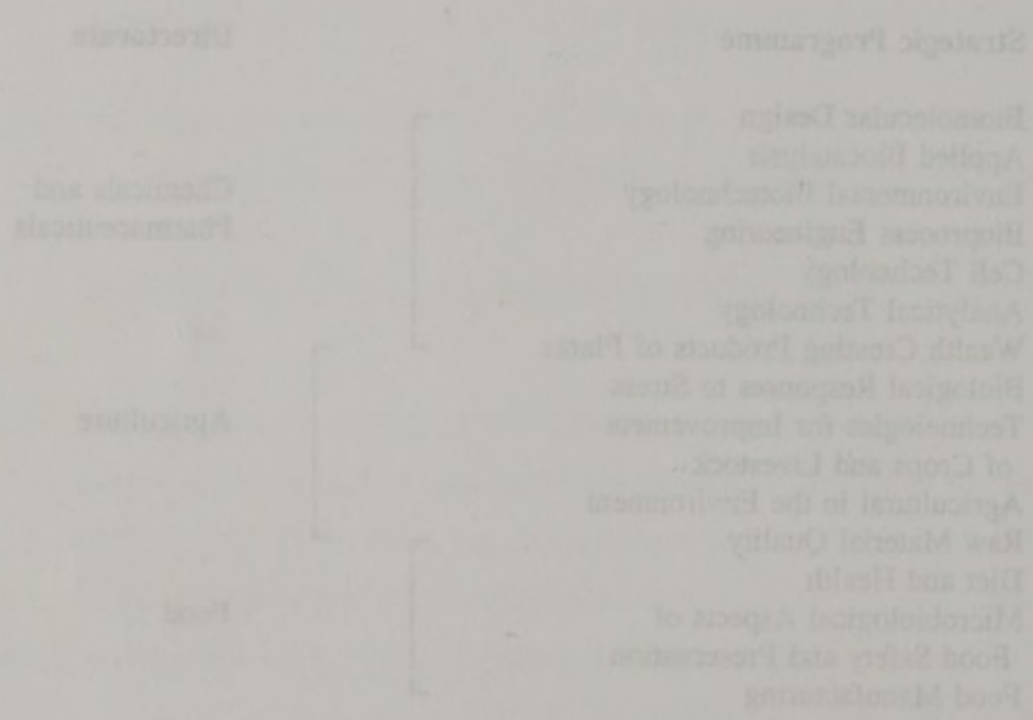
6. The emerging findings of Technology Foresight have, therefore, extensively shaped the strategic thinking of the Directorates. With the publication of the outcome of the Technology Foresight Initiative, the BBSRC intends to reorient its programme so that resources for strategic research underpin the following fourteen programme areas:

Strategic Programme	Directorate
Biomolecular Design	Chemicals and Pharmaceuticals
Applied Biocatalysis	
Environmental Biotechnology	
Bioprocess Engineering	
Cell Technology	
Analytical Technology	
Wealth Creating Products of Plants	Agriculture
Biological Responses to Stress	
Technologies for Improvement of Crops and Livestock	
Agricultural in the Environment	
Raw Material Quality	Food
Diet and Health	
Microbiological Aspects of Food Safety and Preservation	
Food Manufacturing	

7. These programmes take forward many of the priorities of the four Panels most relevant to BBSRC, as well as generic science and technology priorities identified by the Steering Group. The programme will be pursued through a variety of delivery mechanisms, including LINK, where BBSRC is already active in 13 programmes and is actively pursuing others. Not all research areas are at a stage appropriate for 50:50 funding with industry; nevertheless, some form of user involvement will be

correspondence and workshop. Throughout this period there has been a good interaction with the Technology Foresight Initiative, assisted by the extensive cross-membership between the Economic Advisory Committee and Technology Foresight Sector Panels. For example, four members of the Food Directorate Advisory Committee are also members of the Food and Drink Sector Panel.

The emerging findings of Technology Foresight have, therefore, extensively shaped the strategic thinking of the Directorate. With the publication of the outcome of the Technology Foresight Initiative, the HSEHC intends to review its programme so that resources for strategic research underpin the following research programme areas:



These programmes take forward many of the priorities of the Food 2025 vision relevant to HSEHC, as well as genetic science and technology related identified by the Steering Group. The programme will be pursued through a range of delivery mechanisms, including LRI, where HSEHC is already active in its programme and is actively pursuing others. Not all research areas are in a stage appropriate for 2025 funding with mature technologies, some form of near technology will be

encouraged in all the proposals considered within strategic programme areas and applicants will be invited to address at the outset possible exploitation routes. The Directorates will encourage team-working by specialists in different fields and this process will be promoted by programme managers seconded from industry wherever appropriate.

8. Both the Council's new Directorate strategic programmes and BBSRC's existing portfolio of basic research and training address the generic science and technology priorities and the generic infrastructural priorities identified by the Technology Foresight Initiative.
9. In relation to the science and technology priorities, BBSRC:
 - has introduced a new bioinformatics research initiative jointly with EPSRC, with funding of £10 million over 4 years
 - has existing initiatives in plant and animal genome analysis (funding for which has been increased by £3.6 million in 1995/96), and in plant molecular biology and which underpins genetics and biomolecular engineering
 - has a new LINK programme which is contributing to sensors and sensory information process research
 - will develop new applications on environmentally sustainable technology which will depend on greater understanding of molecular, cellular and physical processes and will be supported in BBSRC Institutes and by responsive mode grants
 - has diet and health as a strategic priority of its Food Directorate and will continue to underpin this area through basic animal nutrition research in its Institutes and in universities
10. In relation to generic infrastructural priorities, BBSRC:
 - is maintaining the skills base through strong studentship and fellowship schemes aimed at identifying the best supervisors, departments and research programmes

encouraged in all the proposals contained within strategic programme areas and applicants will be invited to address in the various possible expenditure claims. The Directorate will encourage cross-working by applicants in different fields and the process will be promoted by programme managers seconded from industry organisations.

Both the Council's new Directorate strategic programmes and EPSRC's existing portfolio of basic research and training address the generic science and technology priorities and the generic technological priorities identified by the Technology Foresight Initiative.

In relation to the science and technology priorities, EPSRC has announced a new programme of research funding with EPSRC's £10 billion over 4 years.

The existing initiative in plant and animal research (funding for which has been increased by £2.5 million in 1997/98) and in plant molecular biology and which includes research and development engineering.

has a new LINK programme which is complementary to sector and industry information/industry research.

will develop new applications on environmental, molecular biology which will depend on greater understanding of molecular biology and physics of processes and will be supported by EPSRC funding and by responsive grants from

the other and health as a strategic priority of the EPSRC Directorate and will continue to develop this area through basic research and research in the health and in universities.

In relation to generic technological priorities, EPSRC is maintaining the skills base through strong industrial and university research aimed at shortening the time to market, development and testing programmes.

- is maintaining support for truly excellent research, whether or not in a Technology Foresight priority area, through the peer review process
- is providing incentives for multi-disciplinary research through workshops, coordinated programmes, Interdisciplinary Research Centres, research groups, Institutes, LINK programmes and joint programmes between Institutes and universities
- is providing incentives for universities to work with industry through LINK, ROPA, CASE, Teaching Company Scheme, equipment-with-industry initiatives and workshops between academics and industrialists

ECONOMIC AND SOCIAL RESEARCH COUNCIL (ESRC)

11. ESRC considers its response to the Technology Foresight Initiative to be one of its principal objectives. Planning began in late 1994 when the Council arranged a meeting with the Chairs of Foresight Sector Panels to gain an insight into the issues emerging from the Panels' discussions which would impinge upon the social sciences. In the Spring of 1995 ESRC organised a successful one-day seminar of all social scientists on Foresight Panels. On the basis of these discussions with the Panels, and an analysis of the Panel Reports, ESRC has carried out an internal review of the issues raised which are relevant to the Council's mission. The Council is now well advanced with an extensive and unique national consultation exercise aimed at specifying future priority themes that will not only meet the requirement of *Realising Our Potential* but also have a high level of scientific interest and legitimacy within the Council's academic community.
12. This consultation involves the following elements:
 - eight detailed consultant reviews of the Council's existing portfolio
 - in-depth interviews with key researchers and specialists

- is maintaining support for early research research, whether or not in a Technology Foresight priority area, through the peer review process
- is providing incentives for cross-disciplinary research through workshops, coordinated programmes, interdisciplinary Research Councils, research groups, institutes, LINK programmes and joint programmes between institutes and universities
- is providing incentives for universities to work with industry through LINK, ROPA, CASE, Teaching Company Scheme, agreement with industry institutes and workshops between academics and industrialists

ECONOMIC AND SOCIAL RESEARCH COUNCIL (ESRC)

11. ESRC considers its response to the Technology Foresight Initiative to be one of its principal objectives. Planning began in late 1994 when the Council arranged a meeting with the Chair of Forefront Sector Panels to gain an insight into the issues emerging from the Panel's discussions which would impact upon the social sciences. In the Spring of 1995 ESRC organised a two-day one-day seminar of all social scientists on Forefront Panels. On the basis of these discussions with the Panel, and an analysis of the Panel Report, ESRC has carried out an internal review of the areas most relevant to the Council's mission. The Council is now well advanced with an extensive and unique national consultation exercise aimed at identifying future priority themes that will not only meet the requirements of Academics but also have a high level of academic interest and relevance within the Council's academic community.

12. This consultation involves the following elements:

- eight detailed consultative reviews of the Council's existing portfolio
- in-depth interviews with key researchers and researchers

- the organisation of nine focused groups by a leading market research organisation to examine the major policy areas of the social sciences and involving groups of carefully selected users
- a detailed survey using a stratified sample of 600 users, divided into different areas of policy relevance
- written consultation with all the main professional associations and learned bodies in the Council's sphere of interest

All of these consultations have taken the outcome of the Technology Foresight Initiative as their basis.

13. ESRC has already developed the following provisional Council themes in response to the Foresight Initiative. These themes will be revised and extended substantially in July.

- Innovation as a Business Process
- Trade, Instability and the Changing International Order
- The Impact of Electronic Technology on Human Activities
- Social Exclusion and Social Integration

14. The following table sets out the way in which the Council's existing strategy already maps onto the recommendations of the Sector Panels.

- the organization of nine focused groups by a leading national research organization to examine the major policy areas of the seminar and involving groups of carefully selected members
 - a detailed survey using a stratified sample of 600 members divided into different areas of policy relevance
 - written consultation with all the main professional associations and learned bodies in the Council's sphere of interest
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13. ESCO has already developed the following provisional Council themes in response to the Foreign Initiative. These themes will be revised and extended substantially in July.
- Innovation as a Human Process
 - Trade, Investment and the Changing International Order
 - The Impact of Electronic Technology on Human Activities
 - Social Exclusion and Social Integration
14. The following table sets out the way in which the Council's existing strategy already maps onto the recommendations of the Sector Panel.

TF RECOMMENDATION	ESRC PROGRAMMES
<p>A. <u>Understanding consumer behaviour and developing markets</u></p>	<p><u>Global Economic Institutions Programme</u> Analyses ways in which existing international institutions respond to changes in the world economy</p> <p><u>Pacific Asia Programme</u> Examines UK lessons to be learnt from Pacific Asian market mechanisms</p> <p><u>Single European Market Programme</u> Analyses the problems and consequences of a single market</p> <p><u>Centre for Fiscal Policy</u> Uses microeconomic and macroeconomic techniques in analysis of fiscal policy and its relationship to households and companies</p> <p><u>Economic Beliefs and Behaviour Programme</u> Focuses on economic choices and how people make them</p> <p><u>Population and Household Change Programme</u> Looks at crucial determinants of future markets in a changing demographic context</p> <p><u>Research Centre for Micro-Social Change in Britain</u> Undertakes the British Household Panel Survey</p>
<p>B. <u>Exploiting new technology</u></p>	<p><u>Programme on Information and Communication Technologies</u> Explores the long term economic and social issues</p> <p><u>Media Economics and Media Culture Programme</u> Analyses the media as competitive industries</p> <p><u>The Learning Society Programme</u> Analyses the nature of knowledge and skills for employment in contemporary labour markets</p> <p><u>Cognitive Engineering Programme</u> Researches design problems</p> <p><u>Human Communication Research Centre</u> Focuses on the influence of language and speech on design of IT systems</p> <p><u>Centre for Research and Development Instruction and Training</u> Tests and develops principles for the design of human and computer based teaching systems</p>

THE RECOMMENDATION	THE PROGRAM
<p>A. Recommendation: Academic and Professional Development</p> <p>1. Academic Development a. Academic Development: General This recommendation is based on the findings of the study that the academic development of the students is a key factor in their success. The study found that the students who had a strong academic background were more likely to succeed in their professional careers. Therefore, it is recommended that the students be provided with a strong academic foundation. This can be achieved by providing them with a rigorous curriculum that includes both theoretical and practical aspects of the field. Additionally, the students should be encouraged to pursue research and scholarship opportunities, which will help them to develop critical thinking and problem-solving skills. Finally, the students should be provided with access to a variety of resources, including books, articles, and online materials, to support their learning.</p> <p>b. Academic Development: Specific This recommendation is based on the findings of the study that the students who had a strong academic background in their specific field were more likely to succeed in their professional careers. Therefore, it is recommended that the students be provided with a strong academic foundation in their specific field. This can be achieved by providing them with a rigorous curriculum that includes both theoretical and practical aspects of the field. Additionally, the students should be encouraged to pursue research and scholarship opportunities, which will help them to develop critical thinking and problem-solving skills. Finally, the students should be provided with access to a variety of resources, including books, articles, and online materials, to support their learning.</p>	<p>2. Professional Development a. Professional Development: General This recommendation is based on the findings of the study that the students who had a strong professional background were more likely to succeed in their professional careers. Therefore, it is recommended that the students be provided with a strong professional foundation. This can be achieved by providing them with a rigorous curriculum that includes both theoretical and practical aspects of the field. Additionally, the students should be encouraged to pursue research and scholarship opportunities, which will help them to develop critical thinking and problem-solving skills. Finally, the students should be provided with access to a variety of resources, including books, articles, and online materials, to support their learning.</p> <p>b. Professional Development: Specific This recommendation is based on the findings of the study that the students who had a strong professional background in their specific field were more likely to succeed in their professional careers. Therefore, it is recommended that the students be provided with a strong professional foundation in their specific field. This can be achieved by providing them with a rigorous curriculum that includes both theoretical and practical aspects of the field. Additionally, the students should be encouraged to pursue research and scholarship opportunities, which will help them to develop critical thinking and problem-solving skills. Finally, the students should be provided with access to a variety of resources, including books, articles, and online materials, to support their learning.</p>
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TF RECOMMENDATION	ESRC PROGRAMMES
<p>C. <u>Regulating investment</u></p>	<p><u>Centre for Fiscal Policy</u> (See A. above) <u>The Risk Programme</u> Studies the interrelationship between human behaviour and risk <u>Pacific Asia Programme</u> (See A. above) <u>Global Economic Institutions Programme</u> (See A. above) <u>Centre for Economic Performance</u> Addresses the impact of both the internal structure and organisation of trends, and the external market environment on output productivity and technical change <u>Financial Market Centre</u> Researches into the nature of financial markets and their links with the flow of savings and investments <u>Contracts and Competition Programme</u> Seeks to advance understanding of the problems, processes and outcomes associated with the growing use of contracts</p>
<p>D. <u>Improving innovation organisation.</u></p>	<p><u>Centre for Business Research</u> Analyses business organisation <u>ESRC/DTI Intellectual Property Programme</u> Studies the way in which a range of businesses used formal and informal systems for the effective management of knowledge assets <u>Innovation Research Programme</u> Focuses on innovative management <u>Centre for Economic Performance</u> (See C. above) <u>Business Process Resource Centre</u> Focuses on the analysis of business process and the dissemination of knowledge in this field</p>
<p>E. <u>Managing environmental change</u></p>	<p><u>Global Environmental Change Programme</u> Researches the causes of global environmental change <u>Centre for Social and Economic Research on the Global Environment</u> Focuses on the causes, consequences and policy implications of global environmental change <u>NERC/ESRC Land Use Programme</u> Develops new computer models <u>Transport and the Environment</u> Focuses on the interface between environment and society in terms of air quality and global warming <u>Transport Study Unit</u> Examines the causes, consequence, problems and solutions associated with traffic growth</p>

TF RECOMMENDATION	ESRC PROGRAMMES
F. <u>Organisation of the Science Base</u>	<u>ESRC/DTI Intellectual Property Programme</u> (See D. above) <u>European Context of UK Science Policy Programme</u> Aims to provide research relevant to a range of research policy and management choices which the UK faces in the short and medium term

ENGINEERING AND PHYSICAL SCIENCES RESEARCH COUNCIL (EPSRC)

15. Fourteen of the 15 Sector reports make key recommendations of relevance to EPSRC, and at least 50 of the 76 recommendations relevant to EPSRC from Technology Foresight Sector Panels are already addressed within existing EPSRC programmes and activities. During the coming months, the Council will be discussing the outcome of the Foresight Initiative and expects to increase the convergence.
16. The EPSRC has put in place a mechanism to enable the outcome of the Technology Foresight Initiative to feed directly into its planning cycle. Following the completion of its recent planning cycle, the Council has published its research priorities and intentions for each of its programme areas. This document has been widely circulated to universities, institutions, professional bodies and Government Departments. There has been a very positive response to this. Feedback from recipients of the document will be used, with the Foresight reports, to provide input to the next planning cycle.
17. The Council will be considering the recommendations from the Technology Foresight Initiative at its June Council meeting. The Council's recommendations, together with the Foresight recommendations will then be examined by the Council's Technical Opportunities Panel and by the Users Panel. The advice from these Panels will be

RECOMMENDATION	REMARKS
<p>1. The Council should continue to provide a forum for the exchange of views and information between member countries and the public.</p>	<p>2. The Council should continue to provide a forum for the exchange of views and information between member countries and the public.</p>

1. THE FOREIGN COUNCIL'S RESEARCH COUNCIL (1952)

1. The Council of the 15 member states made key recommendations of relevance to the Foreign Council's research activities. At least 50 of the 36 recommendations relevant to the Foreign Council's research activities were adopted. During the coming months, the Council will be discussing the content of the Foreign Council's research activities and aspects to improve the effectiveness of the Foreign Council's research activities.

2. The Foreign Council has put in place a mechanism to enable the members of the Foreign Council to participate in the planning of the Foreign Council's research activities. Following the completion of its recent planning cycle, the Council has published its research priorities and intentions for each of its programme areas. This document has been widely circulated to universities, institutions, professional bodies and Government Departments. There has been a very positive response to this. Feedback from members of the Council will be used, with the Foreign Council's research, to provide input to the next planning cycle.

3. The Council will be considering the recommendations of the Foreign Council's research activities at its next Council meeting. The Council's research activities, linked with the Foreign Council's research, will then be examined by the Council's research activities. The research from these studies will be

discussed at the Council's December meeting. The outcome of this meeting will be the publication in the Spring of 1996 of the Council's new cycle of priorities.

18. The Council anticipate that the priorities identified in this 1996 publication will fully reflect the Technology Foresight recommendations and will clearly identify how the Council's priorities have changed since the 1995 booklet was published.
19. It is expected that one outcome will be the establishment of a research centre for one or more priority areas. Discussions have already begun with the Directors of the Interdisciplinary Research Centres so that the future requirement for such Centres can be identified. The Council hopes that this approach will release sufficient finance over the long term for the establishment of new Centres as earlier ones are modified, or closed.
20. The Council will consider several options for Centres. These will include the Interdisciplinary Research Centre concept, the Faraday concept and a number of mixed mode possibilities. The Council will, therefore, have a range of options available to respond to the recommendations of the Technology Foresight exercise.
21. The following table shows how some of the Council's current activities relate to the 11 key topic areas identified by the Technology Foresight Steering Group.

discussed at the Council's December meeting. The outcome of this work will be published in the Spring of 1996 of the Council's new cycle of priorities.

The Council anticipates that the priorities identified in this 1996 publication will fully reflect the Technology Foresight recommendations and will clearly identify how the Council's priorities have changed since the 1993 booklet was published.

It is expected that one outcome will be the establishment of a research centre for one or more priority areas. Discussions have already begun with the Directors of the Interdisciplinary Research Centres so that the future requirement for such Centres can be identified. The Council hopes that this approach will ensure sufficient finance over the long term for the establishment of new Centres as rather ones are modified or closed.

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The following table shows how some of the Council's current activities relate to the 11 key areas identified by the Technology Foresight Working Group.

TF RECOMMENDATION	EPSRC PROGRAMMES
Telepresence, Multimedia	Initiative within multimedia networking applications with ITCS programme.
Bioinformatics	Subject of a jointly managed programme with BBSRC.
Genetics and Biomolecular Engineering	The joint Biomolecular sciences programme with BBSRC comprises the second largest element of the Chemistry programme.
Software Engineering	The systems engineering theme within the ITCS programme supports work across this area.
Management and Business Process Engineering	This is a central theme of both the Innovative Manufacturing Initiative and the Design and Integrated Production Programme.
Sensors and Sensory Information Processing	The Control and Instrumentation programme, with a budget of £5.6 million in 1995/96, provides a focus for this work. This is supported by initiatives across the Council's programme in Communications, Advanced Magnetics, Process Systems Engineering, and Analysis and Sensors.
Communications with Machines	The multimedia initiative, together with work within the human factors theme of the IT programme, covers much of this area.
Security and Privacy Technology	Encryption techniques are addressed in the Mathematics and ITCS programmes. Other aspects relating to the use of smart materials are part of the Materials programme.
Environmentally Sustainable Technology	The Cities and Sustainability initiative and the LINK Programme on Waste Minimisation Through Recycling, Re-use and Recovery in Industry within the Clean Technology programme, and work with the Electrical and Mechanical Engineering programmes on efficiency are all relevant.
Health and Lifestyle	The medical engineering theme within the Materials, the Biomolecular Sciences and Bioinformatics (joint with BBSRC) programmes and networking within the Information Technology programme are relevant.
Optical Technology	Linked initiatives in Optical Physics and Technology, Next Generation Laser Diodes, Microstructures and Photonic Materials are all relevant. There are also initiatives in Electronic Materials for displays, a LINK programme in photonics and the Optoelectronics Interdisciplinary Research Centre.

TE RECOMMENDATION	STRICT RECOMMENDATION
Information Management	Information Management Systems with ITCS
Information	System of a highly integrated program with BSCC
Database and Information Technology	The total information system program with BSCC, including the second phase of the program
Software Engineering	The system engineering phase with the ITCS program requires work across the line
Management and Business Process Reengineering	This is a central theme of both the Information Management Initiative and the Design and Integrated Production Program
Science and Society Information Processing	The Council and Information Program, with a focus of 12.5 million in 1992/93, provides a basis for the work. This is supported by initiatives under the Council's program in Communications, Advanced Materials, Energy Systems, Environment, and Health and Society
Communications with Distance	The multimedia initiative requires work across the line, across the line of the IT program, across the line of the line
Security and Privacy Technology	Technology initiatives are related to the Information and ITCS programs. Other areas related to the use of information are part of the multimedia initiative
Environmentally Sustainable Technology	The Green and Sustainable Initiative and the ITCS Program on Sustainable Technology Initiative. The use of technology is related to the Green Technology Program and work with the Environment and Sustainable Technology Program on all levels
Health and Lifestyle	The medical engineering theme with the Health and Information Science and Technology Program with BSCC, including and involving with the Information Technology Program are relevant
Optical Technology	Related initiatives in Optical Science and Technology, Vision, Greenhouse Effect, Biotechnology and Health Sciences are relevant. There are also initiatives in Health Sciences for example, a 12.5 million in health and the Department's Information Technology Program

MEDICAL RESEARCH COUNCIL (MRC)

22. The MRC has been actively involved in the Technology Foresight Initiative. From late 1994, it began taking account of the emerging conclusions in its annual planning cycle. These have already had a substantial influence on the Council's Corporate Plan and Business Plan.
23. Following the publication of the final reports from the Technology Foresight Panels and from the Steering Group, the Council's Research Boards and Strategy Committee are reviewing the recommendations to formulate input to the next annual revision of the MRC's Scientific Strategy this autumn. The MRC Directors Conference in July will also review the Foresight findings and consider opportunities for MRC Institutes and Units.
24. Much of MRC's long-term basic and strategic research work already supports the priority areas highlighted by the Technology Foresight Initiative, including:
- Bioinformatics
 - Genetics and Biomolecular Engineering
 - Health and Lifestyle
 - Risk Assessment and Management
- The Council is also responding to specific opportunities identified for research, collaboration and application.
25. The Council has developed two new LINK proposals in Foresight Initiative priority areas. These are described in the following table.

MEDICAL RESEARCH COUNCIL (MRC)

22. The MRC has been actively involved in the Technology Foresight Initiative. From late 1994, it began taking account of the emerging consensus in its annual planning cycle. There have already had a substantial influence on the Council's Corporate Plan and Business Plan.

23. Following the publication of the first report from the Technology Foresight Panel and from the Steering Group, the Council's Research Board and Strategy Committee are reviewing the recommendations to formulate plans for the next several years of the MRC's Scientific Strategy. This summer, the MRC Director's Committee in July will also review the Foresight findings and consider opportunities for MRC initiatives and plans.

24. Much of MRC's long-term basic and strategic research work already supports the priority areas highlighted by the Technology Foresight Initiative, including:

- Biotechnology
- Genomics and Biotechnology Engineering
- Health and Lifestyle
- Risk Assessment and Management

The Council is also responding to specific opportunities identified for research collaboration and application.

25. The Council has developed two new LINK projects in Foresight Initiative priority areas. These are described in the following table.

TF RECOMMENDATION	MRC PROGRAMMES
<p><u>Ageing</u> Basic research into ageing and disabling degenerative disease, coupled with technologies for sustaining reasonable quality of life for the elderly and infirm.</p>	<p><u>Integrated Approaches to Healthy Ageing</u> This programme aims to help develop integrated, deliverable, prevention, treatment and management methods which are based on sound biological, physiological, and sociological understanding. These will also be of benefit to the pharmaceutical, biotechnology and device manufacturing industries, and to the health and social service industries.</p>
<p><u>Genetics in risk evaluation and management</u> Understanding how genetic information can be applied to preventing and treating common multifactorial diseases.</p>	<p><u>Development of a Programme on Genetic and Environmental Interactions in Health</u> This seeks to deploy the potential of the new molecular, cellular and genetic technologies and to enhance understanding of environmental mechanisms in health. By integrating these with genetic variation it will develop individually tailored approaches to diagnosis of risk and to prevention and treatment. There is increasing potential for collaboration with the diagnostics, biotechnology and pharmaceutical industries in developing these approaches.</p>

26. In addition, the Council is currently pursuing with industry, the Health Departments, and other research funders, a range of collaborative developments which may be possible in the near term. These include areas such as:

- application of genetic and biomolecular engineering techniques to control of cell behaviour and cancer
- technologies for gene therapy
- genome sequencing
- genetic diagnostics - developing the know-how to move from theory to practice
- ageing
- brain repair

- developing twin registers as a tool for studying the genetic and environmental influences on an individual's health

27. These new programmes and projects, and the development of the Council's scientific strategy, are being taken forward in discussion with BBSRC, The Wellcome Trust, the Association of Medical Research Charities, the Department of Health and other funding agencies, to ensure effective coordination.

NATURAL ENVIRONMENT RESEARCH COUNCIL (NERC)

28. Following the publication of the White Paper and the establishment of new Research Councils, NERC was reorganised into a single Science and Technology Directorate with Science and Technology Boards advising Council on strategy. Each Board has representatives from the academic and user communities. As an integral part of their planning process, each Board is mapping its area of responsibility onto Foresight priorities. NERC also set up a new group the 'Technology Foresight Interaction Group', headed by a recruit from industry with a major focus on Foresight. The Council has been actively involved in discussion with all the Technology Foresight Panels. Although environment was the focus of only one of the Sector Panels, environmental issues are pervasive and have emerged as key elements in many of the Panels recommendations. A Cleaner World is one of the six SET priorities identified by the Steering Group.

29. The Council has already reoriented its thematic research programme around six key environmental issues, all of which are relevant to Foresight recommendations. These are:

- resources
- biodiversity
- pollution
- waste
- risks and hazards
- global change.

- developing two regions as a model for the rest of the country and environmental indicators for an individual's health.

17. These new programmes and projects, and the development of the Council's scientific strategy, are being taken forward in discussion with ERDF, The Wellcome Trust, the Association of Medical Research Charities, the Department of Health and other funding agencies, to ensure effective coordination.

NATURAL ENVIRONMENT RESEARCH COUNCIL BOARD

18. Following the publication of the White Paper and the establishment of new Research Councils, NERC was reorganised into a single Science and Technology Directorate with Science and Technology Boards advising Council on strategy. Each board has representatives from the academic and non-academic sectors. As an integral part of their ongoing research, each Board is keeping its own set of representatives and liaisons with the Government. NERC also set up a new group, the Technology Research Innovation Group, headed by a senior team leader, with a major focus on Energy. The Council has been actively involved in discussion with all the Technology Research Boards. Although the Government has been at the forefront of the Science and Technology Research Council, it has been active in the development of the Science and Technology Research Council. A Council Board is one of the 257 projects funded by the Research Group.

19. The Council has already reviewed its current research programme in order to help environmental issues, all of which are relevant to the current environmental issues.

•	Research
•	Technology
•	Policy
•	Work
•	Education and Research
•	Global Change

It has also developed a new scoring methodology to assess grant proposals submitted under this new thematic programme. The methodology takes into account the quality of the proposed science and relevance to user needs.

30. During 1995, NERC will launch a new programme related to Foresight priorities 'Environmental Diagnostics', with an emphasis on pollution and waste. Additionally, the Council is developing a bid for four new LINK programmes in the following topic areas relevant to Foresight priorities:

- earth observation
- sensors for the oceans
- remote sensing of the oceans
- enhanced oil/gas recovery

31. Certain key user groups had not contributed fully to the Foresight Initiative. NERC therefore commissioned its own parallel survey of 'user' needs from the Science Policy Research Unit. The objectives of this exercise were to:

- identify and provide a taxonomy of the Council's user community
- identify and develop a dialogue with key individuals in the user community with respect to environmental and natural resources issues and to identify cross-sectoral themes
- provide a platform for more detailed surveys of user needs to be conducted by the Council's Science and Technology Boards, either alone or in partnership where needs cut across the scientific remit of the Boards

32. The Council has established a Technology Foresight Implementation Group composed of members of NERC Council. The Group is composed of the Science and Technology Board Chairmen and representatives of the user community. It has reviewed the Council's existing science portfolio against the recommendations of the Technology Foresight Initiative and the outcome of the Council's own user survey.

It has also developed a new research methodology to assess green proposals submitted under this new research programme. The methodology takes into account the quality of the proposal, science and relevance to most needs.

During 1995, NERC will launch a new programme related to Foreigner research 'Environmental Degradation', with an emphasis on pollution and waste. Additionally, the Council is developing a bid for the first new LIFE programme in the following topic areas relevant to Foreigner priorities:

- earth observation
- systems for the oceans
- remote sensing of the oceans
- enhanced oil/gas recovery

Certain key user groups, but not restricted fully to the Foreigner Initiative, NERC therefore commissioned its own parallel survey of 'user' needs from the Science Policy Research Unit. The objectives of this exercise were to:

- identify and provide a taxonomy of the Council's user community
- identify and develop a dialogue with key individuals in the user community with respect to environmental and natural resources issues and to identify cross-sectoral themes
- provide a platform for more detailed surveys of user needs to be conducted by the Council's Science and Technology Boards, either alone or in partnership with users outside the scientific remit of the Board

The Council has established a Technology Policy Implementation Group composed of members of NERC Council. The Group is composed of the Science and Technology Board Chairman and representatives of the user community. It has reviewed the Council's existing science portfolio against the recommendations of the Technology Foresight Initiative and the outcome of the Council's own user survey.

33. Against the background of the Technology Foresight Initiative, NERC is conducting its own specialised foresight exercise. This has initially identified fifteen environmental themes from the Foresight reports and the Council's own user survey. These emerging themes relate to:

Industry - Environment Interaction

Improve understanding of the robustness of the environment to the impact of man's activities and the development of the means to access the whole life cycle environmental performance of new products and processes. Likely priority user sectors are chemicals, construction, manufacturing, materials, agriculture and energy as well as other high environmental impact industries.

Environmental Evaluation

Develop a methodology which brings together social and economic values of different aspects of the natural environment from the view point that the environment is a national asset. Likely priority user sectors are construction, high environmental impact industries, energy, environmental industry, SMEs and local authorities.

Land and Soil

Define and better understand the relationship between land use and soil processes to provide a basis for reducing and remediating adverse consequences of human behaviour. Likely priority user sectors are agriculture, leisure, chemicals and materials, retailing, insurance, local authorities, and those concerned with potential uses for brown land eg financial sector.

Against the background of the Technology Transfer Initiative (TTI) is contained its own specialized knowledge network. This has already identified relevant environmental themes from the Technology Transfer and the Council's own work strategy. These emerging themes relate to:

Industry - Environmental Interaction

Improve understanding of the relevance of the environment to the impact of man's activities and the development of the means to assess the whole life cycle environmental performance of new products and processes. Identify priority new sectors and chemicals, construction, manufacturing, materials, agriculture and energy as well as other high environmental impact industries.

Environmental Protection

Develop a methodology which brings together social and economic values of different aspects of the natural environment from the view point that the environment is a national asset. Identify priority new sectors and construction, high environmental impact industries, energy, environmental industry, SMEs and local authorities.

Land and Sea

Define and better understand the relationship between land use and soil processes to provide a basis for reducing and minimizing adverse consequences of human activities. Identify priority new sectors and agriculture, forestry, chemicals and materials, mining, industry, ports, fisheries and those connected with potential uses for land and sea.

The Urban Environment

Develop an integrated analysis of the urban ecosystem. Likely priority user sectors are transport, construction, health, local and central Government.

Prediction of Extreme Atmospheric Events

Understand and predict extreme atmospheric events to aid risk reduction in affected areas of the economy, including, and for example, improved weather forecasting. Likely priority users are from planning and risk reduction groups in food, finance and insurance.

Mechanisms of Climate Change

Describe and understand the nature of climate change and predict the likely impact upon man and man's contribution to climate change. Sectors that have indicated an interest include transport and materials and those involved in land use.

Fluid dynamics in Natural Resource Management

Understand the interactions between fluids in the ground and rocks leading to, for example, increased recovery of oil and gas from known reservoirs. Likely user sectors are oil and gas, water and waste disposal.

Coastal Zone Modelling and Management

Develop predictive models for use in coastal zone management including coastal defences and coastal zone remediation. Likely priority user sectors include leisure, construction, transport and agriculture, and local authorities.

The Kyoto Protocol

Develop an integrated analysis of the main objectives. Kyoto priority areas include energy, transport, construction, industry, local and central government.

Integration of National Adaptation Plans

Integrated and provide various approaches to risk reduction in affected areas of the economy, including, for example, improved water management. Kyoto priority areas are local planning and risk reduction groups in food, finance and industry.

Mechanism of Climate Change

Describe and understand the nature of climate change and provide the likely impact upon man and man's contribution to climate change. Kyoto has been indicated as a major factor in climate change and Kyoto has been in fact.

Field Studies in National Adaptation

Understand the interaction between field in the ground and water leading to, for example, increased productivity of oil and gas from water resources. Kyoto has been in fact.

Central Asia Adaptation and Management

Develop predictive models for use in central zone management including central climate and central zone management. Kyoto priority areas include energy, construction, transport and agriculture, and local authorities.

Structure and Properties of Earth's Subsurface

Improved imaging of the Earth's substructure with a view to improving the utilisation of subsurface resources including oil and gas. User sectors should include hydrocarbons, nuclear energy, waste and water.

Use of Natural Processes and Materials

Improved exploitation of naturally occurring materials, both inorganic and organic, as a basis for new drugs, adhesives etc. Likely priority user sectors are health, materials, manufacturing and environmental industries.

Sustainable Use of Marine Resources

Improved understanding of the relationship between marine life ecosystem stability and sustainable use of marine resources including wild fish populations. Likely user interests come from the food and Government sectors.

Ocean Circulation

Develop realistic ocean circulation models, to better understand the impact, dispersion and fate of pollutants. Likely priority user sectors include chemical and pharmaceutical, food, and there are interests from the electronics sector.

Remote Data Acquisition

Gather high quality relevant environmental data as a basis for modelling and predicting the environment particularly with respect to man's impact and improved management of environmental impacts. There are a wide range of sectors requiring good environmental data, of which the following have reinforced this need during the Foresight exercises: insurance, energy, leisure, and the environmental industry.

Summary and Overview of EPA's Initiatives

Improved management of the EPA's resources with a view to improving the utilization of resources, including oil and gas. User sectors should include hydrocarbon, nuclear energy, waste and water.

Use of Natural Resources and Materials

Improved exploration of naturally occurring materials, both inorganic and organic, as a basis for new drugs, plastics etc. Likely priority user sectors are health, materials, manufacturing and environmental industries.

Sustainable Use of Marine Resources

Improved understanding of the relationship between marine life ecosystem stability and sustainable use of marine resources including wild fish populations. Likely user interests come from the food and fisheries sectors.

Green Chemistry

Develop realistic ocean circulation models to better understand the impact dispersion and fate of pollutants. Likely priority user sectors include chemical and pharmaceutical, food, and other are interests from the electronics sector.

Marine Data Acquisition

Obtain high quality marine environmental data as a basis for modelling and predicting the environmental consequences with respect to man's impact and improved management of environmental impacts. There are a wide range of sectors requiring good environmental data, of which the following have mentioned this need during the 1-2 year period: marine, energy, health, and the environmental industry.

Social and Human Health Impacts of Environmental Change

Understand better the links between human health and the environment. Likely user sectors include local authorities, health, transport, leisure, high environmental impact industry.

Management of Freshwater Resources

Improve scientific tools for the sustainable management of freshwater resources including the supply of potable water. Likely priority user sectors include chemicals, manufacturing, extractive and water industries, and the environmental industry.

34. The Science Policy Research Unit are now assisting the Implementation Group to refine and prioritise these themes in terms of their attractiveness and feasibility. The process involves consulting over 100 key members of the NERC academic and user communities. At the same time the Council's present research programmes are being mapped onto the above Foresight themes.
35. The Implementation Group will then put forward their recommendations to the NERC Council relating to the extent to which existing NERC activities reflect Foresight priorities and identify any gaps in the programme where new research initiatives are appropriate.
36. It is intended that the findings of the Foresight Implementation Group will be incorporated into a new NERC Strategy Document to be published later this year. Additionally, recommendations relating to infrastructural requirements, such as the need to establish new capabilities to meet user needs and requirements for cross-Council working, will be made.

Science and Human Health: Issues of Environmental Change

Understand better the links between human health and the environment. Identify new sectors within local authorities, health, transport, leisure, high environmental impact industry.

Management of Freshwater Resources

Improve scientific tools for the sustainable management of freshwater resources including the supply of potable water. Identify priority water resources within chemical, pharmaceutical, automotive and water industries, and the environmental industry.

The Science Policy Research Unit was now a member of the Environment Group to advise and provide the Council in areas of their environment and technology. The process involves carrying out 100 key projects of the NERC academic and non-academic. At the same time the Council's priority research programme are being mapped onto the above research themes.

The Environment Group will also put forward their recommendations to the NERC Council relating to the extent to which existing NERC activities within the environment and health are gaps in the programme which new research initiatives are appropriate.

It is intended that the findings of the Environment Group will be incorporated into a new NERC Strategy Document to be published later this year. Additionally, recommendations relating to environmental education, such as the need to establish new capabilities in new areas and equipment for new Council working, will be made.

PARTICLE PHYSICS AND ASTRONOMY RESEARCH COUNCIL (PPARC)

37. Much of the Council's basic research is necessarily long term. Therefore the recommendations of the Technology Foresight Initiative are less likely to impact on it than that of most of the other Councils. However, to pursue such research requires access to the most advanced technology, for example detectors, high precision instrumentation, and pattern recognition systems. In these areas, the Council is keen to build on the Foresight recommendations to guide its industrial collaboration programme. The Council also recognises that the skilled workforce generated by its programme helps to provide the knowledge and skills base identified by the Foresight Initiative as a key infrastructural priority.
38. The Council played an active role in the Initiative itself with its research community involved in five of the Foresight Panels. PPARC will continue to maintain its involvement in the Foresight Programme and subsequent exercises, building on the networks already developed.
39. The Council's Industrial Liaison Panel, and Education and Training Committee will both target Technology Foresight recommendations for particular attention.
40. The Council has identified four key recommendations from the Foresight Panels which are of particular relevance to its areas of activity. These are:
- detector technology
 - mathematical modelling
 - high speed data handling
 - image processing

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40. The Council has identified four key recommendations from the Foreigner Panel which are of particular relevance to its areas of activity. These are:

- detector technology
- mathematical modelling
- high speed data handling
- image processing

41. Other important Foresight priorities in the PPARC area include:
- advanced networks
 - optronics
 - satellite communications and communications security
 - electronic structural and high Tc materials
 - human-computer interface
42. PPARC's Industrial Liaison Panel has completed a preliminary analysis of the range of technologies developed in the Council's programme against the technology priorities identified by the 15 Panels. This analysis will be developed to help guide the Council's programme in support of academic/industrial collaboration and technology transfer. Specifically, this will help to prioritise the Council's own collaborative scheme - the PPARC Industrial Programme Support Scheme (PIPSS) - now in its second year, and the award of CASE studentships. The developments will be incorporated in the Council's next Business Plan.
43. The Council's Education and Training Committee will draw upon Foresight findings on infrastructural issues in developing PPARC's studentship and fellowship policy. As recommended by the Foresight Steering Group, the Council has already agreed to encourage women in science by abolishing all age limits for fellowships, thus removing a bar to their return to research work.

COUNCIL FOR THE CENTRAL LABORATORY OF THE RESEARCH COUNCILS (CCL)

44. The Council recognises that its multi-disciplinary research role will be important in the implementation of the Technology Foresight Initiative recommendations. In addition, the increasingly international nature of research, recognised by the Foresight Initiative, is an important aspect of CCL's research programmes.

41. Other Important Foreign Priorities in the PPARC Area Include:

- advanced materials
- optics
- satellite communications and communications security
- electronic structural and high TC materials
- human-computer interface

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of technologies developed in the Council's program against the technology priorities identified by the 15 Panels. This analysis will be developed to help guide the Council's program in support of technology/industrial collaboration and technology transfer. Specifically, this will help to prioritize the Council's own collaborative scheme - the PPARC Industrial Program Support Scheme (PIPSS) - now in its second year, and the award of CASE studentships. The development will be incorporated in the Council's next Business Plan.

The Council's Education and Training Committee will draw upon foreign findings on international issues in developing PPARC's strategy and following policy. As recommended by the Foreign Funding Group, the Council has already agreed to encourage women in science by abolishing all age limits for technology, thus removing a barrier to their entry to research work.

COUNCIL FOR THE CENTRAL LABORATORY OF THE RESEARCH COUNCILS (CLC)

43. The Council recognizes that its multi-disciplinary research will be supported in the implementation of the Technology Panel in related recommendations. In addition, the increasingly international nature of research, as agreed by the Foreign Funding Group, is an important aspect of CLC's research programme.

45. The Council is able to offer strong support to technology across interdisciplinary boundaries and to provide synergy and added value through its national facilities. CCL programmes are strongly aligned with the delivery requirements of the Foresight recommendations which are being proposed by the Research Councils which it supports.
46. The Council has identified key areas from the Panel recommendations where it can make a significant contribution. These are:

TF RECOMMENDATIONS	CCL PROGRAMMES
<u>Materials Development/Application</u> Generic technology underpinning the range of industrial Foresight activities	<u>Materials Research:</u> CCL has substantial involvement and experience at the industry/academia interface in advancing the understanding of materials, their structure, behaviour and use through its large scale ISIS and SRS. The laboratory is also active in the rapidly growing field of surface science and the interaction of conventional and biological materials. CCL will deploy its technical capabilities in support of Technology Foresight programmes, in particular those of BBSRC, EPSRC and MRC.
<u>Sensor Technology</u> Sensors have been identified by more than half the Panels as having high priority and as a key technology for wealth creation	<u>Sensor Development:</u> This is a core activity for CCL since it is fundamental to accelerator based physics, earth observation by satellite, and laser research. Within the Council there is a massive body of sensor expertise supported by advanced fabrication and delivery capabilities for realisation of physical, molecular and chemical sensor devices. The Council will build on its existing capabilities to enhance its interdisciplinary mix of sensor, IT and communications expertise to align with Foresight recommendations.
<u>Convergence of Information Technology, Electronics and Communication</u> Identified as critical to future national prosperity	<u>Information Science:</u> The CCL is a national centre for high performance computing. It has one of the finest microstructure engineering facilities in Europe, world-class communications and opto-science skills, and a leading micro-circuit design group. Its systems-based approach offers strong support to new research and the onward application of existing techniques. It will be a critical resource in the successful implementation of Foresight recommendations.

The Council is also to offer strong support to technology action internationally. It will provide support and added value through its national facilities. CCI programmes are strongly aligned with the delivery requirements of the Foreign Investment which are being proposed by the Research Councils which it supports.

The Council has identified key areas from the Joint recommendations where it can make a significant contribution. These are:

CCI PROGRAMMES	TY RECOMMENDATIONS
<p>Basic Research</p> <p>CCI has substantial investment and experience in the basic research areas of the Community. It has a strong tradition in supporting the development of research, from the early stages of research through to large scale R&D. The Community is also active in the rapidly growing field of nuclear science and the interaction of environmental and biological sciences. CCI will develop its research capabilities in support of technology transfer programmes, in particular those of ECSEL, EEC, and EEC.</p>	<p>Basic Research</p> <p>Research has been identified by the Council as being of high priority and a key technology for the world economy.</p>
<p>Small Enterprises</p> <p>This is a core activity for CCI, since it is fundamental to the growth of the Community. It is a key area for research and development. Within the Council there is a number of small enterprises supported by research, development and technology capabilities for research in applied, scientific and technical areas. The Council will build on its existing capabilities to enhance its interactivity with the small, medium and large enterprises to support their research and development.</p>	<p>Small Enterprises</p> <p>Research has been identified by the Council as being of high priority and a key technology for the world economy.</p>
<p>Education and Training</p> <p>The CCI is a national centre for high performance computing. It is one of the most advanced computing facilities in Europe, with a leading role in the design of high performance computers and the development of new research and the training of research scientists. It will be a centre for the research and development of high performance computing.</p>	<p>Education and Training</p> <p>Research has been identified by the Council as being of high priority and a key technology for the world economy.</p>

TECHNOLOGY FORESIGHT KEY TOPIC AREAS - RESEARCH COUNCIL RESPONSE

	BBSRC	ESRC	EPSRC	MRC	NERC	PPARC	CCL
TELEPRESENCE, MULTIMEDIA		✓	✓				✓
BIOINFORMATICS	✓	✓	✓	✓			
GENETICS AND BIOMOLECULAR ENGINEERING	✓		✓	✓			
SOFTWARE ENGINEERING			✓			✓	✓
MANAGEMENT AND BUSINESS PROCESS ENGINEERING		✓	✓				
SENSORS AND SENSORY INFORMATION PROCESSING	✓		✓		✓	✓	✓

	BBSRC	ESRC	EPSRC	MRC	NERC	PPARC	CCL
COMMUNICATING WITH MACHINES		✓	✓				✓
SECURITY AND PRIVACY TECHNOLOGY			✓				
ENVIRONMENTALLY SUSTAINABLE TECHNOLOGY	✓	✓	✓		✓		
HEALTH AND LIFESTYLE	✓	✓	✓	✓	✓		
OPTICAL TECHNOLOGY			✓			✓	✓



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