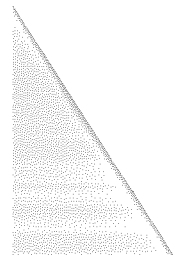


CSIRO
PRIORITY DETERMINATION
1990
ROLE STATEMENTS

11 March 1991

This is a working document, and as such its contents are not final. The Role Statements will be finalised to provide the basis for the CSIRO Strategic Plan 1991-92 to 1996-97.



PREFACE

The Role Statements presented in this document represent the culmination of deliberations by the CSIRO Executive Committee at a number of special workshops and regular Executive Committee meetings held during 1990 for the purpose of determining CSIRO's strategic directions and research priorities for the next 5 years. The material in this paper encompasses critical directions, objectives and strategies for the use of CSIRO research managers in their planning. The Role Statements form the basis of the Organisation's Strategic Plan for 1991/92 to 1996/97.

This document was prepared by Dr Michael Blyth of the Corporate Planning Office with the cooperation of Institute Planners, Directors and other staff of the Corporate Planning Office. Much of the input material was synthesised from the Executive Committee workshops and meetings. Supporting information, and data on macro-economic indicators and R&D expenditures, were provided by the Institute Planners, the Research Data Office and the Corporate Planning Office.

This document is a companion to the research priorities method paper, *CSIRO Priority Determination 1990 Methodology and Results Overview (1991)* and the implementation paper, *Implementation of Research Priorities (1991)*.

Other CSIRO documents referred to in this paper can be obtained from the Corporate Planning Office, PO Box 225, Dickson. ACT. 2602.

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Corporate Planner



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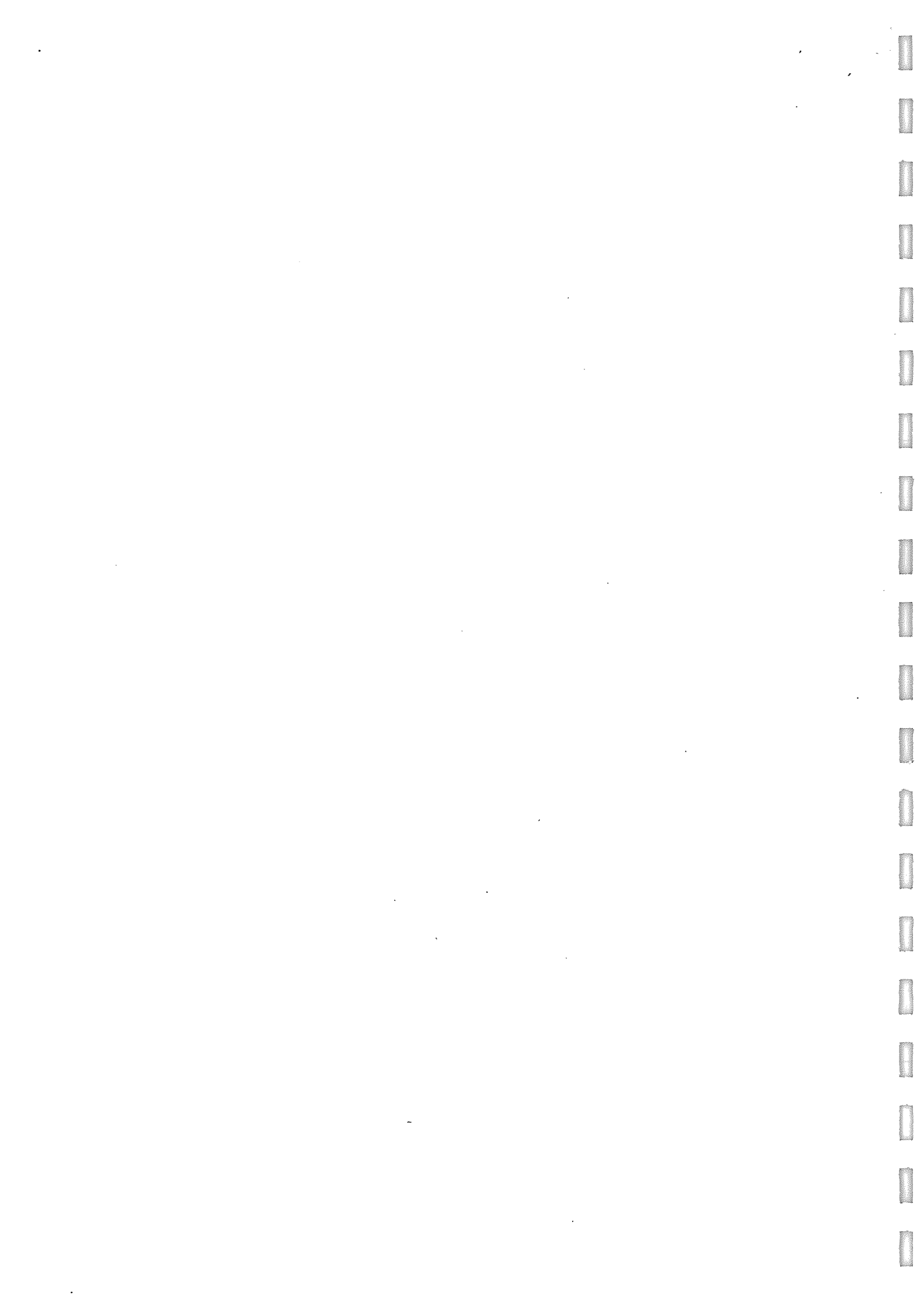
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INTRODUCTION

The role statements summarise the Executive Committee's principal arguments and conclusions on the likely returns to Australia from scientific and technological research, CSIRO's expected role, and the Organisation's research strategies, including funding arrangements for the next five years. The bottom line of each role statement, the Decision, is the key message for the direction of research for CSIRO over the next 5 years. As such, the role statements are the key input to the Organisation's next Strategic Plan.

The Executive Committee considered national and CSIRO research priorities and strategic directions by sub-division. A sub-division is a component of the CSIRO classification hierarchy which was adapted from the Australian Bureau of Statistics' Interim Australian Standard Research Classification by socio-economic objectives (SEO). Sub-divisions sit below divisions, and above groups and classes. In aggregate the sub-divisions encompass all economic, social and environmental activity in Australia. For CSIRO, the SEO classification system provides a meaningful basis for classifying research. Research is classified according to the purpose for doing the research or the most direct Australian beneficiary. The Organisation's research purposes are generally recorded at the group and class levels and then aggregated to provide research purposes by sub-division. There are 17 sub-divisions and thus, 17 corresponding Role Statements. More detailed discussion on the CSIRO research classification scheme is contained in *CSIRO Priority Determination 1990. Methodology and Results Overview* (1991).

KEY COMPONENTS OF THE ROLE STATEMENTS

The key components of the role statements are described below. A full description of the method and how it was applied to determine CSIRO's strategic directions and research priorities is contained in the methodology and results paper referred to above.

Indicators of Research Prospects

Key arguments are summarised for each of the four criteria considered in the assessment of national research priorities. The first criterion, potential benefits is an indication of the maximum possible economic, social and environmental returns from technological improvement in the sub-division for Australia. The second is ability to capture, which is an indication of the likelihood of capturing research benefits for Australia. The third is R&D potential, which is an indication of the overall fertility of the research field. The fourth criterion is R&D capacity, which is an indication of the quality and quantity aspects of the national research effort. The assessment of each research purpose at the sub-division level in terms of the criteria provides the rationale for the Executive Committee's national research priority ratings.

Depending on the relative "attractiveness" (potential benefits X ability to capture) and "feasibility" (R&D potential X R&D capacity) a sub-division may be rated as warranting "strong emphasis", "selective emphasis" or "limited support", in regard to the research effort (these concepts are described fully in the methodology and results paper).

CSIRO Response

CSIRO's level of involvement in research for the sub-division is assessed relative to the total CSIRO effort and the total national effort. Strategic importance is indicated, with areas of particular strength and significance noted, as well as areas of weakness. CSIRO's relationships with private companies and external funding agencies are also noted.

CSIRO Strategy

The CSIRO Strategy is derived from the national priorities assessment and takes into account specific aspects of CSIRO's operations. It sets out CSIRO's overall research directions for the next five years and key elements of associated objectives and targets. The main aspects covered are the specific research focus, the level of appropriation, the proportion of research funded from external sources, and particular areas of past weakness in need of improvement.

Decision:

The Executive Committee's Decision concludes the statement. It contains the essence of the Organisation's strategy for future research for the sub-division, as well as objectives for appropriation and non-appropriation (external) funding. A number of specific Decisions refer to "proposals". Proposals for research are to be prepared in support of the allocation of appropriation funds by the Chief Executive to specific areas or to specific aspects of a sub-division, in accordance with Decisions. This is consistent with the concept of "selectivity", according to which appropriation support for research will be more selective than previously, focusing on priority areas. Research proposals or submissions will be developed on an Institute basis to be examined by the Executive Committee in sub-divisional groupings and presented by the Director responsible for the sub-division (see table in next section). Each Institute will develop a target research profile, showing the specific allocation of research funds by research purpose at the group level (aggregated to sub-divisions), in accordance with the Executive Committee's Decisions, as recorded in the Role Statements. Further details on aspects implementing the research priorities are contained in the paper, *Implementation of Research Priorities*.

INDUSTRY COVERAGE

The 17 sub-divisions for which Role Statements and therefore, research directions have been determined are listed below, together with the responsible Institute Director.

CSIRO SUB-DIVISIONS AND RESPONSIBLE INSTITUTES

SUB-DIVISION	DIRECTOR	INSTITUTE
1. Plant Production and Primary Products	Dr Ted Henzell	IPPP
2. Animal Production and Primary products	Dr Alan Donald	IAPP
3. Rural Based Manufacturing	Drs Donald & Henzell	IAPP/IPPP
4. Minerals Industry	Dr Alan Reid	IMEC
5a. Energy Resource Industry	Dr Alan Reid	IMEC
5b. Energy Supply Industry	Dr Alan Reid	IMEC
6. Manufacturing Industries	Dr Colin Adam	IIT
7. Information and Communications Industries	Dr Bob Frater	IISE
8. Transport Industry	Dr Alan Reid	IMEC
9. Construction Industry	Dr Alan Reid	IMEC
10. Commercial Services	Dr Bob Frater	IISE
11. Economic Development-Environmental Aspects	Dr Roy Green	INRE
12. Environment	Dr Roy Green	INRE
13. Health	Dr Alan Donald	IAPP
14. Defence	Dr Colin Adam	IIT
15. Social Development and Community Services	Dr Roy Green	INRE
16. Advancement of Knowledge	Dr Bob Frater	IISE

The sub-divisions more than cover the principal areas of CSIRO's research involvement. One important area of CSIRO involvement (\$9.25 million in 1989-90) which is not accorded sub-division status is research conducted as part of International Aid projects and programs. In 1989-90, research associated with International Aid was undertaken in the following sub-divisions: Plant Production and Primary Products, Animal Production and Primary Products, Rural Based Manufacturing, Economic Development - Environmental Aspects, and Environment.

A separate priorities assessment exercise is being conducted for Research Support, covering services provided by the Corporate Centre and other centrally managed services. The results of that exercise will be summarised in a similar fashion to the role statements for research activities and will be included in the Strategic Plan. Implementation of decisions on research support will proceed in a similar way to the implementation of research decisions.

DATA AND INFORMATION SUPPORTING THE ROLE STATEMENTS

The Role Statements are based on four principal input sources: data on the external environment and the internal CSIRO environment, individual criteria assessment summaries, the CSIRO response to national research priority assessments, and the CSIRO strategy for future research directions. Supporting data pervade the Role Statements and are discussed in detail below. The other three inputs, which correspond to the three main sections of the Role Statements (ie, Indicators of Research Prospects, CSIRO Response and CSIRO Strategy), are outputs from the Executive Committee workshops and meetings. Following the first stage of the exercise the Executive Committee's arguments supporting their assessment of national priority ratings were recorded and summarised. These form the basis of the "Indicators of Research Prospects". At the completion of the second stage, deliberations on the CSIRO response to national priorities were summarised. This formed the basis of the "CSIRO Response". The second stage also produced "the CSIRO Strategy". Relevant internal and external data were combined with these summaries to produce final versions of each section of the Role Statement.

Supporting Data

The deliberations and final decisions on research directions and priorities for the sub-divisions were supported by various data on the external and internal environments. External data comprised macro-economic indicators which provide measures of the relative size and economic significance of each sub-division within the economy. The specific data used were Gross Product, which measures the sub-division's contribution to Gross Domestic Product (GDP) and is a measure of value added by a sub-division. Also used were the value of exports and the value of imports, which reveal the relative trade orientation of a sub-division. These macro-economic data are presented in Figure 1. These data were chosen because they best describe the economic status of each sub-division in terms of production and contribution to the nation's total production and income. Australia's dependence on foreign markets for many of its industries and sectors, makes trade data and trade performance measures vital to the consideration of research priorities.

Reference to Figure 1 reveals a number of gaps, most notably for Economic Development - Environmental Aspects, Environment, and Advancement of Knowledge in relation to production and trade data. The absence of trade data for these sub-divisions and others in Figure 1 reflects either the relative insignificance or nonexistence of trade for the sub-division. In the case of Economic Development - Environmental Aspects and Environment, official national income estimates for environmental goods and services are not available. Therefore, alternative measures were sought. For Economic Development - Environmental Aspects the likely income foregone from the continuation of all forms of environmental degradation associated with use of the environment and assuming no preventative action, was considered. For Environment, it was agreed that its economic value is proportional to the total value of all economic activities. Estimates of its value were simulated at 2.5%, 10%

and 25% of Australia's GDP for comparative purposes. Otherwise, it was considered that its value was high. Advancement of Knowledge does not contribute to national income and output in a way that is directly measurable. The benefits of this research purpose are derived from adoption of product and process technologies which are the result of specific applications of new scientific knowledge within a particular research purpose.

Data on the internal environment relate largely to CSIRO R&D expenditure by sub-division. To gain an indication of the relative importance of the CSIRO research effort in each sub-division estimates of the total Australian research effort were made for each sub-division, using the latest available data from the Australian Bureau of Statistics and the Department of Industry, Technology and Commerce (1986-87). These were compared to equivalent CSIRO expenditure levels. R&D expenditure data for Australia and CSIRO by sub-division are presented in Figure 2. Figure 3 presents CSIRO R&D appropriation and non-appropriation expenditure data by sub-division. Table 1 shows the distribution of CSIRO R&D effort by sub-division by Institute. For the Executive Committee workshops and meetings all data were presented in bar charts to facilitate comparisons within each chart and between charts.

Other less prominent data were provided for consideration in the priorities exercise including international R&D intensity data, data and information contained in *Outlook for CSIRO A Preliminary Analysis* (1990), and medium term projections for key macro-economic variables as well as the medium and long term effects of a 1% increase in technology-induced productivity improvement in each sub-division using the ORANI model of the Australian economy. The Corporate Planning Office has commenced a review of the data requirements for future research priorities exercises. This review includes, among other matters, the possibility of assessing the prospects for particular research purposes according to alternative scenarios, with the aid of an objective framework, such as the ORANI model. Other aspects to be addressed include the ability to make valid and consistent international comparisons in all sub-divisions for R&D measures such as R&D intensity and various macro-economic measures and indicators. Procedures for more objective measurement of R&D Capacity and R&D Potential will also be considered.

Figure 1: MACRO-ECONOMIC INDICATORS BY SUB-DIVISION
AUSTRALIA 1988-89

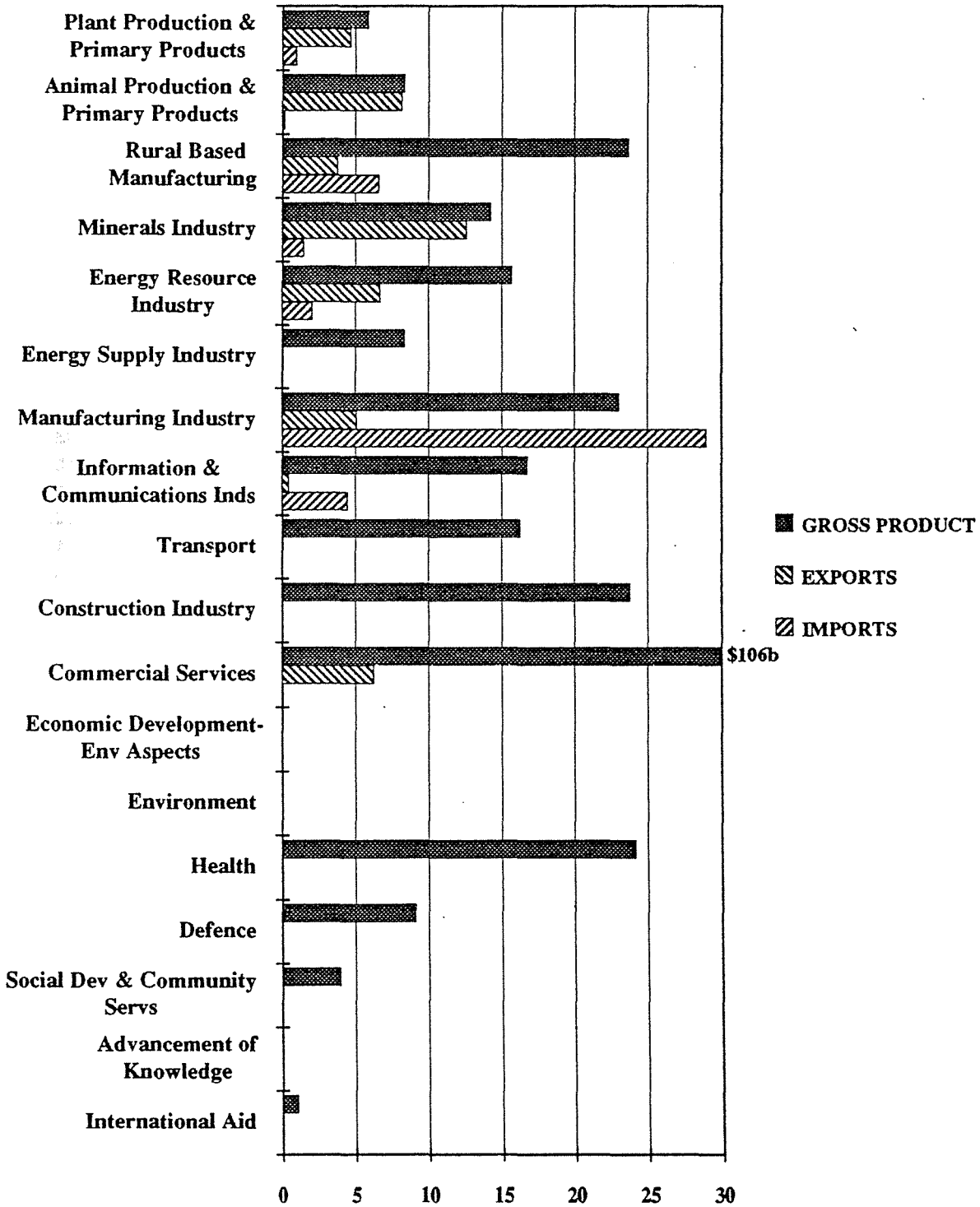
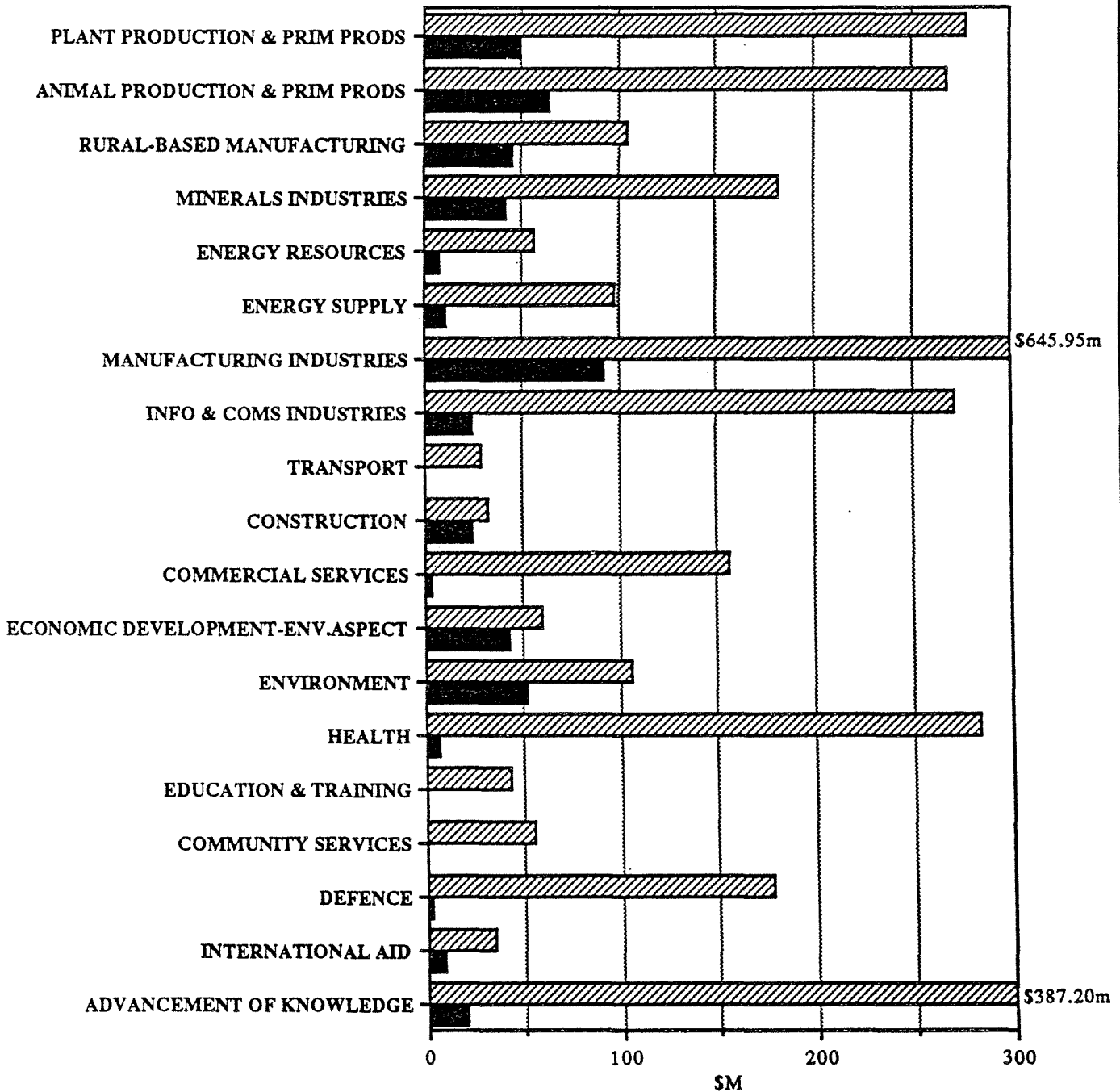


Figure 2: NATIONAL AND CSIRO RESEARCH EXPENDITURE BY SUB-DIVISION (\$MILLION)

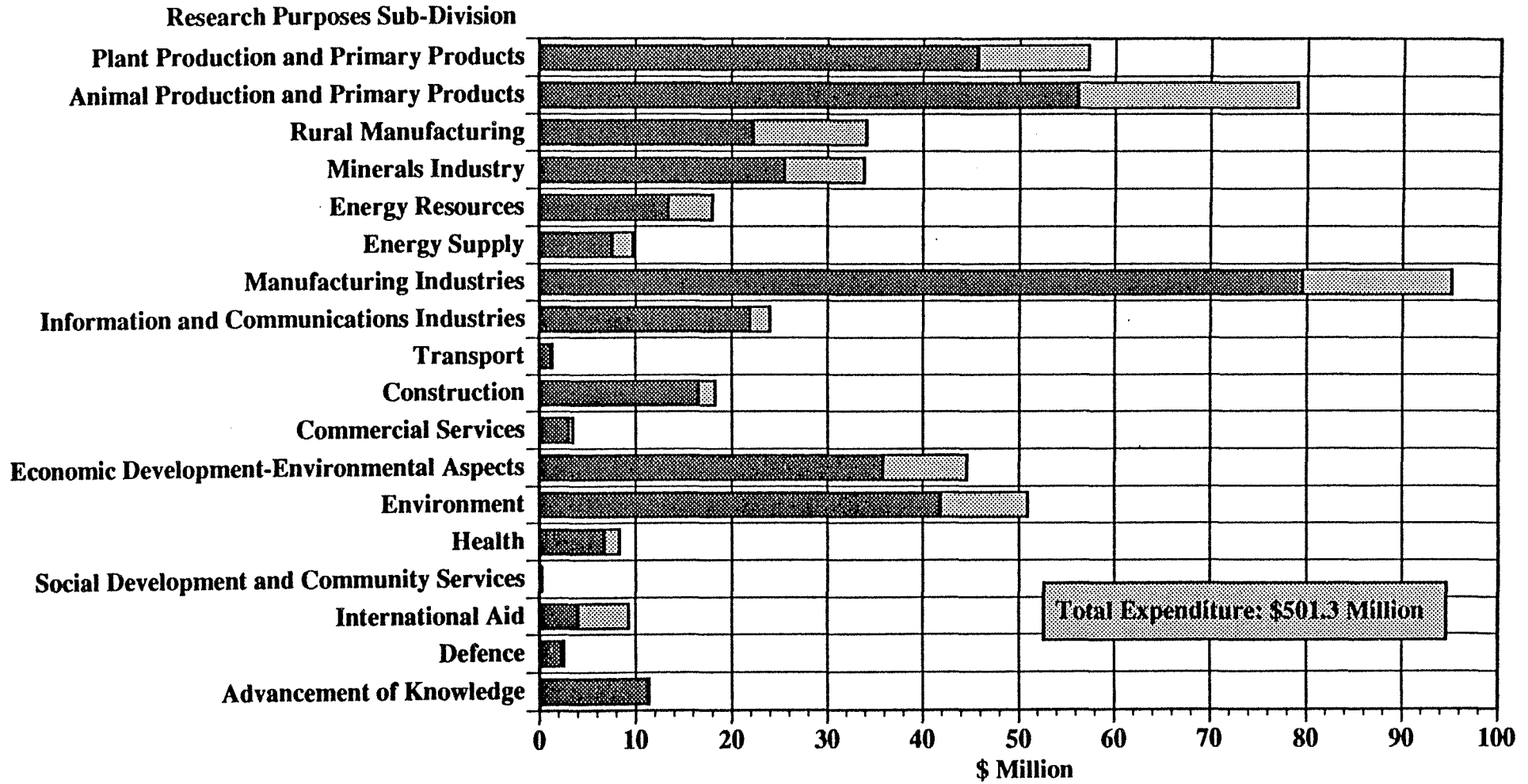


Source: CSIRO Research Data Office
 Australian Bureau of Statistics
 August 1990

▨ NATIONAL TOTAL (1986-87)
 ■ CSIRO TOTAL (1989-90) Preliminary

Figure 3:

**CSIRO APPROPRIATION AND NON-APPROPRIATION
EXPENDITURE BY SUB-DIVISION 1989-90**



Source: CSIRO Research Data Office
December 1990

Table 1:

CSIRO DISTRIBUTION OF RESEARCH EFFORT 1989-90

SUB-DIVISIONS BY INSTITUTE

(\$ Million)

Sub-Division	Institute	IAPP	IIT	IISE	IMEC	INRE	IPPP	Corporate Research Support	TOTAL
Plant Production & Primary Products		0.87	0.62	0.08	0.00	2.44	47.53	5.69	57.22
Animal Production & Primary Products		41.35	0.39	0.84	0.00	10.58	18.75	7.11	79.01
Rural-Based Manufacturing		27.38	0.00	0.00	0.31	0.07	3.48	2.85	34.08
Minerals Industries		0.00	1.59	1.19	27.75	0.00	0.14	3.18	33.84
Energy Resources Industries		0.00	0.14	0.55	15.41	0.22	0.00	1.67	17.99
Energy Supply Industries		0.42	1.90	0.05	6.40	0.03	0.00	0.94	9.74
Manufacturing Industries		15.03	58.70	3.94	4.47	0.68	2.51	9.79	95.12
Information & Communications		0.00	0.47	17.57	0.70	1.09	1.47	2.66	23.98
Construction Industries		0.00	0.00	0.00	15.34	0.00	0.87	2.03	18.24
Transport Industries		0.37	0.36	0.00	0.35	0.13	0.00	0.15	1.36
Commercial Services		0.00	1.48	0.18	0.00	1.41	0.00	0.37	3.45
Economy		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Economic Dev-Environmental Aspects		6.58	3.70	0.62	3.45	15.15	10.65	4.44	44.59
Environment		0.00	0.00	2.82	0.34	36.12	6.44	5.19	50.91
Health		5.03	0.46	0.58	0.51	0.17	0.76	0.83	8.34
Education & Training		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Social Dev & Community Services		0.06	0.00	0.18	0.00	0.00	0.00	0.03	0.27
International Aid		3.58	0.00	0.00	0.00	0.08	5.05	0.55	9.25
Defence		0.00	0.61	0.66	0.96	0.00	0.00	0.28	2.50
Advancement of Knowledge		0.00	0.00	10.05	0.00	0.07	0.00	1.27	11.39
TOTAL		100.66	70.42	39.30	76.00	68.23	97.65	49.03	501.28

NOTE:

Expenditure by National Facilities are included in Institute totals - Australia Telescope in IISE; ORV Franklin in INRE.

Expenditure on super-computing is included in IISE.



1. PLANT PRODUCTION AND PRIMARY PRODUCTS (Field Crops, Horticultural Crops, Forestry, Primary Products from Plants)

Indicators of Research Prospects

Major export earner, high research potential and a well-developed R&D infrastructure: Produced 1.7% of the nation's GDP and generated 10% of Australia's total exports in 1988–89. Adoption of new technologies and techniques have helped industries to become internationally competitive. Field crops have been most successful and horticulture least, except for the grape industry. Although horticulture has a high R&D intensity, spread over many products and regions, capture of research benefits is low. Overall, research potential for the sub-division is high, especially for plant improvement through advances in molecular genetics. Supported by a well-developed R&D infrastructure involving the States, Commonwealth, R&D Corporations and industry.

National Research Priority Rating

Attractiveness and feasibility of research were rated sufficiently high to yield an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides major strategic focus; scope for improved efficiency and effectiveness in research: In 1986–87 8.6% of Australia's total R&D effort was for Plant Production and Primary Products. In 1989–90 11% of CSIRO's total expenditure was for this sub-division (of which 20.2% externally funded). At around 20% of the national R&D effort CSIRO provides the major strategic focus on national research issues affecting field crops, horticulture and forestry. It has an increasing role in molecular biology and provides the major effort for integrating forestry with forest product needs. It has an important role in developing crops which are new to Australia and which have been shown to have potential. Australia's research effort could be more effective if resources were better directed toward national objectives, through regional alliances between States and a wider role for universities. CSIRO will increase its collaboration with other agencies, assembling teams to tackle major national and regional problems facing plant industries.

CSIRO Strategy

Greater selectivity, and redeployment of resources to environmental aspects of production: CSIRO's research effort will be selective, addressing such objectives as enhancing exports and import replacement; improving product quality; developing practices and systems that result in efficient, sustainable production; and improving disease and pest control while minimising use of harmful chemicals and reducing contaminants. In the short term, experienced research staff will be redeployed to environmental aspects of plant production in response to national and CSIRO research priorities (see 11. *Economic Development – Environmental Aspects*).

Horticulture and forestry priorities to be reassessed: Particular account will be taken of moves to improve horticultural industry efficiency and commitment to research, and of government decisions on forestry resources over the next two years. External funding of horticultural and forestry research will be expected to increase substantially.

Decision

Proposals to be selective; priority of field crops confirmed but horticulture and forestry will be reassessed within the next two years with particular account being taken of changes in horticultural industry performance and government decisions on forestry resources; proportion of external funds for horticulture and forestry expected to increase substantially.

- molecular biology underpin advance in ^{field} crops + forestry.
- horticulture + forestry. Action is planned - on ^{policy} beyond level
- not state relevant

2. ANIMAL PRODUCTION AND PRIMARY PRODUCTS (Livestock, Fishing, Primary Products from Animals)

Indicators of Research Prospects

Major export earner, high research potential, well-developed R&D infrastructure: Contributed 2.5% of the nation's GDP and generated 17% of Australia's total exports in 1988-89. Wool and meat dominate, with high proportions of production exported. Potential benefits are high, especially in wool and meat. Ability to capture research benefits is high reflecting Australia's strong track record in exploitation of new technology and the unique needs of Australian production conditions. Research potential and capacity are high, with internationally competitive research, and support from a well-developed R&D infrastructure involving the States, Commonwealth and industry R&D Corporations.

National Research Priority Rating

The attractiveness and feasibility of this research effort were rated sufficiently high to yield an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides major strategic focus: In 1986-87 8.3% of Australia's total R&D effort was for Animal Production and Primary Products. In 1989-90 CSIRO devoted 15.7% of its total expenditure to this sub-division. At around 30% of the national R&D effort CSIRO undertakes strategic research on animal and pasture production and first stage processing of animal products, and applied research in collaboration with relevant State government departments. Its efforts are concentrated on the major extensive livestock industries, wool, sheep meats, beef and dairy as well as fisheries, pasture production and to a lesser extent the major intensive industries. Rural industry R&D Corporations and other external funds provide 29% of CSIRO funds for this sub-division. Public support is warranted because individuals cannot appropriate sufficient benefits from research to cover costs, particularly strategic research. CSIRO will seek closer collaboration with relevant Commonwealth and State government departments and industry to improve research uptake, to improve understanding of industry needs, and to build more effective multi-disciplinary research teams to tackle major issues.

CSIRO Strategy

Greater focus on product quality and marketability and more resources to environmental aspects of production: External funding will continue at or above the CSIRO target level. CSIRO will increase research on techniques for measuring and improving product quality and on the efficiency and quality of first-stage processing. Pasture research will focus on sustainable pasture management. CSIRO will focus appropriation support for research into aspects of prediction and management of fish stock abundance and distribution. Livestock production research will receive relatively less support, with resources shifted to sustainability aspects of intensive and extensive livestock production (see 11. *Economic Development Environmental Aspects*).

Particular areas of emphasis will include biotechnology for genetic improvement of plant and animal productivity, and pest and disease resistance; biotechnology to improve pest and disease control, with particular regard to sustainability, product quality and cost-effectiveness; and relevant developments in information technologies.

Decision

Proposals should be selective, focusing particularly on product quality and marketability as well as sustainable production systems. Industry funding should increase in fisheries; external funding should remain at or above the CSIRO target level.

3. RURAL BASED MANUFACTURING

(Processed Food Products & Beverages, Fibre Processing & Textiles, Wood Products & Furniture, Other (Processed Skins, Leather & Leather Products))

Indicators of Research Prospects

Large sector, but only moderate expected benefits from R&D; limited R&D infrastructure: Contributed 7% of the nation's GDP, generated only 8% of Australia's total exports and accounted for 14% of imports (60% of imports in food and forest products) in 1988-89. Although the potential benefits from R&D are moderate to high, their capture for Australia is difficult. Far greater returns in the short to medium term are likely from micro-economic reforms to remove industry constraints. This will improve the uptake of research results. Capture is also restrained by the high proportion of foreign ownership, the worldwide applicability of the technologies used and the increasing globalisation of the firms involved. Industries are generally not high technology, but there are some important opportunities to develop technologies which may improve the comparative advantage of Australian firms in the industry.

National Research Priority Rating

Attractiveness and feasibility of research were rated in the medium range to yield an overall rating of "selective emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides the major research effort, with external funding proportions varying from industry to industry: In 1986-87 3.2% of Australia's total R&D effort was devoted to Rural-Based Manufacturing. In 1989-90 7% of CSIRO's total expenditure was for this sub-division (of which 34.8% was externally funded). At around 30% of the national R&D effort, CSIRO has the dominant role over Universities and some State research institutes in research, the dissemination of research results and contract and collaborative research for rural industry research funds. Industry funding support in food processing and forest products is low and should increase, in contrast to strong support from the meat, wool and grains industries.

CSIRO Strategy

Greater selectivity in research: CSIRO will give greater emphasis to strategic research, relative to other research organisations. Applied research will be conducted more selectively and with a greater share funded by industry. Greater selectivity will be practised, with research emphasis on improving processing, packaging, storage, transport, new products, product quality, measurement and specification (including detection and measurement of contaminants and undesirable attributes). In its selection of research programs, CSIRO will take account of ability to capture, especially in those areas where industry funding has been low in the past. CSIRO will increase the proportion of industry funding in food and forestry toward the CSIRO target level, where currently deficient, through information programs and commercial negotiations with firms, and by taking advantage of relevant government programs and incentives.

Decision

Wool processing appropriation to be maintained by proposals in wool priority research areas; external funding in food processing and forest products to increase to the CSIRO target level, where currently deficient.

? for further.

• Phillip As Caplan has
 Improved —
 (Value adding to softwood)

4. MINERALS INDUSTRY

(Exploration, Mining and Extraction, Processed Minerals, Basic Metal Products)

Indicators of Research Prospects

Major export earner, capital and technology intensive, high R&D potential and capacity: Accounted for 4.2% of Australia's GDP and 26.3% of total goods and services exports in 1988-89. With over 80% of mine output exported, R&D is vital to Australia's international competitiveness. The increasing costs of access to minerals suggests high returns from research to reduce costs in the future. High pay-offs are expected from further processing of minerals into basic metals, including aluminium, mineral sands and magnesium. Industries are receptive to research outputs, with a high ability to capture the benefits from research. Technologies for minerals exploration, extraction and processing must accommodate Australia's unique geology. In future, demands for mining technologies which are environmentally safe are expected to be high. National R&D capacity is high.

National Research Priority Rating

Attractiveness and feasibility of research were rated sufficiently high to yield an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

Strong strategic and applied focus in CSIRO: Of Australia's total R&D effort in 1988-89, 6.7% was for Minerals. In 1989-90 CSIRO devoted 6.7% of its total expenditure to research for the Minerals industry. At a around 19% of the national effort, CSIRO has a strong strategic and applied focus in exploration, mining, processing and refining. CSIRO's close working relationship with industry is reflected in the strong growth in external funding, which was 24.8% in 1989-90. Linkages with industry have facilitated effective technology transfer, as well. CSIRO will continue to provide research leadership and its strong discipline base will be maintained.

CSIRO Strategy

Appropriation funding to increase: CSIRO will increase its proportion of appropriation funds directed at strategic research for the Minerals Industry. There will continue to be a major role in technological improvement and innovation as a result of Australia's unique geological environment and the nature of deposits. New research opportunities include developments surrounding the magnesite deposits in Queensland, and the production of synthetic rutile from ilmenite. The scope for R&D in exploration is high. Increasing interaction with major companies through the establishment of long-term strategic alliances will improve the effectiveness and efficiency of research and technology transfer. Industry funding of research will increase, especially in applied areas and under the encouragement and direction of CSIRO.

Decision

Increased appropriation for strategic research across the minerals industry; external funding to approach the CSIRO target overall, with substantially higher external funding for applied research.

5a ENERGY RESOURCE INDUSTRY

(Exploration, Mining and Extraction, Preparation and Supply)

Indicators of Research Prospects

Major export earner, high research potential: Contributed approximately 4.7% of the nation's GDP and 14% of Australia's goods and services exports in 1988-89. Coal is Australia's largest export earner and exports are projected to double by 2000. Oil self-sufficiency is projected to decline steeply over the next decade, leading to increased reliance on imports, unless new fields are developed. Natural gas production and exports are growing strongly. Technology capture has been relatively low in the past, but is expected to improve with the industry in a better position to adopt new technologies. Research potential and capacity are high. Public sector funding of total energy research through agencies such as NERDCC is high, of the order of 56%.

National Research Priority Rating

Attractiveness and feasibility of this research effort were rated high and medium respectively, yielding an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO a significant contributor to research: In 1986-87 1.7% of Australia's total R&D effort was devoted to Energy Resources. In 1989-90 3.6% of CSIRO's total expenditure was for Energy Resources (of which 25.5% externally funded). At around 32% of the national effort CSIRO is an important contributor to research for the sub-division. CSIRO has a critical mass and expertise to continue its strategic role in exploration (particularly oil), mining and extraction, and preparation and supply in the coal, oil, gas and uranium industries. The high level of effort in coal production and preparation will continue, given increasing international competition and environmental awareness. CSIRO has strong links with industry in coal, oil, gas and oil shale. Industry wants home-grown technologies because of Australia's unique geology and environment.

CSIRO Strategy

CSIRO will focus on strategic research, with R&D growth funded by industry: Growth in research will be funded from external sources, especially by industry. CSIRO will focus on areas of high potential return, such as oil exploration, coal bed methane, mining and extraction, characterisation and preparation of coal (eg, clean coal technologies). CSIRO will carry out strategic work on alternative fuels, such as oil from shale, gas and coal bed methane, providing fuel choice options to industry which are environmentally and economically low cost. Applied research into specific industry problems and matters such as productivity enhancement will continue with a high degree of industry support.

Decision

Australia's R&D capacity should be increased, but largely from industry funding; proposals should include a high contribution from industry; external funding to be substantially above the CSIRO target.

5b ENERGY SUPPLY INDUSTRY

(Energy Transformation, Energy Distribution, Conservation and Efficiency)

Indicators of Research Prospects

Significant input supplier to industry; mature, with low research prospects: Contributed 2.5% of the nation's GDP in 1988–89. Not in the internationally traded goods sector, but a significant input supplier to Australian industry. Potential benefits of research are relatively low. A lot of technical change is needed to get a significant increase in benefits for the industry. The industry is relatively mature, with little prospect of major technical change, other than the move to fluid bed combustion in power stations over the next 10 years. The industry has a poor record for technology uptake, but this may change with the establishment of an R&D association, improved attitudes to R&D, and increasing competition in the industry. Much of the technology for the industry can be readily imported. R&D potential for alternative energy sources, including fuel cells, superconductors and methane conversion, is high with increasing public interest in alternative energy.

National Research Priority Rating

Attractiveness and feasibility of this research effort were both rated in the medium range, yielding an overall rating of "selective emphasis" on the "return to Australia" screen.

CSIRO Response

Research prospects for natural gas, alternative energy and environmental aspects of energy production and use are high: In 1986–87 3% of Australia's total R&D effort was devoted to Energy Supply. CSIRO devoted 1.9% of its total expenditure to Energy Supply in 1989–90 (of which 22.2% externally funded). At around 10% of the national R&D effort, CSIRO is a relatively minor research performer. In the past CSIRO has not had a lot of impact, but with increasing privatisation of electricity generation and ensuing competition, research needs are likely to increase and attitudes improve. Universities will continue to be the mainstay of renewable energy research. There are greater research prospects for CSIRO in natural gas, such as compressed natural gas for transport fleets, and for electricity generation. Environmental aspects will be important in future research. Problems centre largely on the conversion of coal to electricity, although it is not as pressing an issue in Australia as in other countries. Also, reduction in the levels of CO₂ emissions from transport fuels is an increasingly important matter, related to greenhouse gas emission targets. Work on alternative energy supply includes fuel cells and photovoltaic systems.

CSIRO Strategy

Research effort to be highly selective: CSIRO's research effort will be selective, due to the highly applied nature of research for this sub-division. Consequently, external funding from State governments and electricity authorities will have to increase considerably. CSIRO will concentrate on energy transformation where technological gains can be made and transferred. CSIRO has a comparative advantage in coal combustion science related to power generation. CSIRO will maintain a research capability in alternative and synthetic fuels. Environmental aspects of energy production and use will be important. Planning and design, cogeneration, coal combustion, and operational efficiency matters will be targeted in relation to harmful emissions and lowering energy costs.

Decision

Resources to be shifted to environmental aspects; external earnings at or above the CSIRO target; proposals to emphasise areas which couple users to research in both IMEC and IIT, wherever appropriate.

6. MANUFACTURING INDUSTRIES

(Ceramics, Glass & other Industrial Mineral Products, Fabricated Metal Products, Transport Equipment, Chemical, Petroleum & Coal Products, Machinery & Equipment, Instrumentation, Measurement Standards & Calibration services, Other Industrial Production)

Assessment of National Research Prospects

Major trading sector, high R&D potential and research capacity in selected areas: Contributed 6.8% of the nation's GDP and accounted for approximately 10.6% of exports and over 60% of Australia's imports in 1988-89 (net trade deficit exceeding \$20 billion). Trade in manufactures is currently the fastest growing sector of world trade. Through tariff reform and other micro-economic reforms and selective assistance measures, including those to encourage improved technology performance, the Australian Government is creating an environment for manufacturing industry to improve its efficiency and international competitiveness. Such reforms will ultimately increase the pay-offs to research. Manufacturing is a major focus of research in industrialised trading nations, but Australia's effort is below international levels. In 1985 Australia's manufacturing R&D intensity was half that of the US, Japan and West Germany. Although the potential benefits of research are high, the ability to capture them is limited by the high level of involvement of multinational firms and various institutional arrangements, including industry assistance arrangements and work and management practices. Australia's R&D capacity is high in selected areas, with established internationally competitive research groups and an established infrastructure.

National Research Priority Rating

Attractiveness and feasibility were rated in the medium range yielding an overall rating of "selective emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO a major contributor to research: In 1986-87 19% of Australia's total R&D expenditure was for Manufacturing. In 1989-90 20% of CSIRO's total expenditure was for this sub-division (of which 16.4% externally funded). At almost 15% of the national effort CSIRO is a significant contributor to research for the industry. But, as the national effort continues to grow rapidly, CSIRO's role will decline, focusing more on strategic research. CSIRO has an important role in assisting Australia's manufacturing industry to improve its international competitiveness through the development and transfer of technologies which provide a competitive edge for export and import competing firms. CSIRO will participate in government programs and initiatives designed to restructure manufacturing industry and provide incentives to boost output and trade.

*o/o of mfg
total*

CSIRO Strategy

Degree of capture and industry linkages will be important elements: CSIRO will be increasingly selective in its research activities, taking into account such factors as the expected degree of capture for Australia and the extent of industry collaboration, including Australian and international firms. CSIRO will continue to provide generic standards for industry. Growth in research will be funded largely from external sources, through direct association with industry. Future research to improve the productivity of Australian industry will build on established expertise in areas such as molecular biology for veterinary vaccines, agricultural and specialist chemicals, measurement and control, advanced materials and advanced manufacturing technologies, and in interdisciplinary areas such environment-related technologies.

Decision

High selectivity; proposals to specifically address the ability of Australia to capture the benefits of the proposed research; external funding should be at least at the Organisation's target level.

7. INFORMATION AND COMMUNICATIONS INDUSTRIES

(Computer Hardware & Electronic Equipment, Communications Equipment, Computer Software & Services, Communication Services, and Other Information Services)

Indicators of Research Prospects

Major infrastructure provider, high R&D potential, moderate R&D capacity: Contributed 5% of Australia's GDP and accounted for about 1% of the nation's exports and 10% of imports in 1988-89. The resulting \$5 billion trade deficit was some 25% of Australia's total. The high growth rates (up to 25% a year) of the last decade are expected to ease to 12% a year over the next decade. Information and communications technologies are a major infrastructural component of all sectors (estimated by OECD to contribute 15% of world production in 1990), particularly the rapidly growing service sector. R&D potential is high. Firms are highly dependent on R&D for commercial success. Consequently, computing and communications are a major focus of research in industrialised nations. Australia's effort is well below international levels and ability to capture research benefits is limited as the young and still developing industry faces strong import competition and a high level of involvement of multinational firms. Australia's R&D capacity is limited with few established internationally competitive research groups. The current R&D infrastructure is adequate for existing needs but not for supporting growth required to tackle the trade imbalance.

National Research Priority Rating

Attractiveness and feasibility of this research effort were rated in the medium range yielding an overall rating of "selective emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides a major strategic focus : In 1988-89 6.5% of Australia's total R&D expenditure was for the Information and Communication Industries. In 1989-90 4.8% of CSIRO's total expenditure was for this sub-division (of which 9% is externally funded). At around 9% of the national R&D effort, CSIRO provides a major strategic focus which complements industrial R&D (1-2 years time frame) and university research (5-10 years time frame). CSIRO has an important role in helping to reduce the trade deficit of the information and communication industries through development and transfer of technologies which provide a competitive edge for export and import competing firms. CSIRO participates in government programs and initiatives designed to foster R&D in the information and communication industries, as well as to encourage output and trade. The relative immaturity and fragmented nature of the industry limit opportunities for rapidly increasing the extent of external funding.

CSIRO Strategy

Research effort to be highly selective, with attention on capture: CSIRO will be highly selective in its allocations to research activities for this sub-division, taking into account the ability of Australia's firms to capture the potential research benefits. Efforts will continue to increase industry involvement in funding R&D, in line with the CSIRO target level. Strategies for improving technology transfer will be important, including encouragement of graduates into CSIRO for a time before they move to private firms, collaborative relationships with firms, and direct consulting. Research to improve the productivity and performance of the Australian information and communication industries requires a vertically integrated research capability ranging from understanding electronic components through to integrated computer and communications systems.

Decision

High selectivity; Australia's ability to capture benefits to be specifically addressed in proposals; external funding to increase to the CSIRO target level.

8. TRANSPORT INDUSTRY (Ground, Water, Air, Other Transport)

Indicators of Research Prospects

Major input/infrastructure supplier; low research prospects: Contributed 4.8% to Australia's GDP in 1988-89; not significant in the internationally traded goods sector, but a major input/infrastructure supplier to Australian industry. While significant gains from research are possible, greater benefits are likely to flow from institutional and micro-economic reform in the transport industries. Furthermore, suitable technologies are available from overseas. Technology uptake has been restricted by institutional rigidities, including State legislation and industry work practices. As a result, there is much technology not in use. Some internationally competitive Australian firms have a strong history of technology uptake, a key factor in their international success. R&D potential is narrow, with scope in advanced transport modes such as supersonic air travel and fast trains. There is also scope for research in transport services. R&D capacity is low.

National Research Priority Rating

Attractiveness and feasibility were rated low, yielding an overall rating of "limited support" on the "Return to Australia" screen.

CSIRO Response

CSIRO a minor contributor: In 1986-87 around 1% of Australia's total R&D expenditure was devoted to Transport. In 1989-90 0.3% of CSIRO's total expenditure was for this sub-division (of which 8.8% externally funded). CSIRO has a minor role in research for the transport sector. Given that most decisions on improvements to the design of inputs to the industry are made overseas, there is little scope for Australian and CSIRO research to have any influence. Scope for some further research exists with projects such as the Very Fast Train.

CSIRO Strategy

CSIRO will operate on an opportunistic basis only, largely externally funded: CSIRO will wind down its proportion of appropriation funds toward zero, with the research effort continuing purely on an opportunistic basis, and largely externally funded. Generic research such as in infrastructure, operational efficiency and energy conservation will largely be conducted in other areas of CSIRO with focus on the specific application, such as environmental aspects, construction materials or information technology, rather than the broad sector or industry in which the technology is to be applied.

Decision

Wind down appropriation funding toward zero; opportunistic approach; generic research for the sub-division will be carried out largely in other areas; should be mostly externally funded.

9. CONSTRUCTION INDUSTRY

(Planning and Design, Materials and Manufactures, Products and Services, Construction and Operation)

Indicators of Research Prospects

Major infrastructure provider; R&D potential limited and low research capacity: Contributed 7% of Australia's GDP in 1988-89. An important provider of industry infrastructure, oriented largely to the domestic market. Potential for large gains from research, including replacement of higher value building products imports and product, services and technology exports. Pay-offs from research have been slow to emerge in the past. Work and management practices as well as government regulations and standards limit an otherwise high ability to capture research outputs. Overall, R&D potential is low, although considerable potential exists in a number of specific areas, such as control and management systems and improved techniques for steel and concrete. R&D intensity is low, as is the overall R&D effort, with a history of low industry funding.

National Research Priority Rating

Attractiveness and feasibility of this research effort fell into the medium and low regions, respectively, yielding an overall rating of "selective emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides almost 50% of the national R&D effort: In 1986-87 approximately 1% of Australia's total R&D effort was for Construction. In 1989-90 CSIRO devoted 3.6% of its total expenditure to research for this sub-division (of which 9.5% externally funded). CSIRO provides almost half of Australia's research effort and is a major source of strategic and applied expertise for the industry in areas of planning and design, construction, materials and manufactures and construction services and products. CSIRO research is aimed at lowering construction costs and at the same time providing safe and environmentally acceptable technologies. CSIRO has attracted increased industry support for its research and will continue to encourage industry involvement.

CSIRO Strategy

CSIRO effort to be maintained, but industry funding to increase to 30%: CSIRO will maintain its proportion of appropriation funding, subject to successful research proposals in high priority areas. Greater contribution to external funding from industry will be encouraged, up to the 30% target level. All growth in R&D will be funded from external sources. CSIRO will indicate to industry that it needs to increase its share of R&D funding. CSIRO will continue its public role as a contributor of independent scientific input to the setting of standards and building codes and regulations for the Australian industry, and will encourage the adoption of performance-based regulations which have great economic and environmental benefits. Environmental aspects of design and materials will be of increasing importance in research for the construction industry. CSIRO will maintain its key strategic input to the industry, but will become more selective in its research, focusing in such areas as improved planning and design strategies, least cost optimization of material compositions, and improved energy efficiency and construction techniques.

Decision

External funding to increase markedly.

10. COMMERCIAL SERVICES

(Electricity, Gas & Water Services and Utilities, Wholesale & Retail Trade, Finance, Property & Business Services, Recreation & Other Services, and Measurement Standards & Calibration Services)

Indicators of Research Prospects

The major contributor to Australia's GDP: Accounted for 31% of Australia's GDP in 1988-89, making it the largest sector of the Australian economy. Commercial services are also an important source of export revenue, contributing the equivalent of almost 13% of the nation's total export earnings in 1988-89, most of which are from international tourism. Indirectly, services have a large impact on Australia's exports. Although the sub-division is largely domestically oriented, trade in services is the fastest growing segment of world trade on a long term trend basis. Greatest potential lies in the operational aspects of finance, retail, wholesale and tourism services, and in information technology based systems. In general, Australia's past record for the capture of research benefits is poor. For example, in water supply emphasis has been on basic and strategic research at the expense of applied research. R&D potential is high in the areas of applications of Operations Research methods, IT-scheduling and decision support, and research into asset management and rehabilitation, and system planning and design in the case of utilities. Australia's R&D capacity is adequate for current needs, but not to support growth in the sector.

National Research Priority Rating

Attractiveness and feasibility of this research effort were rated medium and low, respectively, yielding an overall rating of "selective emphasis" on the "Return to Australia Screen".

CSIRO Response

CSIRO a minor contributor to R&D: In 1988-89 around 10% of Australia's total R&D expenditure was for Commercial Services. In 1989-90 0.7% of CSIRO's total expenditure was for this sub-division (of which was 13.3% externally funded). At around 2.2% of the national R&D effort CSIRO is a minor contributor, the major contributor being the business sector. Research for Commercial Services is largely applied. For CSIRO, R&D for Commercial Services involves targeted applications of a range of generic technologies. But, strategic research for the development of appropriate generic technologies generally is not conducted in this sector, and therefore is not classified to this research purpose. CSIRO also has statutory obligations to conduct work on standards and measurement for Commercial Services. Opportunities exist for increased industry funding of research, especially from leading edge users of technology such as the finance and insurance industries.

CSIRO Strategy

Growth in R&D to be funded largely from external sources: CSIRO will maintain its proportion of appropriation funds for Water Supply and Standards. Overall growth in research for this sub-division will depend on identified opportunities, to be funded largely from external sources. CSIRO will target applications of generic research, developed in other research areas, including information technologies and technologies for water quality, asset management and rehabilitation in the case of utilities and research into planning and design of new systems for utility supply and distribution. The strategy for this sub-division will be revised as more information becomes available, especially on information and communication technologies applications.

Decision

External funding is expected to increase in areas other than Water Supply and Standards; expansion of activity in other areas will depend on identified opportunities and external funds.

11. ECONOMIC DEVELOPMENT – ENVIRONMENTAL ASPECTS

(Rural Production, Minerals, Energy Resources and Supply, Manufacturing, Construction, Transport, Commercial Services; Economy)

Indicators of Research Prospects

High economic benefits, high research potential, low national research capacity: The contribution to GDP of environmental aspects of economic development is difficult to measure as markets do not exist for all environmental products, and as yet estimates are not included in the national accounts. But, the net economic benefit from R&D for environmental aspects is likely to be high, given that it relates to every production activity in the economy. Adoption of environmentally safe and friendly technologies is expected to increase. Consumption of environmentally safe commodities is also expected to increase, with increasing public awareness and concern for environment, health and safety. The three-tiered system of government has impeded uniform technology adoption, but initiatives such as the Murray–Darling Basin Commission, ecologically sustainable development strategies and greenhouse gas emission targets reflect growing cooperation between state and federal governments. R&D potential is high with many problems yet to be solved. The current capacity of R&D at the national level is inadequate, although an R&D infrastructure is emerging.

National Research Priority Rating

Attractiveness and feasibility of research were rated high and medium, respectively, yielding an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO to take a national lead: In 1986–87 1.8% of Australia's total R&D effort was devoted to Economic Development – Environmental Aspects. In 1989–90, 8.9% of CSIRO's total expenditure was for this sub-division (of which 19.6% externally funded). At almost 75% of the national R&D effort CSIRO is the major R&D performer, particularly for rural, industrial, and minerals and energy production. This is considered appropriate and necessary for the sub-division. With its high research capacity, CSIRO is positioned to take a national lead in research, being active in technologies for economic development and scientific understanding of environmental processes which underpin economic activities or are affected by them. There is scope for greater collaboration within CSIRO, especially on waste management control, and externally with private firms, government agencies and universities in Australia and overseas.

CSIRO Strategy

Appropriation and external funding to increase, especially in rural production, minerals, energy and commercial services: CSIRO will increase its proportion of appropriation funds, with short-term redeployment of experienced staff from production to environmental aspects to respond rapidly to national and CSIRO research priorities, especially in rural production (including fisheries), mining, energy and commercial services industries. At the same time CSIRO will actively seek increased funding from external sources. The research effort in estuarine and coastal environments, and waste management will expand, while the effort in pollution abatement will be maintained. Emphasis will be on sustainable development: eg attention will be given to integrating physical, biological and ecological components in sustainable agricultural production systems. Inter-divisional programs are anticipated. Efforts will be increased to improve technology transfer.

Decision

Appropriation funding to increase by a small amount in the confident expectation that this will produce external funds by aggressive "marketing"; external funding to increase from 20% to at least 30% of total effort. CSIRO to take a national lead.

12. ENVIRONMENT

(Climate, Natural Ecosystems, Oceans, Land Use, Atmosphere, Water Resources, Environmental Impact and Protection nec, Other Environment)

Indicators of Research Prospects

High potential benefits and ability to capture, but low research capacity: The Environment's contribution to Australia's GDP is not yet included in the system of national accounts, reflecting the difficulty of assigning economic values to the environment (mostly non-priced values). However, the potential benefits of research are likely to be large, as it provides the knowledge and understanding which underpins the use and conservation of natural resources, as covered in *11. Economic Development – Environmental Aspects*. Legislation to protect the environment and increasing public concern encourage the adoption of research for the environment. The field of research is highly fertile and most research issues are unique to Australia. Despite having a basic research infrastructure, Australia's current capacity is low, which limits the research effort, especially long-term baseline monitoring studies which are so important to the more applied research for the environment, such as that associated with resource development. Basic environmental research is predominantly funded by the Commonwealth government, with State governments funding more applied or industry related research areas, such as pollution control.

National Research Priority Rating

Attractiveness and feasibility of research were rated sufficiently high to yield an overall rating of "strong emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO provides the major strategic focus: In 1986–87 3.3% of Australia's total R&D effort was devoted to research for the Environment. In 1989–90 CSIRO devoted 10.2% of its total expenditure to research for the Environment (of which 17.8% externally funded). With almost 48% of the national research effort, CSIRO provides the major strategic focus for the sub-division. The largely public good nature of research for the Environment suggests a large public sector role in R&D and a high proportion of appropriation funding within CSIRO. CSIRO's role is such that should the Organisation reduce its effort the likelihood of it being taken up by other research organisations is very low.

CSIRO Strategy

Total research effort to increase largely from growth in external funding: CSIRO will maintain its proportion of appropriation funds, but the total effort in the area is expected to increase. Growth is expected to come from external sources, especially from client State and Commonwealth government instrumentalities, by way of specific contracts and commissions. CSIRO should take a long-term view. The Organisation's major role is in understanding the dynamics of natural systems in order to develop ecologically sound management principles and tactics. Securing access to, and assessment of data from a new generation of earth orbiting satellites, and the application of molecular biology to aspects of research for natural ecosystems warrant special attention. Other important considerations in future research include technology transfer and the public interest. CSIRO will maintain an involvement in natural resource accounting which will be useful in demonstrating the economic value of environmental research as well as its policy implications.

Decision

Total appropriation effort to be maintained through specific proposals in priority Environment areas; any growth in CSIRO's effort to be largely from external funds; external funding could be less than the CSIRO target level.

13. HEALTH

(Public Health, Clinical Health, Health and Support Services)

Indicators of Research Prospects

Very large national expenditure item, high research potential and well-developed R&D infrastructure: Contributes 7.2% of the nation's GDP, making it a large sector. In the case of nutritionally related diseases, the cost to the economy has been estimated at \$6 billion per year. There is considerable scope for Australia to reap economic and social benefits from advances in knowledge and technology particularly in public health. Capture of benefits is moderate. A competitive international industry exists although leakage overseas occurs because problems are not unique to Australia and information can not always be commercialised. Capture will depend upon continued modification of diets and other behaviour in response to R&D information provided through public health education programs. With realistic targets on the performance of public health education it should be possible to reduce the cost of cardiovascular diseases and cancer by \$2 billion per year. Australia has a good record in medical research. R&D potential is high with scope for major advances in areas in which Australia has an international reputation. Although research and technologies are available from overseas, Australian research has a good record and enjoys a relatively high level of output.

National Research Priority Rating

Attractiveness and feasibility of this research were rated sufficiently high to yield an overall rating of "strong emphasis" on the "Return to Australian" screen.

CSIRO Response

CSIRO provides major public health research effort: In 1986-87 8.7% of Australia's total R&D expenditure was for Health. In 1989-90 1.7% of CSIRO's total expenditure was for this sub-division (of which 19.2% externally funded). At around 3% of the national R&D effort CSIRO is only a minor player in the total health field. However, in public health and in particular nutrition research it is the major research organisation.

CSIRO Strategy

Continued key role in nutrition related research and medical applications of molecular biology: CSIRO will maintain its proportion of appropriation funding for human nutrition research. CSIRO will complement the national health effort with strategic and applied research into combating nutrition-related chronic diseases (predominantly cardiovascular and cancer), developing tools to implement appropriate nutrition policies in the community, and assisting the food industry to provide the choice of foods necessary to considerably improve health. Special responsibility will be undertaken in areas of environmental health and food safety. Transfer of information and technology to the community, health organisations and food industry will have high priority. Opportunities to commercialise technology and medical instrumentation, and to develop new drugs, will be exploited. Due to the public good nature of public health research, there is little opportunity for individual firms to appropriate benefits. Benefits accrue to the entire Australian population. CSIRO will conduct research outside the public health area only where it is substantially externally funded.

Decision

Strong role for CSIRO activity in the area of human nutrition (Public Health), which should be maintained; external funds for this area expected to be below the CSIRO target; involvement in areas of health research outside human nutrition (Public Health) to be on an opportunistic basis only - substantially externally funded.

Ernst/Perch

14. DEFENCE

(Defence, Measurement Standards and Calibration Services)

Indicators of Research Prospects

Major area of government expenditure; Potential benefits of research low and low R&D capacity by world standards: Represented 2.7% of Australia's GDP in 1988-89 but is a major Commonwealth government expenditure item. The Australian government is the major customer for defence products. Potential benefits of research are low, limited by import competition and the relatively small size of the Australian market, compared with the United States and Europe. Ability to capture is moderate, although the small number of specialist Australian producers have a good past record. In some cases capture is restricted by agreements and standards governing replacement and new technology. Scope for research in the information technologies area is high. R&D capacity is adequate, although it is low by world standards. Capacity may be politically determined.

National Research Priority Rating

Attractiveness and feasibility of this research were rated in the medium and low ranges, respectively, yielding an overall rating of "selective emphasis" on the "Return to Australia" screen.

CSIRO Response

CSIRO a minor contributor: In 1986-87 5.4% of Australia's total R&D expenditure was for Defence. In 1989-90 0.5% of CSIRO's total expenditure was for this sub-division (of which 11.6% was externally funded). CSIRO is a relatively minor contributor (around 1.4%) to the national effort and does not have a direct research role. Most of the defence related research conducted by CSIRO is covered in other areas, such as information technologies or manufacturing. The major research organisation is the Defence Science and Technology Organisation (DSTO) whose role includes indigenous development and adaptation of military equipment, scientific and technical advice for acquisition of new equipment, and problem solving in equipment use, and provides expert advice to buyers, builders and users. Opportunities in Defence related research arise in relation to large industrial projects, such as the ANZAC frigate and submarine projects, in relation to specialist services, such as standards, oceanographic data or environment assessment, or in collaboration with DSTO on matters of common interest (under the 1989 Memorandum of Understanding between CSIRO and DSTO).

CSIRO Strategy

CSIRO's effort to continue only where flow-on benefits to other areas: CSIRO will continue its current proportion of appropriation funding only where flow-on benefits to other sectors/industries are expected. Otherwise, research will be conducted on an opportunistic basis, largely externally funded. This may involve collaborative work with DSTO, under the Memorandum of Understanding.

Decision

Appropriation funding only if flow-on benefits to other areas are expected; otherwise an opportunistic approach substantially externally funded.

15. SOCIAL DEVELOPMENT & COMMUNITY SERVICES

(Community Services, Public Services, Recreation & Culture, and Ethics)

Indicators of Research Prospects

Minor sector of the economy; low R&D potential for the natural sciences: Accounted for 1.2% of Australia's GDP in 1988–89. Being predominantly domestically oriented, this sub-division does not figure prominently in the traded goods sector. Overall, the contribution of natural science research to Australia's national income is low relative to that which social science research is likely to yield. While the R&D potential may be high, the prospects for contributions from the natural sciences are low, reflecting expected demand. Consequently, Australia's R&D capacity in natural sciences for this sub-division is low.

National Research Priority Rating

Attractiveness and feasibility of research were rated low, yielding an overall rating of "limited support" on the "Return to Australia" screen.

CSIRO Response

CSIRO a minor contributor to national R&D: In 1986–87 1.7% of Australia's total R&D was for Social Development and Community Services. In 1989–90 0.05% of CSIRO's total expenditure was for this sub-division (of which 7.4% externally funded). At less than 0.5% of the national R&D effort, CSIRO is a very minor contributor of research for this sub-division. For CSIRO, R&D for Community Services largely involves targeted applications of generic technologies. The strategic research for the development of these generic technologies is conducted elsewhere, and therefore is not classified to this research purpose. Employment of Aborigines and Torres Strait Islanders and activities such as Women in Science and Double Helix are examples of CSIRO's contribution to this sub-division, although not through research *per se*.

CSIRO Strategy

CSIRO to operate on an opportunistic basis only, largely externally funded: Growth in research for this sub-division will be on an opportunistic basis, largely funded from external sources. Only in exceptional circumstances will appropriation funds be allocated to this sub-division. Much research of relevance to Social Development and Community Services is conducted in other areas such as Health, Commercial Services, Manufacturing and Information and Communications Industries.

Decision

Expect very little, if any, appropriation funding; targeted applications of research conducted for other purposes; opportunistic approach substantially externally funded.

16. ADVANCEMENT OF KNOWLEDGE

(Advancement of Knowledge)

Indicators of Research Prospects

Underpins all scientific research, provides the scientific intellectual infrastructure: Although not contributing directly to Australia's economic growth, advancement of knowledge is a key input to strategic and applied research directed at development of new technologies for Australian industry. In this respect, research which is purely concerned with providing new knowledge for possible incorporation into specific strategic and applied research programs is generally conducted in association with those programs. Consequently, the prospects for research to advance scientific knowledge in specific areas, such as sub-divisions, are related to the prospects for those specific sub-divisions. For example, substantial pay-offs are expected from the successful application of advances in molecular biology for the plant and animal industries, and similarly from the application of knowledge on specific materials for the manufacturing industries, and from the application of knowledge on the structure and behaviour of particular mineral components to the minerals and energies industries. Advancement of Knowledge underpins all scientific research, providing the basic scientific infrastructure. The benefits from research in this area include links with the international research community. The benefits can be cultural as well as economic.

National Research Priority Rating

The Sub-division was not rated by the four assessment criteria, as the attractiveness criteria could not be applied as effectively in this case.

CSIRO Response

CSIRO is a major contributor to Australia's scientific knowledge base: In 1989-90 2.3% of CSIRO's total expenditure was for this sub-division (of which 1.5% was externally funded). But, this underestimates CSIRO's total effort, as much of the effort is included in each of the specific sub-divisions' research efforts. The principal area accounted for here is research associated with the Australia Telescope National Facility, for which CSIRO has responsibility. CSIRO is an important source of basic scientific knowledge for strategic and applied research and for teaching, in Australia and overseas.

CSIRO Strategy

CSIRO effort is reflective of priorities in the individual sub-divisions: CSIRO will allocate appropriation funds to this area according to CSIRO research priorities. Research which pursues the advancement of knowledge will be funded generally from appropriation, given the public good nature of the product of such research. CSIRO will maintain a core of effort in the relevant priority areas, comprising the best talents to provide a standard for research and teaching.

In the specific case of Astronomy and the Australia Telescope National Facility, CSIRO will maintain its proportion of appropriation funding. Specific proposals should heed the benefits of the advancement of knowledge including the expansion of our stock of scientific knowledge, and the international exchange of ideas and people. External earnings will be sought for research which does not distort the purpose of undertaking research for the advancement of knowledge.

Decision

Appropriation funds allocated to this Sub-division are only for research associated with radioastronomy and the Australia Telescope National Facility.

APPENDIX 1

CSIRO RESEARCH CLASSIFICATION SCHEME

Classification is by Socio-Economic objective at the following levels of disaggregation:

- . Division, eg. Economic Development
- . Sub-division, eg. Plant Production and Primary Products.
- . Group, eg. Field Crops; and
- . Class, eg. Wheat.

Socio-Economic Objective (SEO) refers to the area of expected national benefit rather than to the immediate objectives of the researcher. Guidelines are currently being developed for the classification of research at the program and project level to CSIRO SEOs.

**CSIRO NATIONAL RESEARCH PRIORITIES EXERCISE 1990
RESEARCH PURPOSES CLASSIFICATION SCHEME**

INTRODUCTION

The Sub-Divisions presented in the attached charts have been developed from the Interim Australian Standard Research Classification - Socio-Economic Objective sub-classification - specifically for the CSIRO Executive Committee National Research Priorities Exercise, June 1990. Although the classes are common to both classifications, the groups and sub-divisions have been aggregated in a different way as an aid to research priorities discussion. ASRC codes are shown in parentheses after each title.

Malcolm Robertson
Research Data Office
December 1990

Revisions current as at 1 December 1990.

