HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON PRIMARY INDUSTRIES AND REGIONAL SERVICES

INQUIRY INTO INFRASTRUCTURE AND THE DEVELOPMENT OF AUSTRALIA'S REGIONAL AREAS CSIRO SUBMISSION

SUMMARY

The most densely populated 1% of Australia contains 84% of the population. The remainder is thinly spread in small clusters over 99% of the Australian continent. This creates problems in providing an adequate infrastructure for this sparse, dispersed population.

From CSIRO's experience we conclude that infrastructure for the regions is generated in response to expanding and new industries. It is therefore critical that efforts to sustain existing industries and to create new industries suited to rural and remote Australia are encouraged.

CSIRO allocates a large proportion of its spending to business activities that have a direct impact on industry development in the regions.

Our submission provides examples of CSIRO research that have the potential to sustain and develop existing and new industries in regional Australia and to conserve or create infrastructure. It does not set out to address all the terms of reference since CSIRO does not have relevant experience, nor a role, in relation to several of them.

CSIRO AND THE RESEARCH INFRASTRUCTURE

CSIRO is located on about 60 sites round Australia, many of these being in regional Australia. It is not our regional presence in itself that contributes to the development of regional Australia. Our contribution lies instead in our ability to provide a research infrastructure for so many of the industries and services that are critical to the life of the regions.

For instance, CSIRO allocates a large proportion of its spending to business activities that have a direct impact on industry development in the regions. Agribusiness comprises 33% of our total effort; energy, mining and minerals comprise 18%, as does environmental research.

Our work of most relevance to the Inquiry is in water and waste management, in investigation into alternate energy sources and in identifying new mineral deposits.

There are direct results from improved water management in enabling people and industries to stay in certain regions of Australia. If water supplies dwindle or if certain water management practices increase dryland salinity, then these areas will lose population.

If alternative energy supplies can be provided the opportunities for expanded industries will be much greater, as well as enhanced quality of life for those in more remote areas.

Minerals companies provide much-needed infrastructure in remote areas and any new mineral discoveries can lead to the creation of new mines and therefore new infrastructure and job creation. CSIRO has a number of examples where it has provided the tools for the discovery of major new ore bodies.

Term of Reference 1- Deficiencies in infrastructure which currently impede development in Australia's regional areas

Within the bounds of our expertise we would say that reliable and safe water and energy supplies must be available to people in regional and remote areas if Australia is to retain any significant population outside the coastal cities.

Term of Reference 2- Factors that would enhance development in these areas, including the provision of infrastructure such as energy, transport, telecommunications, water supplies, and facilities that deliver educational, health and financial services

WATER SUPPLY AND MANAGEMENT

Access to water for households and industry use is becoming more difficult in many areas of Australia. The examples below sketch out some of these problems and show what CSIRO and its partners are able to do to alleviate the problems. The major issues cover access to suitable water, dryland salinity and improved water treatment.

1. Providing Reliable Water Supplies

Approximately 70% of Australia's developed water resources are used for irrigation to support farm-gate production which exceeds $6 billion a year. In these circumstances, water supply and conservation are very important.

As one example, the Clare Valley wine industry is growing rapidly but its expansion will be restricted by access to a reliable water supply. In some instances wine growers have found their water bores have dried up because a new, neighbouring bore has been drilled through the cracked, underground aquifer.

CSIRO and SA Primary Industries and resources are working on a three year project. It aims to solve the mystery of how much water flows through cracks in underground rock and to determine how much water is stored in the rock and the rate at which it is replenished.

Without knowledge of how much water is passing through the cracked aquifer producers risk increased salinity levels in the medium term and depleting the water supplies in the longer term.

The research should provide producers and water authorities with world-first measures to gauge natural aquifer replenishment rates.

2. Controlling salinity

Dryland salinity affects almost 2.5 million hectares of Australian farmland and is expanding at the rate of 3-5% a year. It is not expected to stabilise before it affects some 12 million hectares of land. At present it costs us $270 million a year in lost production.

The central Victoria catchment of Burkes Flat has introduced a successful control program. By 1983 this small catchment was 12% saline and the four major landholders began a control program in the mid 1980s. They planted trees and perennial pastures in the recharge zones and the saline watertable has been drawn down by between one and four metres.

In another salinity control project, CSIRO and state agencies are studying deep drainage beneath crops and pastures on the Liverpool Plains. The strategy is to develop agricultural systems that mimic the hydrological functions of the natural ecosystem which could extend to breeding plants that mimic the function of native species, yet produce higher yields.

Hydrologically effective and economically attractive options do not yet exist for most of the salt-affected regions of southern Australia.

Unfortunately few salinity control programs promise economic returns to landholders. Remedies have to be tailored to each catchment and often to each site. If policy and infrastructure permitted better consideration of regional benefits such as downstream environments and users of water and wider community values, then control strategies such as plantations would be more attractive.

EFFLUENT TREATMENT

Investment in improved water treatment to support urban and rural needs is increasing as a result of declining water source quality. Security of water supply is crucial, particularly under highly variable climatic conditions.

1. Green Raper Process

Processing industries, such as abattoirs, piggeries, dairies and feed lots, often produce large quantities of effluent that must be treated before being released on to land or into rivers. This effluent is rich in nitrogen and phosphorus. If effluent loaded with these nutrients is discharged into rivers the algae in the water feed on it and multiply to enormous numbers, creating algal blooms which then die and poison the water.

If the effluent is treated in the local sewage plant there are still problems as the treatment encourages bacteria to grow and feed on the nitrogen rich fats, sugars and proteins in the effluent. These bacteria carrying high concentrations of nitrogen are then allowed to settle out while the clear water is run off for harmless discharge or is used again. The remaining bacteria form a sludge which can then be used as a fertiliser. The sludge is very high in nitrogen and crops and pastures can handle only limited amounts. Eventually excess nitrogen will damage pasture and will percolate into the groundwater where concentrations can make the water undrinkable. This has already happened in a number of places in Australia.

The Green-Raper process developed by CSIRO and Australian Meat Technology removes polluting nutrients from waste water discharged by abattoirs and other rural industries. It is already in use at a Poowong abattoir where it meets all Environmental Protection Authority standards. It will work on a small scale at a reasonable price.

For an abattoir using 250 000 litres of water a day the cost of the technology would be about $200 000 with a treatment cost between 10 and 20 cents per 1000 litres of effluent.

It produces water that can be reused directly as irrigation or can be discharged directly into water ways.

2. Protocols for Effluent-Irrigated Tree Plantations

As mentioned in the example above, effluent discharge into rivers can cause catastrophic algal blooms. Growing tree plantations irrigated with effluent has become a popular way to solve the effluent disposal problem and to provide an additional wood resource. Many of these plantations, however, could cause serious degradation to soil, rivers and groundwater, as there are no authoritative guidelines for the design, establishment or management of sustainable effluent-irrigated plantations in Australian conditions.

The Murray-Darling Basin Commission and the NSW Public Works Department approached CSIRO in 1991 to develop protocols and national guidelines for effluent-irrigated plantations.

CSIRO led a multi-agency team which developed "*Principles and Practice of Effluent-Irrigated Plantations in Australia"*. Over twenty thousand copies of the guidelines have been distributed and the project won the BHP Landcare Research Award for NSW. A diverse range of users has applied the guidelines.

3. Uses for Saline water

Although the work is only at the trial stage, there is potential to use salt from the Murray River for a range of beneficial products. CSIRO scientists at Griffith believe that the saline discharge from irrigation areas could be used stage by stage as it became saltier to grow crops, for aquaculture, to generate electricity and finally to produce salt and other chemicals.

The potential for new industries such as aquaculture, once research has overcome the problems of aquaculture in salty water inland, is exciting.

NSW Fisheries and the Cooperative Research Centre for Aquaculture have grown salt-water snapper 300 kilometres from the coast in the saline Wakool Dam near Deniliquin. This is the first Australian sea fish to be farmed using inland salt water.

About five tonnes of snapper can be produced each year on a hectare of salt water pond with each kilogram fetching $10 to $14 wholesale.

At a National Science Briefing in Parliament House on 11 March 1999, the Director of the CRC for Aquaculture, Dr Peter Montague emphasised the small space needed for aquaculture. Australia's projected need for snapper could be met by 200 hectares of salt ponds in Wakool.

The farming of marine fish could provide the impetus for rehabilitating salt-damaged land inland.

ENERGY SUPPLY

In a country which is as vast as Australia decentralised power supplies are essential if people and business in remote areas are to receive an adequate and reliable power supply. The examples which follow are energy sources that can all be used in regional and remote communities and do not depend on the main power grids.

1. Ceramic Fuel Cells

Reliable energy supplies are long-standing, intractable problems in many part of remote Australia. Solutions such as forms of solar power often prove to be too expensive for many farms and families to contemplate. Ceramic Fuel Cells Ltd has developed a prototype ceramic fuel cell which has successfully demonstrated a 5 kilowatt unit -enough to supply power for several homes. The technology has some years to go before it is commercially available but could meet some of the needs of rural and regional communities and small business.

The solid oxide fuel cell is a novel source of electrical energy which is twice as efficient as conventional power generation. It cuts greenhouse emissions in half and pollution to a fraction of present levels.

The CFCL test stack consists of 400 ceramic fuel cells arranged in 50 layers with a collective power output of more that 5000 watts.

The beauty of this technology is that it is modular. By adding more fuel cells you can build it up to 25 kW or even higher.

The company sees world market potential for power generation units in the 100-300kW range -ideal for providing electricity to rural communities, large factories, or for extending the metropolitan power grid to new suburbs economically.

However it will also be possible to group several 200kW fuel cell stacks together to create power stations in the megawatt range.

Ceramic Fuel Cells Ltd is an Australasian enterprise backed by CSIRO, the Energy Research and Development Corporation, Western Power Corporation, the Electricity Trust of South Australia, Pacific Power, the Strategic Industry Research Foundation, BHP Ltd, the Electricity Corporation of New Zealand and the South East Queensland Electricity Corporation.

2. Wind Prospecting

CSIRO's wind energy project has been influential in developing large-scale wind power production in Australia. It has produced a range of products that enable its collaborator Pacific Power to build up a sizeable capacity in wind power generation.

Wind farm operations can take advantage of enhanced wind speed on hill tops and ridges by siting wind turbines at the optimal height and position. The economics of wind energy production depend on accurate wind prediction. A 1% deficiency in wind farm output from poor siting corresponds to about $1 million in production from a typical wind farm. Choosing the best site requires complicated calculations and this is where CSIRO expertise is invaluable.

CSIRO has produced the first accurate prediction of wind energy yields for regions and locations in south-eastern Australia. It has produced highly detailed maps that show the most advantageous siting of wind farms. For example, maps to 1 kilometre enabled wind turbines in the Crookwell 5MW wind farm to be located to the nearest 24 metres relative to the wind available. The research team was able to optimise the layout of the wind farm to produce an enhanced power yield worth about $1.5 million.

The project is now in its commercial stage.

3. Biomass

Biomass (by burning or conversion of woody crops, residues and wastes) supplies 14% of the world's primary energy needs but has been largely unused as an energy source in Australia.

Biomass is, however, a significant source for electricity generation world wide as it generates more electricity than any renewable resources except hydropower.

CSIRO Forestry and Forest Products believes that many of the new plantations which are part of the "Plantations 2020" program could be used for energy production. Tree planting will help to rehabilitate degraded land and act as an energy source for rural communities. One possible use for thinnings from the very fast growing Wagga Wagga Effluent Plantation Project mentioned earlier is for bioenergy.

Wood residues left in the forest to decay or produced in saw mills have considerable potential as a renewable energy source. Using them for energy production might reduce greenhouse gas emissions by Australia up to 10%.

Energy from wood residues is even cheaper than using coal. CSIRO is developing a gasification system that burns wood residues and thinnings to drive a microturbine generating electricity.

It is a decentralised individual energy production perfect for regional and remote areas where wood residues are available at low cost. Small townships, farms or households in these areas could provide themselves with their own locally-grown energy wood.

4. Solar-Fossil Fuel Energy Mix

CSIRO is developing a revolutionary power system for Australia's communities. It is a hybrid solar/fossil fuel system that runs at up to twice the efficiency of today's coal-fired electricity generators.

The goal of the project is to combine available and emerging energy technologies in an innovative way which virtually eliminates greenhouse gas emissions.

CSIRO's solid oxide fuel cell being developed with Ceramic Fuel Cells Ltd has been used in the demonstration project. Fuel cells allow the co-generation of electricity and heat because of the high temperature of their exhaust gases.

Used in combination with microturbines they can achieve electric power conversion efficiencies approaching 70%, compared with 35% for a coal-fired power station.

Fuel cells or fuel cell/microturbine systems can operate on hydrogen derived from natural gas or coal. The unique aspect of this project is that it introduces solar thermal power into the equation. High temperature solar energy can reform gas (methane) to increase its energy content by some 20-30% with no increase in greenhouse gas emissions. This involves generating a fuel gas which is a combination of carbon dioxide and hydrogen.

5. Underground Coal Gasification

There is strong interest in renewing an old but little-known technology known as underground coal gasification. The process involves burning coal while it is still underground. Air and steam are injected into a suitable coal seam and used to start and maintain coal combustion. The gases which result are piped to the surface directly to power generation or industry facilities. The process can use coal that is otherwise unrecoverable or unusable.

With increased control over the process it is possible that we could reduce emissions of carbon dioxide by almost half of that released from conventional coal-fired power stations. Other pollutants are either left in the ground or are easily removed from the product through a cheap, efficient, existing technology.

TELECOMMUNICATIONS

Better Mobile Phone Performance

CSIRO has developed radio-receiving systems and antennas and microwaves that will allow high volumes of data to be transferred quickly and reliably. The technologies will benefit people where it is not possible to lay large amounts of cable and they are looking at wireless technologies as a means of providing telecommunications services.

The technologies provide faster internet access, and better mobile phone performance.

FORESTRY

Satellite Tracking Technology and the Logging Industry

Satellite technology that can track logging equipment in space and time is helping smaller forest-based industries to improve their efficiency. CSIRO is working with the University of Melbourne to collect information which is helping develop a road network model for East Gippsland. The model will be linked to a Geographic Information System to help plan logging roads and log storage sites in the future. This should reduce transport and road maintenance costs and mean fewer and shorter tracks.

MINERALS

Many mining companies provide valuable infrastructure in remote Australia by building roads, providing housing, water and power for the people who work there. While these facilities are dotted round the large expanse of outback Australia we have the potential to find more mineral deposits and thus to encourage more such development which improve our infrastructure at the same time as increasing our export performance.

In Western Australia, for example, 50% of all new jobs have been attributed to the minerals industry. The Australian minerals industry spends over $15 billion a year on goods and services in Australia. It has been largely responsible for the extension of technology, particularly in communications, transport and energy distribution throughout rural and remote areas of Australia.

In addition, for each person employed directly in the industry, approximately four are indirectly employed in other sectors such as services and manufacturing.

CSIRO's role in assisting the industry is mainly in finding new ore deposits with leading edge technology. A few examples follow.

1. Billion Dollar Gold Find

Exploration techniques based on research by the CSIRO Regolith-Dominated Terrains Project have slashed costs and dramatically accelerated mineral discovery in Australia by opening up terrain previously inaccessible for exploration.

As a result, the market capitalisation value of one leading Australian gold producer in Western Australia increased from $100 million to $1 billion in 5 years. In South Australia, capitalisation of companies using CSIRO techniques in their exploration in the Gawler Craton increased from $95 million to $600 million in a single year.

Major deposits of gold and other minerals have remained undiscovered in Australia because they are covered by deep layers of soils and weathered rocks. This project has developed new and effective techniques for mineral exploration in these difficult terrains and disseminated them to industry.

The close interaction between researchers and mining companies meant the new concepts have been adopted quickly and to good effect. From 1987 to 1996 the laterite geochemistry project has been a major contributor to the discovery of six major gold deposits in WA and the NT with proven reserves valued at more than $5.5 billion. Laterite geochemistry is now well established as an exploration technique in Australia and overseas for a wide range of commodities, including diamonds.

Calcrete geochemistry met immediate success in the well-established Kalgoorlie goldfield and was the key to the discovery of the Gawler Craton (South Australia) as a major gold province. The technique has considerable scope elsewhere in southern Australia and in arid environments overseas.

The research has been recognised widely by the mineral industry and the scientific community nationally and internationally. The research approach used initially by CSIRO has been adopted by the Cooperative Research Centre for Landscape Evolution and Mineral Exploration (the CRC LEME), formed in 1996 when CSIRO combined with the Australian Geological Survey Organisation, the Australian National University and the University of Canberra. Drs Smith, Anand and Butt have received many prestigious awards for their work.

Research has involved collaboration with more than 52 companies, much of it conducted through the Australian Mineral Industries Research Association. From 1987 to 1997 the total cost to CSIRO was about $6.2 million. Industry contributed $5.1 million in cash and an estimated $400 million in exploration and development.

2. Creating a Magnesium Industry for Australia

A thirteen-year partnership between CSIRO and Queensland Metals Corporation (QMC) has attracted domestic and foreign investment and is creating new industries for Australia.

The $46 million R&D project developed the expertise and technology to maximise the value to Australia of the world's largest deposit of magnesite ore. The deposit was discovered in 1985 at Kunwarara in Central Queensland.

The technology adds value to raw materials to produce new products. One of them, Magmetal, is a lightweight metal ideal for applications in the vehicle and aviation industries. It has attracted foreign investment to establish a $700 million Magmetal production plant in Australia that is expected to create up to 1400 jobs. There is also potential to create a cluster of SMEs producing automobile components.

The opportunity is enormous. World demand for magnesium is around 300,000 tonnes annually and rising at 15 per cent a year. The global motor vehicle and aviation industries are demanding lighter, more robust components to improve performance and fuel economy. At about half the weight of aluminium and a quarter that of steel, yet stronger than both, magnesium fits the bill.

As part of the Magmetal project the partnership has patented the Australian Magnesium Process, one of the most cost-efficient and environmentally sound in the world. The process will provide the basis for the commercial production of Magmetal, which is scheduled to begin in late 2002. The production plant will be the culmination of joint research involving CSIRO, the Australian Magnesium Corporation, the Ford Motor Company (AUD$40 million), Normandy Mining (AUD$20 million) and QMC (AUD$5 million). Annual revenue is expected to be around $400 million at full production, with 300-400 jobs created directly and up to 1000 new jobs in downstream industries.

The Flamemag project has developed a patented process to produce a magnesium hydroxide flame retardant that has surpassed the performance of other available retardants. Such products are in strong demand to meet stringent safety legislation for plastics. A bench-scale plant for the retardant is operational and a demonstration plant is planned for Clayton, Victoria, in 1999. Market potential is estimated at $5 million per annum.

The Enviromag project has developed a magnesium hydroxide slurry for treating acidic effluents. The joint venture has established a 25 000 tonnes/annum capacity plant in Yarraville to produce the slurry using a CSIRO-developed and patented process. The product has been well received in the market as an alternative to lime and caustic soda.

Since 1985 around $46 million has been spent on R&D to develop value-added products for the Kunwarara ore. Industry partners have provided about 50%; CSIRO's contribution includes staff and the facilities of six CSIRO divisions to support a range of value adding projects, including Magmetal, Flamemag and Enviromag. The Federal and Queensland Governments have also contributed significant funding.

3. Mineral Exploration System

In January 1999, one of the world's most advanced airborne mineral exploration systems began a demonstration survey near Temora in south-western NSW.

The Australian designed and developed system will be released commercially later this year. It is expected to be used world-wide to explore for minerals such as gold, diamonds, nickel, copper, lead and zinc buried at depths of up to 300 metres. It is also able to detect underground water and groundwater salinity which makes it a valuable environmental management tool.

The system, known as TEMPEST, was developed by the Cooperative Research Centre for Australian Mineral Exploration Technologies and is being commercialised by one of the CRC's participants, World Geoscience Corporation Ltd.

Minerals are our largest commodity export but our existing mines are largely based on surface discoveries made many years ago. Because much of Australia is covered with silt and rubble new ore bodies are becoming harder to find and local explorers are looking offshore. Australia needs this new technology to help us find world-class deposits and to protect our export income.

Term of Reference 4 - The role of different levels of government and the private sector in providing infrastructure in regional areas

See the introduction to the section on minerals for the role played by the minerals industry.