

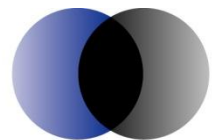
Executive Summary only

Assessment of CSIRO Impact & Value

Report prepared as input to
CSIRO's Lapsing Program Review

Prepared for CSIRO

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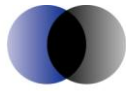
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Executive Summary & Recommendations

Purpose & approach

Review focused on whole-of-CSIRO impact & value

This report is designed to provide an overview of the processes through which CSIRO has impact and creates value for the Australian community, along with some credible indicators of the scale of its impact and value. It seeks to build an understanding of the value supported by the organisation as a whole – as a technical input to the Lapsing Program Review process. This has been done through a combination of

Case studies & vignettes

- Probing of a range of CSIRO initiatives to demonstrate forms of value and the various ways that CSIRO complements Australia’s overall innovation capability. This probing has led to a number of specific indicators of value and impact, and a better understanding of how these values are likely to evolve over time.

Update of past studies

- Briefly reviewing a number of the assessments and case studies done as part of our earlier assessment of CSIRO impact and value (ACIL Tasman, 2006), providing a longitudinal dimension to the current assessment.

Collective value in capability, systems etc

- Taking a higher level, whole of CSIRO, view of the ways in which CSIRO brings value to the whole system, including consideration of culture and incentives, breadth and depth of capability, including responsiveness and leadership, track record and forward prospects.

- Drawing from these elements, some conclusions about overall value and impact have been inferred – especially about overall CSIRO impact and value relative to overall CSIRO costs.

We used and extended the approach utilised in our 2006 review, but with a stronger emphasis on the factors driving the value of CSIRO as a whole. This approach has included emphasis on CSIRO as an integrated entity offering a flow of R&D services while building and maintaining a high quality, broad and deep capability to respond to emerging questions. There was also more scope than in 2006 to consider actual ‘runs on the board’ ranging from proof of concept out to active implementation and commercialisation.

Basis for CSIRO’s contribution to value

Value added to national innovation capability

CSIRO’s value has been approached as an addition to national innovation capability that fills gaps, adds critical mass and leadership, and in particular that brings a capacity for highly responsive, mission-oriented research and policy and strategy advice in relation to national priorities. Economic, environmental and social values, including societal risk management, are all relevant targets for CSIRO work – and examples of all have emerged from the case studies.

CSIRO's value is viewed as lying in:

- the *flow of delivered research outcomes and research based advisory services*
- the *building and maintenance of potentially valuable research capabilities* (skills, research infrastructure, networks, databases and other collections)
- the *systems and internal cultures* that allow these capabilities to be managed to add value to Australia's innovation efforts

Case studies

Impact and value relative to aggressive counterfactual

A collection of case studies and vignettes was selected on the basis of their power to illustrate the range of value creation mechanisms in use across CSIRO and to provide some indicators of actual value. The activities probed range from modest stand-alone activities up to Flagships and prospects for growing cross-Flagship collaboration. Where dollar values were estimated, these were assessed relative to an aggressive counterfactual (the no CSIRO case) and in general excluded a range of plausible high value impacts. In this sense, the valuations were conservative – usually highly conservative.

Conservative case study value of \$6 billion

That said, across the collection of case studies, we inferred a credibly conservative – that we believe to be highly conservative – valuation, in terms of realised benefits and serious forward options, of \$6 billion. The figure should be viewed as a *lower bound on the present value* of the extra options delivered by CSIRO involvement across this subset of CSIRO activities – net of forward costs in implementing the options but not net of CSIRO's costs. This figure could be viewed as an underestimate of the value of the case studies, to be compared to the costs incurred.

The period over which that value is delivered varies depending upon the nature of the example and the counterfactual (the case where there is no CSIRO) considered as appropriate for each example. ACIL Tasman notes that some of this value is beginning to be realised now, other amounts have strong prospects for being realised in the near term, while others are necessarily longer term and in some cases relate as much to insurance against future risks as they do to guaranteed revenue streams.

Specific case study and vignette impacts and inferred values that underpin this \$6 billion underestimate include:

- Climate Adaptation Flagship:
 - Top down assessment suggested contribution to reduction in Australia's costs of adapting to climate change, only across the period to 2030, of the order of \$2 billion – plus other benefits and insurance;
 - As examples, 'bottom up' assessments suggested potential value of the order of \$1 billion from climate-ready crops, of the order of \$200



- million for coastal communities through better planning and zoning and substantial value in relation to planning for increased bushfire risks.
- Prawn breeding and novel feed supplementation:
 - Value of delivered prawn yield increases by \$430 million plus additional benefits from extending and diversifying the applications of the technology;
 - Novel feeds add further production value and could support useful royalty streams, export potential and displacement of some stress on wild harvest fisheries.
 - Cement substitutes and novel products:
 - Plausibly conservative royalty streams of tens to hundreds of millions of dollars on niche products that can compete based on functional characteristics – underwriting research risks and offering substantial upside, even before accounting for GHG mitigation effects.
 - ... Early position in potentially large overseas markets.
 - Strong options to support lower cost GHG mitigation strategies:
 - ... With an indicative \$50 million in value through advancing Australian access to the technology under a moderate carbon pricing regime, though plausibly much more;
 - ... Plus potential to accelerate global mitigation through practical expansion and demonstration of low cost mitigation options that are relevant to a substantial proportion of current global emissions.
 - Murray-Darling Basin Sustainable Yields Project:
 - Conservative \$2.8 billion value linked to more efficient deployment and better risk management of the investment funds already committed to buyback and water infrastructure efficiencies.
 - Resistant starch grains:
 - Present value, primarily via improved health outcomes for Australians, *very* conservatively assessed at about \$100 million, and plausibly several times greater as capability is transferred to grains and crops other than barley and wheat;
 - + additional returns to agriculture and CSIRO royalty streams from new non-commodity cereal crops capable of commanding premiums in export markets.
 - Titanium within Light Metals:
 - With commercial partnerships in place, revision of 2006 assessment of the opportunities for TiRO and product fabrication suggests significant strengthening above the earlier assessment of value of \$275 million+



- The UltraBattery
 - Commercialisation in place for both automotive and stationary applications will support returns to CSIRO, though structure is commercially confidential.
 - ... Plausible revenue streams valued at tens of millions of dollars.
 - Substantial opportunities, within a small field of possibilities, to alter the early nature of moves into more fuel efficient hybrid vehicle fleets and to support more effective early use of renewables within the energy mix.
 - ... Plausibly large impacts via the social cost of carbon saved and improved incentives for global mitigation – further enhanced by implications for non-GHG pollutants and oil dependency.
- Mapping undersea mineral deposits
 - No quantified value developed within the vignette, but immediate cultural and policy value, and longer term potentially high value in supporting commercial exploration.
- Biochar
 - Not explicitly valued, but potentially very high value if the work leads to acceptance of certain applications of biochar for purposes of carbon accounting under international protocols.
 - ... Plausible role for biochar as a substantial contributor to lower cost abatement, given its complementarity with several aspects of farm production – with potential value of many billions of dollars under a carbon target policy.
- Radio astronomy and the SKA
 - High value for Australia if wanting to participant in big science projects, probing important science questions, in a cost effective way that plays to Australia's competitive advantages.
 - Indicative estimate of a conservative expected *tangible* value over the life of the project, well over \$100 million – driven by the high prospects for the SKA being located in Australia and funded internationally.
- Cross-CSIRO climate work
 - Currently the subject of an active proposal for a major coordinated program of activities that could deliver very high value, but this value has not been explicitly quantified.

Extension to whole of CSIRO

In looking at wider CSIRO activities, we identified a substantial number of areas broadly analogous to some of the case studies – with high prospects for these activities adding very substantially to the value supported by the case studies and vignettes. We also noted high likely value in the forward planning



for the evolution of CSIRO – including increased collaboration across larger programs and the Transformational Capability Platform investments, which appear to align well with future capability demands.

This probing of where the case studies and vignettes fit relative to the whole of CSIRO supported a conclusion that the value of CSIRO’s impact across the entire research portfolio is almost certainly some significant multiple of the value captured just by the case studies and vignettes – for which \$6 billion was developed as a highly conservative estimate. The value created by recent CSIRO activities is likely therefore to be at least several tens of billions of dollars.

This value, relative to the counterfactual, needs to be compared to the costs incurred in deriving the value. CSIRO has drawn on decades of legacy and capability accumulation in creating this impact. There is a level of subjectivity in determining which costs are relevant for purposes of comparison. We have proceeded on the assumption that the purpose of the analysis is to contribute, alongside other commissioned work, to guiding decisions on forward funding – with a natural interest in whether recent outlays on extracting impact and value from the legacy and skills of CSIRO have been big enough to justify these recent costs.

Viewed in these terms, we concluded that the assessment of impact and value would most sensibly be compared to CSIRO costs over the past 3 to 5 years – with a broadly comparable present value of costs of the order of \$5 billion. CSIRO costs are covered from a range of sources, with about half being appropriation funding, but all funding sources entail opportunity cost.

On this basis, we concluded that the value ‘purchased’ in recent years through CSIRO’s research and advisory activities has almost certainly been several times the relevant costs – plausibly much more – and that the investment has robustly performed well.

Recommendations

Our assessment provides strong support for the mission-oriented, multidisciplinary and responsive model now being used across CSIRO. This model has strong synergies with the real options framework used in our assessment of CSIRO’s value and impact. At an organisational level it appears that CSIRO plans very much with an eye to flexibility and responsiveness. However, we believe, based on our interactions with specific areas of CSIRO in the course of this project, that there is scope for carrying through this approach, and the type of options-based planning tools used in probing value, more deeply in program planning. This could deliver some significant improvements in flexibility and value for money.



Integrate options planning at an early stage “pre-project” to maximise flexibility

We have observed that in some areas CSIRO’s flexibility in redirecting resources is more apparent as reactive than as proactive strategy. It is one thing to periodically assess new information and redirect resources in response. It is another to integrate options planning from the start. In other words when considering investing in a new research project we recommend that CSIRO look at ways of building and maintaining greater flexibility to respond, at low cost, to plausible new information.

We consider there is scope for more *proactive* planning, within Research Groups and Flagships

- There should be planning from the start for flexibility in R&D processes as well as outcomes. This approach will tend to favour choices of technology, capability and commitment to capital investment that are different from the natural strategies if the emphasis is only on reactive use of existing flexibility.
 - For example, in choosing between approaches that rely heavily on physical engineering or ICT, there might be a preference for the latter if it is seen as offering greater flexibility for change, and greater scope for serendipitous application, even if not nominally more prospective or lower cost.
- The various research areas appear good at creating flexibility in R&D outcomes, and at exercising available flexibility in R&D resource management.
 - But they are not necessarily ensuring that new projects and programs are designed to provide maximum flexibility in the first place; i.e. it is not clear that they are creating the optimal level of strategy flexibility.
- The case for a flexible strategy was made in our last review, but it is not clear that substantial progress, below the broader organisational level, has occurred.

Create a stronger emphasis on public good outcomes from research - even research that involves private funds

We believe that there is considerable scope at the “pre-project” stage to provide greater clarity and guidance on the nature of the “problem” to be solved. There is a role for Governments to invest in R&D because they:

- are direct users of the information delivered; and
- recognise limitations on an efficient level and mix of R&D being undertaken without this involvement (i.e market failure, and sometimes regulatory failure, exists).

The case for intervention when markets fail (or regulatory impediments limit market incentives and capacity to respond to opportunities) is well based, provided that the intervention does not do more harm than good. However, sometimes it is better to intervene by attacking the impediments rather than throwing R&D funds at the resultant gaps.



One of the problems with just directing money at market failures is that the very forces that have impeded the markets from making the investment in R&D can act to inhibit effective adoption and use of the R&D funded by governments to address the failure. This is not automatic, but it is a risk, and indeed a generic risk, to be managed when symptoms not causes are attacked. It is also a risk that has not been uncommon in the recent history of R&D support in CSIRO.

It should be recognised that sometimes there are conflicting and even confusing signals regarding the function of Government funded R&D activity. And questions arise on how to balance public against private good emphasis in work and funding. We recognise that the confusion entails perceptions of external as well as internal expectations, and links in part to the statutory functions of CSIRO.

We recommend that CSIRO place stronger emphasis on public good outcomes as the focus of planning. This can often involve engagement with private interest but as a means to that end – as a way to make the delivery of public good outcomes more cost effective.

Current perceptions within the organisation probably favour an excessive emphasis on commercial relative to public good outcomes. It should be clearly recognised that efforts by CSIRO to maximise commercial returns from its work can sometimes conflict with the success of the work in delivering greater public good outcomes – the primary rationale for CSIRO.