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Submission to the National Innovation System Review from the Australian Academy of Technological Sciences and Engineering

Author:

Australian Academy of Technological Sciences and Engineering

Type of Organisation:

The Australian Academy of Technological Sciences and Engineering (ATSE), a not-for-profit organization, is an association of some 750 professional men and women who are elected as Fellows of the Academy on the basis of their achievement in the application of science, technology and engineering to Australian society.

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Declaration of Interest:

ATSE seeks to promote the application of scientific and engineering knowledge for practical purposes, and to encourage:

- the development and practice of existing and new technologies;
- the development of technology for more effective management of natural resources and improved competitiveness of industries and services;
- the study of the effects of technology on the quality of life of the community and on the physical and sociological environment;
- public services dependent on technological sciences and engineering;
- the development of technology for national security and the prevention, control and mitigation of natural disasters; and
- technology for ecologically sustainable development.

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SUBMISSION TO THE REVIEW OF THE NATIONAL INNOVATION SYSTEM

In summary, Australian Academy of Technological Sciences and Engineering (ATSE) believes that there is an urgent need to strengthen Australia's national innovation system. Some of the key actions required are listed below.

- Develop and adopt a ten-year strategic plan to increase innovation in Australia. This strategic plan should include investment milestones and performance indicators and its development should engage all key stakeholders.
- Develop a strategic national intelligence capability that explores critical emerging issues through horizon scanning, technology roadmaps and foresight; and provides findings that can be understood and acted on.
- Recognise the high costs and risks in later stages of technological innovation and provide assistance measures that will address this need.
- Establish a new mechanism to fund collaborative research for projects that are smaller (and involve shorter time frames) than a CRC, but are bigger than ARC Linkage grants.
- Increase the R&D tax concession to 200 per cent, raise the turnover limit for the R&D Tax Offset and adopt other improvements to fiscal incentives in order to increase business expenditure on R&D.
- Include an element in the new university block funding formula which rewards investment in proof-of-concept and innovation/ commercialisation activities.
- Assist firms (especially SMEs) to develop products that government agencies are interested in buying.
- Increase the numbers of science, technology, engineering and mathematics (STEM) graduates from our universities by mechanisms such as reducing fees in these disciplines.
- Improve the teaching of STEM in our schools by making teaching more attractive to STEM graduates and providing better teaching resources.
- Establish an annual Prime Minister's prize for innovation based on the application of Australian-developed scientific discoveries.
- Improve the commercialisation of public sector research results by supporting training and adoption of best practice in knowledge commercialisation.
- Promote greater cooperation between Commonwealth, State, Territory and local government in encouraging innovation.

The Australian Academy of Technological Sciences and Engineering (ATSE) is an association of some 750 professional men and women of outstanding achievement in the application of science, technology and engineering to Australian society. ATSE seeks to promote the application of scientific and engineering knowledge for practical purposes, and to encourage:

- the development and practice of existing and new technologies;
- the development of technology for more effective management of natural resources and improved competitiveness of industries and services;
- the study of the effects of technology on the quality of life of the community and on the physical and sociological environment;
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- technology for ecologically sustainable development.

ATSE believes that it is strongly placed to provide input to this Review. Its membership includes Fellows with expertise in a wide range of different aspects of innovation, as well as in the design, implementation and review of measures to support innovation. ATSE Fellows have a real base of experience in making innovation work.

The importance of innovation to the Australian economy

Australia must increase its investment in innovation. Governments in both developed and developing countries have recognised the importance of innovation¹ to economic growth and have been addressing the need to improve their innovation performance. In spite of previous review processes at both Commonwealth and State Government level, Australia's innovation performance is widely acknowledged as lagging behind many other OECD countries. We cannot afford to delay tackling this problem — the rest of the world is making major strides in strengthening national efforts to increase innovation. For example, China and India are now investing in education and research at levels much higher than that of Australia. Without urgent action, Australia's relative international competitiveness and our standard of living will inevitably decline.

To ensure that Australia improves its innovation performance, ATSE recommends that the present Review should result in the development and adoption of a ten-year national innovation strategy. Such a strategy would address all of the elements required to make Australia a successful innovating nation with a strong knowledge base and the ability to rapidly translate this into new products and services. This national innovation strategy should include an investment plan based on consultation between government and business, performance indicators to track progress towards strategic goals, and an annual stock-take of progress. One element of this strategy would provide a mechanism for identifying challenges as they arise, and bringing together the teams needed to solve them.

¹ “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations”, OECD Glossary of Statistical Terms, (<http://stats.oecd.org/glossary/index.htm>).

Australia needs to develop a significant national capability in strategic intelligence to support innovation. This capability would address and explore critical emerging issues for our society and economy, through a combination of horizon scanning, anticipatory intelligence, technology roadmaps and foresight. Outputs from these activities would need to be in a form which government, industry and the community can understand and act upon. The processes involved are illustrated in Figure 1.

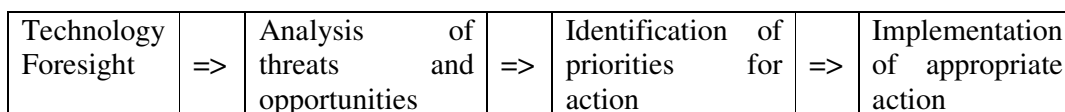


Fig 1 – Use of Technology Foresight to address challenges

ATSE wants to see the use of this strategic intelligence process made an integral part of the proposed ten-year national innovation strategy. Previous technology roadmaps and technology scans have tended to be information documents, adequately describing the state of the art but not always translating these observations into practical suggestions (or warnings) about what individual firms, organisations or governments (including their regulators) should do about the material provided. Technology Foresighting provides a structured process that engages all key stakeholders.

In ATSE’s view, there is scope for the Government to make better use of the Academies and the National Academies Forum (NAF) as sources of advice and expertise to explore some of the challenges we face as a nation. The Academies should play a key role in the development of the ten-year national innovation plan. An expanded consultation process could be established to decide and review an annual work program for the Academies/ NAF.

Innovation is profoundly transforming all aspects of human activity, and needs to become an integral part of all areas of business, government and education activity in Australia. ATSE believes there is a need for new ways of thinking about innovation. While the main focus of this submission is technological innovation — an area where ATSE has significant expertise — ATSE does not discount other types of innovation, which can be just as important.

Innovation needs to be embedded in the Australian community, in firms, educational institutes and government. Innovation involves continuous change and improvement, responsiveness to lateral thinking and new ways of achieving outcomes. Competition is an important driver of innovation.

Knowledge of all kinds contributes to innovation. Knowledge can be derived from R&D. Just as important as a source of innovation however, is the adaptation and adoption of technology from Australia and overseas. All aspects of innovation, including R&D, need to be encouraged and supported by government. Just as the social and economic benefits of innovation flow across our economy, there should also be a sharing of the costs involved.

ATSE believes that, at present, Australian support for innovation is too focussed on assisting research. New mechanisms are required to support innovation. However the development and demonstration phases of innovation can involve much larger investment, while still involving high risk. This is illustrated by the work of Holt² in the figure below, which shows how costs vary for coal technologies at different stages in innovation and deployment processes and that not all technologies are at the same level of maturity. In areas such as energy, which are critical for Australia, the development stage tends to be particularly capital intensive, with associated high technological risks, making the need for government support even more critical.

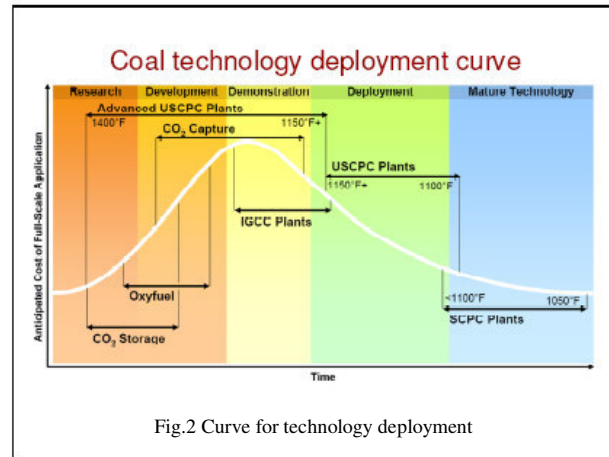


Fig.2 Curve for technology deployment

Demonstration projects involve ‘learning by doing’ — a well-recognised but expensive phase of many innovation processes. Typically for many technologies, every dollar spent on research can lead to a requirement to spend \$10 on development and \$1000 on the demonstration phase. Early stage adopters of new technologies face considerably higher risks. The claim that near-market innovation involves fewer or smaller risks does not stand up to close scrutiny. Even if it did, the substantially higher costs in development and demonstration phases offset any reduction in risk. All this argues for an extended government support role, which could involve grants for demonstration projects or tax concessions for other later-stage innovation phases such as clinical trials. The nature of assistance appropriate for these phases may be different to that provided to support R&D —for example. Tax measures could be available on a project-by-project basis, but subject to merit review.

International collaboration plays an important role in assisting innovation by facilitating access to foreign sources of knowledge. Australia produces around 2 per cent of new knowledge and must rely on accessing the other 98 per cent through a range of networks, programs, publications etc. A key role for government is to provide policy settings that encourage all types of international collaboration to foster innovation, not only amongst researchers but also between businesses, public

² Holt, N., *Preliminary Economics of SCPC & IGCC with CO₂ Capture & Storage*, 2nd IGCC & XtL Conference, Freiberg, Germany, 9-10 May, 2007; see <http://www.tu-freiberg.de/~wwwiec/conference/conf07/pdf/9.2.pdf>

officials, regulators, service providers etc. Anything that reduces the costs and complexity of international collaboration will assist Australia to innovate.

ATSE believes that Australia must increase collaboration between private and public sectors, and between research providers and the users of research outcomes. This requires top-down facilitation including additional funding. It also requires the creation of an environment in which bottom-up collaboration increases. Business should be able to readily access public sector research skills.

ATSE advocates the creation of a new mechanism to fund collaborative research. This new approach should be able to respond quickly to opportunities, reward cooperation between public sector researchers and business, and require some financial commitment on the part of the businesses involved. This new mechanism would support projects that are bigger than the average ARC Linkage grant but smaller than for a Cooperative Research Centre (CRC).

Australia needs to enhance the *demand* for innovation on the part of the public and private sectors. At present Australia is too driven by the supply side — the need for innovators to commercialise their ideas — rather than on creating a demand for innovation. Industry, governments and consumers should be encouraged to support companies that supply innovative products and services. For government, this means providing assistance to firms that can develop products that government agencies are interested in buying. This assistance should be able to be rapidly accessed and should not require the recipients to match government funding. A program along the lines of the former National Procurement Development Program would be appropriate. Governments also need to make Australia's business environment more conducive to growing SMEs. In ATSE's view, government programs need to be more generous to SMEs in their first five years.

There are significant 'holes' in the research infrastructure in some industry sectors in Australia that are inhibiting the path from discovery to commercialisation, forcing venture capital firms to take promising novel technologies offshore to access enabling technologies. A specific example of this is the lack of a centre of excellence with medicinal chemistry expertise in Australia, to build on the world-class research being done by the medical biologists. This is needed if the biotechnology and fledgling pharmaceutical companies are to survive in Australia. There are several possible solutions to filling these 'holes', including attracting teams from overseas, or setting up a new centre of excellence around a specially recruited research leader. In the longer term, ATSE would also like to see NCRIS fund facilities where researchers can interact with Australian industries to ensure that promising technologies are exploited.

ATSE want to see stronger public promotion of science, technology and innovation. Australia needs a strong innovation culture, which is rewarded and promoted within our education system at all levels. National reward schemes that recognise business sector innovation and the commercialisation of public sector research need to be enhanced. The Australian Technology Showcase Awards and the ATSE Clunies Ross Science and Technology Awards need support from state and Commonwealth Governments.

ATSE believes that an additional Prime Minister's Prize to recognise the application of Australian-developed scientific discoveries is needed. Such a Prize would not only assist the resolution of a conundrum regularly faced by the Prizes Committee — how to balance the excellence of the pure science with its impact or application. It would also send a strong signal to the community that the Government wishes to see its investment in research translated into commercial or other benefit.

ATSE observes that a central theme of the Review Panel's paper is the focus on the process – innovating or being innovative – and emphasising interactions between the components of the system.

The Review's Terms of Reference

ATSE has developed a series of observations on each of the Terms of Reference. These are set out in abbreviated form here but could be further elaborated if necessary.

Identify a set of principles to underpin the role and participation of the public sector in innovation.

- The costs associated with innovation should be shared between innovators and the government (on behalf of the public) just as the benefits arising from innovation are also shared. Innovation generates benefits that go beyond those parties immediately involved. It also involves risk to investors. Public support through government funding results in a sharing of risks and costs. Public policy settings need to ensure that innovation is strongly encouraged. Without increased innovation, Australia's relative international competitiveness will decline.
- Public sector research has an important role to play in Australia's national innovation system. Public research priorities must have a strong focus on assisting innovation in both public and private sectors. Commercialising innovations arising from the public sector requires improved commercialisation capability in our research-performing institutions, improved understanding of risk of success/failure, and better access to skills and finance. Public sector research that underpins the development of new industries and companies should be strongly supported by government.
- Public sector Intellectual Property policies need to facilitate the adoption of innovative practices and products by industry and government. These policies should be transparent, be administered in an expeditious manner, and not impose excessive costs or reporting burdens on those whose main objective is to use the IP in an innovative way. The Government should consider placing requirements such as time limits on the commercialisation of government-funded research, similar to those of the US Bayh-Dole Act.
- The Government should help universities and public sector research organisations to raise the standards of research commercialisation, working through Knowledge Commercialisation Australasia. This assistance should focus on training, and the adoption of best practice in licensing and IP management, and a better understanding of the timeframes that industry and investors need to work to.

- Australia must attract more students into STEM studies, as well as ensuring that all levels of education and training encourage innovative behaviour. The supply of skilled human resources is critical to Australia's success in generating economic and social benefits from innovation. Australia is not currently training enough science, engineering, technology and mathematics (STEM) graduates to meet future needs. Shortages of engineers and technologists will limit our ability to benefit from innovation. We need to ensure that school students are well advised on career choices, that university HECS fees for science and engineering students are reduced so as to increase their numbers.
- Science teaching must be made more attractive to graduates. Curriculum initiatives are needed in science, technology and mathematics. These must be based on a highly relevant context. New curriculum support materials and professional training for teachers is essential and science subjects must be taught by science graduates. ATSE's STELR initiative is described later in this submission.
- More scholarships are needed for honours students in science and engineering. Strong research resources – research personnel, research students and research infrastructure — must be a key public sector priority, especially if the private sector is to be persuaded to make better use of them. A high-quality research base provides an environment in which innovation flourishes. World-class R&D increases the likelihood of innovation.
- While not advocating that Government should 'pick winners', ATSE believes that there is a need for a forward-looking view to identify technology opportunities and threats for Australia that take our existing strengths and capabilities into account. Australia also needs to encourage development of innovation support clusters in the public sector, focussing on some of these technology areas where a critical mass of activity is required before growth can become sustainable.
- The innovative performance of individuals should be rewarded. Public sector research performing bodies should recognise innovation by staff, as distinct from peer-group academic recognition, in their promotion procedures for example.
- Within the context of our proposed ten-year national innovation strategy, performance indicators will be needed to monitor achievements. These can be set at national level, at institutional level, or even by sector. Success in promoting innovation should be an important institutional performance indicator for applied science disciplines such as engineering and biotechnology in the higher education sector.

Develop a set of national innovation priorities to complement the national research priorities, ensuring the objectives of research programs and other innovation initiatives are complementary.

- National innovation priorities that complement the National Research Priorities and the objectives of research programs and other initiatives can be established in a number of different ways. For example, they could be quite independent of National Research Priorities, and address such matters as:
 - ensuring an adequate the supply of human capital;

- increasing levels of business R&D;
 - improving links between public sector research and the business sector.
 - investing at a very targeted level in research and technology capability building in key emerging fields;
 - embedding innovation as a key performance criterion in all organisations, through Annual Reports, evaluations, etc.;
 - building principles and experience of Technology Foresight and innovative behaviour into all levels of formal education;
 - use Technology Foresight to ensure that Australia has the all the necessary capabilities to exploit our research strengths and to take up emerging technologies;
 - identifying, celebrating and rewarding innovation throughout our society; and
 - development of a national strategic intelligence capability to better address the challenges of the future through innovation.
- Another approach to innovation priorities, which could operate in parallel with that described above, would involve developing innovation priorities for each of the four National Research Priorities. Thus an appropriate innovation priority relevant to the first National Research Priority ‘An Environmentally Sustainable Australia’ could be ‘Using technologies to enhance Australia’s environmental sustainability’. Innovation in this field would be assisted by government programs that assist the development and implementation of more cost-effective solutions, particularly in the areas of greenhouse gas emission abatement and climate change adaptation. These will eventually become commercially competitive, but need investment in scale-up, demonstration plants etc and possibly the implementation of other policies such as an effective emissions trading scheme to achieve this.
 - In relation to ‘Promoting and Maintaining Good Health’, the innovation priority could be ‘Translating research into new products and practices to improve human health and well-being’. This would include application of results of research from around the world, and would promote innovation by linking public sector researchers and industry. This would reduce the capability gap that occurs when Australian public sector researchers, supported by public funding, reach the limit of the product development process. This capability gap often leads to lack of take-up of Australian research outcomes by domestic industries and loss of valuable IP offshore. Germany and the USA are implementing strategies to close this gap using public funding further along the research and development pathway and Australia needs to do so too.
 - For ‘Frontier Technologies for Building and Transforming Australian Industries’ the innovation priority needs to see such technologies, including, those developed elsewhere in the world, implemented so could be stated as ‘Improving Australian Industries’ capacity to adopt new technologies beneficially’.
 - For ‘Safeguarding Australia’ the priority could be along the lines of ‘World-class technology, procedures and products to safeguard Australia’.

Identify regulatory and other barriers to innovation and recommend ways to minimise these.

- Expensing of the capital involved in R&D and allowing flow through of tax losses, as they are incurred, to shareholders or fund providers would make investing in innovation more attractive.
- There is an urgent need for further simplification of tax laws on partnerships for investment vehicles.
- Competition policy must recognise the need, at times, for Australian competitors to collaborate at least until an Australian-sourced product or process is established in world markets. Regulators need to understand that Australian companies need to be able to compete in a global environment.
- In relation to finance sector participation in innovation, ATSE hopes that the Review will examine the extent to which funding for innovation is provided by the financial industry (venture capital, private equity, superannuation funds) and also the role of the ASX, to determine whether changes in government policy or industry practices could stimulate innovation in industry, both in small businesses and large. The superannuation industry's need to invest, coupled with a growing venture capital industry, suggests that there should be new possibilities to pull through innovative technologies into start-up companies.
- ATSE supports continuation of the Innovation Investment Fund (IIF) Program and its expansion through the provision of additional funding to established venture capital firms to support the training of cadet investment managers who would help to meet skills shortages in this area.
- Identify and remove any regulatory restrictions preventing the formation of industry-wide, levy-based corporations aimed at innovation to maintain technological leadership by Australian industry in specific industry sectors

Examine the scope for simplifying and reducing program duplication and ensuring that any support provided is well-targeted and easy to access.

- ATSE believes that the Commonwealth Government should seek to bring business assistance programs, where appropriate, under the umbrella of the Innovation Australia Board. The Board should seek to harmonise information requirements for the programs that fall within its purview.
- ATSE is not aware of any significant overlap or duplication between Commonwealth and State/Territory Programs and notes that a 2003 study³ found good complementarity in this area. The 169 programs that are sometimes mentioned include programs offered by individual State/Territory governments to firms located within their jurisdictions which are therefore not available to firms located elsewhere. ATSE believes that there is a role for State/Territory and local government in supporting innovation.
- A driving principle for innovation programs should be a requirement to minimise the cost imposed on applicants, and subsequent reporting requirements, consistent with the need for accountability.
- ATSE urges the establishment of a Commonwealth-State Innovation Ministers' Council to encourage cooperation between different levels of government in achieving strong innovation outcomes across Australia.

³ The Allen Consulting Group, 2003 *The Contribution of the States and Territories to Australia's Science and Innovations System*, a report to the Science and Innovation Mapping Study.

Consider the appropriateness, effectiveness and efficiency of the Research and Development (R&D) Tax Concession Scheme in promoting innovation and make recommendations to improve innovation outcomes.

- ATSE believes that the R&D tax concession should be raised to bring the level of assistance closer to that which applied when it was first introduced, when it provided a very effective stimulant to business investment in R&D, this would mean moving to 200 per cent. When the R&D tax concession was introduced the concession was 150 per cent linked to a company tax level of 46 per cent. Now, the tax concession is 125 per cent with the current 30 per cent company tax rate. When compliance costs are taken into account, many firms see no incentive in the current R&D tax concession. Unless Australia offers an effective tax incentive for business R&D, some firms will choose to do their R&D in other countries.
- ATSE considers that new firms and SMEs making R&D tax concession claims for the first time should be treated more generously, to encourage more to participate by sponsoring genuine research and compensate them for the establishment costs for setting up research activities, monitoring and reporting systems.
- The tax concession is only of use to firms who are paying tax. In ATSE's view, lifting the current \$1 million limit on R&D tax offsets, and tapering the benefit above the new limit, would help research intensive start-up companies, particularly in capital intensive research areas such as energy, resources, pharmaceutical development and manufacturing.
- Consideration needs to be given to introducing a new measure that allows investors to benefit from the tax concession where they provide funding for R&D undertaken by companies. Individual proposals could be approved by the Innovation Australia Board. The annual cost to revenue could be capped, with limits and transparency required in relation to fees for intermediaries, and regular monitoring of progress⁴.

Consider ways to improve the governance of the national innovation system to support higher expectations of government agencies and industry.

- The governance of the national innovation system needs to be primarily in the hands of the innovators – any government role should be as supporter/facilitator and to ensure accountability for public funding.
- In ATSE's view, credit should be given in the university system and the new Excellence for Research in Australia (ERA) initiative for patents and commercial publications, as well as publications in leading research journals. Ideally credit should also be given for industry R&D funding, major conference presentations, sponsored consultancy reports and other mechanisms where research work is reported to those who will potentially use it to underpin innovation. ATSE is also attracted to the Proof-of-Concept

⁴ Vision Systems provides just one of a number of illustrations of the potential of this approach. By forgoing around \$100 million in tax revenue the government saw a major business established which eventually created 1200 full time jobs and returned a taxable \$1 billion to shareholders.

metric⁵ as a means of quantifying the level of early stage innovative activity in research performing institutions.

- Grant applicants should be asked to provide information on the potential for innovation arising from their proposal, in the event of success. The relevance of potential research outcomes to Australia also needs to be given more attention.
- The ARC and NHMRC should report publicly annually on the extent to which their sponsored research has improved the nation's innovative output.
- ATSE believes that public research organisations and universities need to be provided with greater incentives to form risk-sharing partnerships with industry.
- ATSE believes that there is a need for a senior person within government who will provide leadership on innovation and serve as a bridge between the innovators in the community and the government. This person should have responsibilities that include addressing the effectiveness of existing and possible future programs, skills issues and improving interfaces between publicly supported researchers and industry. ATSE recognises that the existing Chief Scientist role provides a valuable bridge between the science community and the federal government and sees this new position as having a distinctly different function.

Assess the appropriateness, effectiveness and efficiency of the Cooperative Research Centres (CRC) Program and make recommendations to improve innovation outcomes.

- The CRC Program is valuable and should be retained. The Program has achieved excellent outcomes and has helped to improve research management in Australia.
- The CRC Program should be continued, expanded and diversified. There is scope for two (or possibly more) categories of CRCs, each with some common characteristics but having different guidelines, depending on their objectives. There should be scope for both CRCs with commercially focussed outcomes and CRCs that are primarily directed towards non-commercial objectives. More flexibility is required in the Program to accommodate different sizes and funding durations for CRCs.
- As noted earlier, ATSE advocates the creation of a new mechanism to fund collaborative research which would support projects that are bigger than the average ARC Linkage grant but smaller than a Cooperative Research Centre (CRC).
- The costs of preparing a CRC proposal must be substantially reduced and the reporting requirements made less arduous. ATSE is concerned that the administration of the CRC Program has become overly bureaucratic.
- Industry associations should be encouraged to become members of CRCs, in order to act as a conduit for SMEs to better access this program;

⁵ The Proof-of-Concept metric is a measure of the number of innovations that have been developed to the level of rigorous investment appraisal by external parties. Proof of concept Guidelines are available at <http://www.innovation.gov.au>

- The procedures for establishing a new CRC involve high legal costs. New simpler models are needed to streamline CRC establishment and minimise transaction costs.
- More flexibility is required, to allow CRCs to adapt research programs to changing circumstances, replacing the present approach that tends to lock CRCs into plans drawn up years earlier.
- CRC need to think more creatively about strategies for their eventual exit from the Program. More thought needs to be given to ways of helping CRCs to transition to alternative arrangements.
- CRCs should be able to have their funding extended at least once if they are successful, but possibly with progressively reduced proportions of government funding.
- Agreed methodologies need to be developed to assess public benefit CRC results — methodologies which allow valid comparisons with the current main focus of the program, that of commercialisation of technology and generation of private benefits.

Comments on questions posed in the Issues Paper

The *Call for Submissions* posed seven questions. The Academy’s response to each is summarised below.

“Can we imagine a better world? Are we asking the right questions?”

ATSE’s vision of a better world starts in our schools. In preschools and in early primary schooling, children test the patience of parents and teachers by regularly asking ‘Why?’ As they grow older this innate curiosity is not always encouraged – often learning becomes more a one-way flow of information and ideas. Our education system – primary, secondary and tertiary — must always encouraged students ask ‘Why?’, to question information they do not understand or believe, and to contest ideas they do not agree with. Innovation is a way of thinking and both curricula and pedagogy must provide continuous challenges to those being taught, to imagine how things could be made/ done better.

ATSE believes that school science should involve experimentation and discovery. Practical learning followed by the development of an understanding of the theoretical underpinnings is vastly superior to the converse. This process promotes not only greater interest and understanding, but also a more innovation-oriented culture. There are a number of interesting overseas programs that can provide exemplars for Australia.

ATSE is piloting a school program called STELR (Science and Technology Leveraging Relevance), which uses various small-scale renewable energy technologies in a laboratory setting to illustrate basic scientific principles. The main aim is to have secondary students retain an interest in science and mathematics by seeing it used in a practical manner in an area of interest to them. At the same time, STELR challenges students to think innovatively. More of these sorts of programs are required.

All universities should aim to include innovation among the attributes of their graduates, a quality that needs to be demonstrated in their coursework. A number of university engineering schools are embarking on assessable, practical, multidisciplinary team exercises to illustrate engineering principles, which at the same time will promote innovative thinking. A greater emphasis on ‘being innovative’ is needed. This needs to be matched by practical measures to ensure it is something more than just an aspiration. Australia’s universities should be challenged to demonstrate that their courses provide graduates trained to be innovative. Our universities should be encouraged to offer work experience in industry as part of science and engineering degree courses, in order to provide graduates and post graduates with a better understanding of innovation and its application in product development.

“How do we solve the big challenges we face as a country, an industry or as a community?”

Most of the big challenges Australia faces can only be solved through interdisciplinary approaches. ATSE believes that a ‘silo’ mentality pervades some research institutions, as well as in business, government bureaucracies and service providers. These barriers need to be broken down if the big challenges are to be addressed successfully. Interdisciplinary research and innovation, inter-business and intra-government collaboration, and increasing communication between all sectors are already occurring, but much more is needed.

One of the ways we can solve big challenges is to establish a process for ensuring that innovation contributes to their resolution. Thus ATSE has recommended the development and adoption of a ten-year national innovation strategy. One element of this strategy would provide a mechanism for identifying challenges as they arise, and bringing together the teams needed to solve them.

ATSE is concerned that a wide gulf exists between researchers in Australia’s public-sector research organisations and the potential users of research outcomes from that source. Australia has limited skilled human resources undertaking research. We need to make best use of these resources and this means ensuring that the relationship between researchers and the users of the outcomes is strong, enduring and well-supported.

As noted earlier, there is scope for the Government to make better use of the Academies and the National Academies Forum (NAF) as sources of advice and means of exploring some of the challenges we face as a nation.

“Could we do everyday things better?”

ATSE believes that, with some adjustments to current programs, governments can do better in promoting innovation. For example, it is ATSE’s view that pre-seed funding should be allocated to industry associations, regional development agencies and university commercial arms on a competitive basis. The present venture capital/equity-based approach for this program should be abandoned in favour of direct grants – the government should recognise that the pre-seed stage is too early for sensible equity-based government assistance.

Australia's business R&D tax concession needs to be increased to provide a real incentive for business increasing its investment in this area. We have addressed this in more detail earlier in this submission. The rules for claiming the cost of 'supporting' activities in relation to business R&D should be tightened. Changes are also required to the R&D tax offset.

“How do we get more firms and organisations to use the best available tools and techniques, from anywhere around the world, in what they do?”

ATSE supports the concept behind Government's new Enterprise Connect Program and believes that more centres will be needed to deliver this program across the country. ATSE believes that regional development bodies could play a useful role in this regard.

Australian firms and organisations need good sources of information on such things as new technologies and market trends, in order to stay ahead of their international competitors. Austrade and Invest Australia could help in this regard by bringing to the attention of Australian enterprises innovative practices being adopted in similar organisations elsewhere in the world.

As noted previously, Australia needs to develop a significant national capability in strategic intelligence to support innovation. ATSE would like to see the use of this strategic intelligence process made an integral part of our proposed ten-year national innovation strategy. Technology Foresighting is a structured process that engages key stakeholders.

“How do we make it easy for people to use tools or apply ideas in novel ways?”

While innovation is driven by far more than research, ATSE believes the full potential of the research community to contribute to innovation in Australia is far from being realised. Expanded and better-directed support mechanisms are warranted. As noted elsewhere in this submission, restoring the incentive value to the R&D tax concession scheme, new measures to encourage public-private collaborative activities, improving the CRC Program and a range of other initiatives will make it easier for people to use tools and apply ideas in novel ways.

Scaling back the enormous growth in compliance and accountability requirements, albeit driven by justifiable objectives, poses a significant challenge. However the net effect of striving for very high levels of compliance is that the creative space for innovation is diminished. A truly innovative culture requires a shift, particularly on the media's part, in understanding that risk taking is inextricably part of an innovative society and that a failure often leads to greater understanding and to future success.

“How do we educate and equip our people to be creative and innovative, life-long?”

As previously noted, embedding innovation in curricula and pedagogy should be a priority. At the same time the environment needs to change, to better reward success and risk taking rather than to penalise failure. Rewards systems in enterprises need to

shift to penalise people for not trying to innovate, rather than for innovating unsuccessfully.

Employee share options are important in growing innovative firms. They help to retain key employees and reduce employment costs. In ATSE's view, this needs to be encouraged in Australia as it is in other countries. For example, if a UK employer offers an employee shares in the company as part of a government approved share scheme, the employee gets certain tax advantages. In the USA, share options in the early years of new technology-based companies are deemed to be valued at significantly less, often from as low as 10 per cent, of the price paid by investors for preference shares. ATSE believes that Australia should consider a similar approach. The present Australian tax treatment of share options needs to be examined by the forthcoming taxation Review with the objective of making these options more useful to helping to grow technology-based firms.

Public programs that communicate with and engage the public should be an important element of any effort to increase interest in science, technology and innovation. These programs can enhance public interest, confidence and understanding. They can also ensure that public concerns are identified and addressed. The UK engages the public in discussions on emerging issues in science, technology and innovation, through its Sciencewise Program. While Australia's annual Science Festival and Innovation Festival perform valuable roles, we need to make a greater investment in this area.

“As a relatively small country, how does Australia prioritise its innovation efforts to make the most of what it has or can do?”

Mechanisms for determining and reviewing Australia's innovation priorities should be part of Australia's ten-year national innovation strategy. Research establishments and funding agencies have made establishing priorities part of their planning processes. Procedures vary, and priorities range from the perceived excellence of the research through to solving defined problems. However, the priorities of research-performing bodies are strongly influenced by funding formulae. ATSE believes that if we want to encourage innovation by rewarding research that addresses national or business problems, the funding formulae must reflect this.

ATSE believes that, in funding research programs and establishing research priorities in the public sector, more attention needs to be given to the consequences of success – to what happens next if all objectives are met. This requires specific plans, not just vague aspirations. Discovering something and then setting out to do something about taking it to the next stage is a far more hazardous path