



SUBMISSION TO THE SENATE EDUCATION, EMPLOYMENT AND WORKPLACE RELATIONS COMMITTEE INQUIRY INTO THE EFFECTS OF CLIMATE CHANGE ON TRAINING AND EMPLOYMENT NEEDS

The Australian Academy of Technological Sciences and Engineering (ATSE)¹ welcomes this opportunity to provide input to the Senate Inquiry into the Effects of Climate Change on Training and Employment Needs (the Inquiry). There is a need for increased Australian expertise in research, innovation and the application of up-to-date knowledge in relation to climate change. We also need to improve forecasting and management of events that are brought about by climate change.

ATSE believes that this Inquiry can help to ensure that Australia will have the skills and trained professionals needed to address the consequences of climate change. ATSE welcomes the term of reference relating to promoting understanding of climate change in the Asia Pacific region and suggests that we need to start by promoting this understanding in Australia.

Summary of ATSE comments

ATSE:

- Sees a need for enhanced skills and training in regard to both the threats and opportunities posed by climate change;
- Wants addressing climate change to be seen as a component of a broader approach to sustainable development which addresses all the factors impacting on our planet's biodiversity;
- Believes that the accelerated development of new energy technologies in response to climate change will require increased skills in a range of technical areas;
- Considers that a technologically literate public is essential to understanding climate change and taking rational decisions on how this change should be addressed;
- Urges the adoption of policies to increase the numbers of students studying science, technology, engineering and mathematics in order to provide the technical skills which many solutions to climate change will require.

ATSE is an association of 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:

¹ ATSE was established in 1975 with the mission to promote the application of scientific and engineering knowledge to the future benefit of Australia. ATSE is one of four learned national Academies, which have complementary roles and work together both nationally and internationally. ATSE has about 750 elected Fellows who are the leaders of applied science and engineering across the country. ATSE is comprised of experts from a diversity of professions many of whom have been consulted on this submission.

- 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
- the application of technology for ecologically sustainable development.

ATSE believes that it is strongly placed to provide input to this Inquiry. Its membership includes Fellows with expertise in the wide range of different discipline areas that will be required as Australia and the Asia Pacific region respond to the challenges posed by climate change.

ATSE regards climate change as both a threat and an opportunity. Rising sea levels and the increased frequency of severe weather events present engineering and technical challenges. Australia requires a supply of well-trained researchers and engineers to address these issues. However climate change also provides an incentive for Australia to invest in the development of non-fossil fuel energy technologies. It offers opportunities for Australia to develop its engineering services. Australian energy technologies and related services provide export opportunities in the Asia Pacific region. Australia already has some highly successful engineering companies that are active, not only in our region, but also in other parts of the World.

ATSE believes that addressing climate change is just one element of the wider context of sustainable development which takes into account all factors that impact on our planet's biodiversity. A holistic approach is needed to understand ecosystem interactions and interdependencies. It requires a 'systems thinking' approach to be part of at least some of our higher education programs. It also requires a wider range of skills and disciplines, and capacity building across all levels of education — primary secondary, technical and higher education to consider their relevance to Climate Change. It is hard to think of a discipline where some understanding of climate change is not essential.

If in response to challenges of climate change we are to make massive adjustments to Australia's 'carbon footprint' in the years ahead then we will need additional expertise in a range of energy technologies — geothermal, solar, wind, wave and nuclear². ATSE has argued³ that an emissions trading scheme will not, by itself, provide a timely increase in non-fossil fuel sources of energy. The Garnaut Climate Change Review shares this view.⁴ There is going to be strong world-wide demand for the skills that we need to develop these technologies.

New energy technologies will each have their own impact on training and skills needs. For example, we will need mechanics who can service hybrid and electric cars,

² A discussion on the education and training needs, if Australia decided to expand its role in the nuclear fuel cycle, is given in: *Uranium Mining, Processing and Nuclear Energy - opportunities for Australia?*, Review Taskforce, Commonwealth of Australia, December 2006.

³ ATSE 2008, *Submission to the Garnaut Climate Change Review; Submission to the Garnaut Climate Change Review Issues Paper 4*.

⁴ Garnaut, R 2008, *Garnaut Climate Change Review: Draft report*.

technicians who can install photovoltaic systems, engineers who can develop energy saving equipment for domestic and business applications, and technicians who can design and operate bio-energy systems.

On the adaptation side, Australia will need architects trained in building design for new climatic conditions and energy efficiency. Our agricultural sector will need farmers who know how and what to grow in a changing climate, as well as managing uncertainties and taking climatic information and forecasting into farm planning and management. Climate change has implications for skills and training in many sectors of the economy.

The need for a technologically literate public

ATSE believes that in order to develop sensible approaches to climate change, Australia needs a public which is ‘technologically literate’ and able to understand the issues involved and take rational decisions on how these issues should be addressed. The 2020 Summit shared this view.⁵ ATSE has long held that a good understanding of science and technology developed in our school system plays a vital role in ensuring that we, as a nation, are adequately equipped to succeed in an increasingly sophisticated technological World.

ATSE believes that Australia’s capacity to successfully address climate change issues rests on the strength of our education system. In preschools and in early primary schooling, children need to be encouraged to ask ‘Why?’ As they grow older this innate curiosity must continue to be encouraged. Learning is not just a one-way flow of information and ideas. Our education system – primary, secondary and tertiary — must encourage students to question information they do not understand, and to contest ideas they do not agree with. Curricula and pedagogy must provide continuous challenges to those being taught, to imagine how things could be made/ done better. This is the mind set that we need to build if we are going to be successful in addressing challenges such as those posed by climate change.

Public programs that communicate with and engage the public should be an important element of any effort to increase public understanding of climate change. These programs can enhance public interest and confidence. They can also ensure that public concerns are identified and addressed. The UK engages the public in discussions on emerging issues that are science-related 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. Science communicators also have an important role to play in helping the public to understand climate change.

Meeting skills requirements

If Australia is to successfully address climate change issues, we must attract more students into science, technology, engineering and mathematics (STEM) studies. The supply of skilled human resources is critical to Australia’s success in generating economic and social benefits from all types of innovation. Australia is not currently training enough STEM graduates to meet future needs. Shortages of engineers and technologists will limit our ability to develop solutions to climate change problems and to benefit from related innovation opportunities.

⁵ *Australia 2020 Summit; Final report*

We need to ensure that school students are well advised on career choices and 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 using a problem-based approach, relevant to contemporary issues.

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.

Climate change requires better provision of information on what climate future we need to adapt to, including both variability and change (and their interaction). It also requires improvements in education and training so that, as a nation, we can better understand:

- How different sectors and regions can adapt to change;
- How we reduce our energy use through more efficient use of energy in all sectors including transport;
- More efficient generation (including less emissions), greater use of and integration of renewables; and
- Reducing our emissions through better-informed choices and appropriate lifestyle changes (e.g. better city design).

Nearly all the solutions and plans to counter the effects of climate change involve technical changes, including in areas such as manufacturing processes, water management, energy reduction and sources and agricultural production. While most disciplines need a capacity to address climate change, engineering will be particularly important in this regard. In the recent past there has been growth in Environmental Engineering as a discipline driven by protection and conservation issues. There has also been recent growth in the Civil Engineering discipline that has been driven by demands for civil infrastructure and in the mining sector. There is going to be increasing demand for these skills.

Not only is growth required in training budgets, but curriculum changes are also needed at both TAFE and University courses in a number of disciplines to ensure that course content encompasses sound knowledge that can be applied to the challenges of climate change and, more generally, sustainable development. More attention will also be necessary to postgraduate training, particularly with regard to producing graduates that understand climate change issues while also having a strong industry development vision.

Technological challenges

One of the ways Australia can solve major challenges such as climate change challenges is to establish processes that ensure that innovation contributes to their resolution. Thus ATSE has recommended to the Review of Australia's National Innovation System 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.

Challenges such as those posed by climate change can only be solved through interdisciplinary, total systems approaches. ATSE believes that a 'silo' mentality pervades some higher education institutions, as well as in business, government bureaucracies and service providers. These barriers need to be broken down if climate change 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.

To address these technological challenges and also the opportunities which face Australia as we grapple with deep emissions cuts, ATSE is undertaking a project: 'Accelerating Technological Response to Climate Change' — (our 'ATR project'). We believe that this work will be useful to your Review. This project is addressing two key questions:

1. Are current time scale imperatives to reduce atmospheric CO₂ compatible with investment time frames and capital expenditures required for new technologies to achieve it?
2. If so, what is specifically required in terms of R&D, demonstration-scale facilities, financial resources and political support to accelerate the deployment of new greenhouse gas abatement technologies at full commercial scale, and how soon could this occur?

The ATR project is exploring both the drivers of, and barriers to, rapid technological change and consumer uptake. These clearly go well beyond features of the technology itself and include: funding sources, the sharing of private and public risk, the role of innovation and associated research and development, required education and people resources and future carbon pricing.

As part of the ATR project, ATSE is consulting with our Fellows and other technical experts, seeking their considered responses to a series of questions. The information sought includes in the first instance qualitative data, including descriptions of the technologies, their development status and the barriers to their commercial application. The questionnaire also requests deeper quantitative information, set within a probabilistic framework, which will quantify both the likelihood of the timing and the magnitude of the capital cost requirements for the commercialisation of each technology domain considered. The ATR project will be peer reviewed and its output is also expected to establish how well Australia can respond to projected targets for CO₂ emissions and the investment required to achieve them with acceptable risk. Rather than a forecast, we expect our conclusions to be couched in terms of probabilistic ranges for both timing and costs for each technology.

The focus of our ATR project is on stationary energy sources, distribution and end use including transport which, taken together, comprise well over half of all Australian greenhouse gas emissions. We expected that the first report on this project will be available in later in 2008.