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INQUIRY INTO CURRENT AND FUTURE IMPACTS OF CLIMATE CHANGE ON HOUSING, BUILDINGS AND INFRASTRUCTURE

It is likely that at least some responses to the Inquiry will propose a range of specific actions designed to adapt to the anticipated effects of climate change. There would, however, be merit in the Committee considering a number of less common perspectives with respect to any recommendations for policy formulation.

A historical review of the literature on adaptation to climate change is available in Dobes et al (2014).

The hallmark of climate change is uncertainty

Despite frequent warnings of hotter climates and various natural disasters, there is no objective or accurate means of predicting the future timing of specific events, the extent of specific climate change effects geographically, their intensity, or their frequency. The lack of repeated 'experiments' (events) and independent observations mean that classical frequentist statistical approaches cannot be used to even predict the probabilities. And the statistical alternative of a Bayesian approach is only practical in the long run with the updating of initial guesses (prior distributions) as new information becomes available.

The lack of rigorous information or evidence about the probability of occurrence of various characteristics of expected climate change means that policy-makers are faced with uncertainty. Gruebler and Nakicenovic (2001, p. 15), two of the authors of the *Special Report on Emissions Scenarios* (Nakicenovic and Swart 2000), warned against the risk of 'a dismissal of uncertainty in favour of spuriously constructed "expert" opinion'. Oppenheimer (2005) showed that elicitation of expert advice about what constitutes 'dangerous climate change' resulted in the various scenarios being considered to be equally probable, and Arnell et al (2005) found a similar lack of consensus among experts expressing opinions about a possible collapse of the thermohaline circulation. So-called vulnerability indexes are mathematically and conceptually flawed (Cox 2009; Fuessel 2009; Pollitt 2010; Wolff et al 2011) and cannot be used to assess priorities, say, between the need for adaptation in a bushfire prone area with one threatened by inundation. In

reviewing the vulnerability of the Sydney coastal region, Preston et al (2008, p. 15) identified a number of other practical shortcomings of vulnerability assessments using composite indexes.

Orthodox policy responses would therefore be inappropriate in the face of uncertainty. Premature implementation of adaptation measures would be wasteful of resources, and undue procrastination could court unexpected damaging or disastrous outcomes. Calls to 'future proof' infrastructure, in particular may strike a popular chord, but are unlikely to be in the best long-term interests of society.

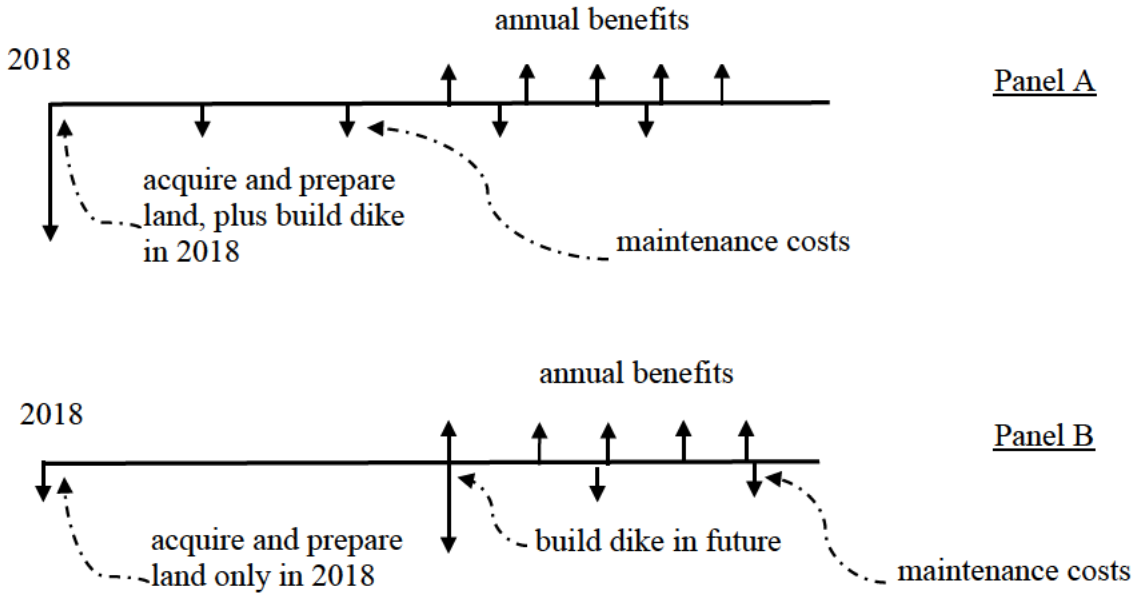
The 'real options' approach to addressing uncertainty

The problem of implementing a policy or project under conditions of uncertainty is typically addressed within a social cost-benefit analysis framework in terms of a 'real options' approach. (Real options refer to physical rather than financial assets.) Options typically involve only partial investment or implementation in the face of uncertainty.

Only as more information is gathered over time are decisions taken on full implementation. This approach provides flexibility to expand a project, or to abandon it. If conditions do not eventuate as expected, the expense of unnecessary investment is avoided, and if they do eventuate, full costs are incurred in the future rather than immediately. More detail is provided in publications such as those by Dixit & Pindyck (1994); Copeland & Antikarov (2001); Borison (2005) and Trigeorgis (1996). A non-technical exposition is available in Dobes (2008).

Figure 1 below illustrates the concept of a real option using the construction of a sea wall as an example of adapting to increasing storm surge.

Figure 1: example of a 'real option' in building a sea wall



A conventional cost-benefit analysis would estimate the net present value of building a sea wall as shown in panel A where the wall would be fully constructed to some predetermined height immediately in 2018. Maintenance costs would also be incurred for some period, with the benefits

of avoiding inundation accruing annually only at some uncertain and indeterminate time in the future.

The alternative of a real options approach is illustrated in panel B where only some of the capital cost of building a sea wall is incurred in 2018 by limiting expenditure to the acquisition of land along the foreshore. Only once more information about actual sea level rise is available, is a wall built, perhaps initially to a low height, with increasing height added as sea levels are seen to rise. The net present value of the panel B approach is higher than that in panel A because costs have been shifted further into the future where benefits are likely to be reaped.

Policies designed to "climate proof" infrastructure immediately, before more information is available about the actual effects of climate change, are likely to resemble the panel A approach in Figure 1 above. Linquiti & Vonortas (2012) model five sea wall scenarios for Dhaka and Dar es Salaam, showing this. Dobes (2012) demonstrates how Sir Sidney Kidman was able to successfully build his cattle empire by concentrating his holdings in the Dead Heart of Australia, an area of significant climatic uncertainty, by using a real options approach.

A real options approach in the housing sector, for example, might involve building houses with shorter lives rather than constructing them today to higher "climate proof" specifications. Once more knowledge is obtained about the actual effects and timing of new climatic conditions, houses can be more cheaply demolished and rebuilt to better match actual conditions. Alternatively, houses could be designed to permit more flexibility for future retrofitting of desirable features like awnings or roof-top vegetation to reduce the radiative effects of the sun.

Undue focus on techno-scientific concerns

For many years, the climate change discourse was dominated by an emphasis on reducing emissions of greenhouse gases. The debate was heavily influenced by scientists and government policy-makers, particularly through the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change.

Although earlier discussion of climate change in the 1980s had included consideration of the need for adaptation, the focus from the mid-1990s was on emissions reduction. This is readily apparent, for example, from the Assessment Reports of the IPCC. Indeed, commentators like Tol (2005, p. 572) have claimed that 'it was politically incorrect to speak about adaptation to climate change, because it presumably implies accepting defeat in the battle against evil emissions'.

In Australia, the Council of Australian Governments (COAG) endorsed a National Greenhouse Response Strategy (Commonwealth of Australia, 1992) that focused on greenhouse gas abatement measures, but with some reference to adaptation. However, it was not until 2006 that COAG agreed to a Climate Change Plan of Action that included a call for development of a national adaptation framework. A National Climate Change Adaptation Framework was endorsed by COAG in April 2007.

Possibly due to the preponderance of technical scientific input into the climate change policy debate, the approach to adaptation also appears to have been shaped unduly by a 'top-down' government bureaucratic and scientific perspective. Table 1 below (Dobes 2009) illustrates the 'top down' sectoral approach, adopted by the IPCC, COAG and Australia's National Climate Change Adaptation Research Facility (NCCARF).

Table 1 below illustrates the framing of adaptation policy by policy-makers in terms of the more obvious expected biophysical effects of climate change. Areas such as 'primary industries', 'water resources' and 'food, national Defence, fibre and forest products' feature prominently.

Totally absent are categories such as tertiary industries, golf courses, urban forests and backyard vegetable gardens. Because these sectoral approaches are limited to apparently "productive" areas of the economy, they suffer from the same limitation as the use of Gross Domestic Product to measure economic well-being.

Table 1 Sectoral coverage of adaptation to climate change

IPCC (1)	COAG (2)	NCCARF (3)
health	human health	human health
coastal systems and low-lying areas	coastal regions	marine biodiversity and resources
	natural disaster management	emergency management
freshwater resources and their management	water resources	water resources and biodiversity
ecosystems	biodiversity	terrestrial biodiversity
food, fibre and forest products	agriculture, fisheries and forestry	primary industries
industry, settlements and society	settlements, infrastructure and planning	settlements and infrastructure
	building adaptive capacity (research, communication, international collaboration)	social, economic and institutional dimensions of climate change
	tourism	

Sources:
(1) M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (2007), Summary for Policymakers, p. 11
(2) Council of Australian Governments (2007)
(3) http://www.nccarf.edu.au/national-adaptation-research-plans, viewed 6 May 2009

A hypothetical example of the likely outcome of such a skewed perspective, might be a town near a river that occasionally floods, cutting rail and road links to other towns. Local Government officials and transport experts are likely to focus immediately on the need to construct 'flood-proof' roads as the top priority. However, local citizens may be more concerned about damage to the riverside golf course. Given the widespread use of internet facilities, a local resident may well be happy to remain cut off from their place of employment in a nearby town for a few days, as long as they can continue to play golf each morning.

In formulating adaptation policies, the well-being of the community cannot be measured by the 'top down' preferences of planners and bureaucrats. There is a need to first establish the preferences of society as a whole, as would be done in a rigorous cost-benefit analysis approach. Various tools, such as choice modelling, could be used for this purpose, but a more inclusive economic approach appears to have been ignored to date. The lack of information about individuals' preferences is currently a barrier to the formulation of sensible adaptation policies.

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