# National Centre for Epidemiology & Population Health submission:

## Productivity Commission Draft Report

## *Barriers to Effective Climate Change Adaptation*

8 June 2012

## Public inquiry

The Productivity Commission invited interested parties to forward submissions to an inquiry into regulatory and policy barriers to effective climate change adaptation.

In undertaking the inquiry, the Commission seeks to identify any specific barriers that inhibit effective adaptation to unavoidable climate change, and high priority options for addressing those barriers.

Our submission relates to the Commission's brief to:

- examine the costs and benefits of the options to address those barriers where it is feasible to do so, including a 'no change' (maintaining the status quo) option

## Key Points:

- Climate change in Australia poses a range of significant health threats.
- Australian summers are hot, and are expected to become hotter, with more hot days and an increasing number of extreme heat events.
- Not all work places can be cooled to provide a comfortable working environment.
- Some of these include emergency and essential services.
- There are physiological limits to the human capacity to work under hot conditions.
- These physiological limits reduce productivity in hot conditions.
- We forecast a growing tension between industry needs to maintain productivity versus occupational health and safety requirements to protect worker health.
- This tension creates a potential barrier to the development of adaptation strategies
- There are no Australian (or International) Guidelines for working in the heat.
- Warm countries, such as Australia, need to identify adaptation strategies that can protect worker health, with minimal interruption to industry and provision of essential services.
- We have secured an NHMRC Project grant to begin to explore a) working thermal environments across southern Australia, b) workers' symptoms, and self-estimates of productivity impacts when working in the heat. This project is limited.

- There remains much more work required in this sphere to protect Australia's interests.

# National Centre for Epidemiology and Population Health, The Australian National University

The establishment of the National Centre for Epidemiology and Population Health (NCEPH) at ANU resulted from a 1986 review of Australian public health teaching and research undertaken for the Australian government by Dr Kerr L White from the Rockefeller Foundation. That review also led to the founding of the Australian Institute of Health (now the Australian Institute of Health and Welfare) and the Commonwealth Department of Health's Public Health Education and Research Program (PHERP), which provided significant funding for NCEPH until 2010. Kerr White's vision for NCEPH is encapsulated in the following statement:

> "Although most of the Centre's studies will be investigator-initiated and curiosity-based, they should take place in the context of a portfolio of clearly defined problem oriented goals and targets and objectives, that are responsive to perceived needs in Australia, the surrounding region and internationally"

NCEPH has devoted itself to improving the population's health through discovery, training and the translation of research into effective health policy. From the beginning, NCEPH's research has been characterised by a multidisciplinary approach, building on the original five disciplines of epidemiology, statistics, sociology, health economics and demography.

Under the Directorship of Professor Tony McMichael (2001-2007), and through his Australia Fellowship, NCEPH has nurtured the world's leading research group examining the human health impacts of climate change. The quality of the group's research helped The Australian National University to receive a rating of 5 in the Excellence in Research for Australia (**ERA**) assessment in Public Health and Health Services, the only Australian university awarded this top rating.

## Climate change, workplace heat exposures, health risks and reduced productivity

It is well established by CSIRO that climate change in Australia will involve more and more days with very high temperatures and related heat stress in most of the heavily populated parts of the country.

The direct health impacts of high heat exposure are generally analysed principally in terms of mortality or hospital admissions (Kovats and Hajat, 2008). Elderly people are at the highest risk for these effects. The risk of heat stroke amongst working people is well known and explained by the limits of human physiological adaptability (Parsons, 2003). Significant numbers of working people die due to heat stroke even in high income countries, as described in a study of agricultural workers in the USA (MMWR, 2008).

As little as 20% of muscle energy contributes to external "work" (Parsons, 2003), and the rest becomes "waste heat" inside the body that needs to be released to the external environment. At high air temperatures (above 34-37 $^{o}$C), the only method of heat loss to counteract bodily heat gain caused by work, is the evaporation of sweat. When there is high humidity, sweat evaporation is insufficient and other physiological changes cannot prevent the core body temperature from rising to dangerous levels. Heavy labour in hot humid environments is therefore a particular health risk.

Apart from clinical health effects, work capacity is affected by excessive heat exposure and hourly work output is reduced (Bridger, 2003; Kjellstrom, et al., 2009a). These impacts on working people are generally ignored in international reviews of climate change, which is partly a symptom of the low priority given to occupational health and the focus on "diseases" in such health impact reviews. However, the Productivity Commission needs to consider this issue as one important aspect of the Barriers to Effective Climate Change Adaptation in Australian enterprises.

## Workplace heat and economic productivity, some Australian evidence

Outdoor work in agriculture, mining, construction or council services involves many jobs where heat protection cannot be applied. The performance of necessary work during the cooler night hours is an option in some situations, but many work tasks are continuous, or depend on daylight and with climate change even the coolest night hours may create heat stress for certain jobs in some parts of the Australia. Traditional practices to reduce heat exposure (e.g. siesta) may be labelled "behavioural acclimatisation" as the preventive effects complement the benefits of "physiological acclimatisation". The problem is that the hotter it gets, the longer the siesta is needed.

A recent paper from Perth, Australia (Maloney and Forbes, 2011) shows the likely effect of heat exposure and physical activity intensity (including work) on work capacity in Perth in the current climate conditions and how it may change in the future based on projections of Australia's climate until 2070. A physiological model was used to estimate how many days would involve heat exposure during the hottest 3-hour period that would cause a core body temperature increase of 2.5 $^{o}$C in less than 2 hours.

Using this approach it was calculated (Maloney and Forbes, 2011) that an average person acclimatized to heat could safely carry out physical activity or manual labour outdoors in the daytime during all but one day per year in the 1990s. However, climate change would increase the number of days with dangerous daytime heat exposure to 15-26 in the 2070s. It should be pointed out that Perth is not a "super-hot" place as high temperatures often occur with concurrent low humidity. Estimates of this type for other parts of Australia are not yet available.

Our research team at ANU have recently received NHMRC funds for a 3-year project to carry out field studies that will measure the thermal working environments, heat strain and impacts on work capacity during hot days and cooler days in 8 different places in Eastern Australia. The basic approach was published some time ago (Kjellstrom et al., 2009b) as a part of the Hothaps program (High Occupational Temperature Health and Productivity Suppression), and a recent review (Hanna et al., 2010) has highlighted the potential problems in Australia. This study has limitations, and should be expanded to include humid environments, detailed measures of productivity decline, and a deeper analysis of adaptation options that will maximise productivity without compromising human health.

There is expertise in the field of heat impacts on working people at ANU, and a few other universities in Australia, but our team is the only one that has studied the issues in relation to climate change in detail with a perspective that focuses on Australia but also analyses the threats to productivity in tropical countries.

## Considerations concerning the Barriers to Effective Adaptation

The routine solution to protecting people working in extreme heat from heat stroke and other health impacts has been to provide advice to take more rest periods and drink sufficient amounts of water. For indoor work, or work that involves vehicles or machines with cabs, the general approach is to provide air conditioning. When the temperature is higher than the normal skin temperature (33 degrees C) fans provide very limited cooling performance.

It is clear that advice to take more rest cannot always be heeded, and when it is done the hourly work productivity goes down. For a particular enterprise during the hot season the productivity loss can become very significant. The loss of hourly work capacity when the temperature gets up into the high 30-degree range could be as much as 10-20% for each degree increase in heat (Kjellstrom et al., 2009a). SafeWork Australia and the International Labour Organisation have yet to develop guidelines on working in the heat, as there is insufficient evidence upon which to base such guidelines. It is also likely that local acclimatisation would influence trigger points. Work situations involving exposure to extreme heat are therefore often managed on an ad hoc basis by management and the working individuals, but there are also union-employer agreements, for instance in the construction industry, that work stops at certain temperatures and the workers go home with full pay.

Increasingly hot summers will amplify already existing health threats, and establish a conflict between occupational health and safety and economic viability. There are physiological limits to acclimatisation. Similarly, economic pressures are likely to apply tolerance limits to employers' willingness to sanction an increasing proportion of rest periods compared to productive time. This problem will emerge across Australia. Preliminary studies conducted by our group revealed that employees are self-selecting, and the prevailing attitude is that "*Australian Summers are hot –get used to it."* Physiologically, this may not be possible during extended heat waves. Upward trends in obesity and an ageing workforce will only exacerbate the problem. Our pilot studies have also revealed the problem is not constrained to employees; self-employed also work beyond their safe limits due economic and professional pressures.

Emergency and essential services will also need protection from heat exposure. The ramifications of their incapacity to continue functioning during extreme events would create a ripple effect throughout the community.

As mentioned earlier, air conditioning cannot always be applied, and if it is, the associated use of electricity (which adds to the greenhouse gas emissions) can become a major barrier. Some estimates indicate that to keep a large building (a factory, shopping mall, school, hospital, etc.) at a constant comfortable indoor temperature requires 10% more electricity for each 1-degree increase of external temperature. Thus, the cost of air conditioning can mount substantially in a situation when climate change creates higher and higher external temperatures.

Unless practical solutions can be found, Australia risks productivity decline, or the health of the workforce, or a combination of both. This is national issue is not limited to specific industries. The

lack of knowledge is currently serving as a barrier to the development climate adaptive strategies, and will continue to do so, and may prove to be costly.

## Proposal for an analysis of ways towards effective and cost-effective adaptation

There is a need to utilize the expertise and experience available in Australia to analyze the issue of adaptation to increased workplace heat exposures as an element of proactive climate change intervention planning. Our ANU team is willing to spearhead such an analysis.

The analysis would include:

1. Mapping likely heat exposures in the outdoor environment (and indoors when no air conditioning is applied) at different future time slots, based on approved CSIRO climate modelling. (Extending the current NHMRC study to include Western Australia, Tasmania, and the humid regions of Queensland and the top end)
2. Using the exposure-response relationships for the heat effects on work productivity established by our ANU team to calculate the likely productivity losses in different parts of Australia as an outcome of climate change if adaptation is not applied.
3. Developing a comprehensive set of heat prevention methods in collaboration with all experts in Australia (and some from overseas), and consulting with different industry sectors to identify adaptation methods they are willing to test.
4. Collaborating with enterprises in testing different adaptation methods across a range of working environments.
5. Preparing Occupational Health and Safety guidelines on effective heat adaptation methods based on such tests and the expert assessment.

**END**

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