Climate change adaptation: Briefing note 4

Engineers

Who might this be relevant for:

Non-specialist engineers, infrastructure managers, asset managers

Climate change will impact on physical structures, demand new designs and materials, and impact on the way we live in our cities and towns. Adaptation options that reduce risks or protect residents from emerging risks may be engineered solutions as well as 'soft options' including planning changes, education and communication programs, and green infrastructure. Engineers have long been at the forefront of climate change adaptation practice, particularly in the coastal zone conceptualising solutions, designing and building coastal infrastructure.

Table 1: Summary of climate projections and impacts. Developed using information from CSIRO and Bureau of Meteorology, Climate Change in Australia website (http://www.climatechangeinaustralia.gov.au/) [Accessed 13 May 2016].

Type of change	Timeframe/ certainty	Projections	Impacts relevant to your sector
Temperature change	Immediate changes High confidence	Average temperatures to increase by between 2.6 and 4.8°C by 2100	Increased demand for cooling technologies and cooler building designs. Bitumen oxidation and hardening in roads.
Extremely hot days	Immediate changes High confidence	More than twice the number in some cities	Risk of failure of or damage to infrastructure (e.g. electricity supply, metal failure), demand for more heat-resistant infrastructure design or materials. In the 2009 Melbourne heatwave, 1300 train services were cancelled in one week due to buckling rail lines, air conditioner failures and power outages.
Fire weather	Immediate changes High confidence	Increased frequency and severity of extreme fire danger. Greatest risk in south-eastern Australia	Risk of failure of or damage to infrastructure (e.g. power transmission, buildings)
Sea level rise	Mid century High confidence	Projected to rise by as much as 0.52 to 0.98m by 2100 bringing increased risk of coastal flooding during storms	Increased risk of erosion and beach-loss, increased demand for engineered solutions to protect properties, risks to stormwater systems from inundation
Rainfall extremes	Mid century Medium confidence	Extreme rainfall events or higher rainfall intensities likely to become more common in throughout Australia, and droughts are expected to be more intense and more frequent in southern Australia	Impacts on the capacity and maintenance of storm water drainage and sewerage infrastructure, drinking water quality and water demand for irrigation and domestic needs.
Storms and cyclones	Mid century Medium confidence	Fewer extreme storms but increased intensity	Greater wind stress and erosion impacts on buildings and structures

NCCARF
National Climate Change Adaptation Research Facility

Adaptation:
Action to limit the negative impacts of climate change and take advantage of any opportunities

Putting the climate change lens on your role

As climate change impacts become more apparent, there will be considerable demand on engineers to provide cost effective solutions that reduce climate risks. It will also provide opportunities for engineers to develop new designs, innovative long-term solutions and co-benefits. Some of the climate change challenges engineers may face in their roles include:

- **Sea level rise will be felt first during storms and an increased risk of coastal erosion and short-term inundation** Coastal housing, infrastructure and habitat are all threatened by sea-level rise. Coastal infrastructure at risk ranges from recreational facilities, roads and housing to major infrastructure including runways and ports.
- **Vulnerability of major infrastructure** This includes roads, bridges, ports, stormwater systems, and communication and power systems. Threats may come from a variety of climate impacts: extreme heat, bushfire, floods and windstorms/cyclones.
- **Building standards and materials may no longer be fit for purpose** Building codes have successfully reduced climate risks in the past (e.g. cyclone ratings). Emerging risks may not be met by design codes. For example, while current design standards address energy efficiency, they may not necessarily improve the cooling capacity of a building, particularly if electricity to power air conditioning is not available as might happen on extreme heat days.
- **Interdependencies between infrastructure sectors leads to a high potential for cascade failure** All sectors are dependent to varying extents on energy – disruptions to energy supply can have cascading impacts on water, telecommunications, transport and community infrastructure.

How adaptation might help shape your response to these challenges

Adapting to climate change means making plans and where appropriate taking action now to reduce the negative impacts of climate change now and in the future while also taking advantage of any opportunities. Existing approaches and frameworks to designing and developing solutions will remain important tools for engineers. Climate change will mean new or increased risks and the challenge will be to balance risk and cost. The key is to be aware of the potential risks and factor them into design and decisions with enough robustness that any of the likely climate scenarios can be accommodated as they develop. Specific adaptation actions you might be thinking about include:

- **Understand the timeframe and vulnerability of projects** In undertaking your risk assessment it is important to understand the timeframe of any climate risk (e.g. sea level will affect projects with a design life into the middle of century, but short term projects may not be at risk).
- **Consider and manage uncertainty** Climate change includes a measure of uncertainty and risk that demands adaptation actions incorporate a considerable safety factor and be robust enough to accommodate scenarios that start to emerge. This might include actions such as building moveable structures, designing sea defences to allow later increased crest height and aligning lineal elements such as roads perpendicular to the coast so that losses are minimised.
- **There may be a business case for the assessment and retrofit of existing structures** Existing developments may deal poorly with climate risks (e.g. extreme heat, severe windstorms). Adaptation options may include retrofit, but the business case for investment should be supported by an assessment of the value of the changes, including the level of risk (e.g. infrequent events).
- **Consider plans for building back better** Infrastructure damaged in extreme events are often rebuilt to the same design standards. It may, however be an opportunity to rebuild to new design standards better suited to new climate risks if plans and financing contingencies are in place. Putting regulations and guidelines for building back better in place needs to happen before climate disasters.
- **Consideration of the long-term climate change impacts in design of coastal and offshore structures** This includes recognition of the differences in performance during normal and extreme climate weather.
- **Consider sustainability principles in designing solutions, particularly for coastal adaptation solutions:** This includes considering the geological, geographical and ecological features of any site in planning development or construction. For example a number of co-benefits and cost effective solutions can be obtained through the use of green infrastructure (e.g. cooling in urban settings, slowing of wave energy through foreshore vegetation).
- **Incorporation of green infrastructure in design** A number of co-benefits and cost effective solutions can be obtained through the use of green infrastructure (e.g. cooling in urban settings, slowing of wave energy through foreshore vegetation).
- **Consider innovative and novel solutions but beware of untested solutions** Progress in engineering comes from creating novel solutions. Before being adopted on a wide scale or in a sensitive development, such solutions need to be thoroughly tested.

This sector brief was developed drawing on the broad body of new adaptation research commissioned by NCCARF. The following reports and factsheets were relied on to develop this sector brief:

- Quantifying the cost of climate change impacts on local government assets
- Climate adaptation decision support tool for local governments: CATLoG
- A framework for adaptation of Australian households to heat wave
- Impact of the 2010–11 floods and the factors that inhibit and enable household adaptation strategies.
- Planning, building and insuring: Adaptation of built environment to climate change induced increased intensity of natural hazards.

All are available for download at: www.nccarf.edu.au/adaptation-library. We also drew on technical information in Engineering solutions for coastal infrastructure. CoastAdapt Information Manual 7 available at CoastAdapt.com.au
For more synthesis reports visit: www.nccarf.edu.au/synthesis