January 18, 2013

Via email: ec.sen@aph.gov.au

Committee Secretary
Senate Standing Committee on Environment and Communication
PO Box 6100
Parliament House
Canberra ACT 2600
Australia

Re: *Submission to the Senate Standing Committee on Environment and Communication - Inquiry into 'Recent trends in and preparedness for extreme weather events'*

Thank you for the opportunity to make this submission to the Senate Standing Committee on Environment and Communication.

Governments of all levels, international agencies, financial institutions, the insurance sector, civil society organisations and businesses around the world are increasingly reflecting on their preparedness for extreme weather. The spectre of devastating events such as Hurricane Sandy (2012)[1] and Katrina (2005), the 2011 Thailand floods,[2] Cyclone Nargis (Burma, 2008), the Victorian Bush Fires (2009),[3] Cyclone Nasi (Queensland, 2010/11) and the 2003 European heat waves have captured significant political and public attention.

These events have inflicted a substantial human toll, led to economic loss and left a trail of environmental damage. Under conditions of more regular and intensified extreme weather, we may see a more diverse range of impacts including the undermining of human security, erosion of political stability, foreign direct investment reduction or withdrawal and credit ratings deterioration.

Australian Governments, both State and Federal, have been proactive and diligent in initiating various parliamentary reviews, inquiries and assessments of specific extreme weather events and natural disasters. What has been lacking is a detailed, macro-level

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[1] See http://www.cnbc.com/id/49622885/Sandy039s_Economic_Cost_Up_to_50_Billion_and_Counting

2 AON Benfield (March 2012) ' 2011 Thailand Floods Event Recap Report' accessed at http://thoughtleadership.aonbenfield.com/Documents/20120314_impact_forecasting_thailand_flood_event_recap.pdf

[3] 2009 Victorian Bushfires Royal Commission. See http://www.royalcommission.vic.gov.au/Commission-Reports

examination of institutional preparedness for the impact of extreme weather and a public evaluation of sector-by-sector climate vulnerability.

For this reasons, it is timely and prudent for the Australian Government to undertake a high level review of its preparedness and vulnerability to extreme weather.

Summary of Recommendations

a. Australian Government should consider a framework for providing technical assistance and leveraged funds to local and state governments to enable dynamically downscaled, climate modelling of major Australian cities.

b. Develop an Inter-Departmental Working Group to investigate public interest, confidentiality and privacy issues associated with disclosure and dissemination of extreme weather and climate risk related information.

c. Support the Department of Industry, Innovation, Science and Research to engage with Small and Medium Enterprises (SME) in critical infrastructure sectors - particularly food production/distribution and manufacturing - on business continuity planning. Specifically, focus on information packages to help SMEs cost effectively implement business continuity plans that address extreme weather scenarios.

d. Attorney General's Department should evaluate the need for the Trusted Information Sharing Network (TISN) for Critical Infrastructure Resilience to undertake more targeted, advanced modelling of food, water and energy interdependency.

e. TISN for Critical Infrastructure Resilience and Department of Sustainability, Environment, Water, Population and Communities should develop a thresholds study similar to the London Climate Change Partnership / Environmental Agency 'Heat Thresholds Project' Report 2012.

f. Australian Government and the Council of Australian Governments to consider whether current regulatory reform proposals for the National Electricity Market sufficiently enable the Australian Energy Regulator and associated market regulators to have regard to the costs of building extreme weather resilience.

g. Australian Government should implement a National Climate Risk and Adaptation Reporting regime for critical infrastructure businesses and key export sector companies.

Introductory Comments

Institutional and organizational preparedness for increased intensity, duration and frequency of extreme weather raises a number of thematic issues. Consideration of extreme weather preparedness is a catalyst for evaluating current approaches to open information sharing, risk management, institutional and corporate governance, risk allocation and environmental security. Current literature and dialogues on disaster response, extreme weather resilience and climate change adaptation are grappling with a number of key challenges and themes.

1) Climate Modelling Innovation and Climate Risk Assessment

Since the First Assessment Report (FAR) of Intergovernmental Panel on Climate Change (IPCC) in 1990, significant advances have been made in climate modelling[4] methodology and enabling technology. Data from ensemble Global Climate Models (GCM) and Regional Climate Models (RCM) are now been fed into weather forecasting models to achieve higher resolution climate projections.[5] Importantly, improvements in modelling resolution and scale are critical to improving knowledge of potential climate change impacts and signatures on extreme weather events.[6] GCMs initially started out at $500km^2$ resolutions. Now we have key weather and climate research institutions 'downscaling' models and improving resolutions to anywhere between $10km^2$ to $1km^2$.

The implications are twofold. Downscaled modelling studies theoretically provide clearer projections on climate impacts at scales/resolution relevant to infrastructure owners, service providers and natural resource managers.[7] Secondly, downscaling can allow for the more effective capture of local geophysical features that GCMs and RCMs do not sufficient represent in climate projections. With organisations and businesses demanding greater confidence and precision in climate projections - before moving ahead with time and resource intensive climate risk assessments - downscaling of climate projections and a renewed focus on exploring climate 'extremes' as opposed to just 'averages' is critical.

Recommendation a.

Australian Government should consider a framework for providing technical assistance and leveraged funds to local and state governments to enable dynamically downscaled, climate modelling of major Australian cities.

[4] From Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T. Peterson and M. Prather, 2007: Historical Overview of Climate Change. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Chapter 1.2

[5] For example, see Future Weather & Climate Driver Study at http://www.toronto.ca/teo/pdf/tfwcds-full-report.pdf and http://www.toronto.ca/teo/pdf/tfwcds-summary.pdf

[6] From Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, US at Chapter 1.5. Accessed at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch1s1-5.html

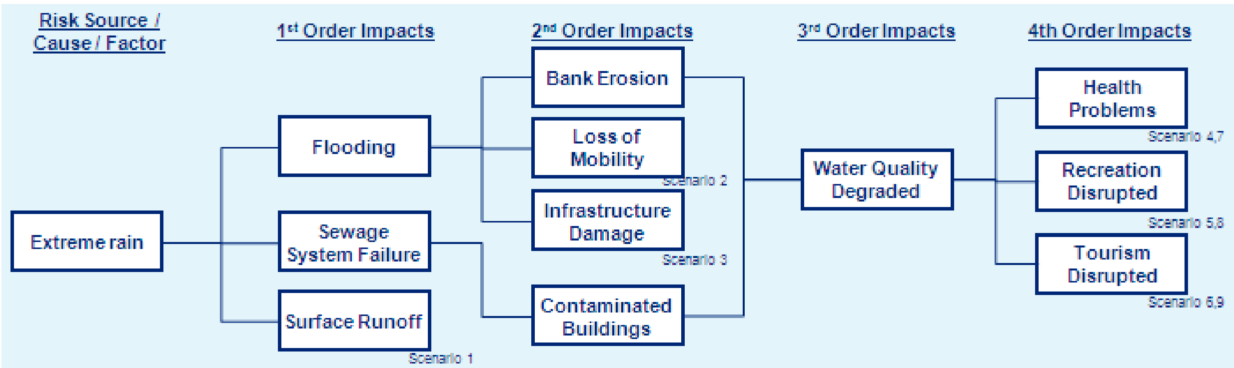
[7] Consider that 2012 was the wettest ever in England, the 3rd wettest for Wales, the 17th wettest for Scotland and the 40th wettest for Northern Ireland. See http://www.guardian.co.uk/environment/2013/jan/03/2012-uk-second-wettest-year

The distinction between examining climate parameter extremes as opposed to climate 'means' is important to acknowledge. Gradual changes in climate conditions over longer time periods pose unique risks and opportunities to infrastructure, institutions and the natural environment. For example, a rising average summer temperature over a 20 year period may gradually reduce the operational lifetime of infrastructure or increase maintenance needs. In contrast, weather extremes, with a climate change signature, pose more immediate risks and challenges to infrastructure performance and thresholds.

It is not clear whether a distinction between impacts from gradual climate change and extreme weather events is helpful in shaping governance, institutional and operational responses. However, there does appear to be a growing divide and differentiation in institutional practice and climate literature, notwithstanding signs the disciples of extreme weather resilience and climate change adaptation are merging.

2) Interdependency and Risk Management

Without detracting from an 'all hazards' approach to risk assessment, all threats are not equal. Some threats pose a greater relative challenge to network integration, interoperability, operational harmonization and system interdependency which have become the cornerstone of modern day urban environments and critical infrastructure systems. Continued functionality of the world's current largest cities is not possible without the assemblage of interlinked critical infrastructure components that streamline everyday human activities and existence. However, with the efficiency of centralised, interlinked infrastructures and networks we have system interdependency, complex chains of reliance and the dark side of connectivity.



Source: City of Toronto Climate Change Risk Assessment Training Materials, as assisted by Deloitte

Patterns of exposure and vulnerability give extreme weather and climate change a unique threat profile when compare to biological attack, insurgency, terrorism, civil war, cyber attack, political risk, regulatory change and epidemic disease. The scale and nature of extreme weather events can mean system interdependency is critically affected. Concurrent, cascading and non-linear infrastructure failure, as witnessed in the Fukushima Daiichi disaster,[8] is often a common feature of extreme weather and natural disaster impacts, exposing the vulnerabilities inherent in interdependency and limited redundancy.

[8] *"...some complex organizations such as chemical plants, nuclear power plants, nuclear weapons systems...have so many nonlinear system properties that eventually the unanticipated interaction of multiple failures may create an accident that no designer could have anticipated and no operator can understand. Everything is subject to failure-designs, procedures, supplies and equipment, operators, and the environment. The government and businesses know this and design safety devices with multiple redundancies and all kinds of bells and whistles. But nonlinear, unexpected interactions of even small failures can*

System interdependency and a tightening of the food/energy/water nexus will drive an inevitable need for innovation in risk assessment methodology. Rather than a wholesale reinvention of risk assessment approaches, innovation in risk assessment methodologies to more accurately account for interdependency is needed. Efforts are already afoot by many organisations to better evaluate and understand system interdependency in order to design more effective resiliency and protection plans. Critical Infrastructure Resilience networks in a number of countries are already modelling contingency and vulnerability scenarios based on extreme weather events.

While this is a promising development, the concepts embedded in critical infrastructure network groups require much wider dissemination to facilitate deeper governance and planning reform. Extreme weather resilience and protection concepts require a much higher level of mainstreaming among urban planners, energy regulators, building and asset managers and social services.

3) Risk Allocation

Over the short to medium term - before wide-scale adaptation and resiliency is implemented - high levels of vulnerability and exposure to extreme weather will most likely result in increased economic, environmental and social costs.[9] Data on insurance costs for the last decade show a trend of rising claims and claim costs. Over the intermediate period, the response from the insurance and reinsurance industry will in most instances be premium increases, withdrawal of products and policy refinement.

Organisational, business and government response is likely to focus on alternative approaches to risk allocation. Companies and planners may not be implementing adaptation responses within the built environment, but there is anecdotal evidence of organisations taking institutional measures to reduce risk exposure.

Reducing risk exposure without tangible alteration to operations or physical assets involves perceiving the frontline of climate and extreme weather adaptation as asset management, contract law and due diligence. Strategic scheduling of asset disposal or sale ahead of significant anticipated extreme weather and climate impacts, reassignment of climate risks to a broader spectrum of suppliers and contractors and increasing uptake of insurance are just some of the trends in institutional and market responses to climate risk.

The potential result could be termed 'contractual based climate and extreme weather adaptation' leading to complexity and opaqueness in risk assignment by governments and companies with implications for risk pricing and civil liability.

4) Information Sharing

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defeat these safety systems. If the system is also tightly coupled, no intervention can prevent a cascade of failures that brings it down." See Charles Perrow (2011) "Fukushima and the Inevitability of Accidents", *Bulletin of the Atomic Scientists 67(6) 44-52.*

[9] See Global Risks 2013 - Eighth Edition | World Economic Forum at http://www3.weforum.org/docs/WEF_GlobalRisks_Report_2013.pdf

One of the fundamental challenges with extreme weather preparedness is information sharing and dissemination. Communication of risks and vulnerabilities to multiple stakeholders is essential for interdependency analysis. Information sharing and communication is also critical to accurately price extreme weather risks and establish market signals that place monetary value on resilience and adaptation.

However, challenges arise from the potential of resilience actions and strategies to become a critical component of competitive market advantage[10] or financial risk. If climate adaptation and extreme weather adaptation is incentivised by competitive advantage objectives, the question becomes one of where is the line for between accurately pricing risk and public interests in resilience in light of intellectual property rights, information sharing and corporate disclosure?

Modern corporate regulatory regimes often make provision for disclosure of material climate risks.[11] Shareholders are awakening to the importance of climate risks to public companies. Of course there is a line where particular disclosure of climate risk may prejudice valid commercial advantage.

A similar dynamic exists in the residential and commercial real estate markets. Some stakeholders are reluctant for open dissemination of extreme weather and climate vulnerability relating to residential assets. Residential homeowner groups have rejected efforts for residential title notification and recording of climate vulnerability in a number of Australian and international jurisdictions. Yet, without such information, accurately pricing risk becomes challenging, if not impossible task.

The balancing of confidentiality and public interest in information and communications pertaining to extreme weather vulnerability, while not novel, does pose some unique questions and needs targeted consideration.

Recommendation b.

Develop an Inter-Departmental Working Group to investigate public interest, confidentiality and privacy issues associated with disclosure and dissemination of extreme weather and climate risk related information.

Note on Definitions

It is appropriate to be aware of key term definitions repeatedly used in the current discourse on extreme weather vulnerability and climate change adaptation. The Intergovernmental Panel on Climate Change in the 2012 Report *'Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation'*[12] provides important definitions of terms

[10] See National Roundtable on Environment and the Economy (2012) *'Facing the Elements: Building Resilience in a Changing Climate'* accessed at http://nrtee-trnee.ca/case-studies

[11] For example see Carbon Disclosure Project (March 2012) 'Insights into Climate Change Adaptation by UK Companies' accessed at http://www.unepfi.org/fileadmin/documents/global_framework.pdf and Carbon Disclosure Project (2011) ' Climate Resilient Stock Exchanges – Beyond the Disclosure Tipping Point' accessed at https://www.cdproject.net/CDPResults/CDP-2011-climate-resilient-stock-exchanges-white-paper.pdf

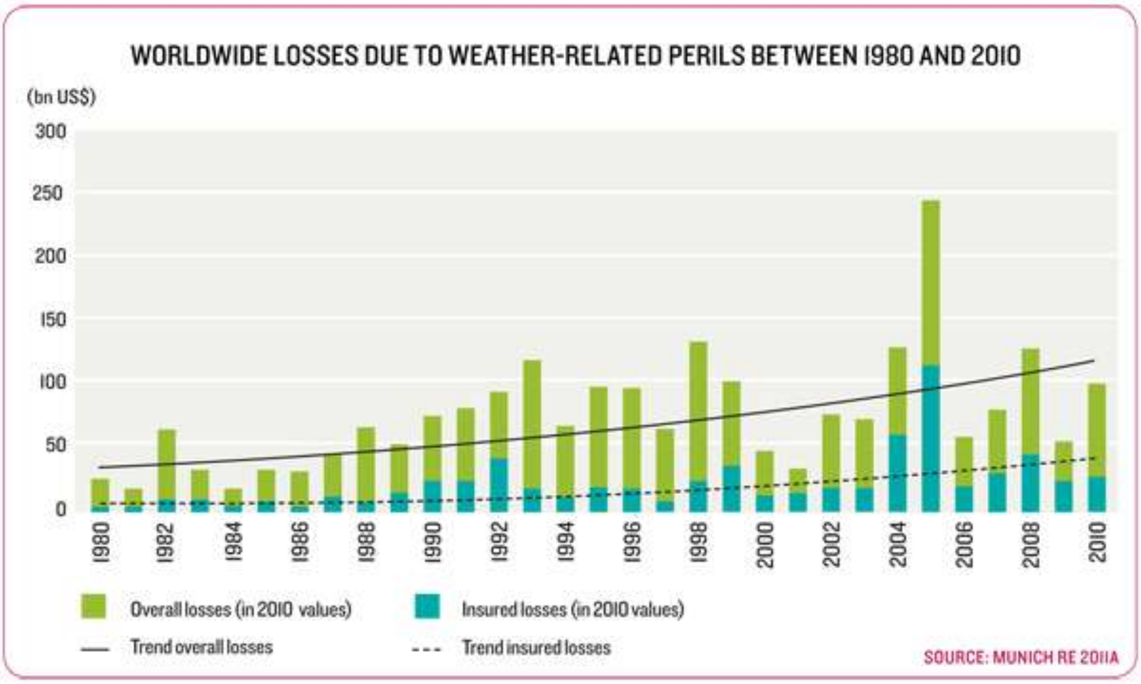
[12] See http://www.ipcc-wg2.gov/SREX/images/uploads/SREX-All_FINAL.pdf at page 5.

such as climate change, extreme weather, vulnerability, exposure, resilience and adaptation. While not a comprehensive list it highlights some key points of difference between terms in a way sufficient to guide the Committee's work for this inquiry.

Submission Response to Select Terms of Reference

The costs of extreme weather events and impacts on natural ecosystems, social and economic infrastructure and human health

Many stakeholders and governments cite rising insurance costs as an important measurement and indicator of extreme weather impacts. The global phenomenon of rising insurance costs associated with extreme weather and natural disasters[13] has been well documented. Recent IMF reports indicate that damages from natural disasters have risen from an estimated $20 billion on average per annum through the 1990s to about $100 billion per annum during the 2000–10 period.[14]



Source: National Roundtable on Environment and the Economy[15]

A number of countries, both in the northern and southern hemisphere, have also collated national data on insurance cost trends and show similar national trends.

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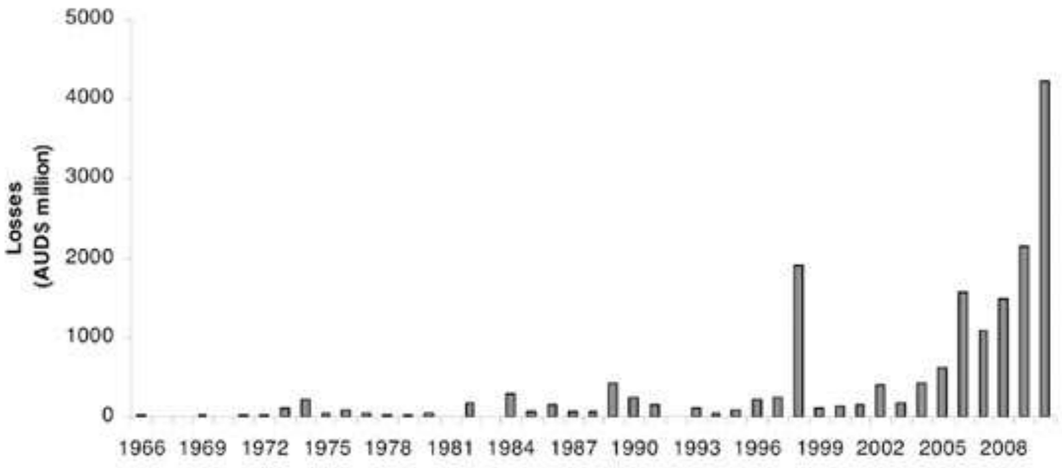
[13] This paper adopts the definition of natural disasters used by the Collaborating Centre for Research on the Epidemiology of Disasters (CRED). CRED registers a "disaster" if at least one of the following has occurred: 10 or more fatalities, 100 or more people "affected," a call for international assistance, or the declaration of a state of emergency.

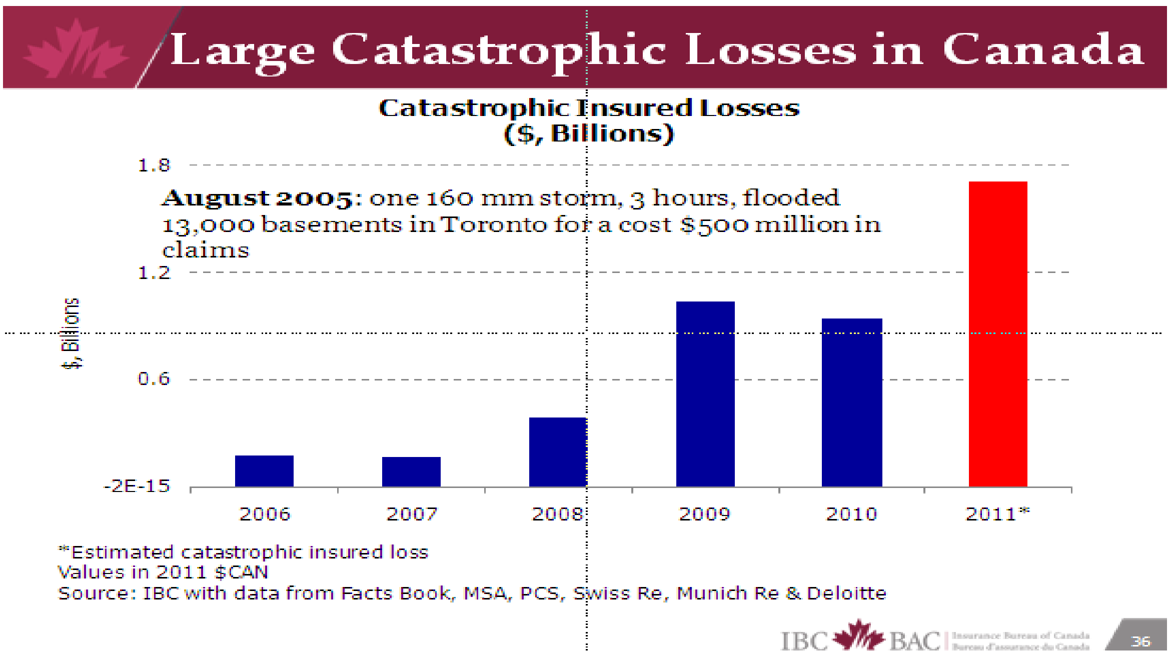
[14] See Lamframboise, Nicole & Loko, Boileau. (2012) "Natural Disasters: Mitigating Impact, Managing Risks." International Monetary Fund accessed http://www.imf.org/external/pubs/ft/wp/2012/wp12245.pdf at page 6

15 See http://nrtee-trnee.ca/wp-content/uploads/2012/03/cp5-case-studies.pdf at page 85-86

Australian insurance losses arising from weather events (Insurance Council of Australia)

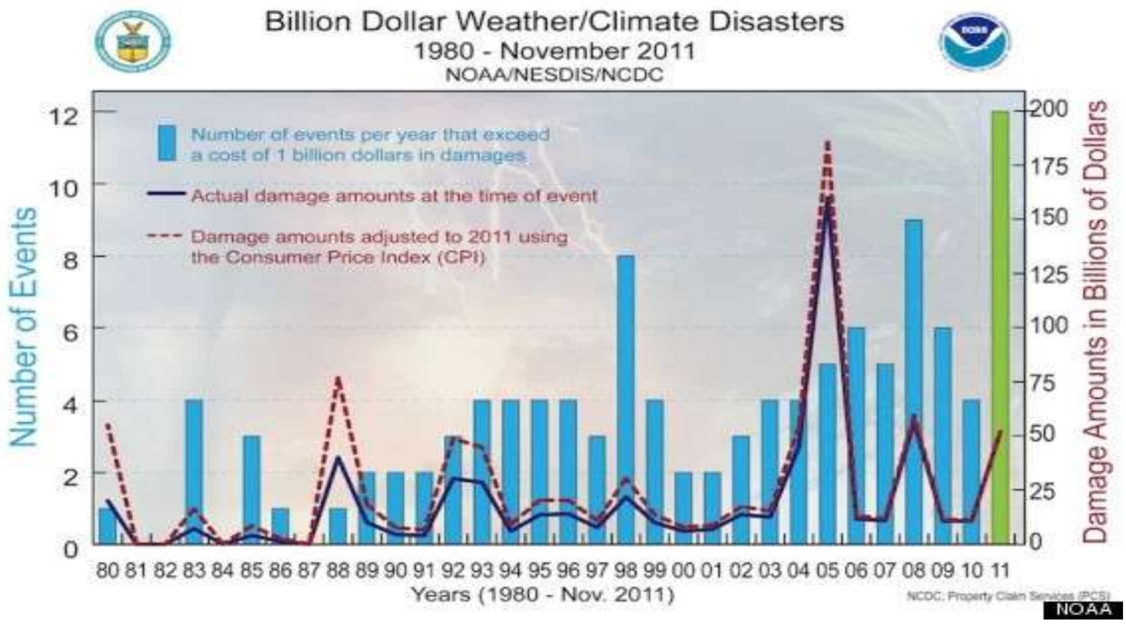


Canadian insurance losses arising from weather events (Insurance Bureau of Canada)[16]

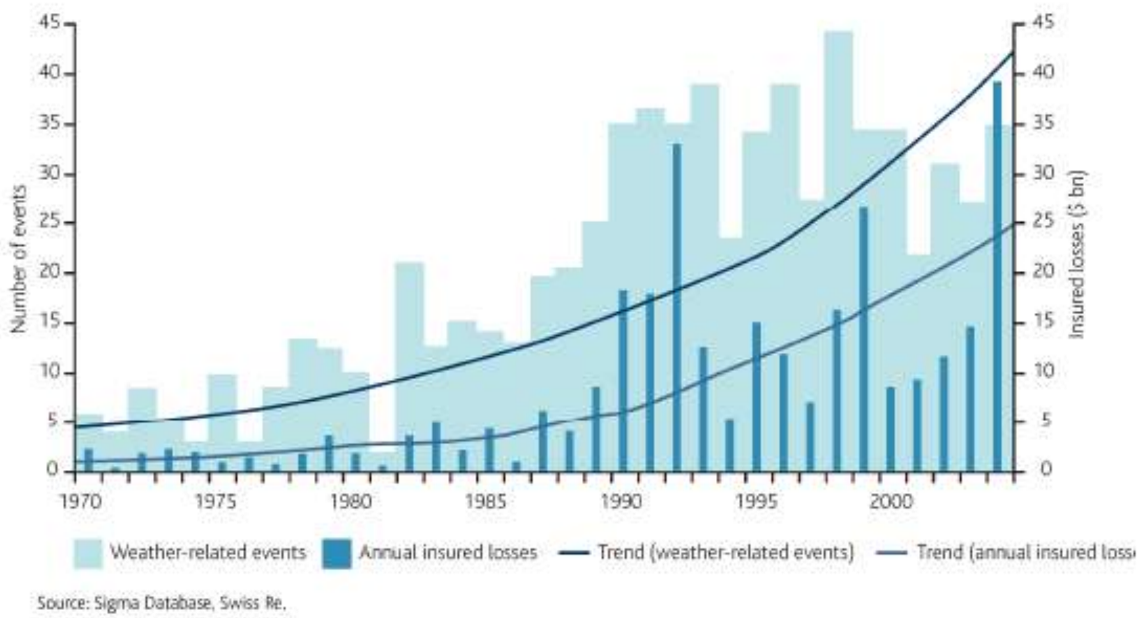


[16] Accessed at http://www.ibc.ca/en/natural_disasters/documents/mcbean_report.pdf

United States insurance losses arising from weather events (National Oceanic and Atmospheric Administration)



United Kingdom insurance losses arising from weather events[17]



Insurance cost increases should not necessarily be interpreted as a function of increasing extreme weather occurrences or magnitude. Exposure and vulnerability are key variables that drive insured damage. Environmental planning, settlement patterns and infrastructure design and configuration that do not give sufficient consideration to climate risks are an important contributor to increased climate exposure and rising insurance costs.

[17] See http://www.rusi.org/downloads/assets/Surminiski.pdf

Table 1: Top 10 Structural Damage/Filed Claim Events in 2011				
Event	**Event Location**	**Fatalities**	**Number of Structures/ Claims**	**Economic Loss Estimates (USD)**
Flooding	Thailand	790	4,000,000	45.00 billion
Flooding	Pakistan	520	1,600,000	2.00 billion
Earthquake*	Japan	15,844	1,100,000	210.00 billion
Hurricane Irene	U.S. Caribbean	46	835,000	8.55 billion
Severe Weather	U.S.	181	750,000	9.10 billion
Severe Weather	U.S.	344	700,000	10.20 billion
Flooding	Thailand	61	609,967	880.00 million
Flooding	China	239	500,000	6.65 billion
Flooding	Colombia	116	375,000	5.85 billion
Typhoon Nock-ten	Philippines, China	94	340,000	126.00 million

**Of the top 10 structural damage/filed claim events in 2011, only the earthquake in Japan is geophysical, and therefore not related to severe precipitation, hurricanes or severe storm events.*

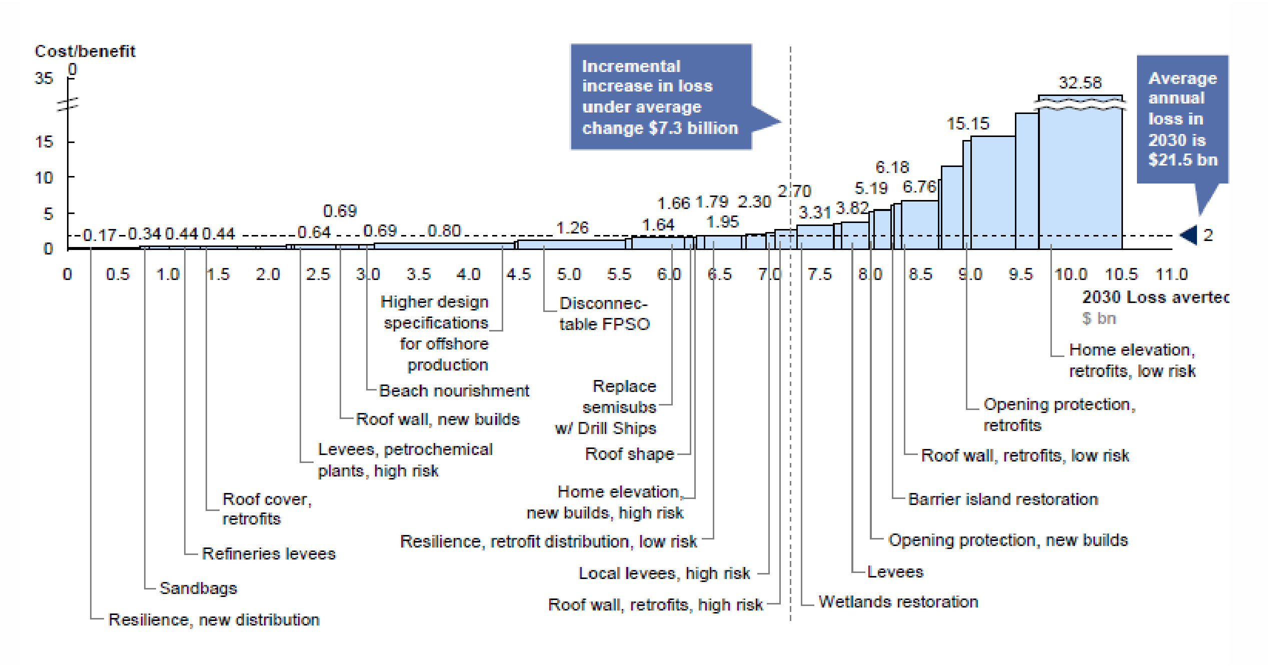
Source: AON Benfield, "Annual Global Climate and Catastrophe Report, Impact Forecasting 2011."

Using insurance claims are a measuring stick for social, economic and environmental costs associated with extreme weather is not sufficient for governments to accurately grasp the full costs of extreme weather and incorporate relevant externalities. Decreased employment productivity, health and mortality costs, lost opportunity costs (export and trade), reputational impacts and ecosystem degradation estimates are just some of the costs not captured by insurance payout estimates.

For example, intensification of poor air quality under increased summer temperature scenarios is a cost that can be evaluated with some level of certainty by applying existing burden of illness air quality estimates. Existing water markets and environmental service market mechanisms can provide a good baseline for modeling extreme weather and climate impacts on resource availability and price. Methodologies are also available to assess labor productivity impacts, housing relocation expenses and additional government social service provision. The more challenging costs analysis involves understanding extreme weather impacts on risk perceptions of investment environment and flow on trade impacts.

One of the challenges in moving to accurately quantify such costs is that they should be done in a holistic way rather than individually. Understanding the cascading cause and effects of a particular climate parameter (e.g extreme heat) and modeling impacts across critical system (city/community) functions facilitates a more realistic understanding of impacts and cost.

Obtaining a more robust picture of costs is essential to enable investment decision making, particularly during period where ageing infrastructure is coming to the end of its useful life and infrastructure investment is a national priority. Some stakeholders will advocate that preventive mitigation work is always a good investment. For example, a 2005 study by the US Multi-Hazard Mitigation Council found that for every $1 spent on proactive disaster mitigation there was a $3 to $4 savings on disasters costs.[18] However, greater sophistication is required to develop more detailed cost benefit scenarios such as the one below created by U.S Gulf utility, Entergy.



Source: A range of measures to address the increase in annual loss between today and 2030 and keep the risk profile of the US Gulf Coast constant (Entergy 2011).

The availability and affordability of private insurance, impacts on availability and affordability under different global warming scenarios, and regional social and economic impacts

The insurance industry globally is indicating that climate risk and extreme weather is having a significant impact on current business models. The Re-insurance company Munich Re received claims worth more than $350 million from the 2010-2011 Australian floods, contributing to a 38% quarterly profit decline.[15] Recent floods in Europe, large scale wild fires in California and Australia and hurricanes in the US Gulf States have spurred the insurance sector to readjust their policies and practices.[16]

A recent CERES Report noted in relation to escalating climate risk that "[t]his changing climate will profoundly alter insurers' business landscape, affecting the industry's ability to

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[18] Multi Hazard Mitigation Council of the National Institute of Building Sciences, Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, December 2005, at http://www.nibs.org/MMC/mmchome.html. See also CBO Potential Cost Savings from the Pre-Disaster Mitigation Program, Congressional Budget Office, September 2007 at http://www.cbo.gov/ftpdocs/86xx/doc8653/09-28-Disaster.pdf

[15] Oxfam America, Calvert Investments and Ceres (2012). *"Physical Risks from Climate Change: A guide for companies and investors on disclosure and management of climate impacts" on p2*. Accessed at http://www.ceres.org/resources/reports/physical-risks-from-climate-change/view

[16] Dr. Blair Feltmate & Dr. Jason Thistlethwaite (2012) *"Climate Change Adaptation: A Priorities Plan for Canada"* Report of the Climate Change Adaptation Project (Canada) at 110 (Chapter 8 by Paul Kovacs)

price physical perils, creating potentially vast new liabilities and threatening the performance of insurers' vast investment portfolios."[19]

Insurance availability and accessible pricing under most IPCC emission scenarios will change. Pricing and availability will not just reflect IDF patterns of various climate parameters. Insurers will equally consider risks and vulnerabilities inherent in the built environment arising from extreme weather. Over the long term, government and institutions that continue poor environmental planning processes, fail to invest in built environment resilience and neglect the need for macro-level strategic, coordinated and integrated urban development planning will most likely face barriers to accessing insurance.

This is an issue that the U.K Government and the Association of British Insurers (ABI) are currently debating in relation to residential surface flooding insurance.[20] Following the 2000 floods, the Association of British Insurers (ABI) entered into an agreement with the U.K Government known as the Statement of Principles[21] – an agreement that the private insurance sector would make flood insurance for residential homes and small businesses available as a feature of standard household and small business policies until June 2013.[22] At the expiry of the Statement of Principles availability and price of flood risk insurance will go back to being determined by the market.

Concern about market determination of flood insurance availability stems from the fear that insurers, particularly non-ABI members could offer much lower rates to low risk properties and cause a market concentration of high risk properties seeking insurance. Market determination would remove any inherent – albeit limited – cross subsidisation of high risk policy holders by low risk property holders created by the Statement of Principles. In terms of new residential developments (2009) the Statement of Principles does not apply. Insurance availability is an important mechanism to discouraging poor construction techniques and inappropriate site selection.

European insurers appear to be limiting policy coverage to extreme weather events tied to event characterization in terms of event frequency and magnitude. For example, insurance companies would not offer policy coverage for 1 in 50 year storm, but 1 in 100 year extreme weather events could receive policy coverage. In order for global insurance industries to equitably and consistently adopt this approach significant investment and installation of monitoring equipment measuring surface flooding levels, localised temperatures, wind speed, storm and tidal surge levels is required.

Information and data are critical in this context. Most countries have a significant deficiency in climate and environmental monitoring infrastructure and governance that impedes the type of sophisticated risk pricing and evaluation insurers, urban planners and infrastructure

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[19] See http://www.ceres.org/press/press-clips/sponsored-by-tapco-underwriters-report-points-to-insurance-industry2019s-vulnerability-to-climate-change

[20] King, Mark (Nov 2011). 'Flood insurance talks reach 'crisis point' The Guardian. See http://www.guardian.co.uk/money/2012/nov/26/flood-insurance-talks-reach-crisis-point

[21] See http://archive.defra.gov.uk/environment/flooding/documents/interim2/sop-insurance-agreement-080709.pdf

[22] See http://www.defra.gov.uk/environment/flooding/funding-outcomes-insurance/insurance/

operators will need to undertake. The Insurance Bureau of Canada has developed a Municipal Risk Assessment Tool based on multiple data sets, including historical payouts and infrastructure failure rates to better evaluate flooding.[23]

It is important to not overemphasize reliance on insurance as a risk mitigation response. Insurance may adequately compensate businesses or organizations for economic loss or asset damage, but it may be unsatisfactory in terms of the addressing public interests arising from lack to essential services and goods.

For example, a recent survey funded by Natural Resources Canada investigating critical infrastructure sector tolerance for power disruption revealed that the food sector had very low levels of business continuity planning but high levels of insurance. While insurance will cover economic loss incurred by food processors, distributors and retailers associated with food spoilage, can it address the public interest implications of limited food supply in the event of extended power outage?

Equally important as access to private insurance products, is credit and finance access. Financial institutions are starting to evaluate extreme weather and climate risk exposures in their credit portfolios and managed funds. Disproportionate or concentrated exposure to particular industries with similar climate risk exposure (for example forestry, agriculture within a particular geographic region) may be seen as a growing business risk and act as a renewed imperative for diversification not just in industrial profile but also climate risk profile.

Banking sectors internationally are already integrating greenhouse gas output and mitigation concerns into project finance assessment.[17] The trend reflects not only the sector's knowledge of corporate social responsibility but its awareness of the business risk associated with climate change. The logical extension of this concept is that extreme weather and climate risks may impact a borrower's capacity to service large loan obligations, particularly where there is insufficient insurance coverage.

Assessment of the preparedness of key sectors for extreme weather events, including major infrastructure (electricity, water, transport, telecommunications), health, construction and property, and agriculture and forestry;

Most critical infrastructure and key export sectors have at some point experienced severe or extreme weather impacts on operations and assets. Prudent companies will have emergency response plans and business continuity plans (BCP) in place to protect infrastructure, assets and operations and ensure the organization or business resilience.

A common refrain of those who take an overly optimistic view of current extreme weather resilience across business and social service sectors is that existing BCPs will ensure continuity of business and service operations in the event of an extreme weather event.

[23] See http://www.ibc.ca/en/Natural_Disasters/Municipal_Risk_Assessment_Tool.asp

[17] International project financing standards such as the International Finance Corporation (IFC) Performance Standards and the Equator Principles require GHG assessments.

However, there are problems with the perception that critical infrastructure, businesses and service sectors have sufficient resilience to extreme weather:

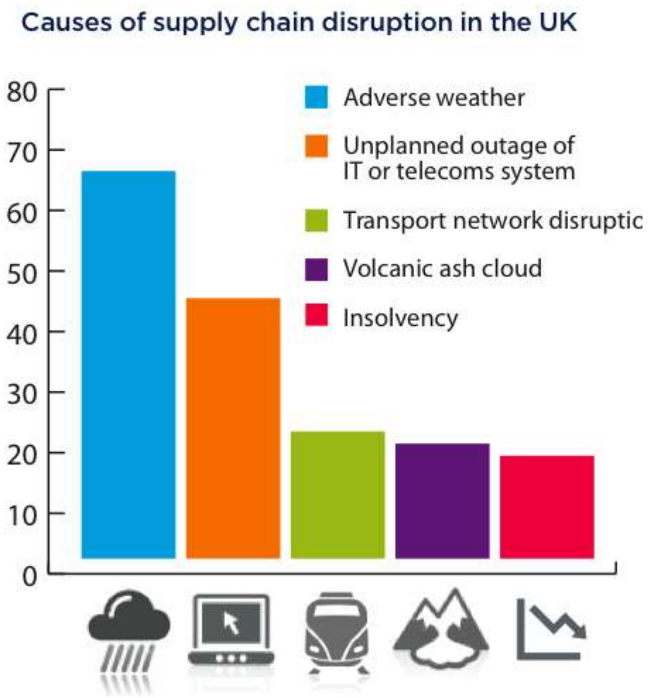
a. An overestimation of the level of emergency preparedness and business continuity planning undertaken by critical infrastructure sectors.

b. Small and Medium Enterprises (SME) have a very low level BCP implementation and high expectations of return to service timeframes.[24]

c. Insufficient appreciation of supply chain disruption and reliance on 'just in time' delivery modes.[25]

d. Lack of understanding about the relative resilience/vulnerability of interdependent services.

e. Lack of planning for multiple and cascading infrastructure and service failure.



Source: Zurich[26]

Surveys in a number of jurisdictions paint a picture of business communities underprepared for disruptions associated with extreme weather. Without pinpointing particular sector

[24] For example see: Research conducted by Redshift Research on behalf of Aviva, with 500 SME owners in October 2010 – Accessed at http://www.continuitycentral.com/news05601.html. A similar 2011/12 survey by Zurich found that only half of UK SMEs surveyed had a business continuity plan in place and interestingly, the figure is similar for mid-corporate and larger companies across the UK. An earlier Zurich Insurance-sponsored study of 310 organizations from 35 countries and 15 industry sectors found adverse weather had jumped to the top of the list (59%) as the main cause of business disruption around the world in 2010, up from 29% in the previous year.

[25] See http://www.zurich.co.uk/NR/rdonlyres/093EDF47-5DB9-4ECB-858F-394EC837796F/0/ExtremeWeatherGreenPaperDec2011FINAL.pdf.

[26] Ibid.

vulnerability, SMEs are an important component of the business community, requiring assistance in improving business continuity and resilience.

Recommendation c. **Support the Department of Industry, Innovation, Science and Research to engage with Small and Medium Enterprises (SME) in critical infrastructure sectors - particularly food production/distribution and manufacturing - on business continuity planning. Specifically, focus on information packages to help SMEs cost effectively implement business continuity plans that address extreme weather scenarios.**

United States, Canada, the United Kingdom and Australia have invested increasing resources into Critical Infrastructure Protection in the post 9/11 environment and in light of rising of cyber security challenges. Listed below is a cross-jurisdictional summary of Critical Infrastructure programs that have considered some extreme weather hazards.

Institutions	Working Groups	Key Policies
U.S Department of Homeland Security[27]	Critical Infrastructure Key Resources Information Sharing Environment Homeland Infrastructure Threat and Risk Analysis Center (HITRAC)	National Infrastructure Protection Plan[28]
Public Safety Canada[29]	National Cross-Sector Forum	National Strategy for Critical Infrastructure[30] Action Plan for Critical Infrastructure[31]
U.K Cabinet Office	Natural Hazards Team[32] UK Centre for the Protection of National Infrastructure (CPNI)[33]	Keeping the Country Running: Natural Hazards and Infrastructure[35]

27 See http://www.dhs.gov/topic/critical-infrastructure-protection

28 See http://www.dhs.gov/xlibrary/assets/NIPP_Plan.pdf

29 See http://www.publicsafety.gc.ca/prg/ns/ci/index-eng.aspx

30 See http://www.publicsafety.gc.ca/prg/ns/ci/ntnl-eng.aspx

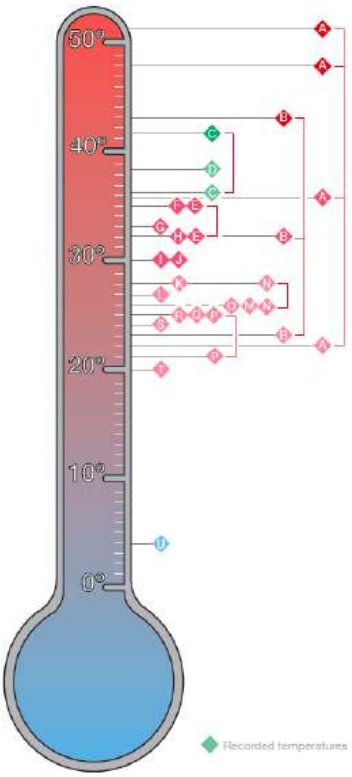
31 See http://www.publicsafety.gc.ca/prg/ns/ci/ct-pln-eng.aspx

32 See http://www.cabinetoffice.gov.uk/infrastructure-resilience

33 See http://www.cpni.gov.uk/

	Sector Based Resilience Groups[34]	
Australian Attorney General's Department	Trusted Information Sharing Network (TISN) for Critical Infrastructure Resilience	Critical Infrastructure Resilience Strategy[36]

TISN for Critical Infrastructure Resilience is an important forum and institutional to examine extreme weather vulnerabilities. With greater access to climate modelling and mapping of infrastructure climate related thresholds, TISN participants may be able to construct an integrated picture of temperature impacts on critical infrastructure similar to a study undertaken by the London Climate Change Partnership & Environmental Agency.



Temp.	
A	36°C External air temperature which results in rail track temperatures of 48°C-52°C. Extreme precautions, such as temporary speed restrictions, taken by Network Rail at this air temperature to avoid buckling of non-pre-stressed rails and overheating of power sources. 22°C Network Rail begin to implement staged preventative measures at this air temperature.
B	43°C Maximum internal air temperature advised for server rooms. 32°C Maximum internal air temperature advised for computer rooms. 23°C Maximum internal air temperature advised for IT equipment rooms.
C	41.5°C and 36.2°C Air temperatures recorded on the tube and on platforms respectively during the 2003 heatwave in London.
D	38.5°C Highest daytime temperature recorded in the UK (at Gravesend, Kent).
E	32°C and 35°C Internal air temperature thresholds to which Crossrail rolling stock and stations respectively are designed not to exceed.
F	35°C Heat stress risk for healthy adults begins at this internal air temperature combined with a relative humidity level of 50%.
G	33°C Softening of tarmac, asphalt and bitumen road surfaces generally begins to occur but is also dependant on direct solar exposure.
H	32°C The highest estimate for summer mean daily maximum temperatures by the 2080s.
I	30°C Vulnerability of commercial buildings to power outages increases when external air temperatures exceed this.
J	30°C Overhead power lines begin to experience a reduced rating factor above this air temperature.
K	28.1°C The highest estimate for summer mean daily maximum temperatures by the 2050s.
L	27°C Threshold temperature specified for overheating in well insulated housing.
M	26.2°C The central estimate for summer mean daily maximum temperatures by the 2080s.

Temp.	
N	28°C Current CIBSE temperature threshold for living areas. If 1% of annual occupied hours exceed this temperature, internal spaces in a building have technically overheated. 26°C Current CIBSE temperature threshold for bedrooms.
O	26°C Threshold for air temperatures of internal cool areas required to be provided by hospitals.
P	25°C Suggested 'hot' temperature threshold for bedrooms. 21°C Suggested 'warm' temperature threshold for bedrooms.
Q	24.8°C The central estimate for summer mean daily maximum temperatures by the 2050s.
R	24.7°C over 2 days leads to greater incidences of morbidity, mortality and hospital admissions in London.
S	24°C London Underground implement overheating plans including public health communications and measures to prevent non-pre-stressed railtracks from buckling.
T	20°C Legionella bacteria begin to develop in potable water supplies (both stored and piped) if water temperature exceeds this.
U	4°C to 60°C Bacterial growth on food encouraged between these temperature. Likelihood of food borne diseases increase by 4.5% for every 1oC increase in air temperature.

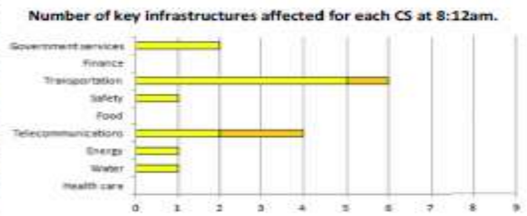
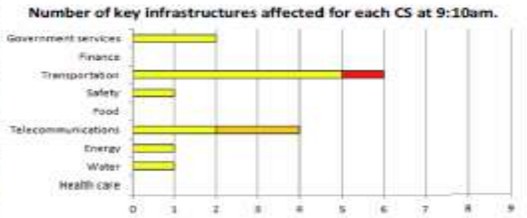
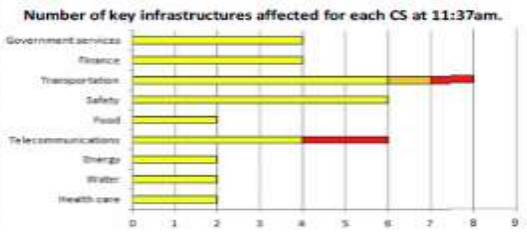
Source: London Climate Change Partnership & Environmental Agency (2012) – 'Heat Thresholds Report'

Other non-government research organisations have undertaken similar work to these critical infrastructure groups using systems analysis and scenario modelling.

35 See http://www.cabinetoffice.gov.uk/resource-library/keeping-country-running-natural-hazards-and-infrastructure

34 See http://www.cabinetoffice.gov.uk/resource-library/sector-resilience-plan-critical-infrastructure

36 See http://www.tisn.gov.au/Documents/Australian+Government+s+Critical+Infrastructure+Resilience+Strategy.pdf

DOMINO simulation	Identification of CSs affected	Notes
		• Interruption of water supply in a specific geographic sector (blue square). • 15 critical assets impacted by the water outage among which 3 have a potential to fail (for confidentiality purposes, the figure do not show the assets).
		• Failure of an infrastructure belonging to a transportation system. • Disruption of road traffic anticipated (red zone).
		• Interruption of certain telecommunication services in the zone shown in purple. • Expansion of the impact zone.

Source: Royal Canadian Mounted Police & École Polytechnique de Montreal (DOMINO) DOMINO Prototype is consequence-based risk management approach used to simulate the domino effects triggered by a specific resource outage in a geographic sector.

Recommendation d.

Attorney General's Department should evaluate the need for the Trusted Information Sharing Network (TISN) for Critical Infrastructure Resilience to undertake more targeted, advanced modelling of food, water and energy interdependency.

Recommendation e.

TISN for Critical Infrastructure Resilience and Department of Sustainability, Environment, Water, Population and Communities should develop a thresholds study similar to the London Climate Change Partnership / Environmental Agency 'Heat Thresholds Project' Report 2012.

Energy Sector Climate Risk Vulnerability

Reliability and security of supply are core business and regulatory objectives of electricity sectors in modern economies. Enterprise risk management and continued risk assessment and management should be the backbone of utility operations. Existing electricity generation, transmission and distribution systems are designed, constructed and operated with equipment thresholds in mind.

The question is whether the electricity utilities have kept pace with climate projections and modeling and whether this work is accurately reflected in utility risk assessments. There are a number of barriers, disincentives and challenges to improving extreme weather resilience and climate risk. These include:

- A growing diversity of needs and expectations across electricity consumer base, all with varied tolerance to power disruption. This creates a challenge in finding a 'cost vs. reliability' equilibrium.

- Limitations on market regulators approving infrastructure and operational investment to improve resilience.

- Accessibility to climate information and modeling containing climate parameters relevant to the sector.

- A rapidly changing landscape with the introduction of distributed generation, conservation and demand management targets and smart grid technology all altering resilience needs and cost effectiveness propositions.

Victoria is one of the few Australian states to undertake and publish a climate change risk assessment for the energy sector. In 2007, the Victoria Government released an infrastructure and climate change risk assessment setting out worst-case scenarios for low and high climate change projections for the years 2030 and 2070.[37] The CSIRO report identified energy sector climate change risks including (pp. 39-41):

- Reduced power generation capacity of hydroelectric dams due to reduced rainfall. Coal-fired power stations may also have reduced generation capacity if there is not sufficient water supply to cool thermal electricity generation systems.

- Damage to generation, transmission and distribution assets from increased occurrence of bush fires.

- Storm damage to above ground transmission lines arising from increased extreme wind events and electrical storm activity.

- Arching faults and increased dust build up on transmission lines due to decreased rainfall and increased drought conditions.

- Accelerated degradation of generation plant sites and transmission infrastructure from groundwater volume and composition changes.

- Substation flooding attributable to sea level rise and coastal inundation.

- Reduced transmission efficiency (30% reduction in efficiency during high/extreme temperatures) concurrent with increased peak demand during extreme heat wave conditions potentially leading to service disruption and extended blackouts.

[37] Commonwealth Scientific and Industrial Research Organization(CSIRO),2006. Infrastructure and Climate Change Risk Assessment for Victoria. – Report to the Victorian Government 2007, CSIRO, Australia 2006

However, it is clear that transmission and generation companies are starting to address climate change at the enterprise level and integrating climate change adaptation into risk management strategies. An AECOM presentation on resilience actions taken by distribution and transmissions companies in Victoria[38] highlights that some companies are taking the following actions:

- New plant siting/design allow watertight height of structures above project flooding or inundation levels ("freeboard"), approximately 1m above 1 in 100 year storm events

- Raising levies on critical substations

Based upon existing climate change risk assessments, both public and enterprise focused, adaptation strategies currently under consideration include;

- Switching gear circuit breakers rated 40˚C – modify switchgear procurement specifications
- Reviewing overhead line ratings for climate change projections – for ground clearance
- Replacement of timber cross-arms on power poles with steel alternatives
- Installation of silicon treatment of insulators as interim measures to reduce pole fires (dust build up during lengthy dry periods)

In 2008, the U.K. Met Office in collaboration with three leading U.K. energy companies completed a scoping study into climate change and its potential impacts on the U.K. energy industry. Following the scoping study an industry-funded project (EP2) was set up, involving 11 UK energy companies.[39] The aim of the study is to assist climate scientists and industry experts understand the industry's precise requirements and develop practical applications and business strategies for extreme weather impacts.

Activities of EP2 include; future soil condition modelling and soil impacts on underground cables to aid in evaluating cost/benefit analysis of building resilience through underground cabling; screening of coastal and marine energy assets and investigation of historic weather patterns and network fault with a view to improving network outage prediction tools.

The Resilient Electricity Networks for Great Britain (RESNET)[40] carries on the work of EP2. Funded by the Engineering & Physical Sciences Research Council (UK) and involving research participation of Newcastle University, National Grid, Environmental Agency, Ove Arup the RESNET project aims to examine extreme weather and climate impacts on electricity infrastructure by developing and demonstrating a comprehensive systems-level approach to analyse of existing and proposed electricity networks resilience. The RESNET project is particularly forward thinking and unique for its focus on the impact of energy system decentralisation on resilience and reliability levels.

[38] Nolan, Michael (2012). 'AECOM: Adapting to Extreme Climate Events' Accessed at https://aecom.webex.com/aecom/ldr.php?AT=pb&SP=MC&rID=66609922&rKey=a4982c800dd0135c

[39] See Met Office (2008) 'Scoping Study – Climate Change Impacts on the UK Energy Industry' accessed at http://www.metoffice.gov.uk/media/pdf/l/n/energy.pdf

[40] See http://www.arcc-cn.org.uk/wp-content/pdfs/RESENET.pdf

Recommendation f.

Australian Government and the Council of Australian Governments to consider whether current regulatory reform proposals for the National Electricity Market sufficiently enable the Australian Energy Regulator and associated market regulators to have regard to the costs of building extreme weather resilience.

Any gaps in Australia's Climate Change Adaptation Framework and the steps required for effective national coordination of climate change response and risk management

Returning to the introductory themes of this submission – information sharing and improved risk assessment – the Australia Government could effectively address these two issues by implementing a national climate risk assessment and reporting regime. Provision is made in the Victorian Climate Change Act 2010 (s16) for a complete a risk assessment of climate change impacts and outlining of state-wide strategic responses for adaptation to potential impacts of climate change.

The U.K Climate Change Act 2008 established a highly effective regime for climate adaptation reporting, which has catalyzed industry awareness, understanding and innovation. Under the Act the Secretary of State issued a directive for over 91 critical infrastructure owners and managers to produce Section 62 Climate Change Adaptation Reports.[41] The Department for Environment, Food and Rural Affairs (DEFRA) has published a summary of 103 climate change adaptation reports and indicated the reporting exercise shows that "the risk assessments have generated priorities for action and flexible adaptation responses are being developed". These reports will be incorporated into the National Adaptation Programme (NAP) to be published with clear objectives, proposals and time frames in 2013.

Recommendation g.

Australian Government should implement a National Climate Risk and Adaptation Reporting regime for critical infrastructure businesses and key export sector companies.

[41] See http://www.defra.gov.uk/environment/climate/sectors/reporting-authorities/reporting-authorities-reports/ for full list of Climate Change Adaptation Reports