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Director
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General Manager, Policy Development
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Re the Draft CPG 229 Climate Change Financial Risks Practice Guide

In way of introduction, I am the Director of the Australian Research Council's Centre of Excellence for Climate Extremes. I have been a lead author or Review Editor on several Intergovernmental Panel on Climate Change (IPCC) reports. I have been on multiple Federal committees linked to climate science, and have written extensively on climate science and climate extremes. I was a member of the technical panel for the CMSI.

APRA are to be congratulated in their leadership reflected by the preparation of this guide. It is very welcome to see the Authority providing positive leadership and useful guidance. I will not detail all the positives associated with this report, but they are many. Rather I want to touch on some problems with the guide. I will refer to the numbered paragraphs.

#9 – I fully agree that a business should take a strategic and risk-based approach to these issues. The problem is, to take a strategic and risk-approach to the management of the various risks and opportunities arising from climate change requires knowledge of, to come degree, what the physical risks are. We know the *direction* of some of those (extreme rainfall will intensify) but not whether the number of extreme rainfall events will increase or decrease – so the risk might be multiplied (increased intensity times an increase in frequency) or moderated (increased intensity times an decrease in frequency). We do not know the sign of the change for hail, for extreme wind and so on. While climate science can inform a business with confidence on the risks associated with changes in temperature averages at regional scales or continental scales, the science of future changes in *extremes*, and the skill in the changes in extremes at the spatial detail required to assess risk is *at least* a decade away. We addressed this in Fiedler et al. (2020) in *Nature Climate Change*[1] to try to explain to business that they have been misled on the capacity of climate science to inform them on most events that threaten business resilience.

In short, the APRA guide hints or suggests that businesses need to address risks associated with climate change (I agree) but many risks occur at a level of spatial detail, or on a timescale (hours, or a day) whereby existing climate science can rarely provide directly useful information. Simply, APRA is asking businesses to assess risks that are beyond the capability of climate science to provide even the sign of the change in many cases.

#11d This statement is not true of many risks, at least on timescales of the next decade or two. If a business has good knowledge of their weather and climate risks from the last 10 or 20 years, and if

[1] Fiedler, T., A.J. Pitman, K. Mackenzie, N. Wood, C. Jakob and S.E. Perkins-Kirkpatrick, 2021, Business risk and the emergence of climate analytics, 2021, *Nature Climate Change*, doi: 10.1038/s41558-020-00984-6

those risks are directly associated with hail, cyclones, extreme winds and so on, a business can assume the last 10-20 years is a good guide to the next 10-20 years. This is not true of temperature, but it is of most weather and climate risks. Specifically, the rate of greenhouse-gas induced climate change as expressed on highly variable rainfall, winds, drought etc is slow relative to natural variability. All this allows an assumption of stationarity.

#22 I agree scenario modelling is potentially powerful, but it is only as powerful as the quality of the scenario used. Using this for stress testing is important, provided the scenario development encompasses the risks. That is not normally done. Most critically, the scenario has to be appropriate and fit for purpose. I do not think a business can be expected to do that without strong external advice from the climate science community. Specifically, the scenario testing has to be bespoke to the individual business, its spatial footprint, its vulnerability and intended future business strategy. The pressures on climate scientists to provide guidance, or the incentive for some businesses to offer guidance that is simply indefensible from the science is very strong. APRA is, to some degree, further incentivising the misuse and abuse of climate science in some recommendations albeit without intent.

#26 and #26 requires the development of suitable metrics. From a physical climate risk perspective, we do not know how to do that and mis-representation of risk with an ill-suited metric risks perverse outcomes.

#38 With exceptions, climate science cannot usually quantify physical risks robustly at regional scales with the exception of some temperature risks. I fully agree a business should "choose approaches appropriate to the circumstances" but note that this is not something that can defined, at present, for most businesses. It is, I would suggest, a meaningless suggestion for APRA to make because "appropriate" cannot be defined in this context. I strongly support the *intent* but the request cannot be implemented usefully.

#40b This is an error on the part of APRA in my view. There is no point examining business risk to 4^{o}C because that is beyond the adaption capacity of most economies. To first order (and very generally), 4^{o}C in the global mean (including a lot of ocean of course) means 6^{o}C in the global mean over land, and 8^{o}C in the mean over mid-latitude land on the annual average. That risks 10^{o}C in the summer average, or perhaps 12^{o}C in heatwaves. Western Sydney has already reached 48^{o}C. If you add 12^{o}C to the 48^{o}C you get summer heatwaves of 60^{o}C. That cannot be realistically adapted to, ecosystem services are not resilient to that, crops cannot be adapted etc.

In any case, *warming* is not the problem. It is the *consequences of warming on weather phenomenon* and *sea levels* and so on that is the problem. There is almost no association between 4^{o}C in the global mean and how weather patterns and weather extremes will change. In short, APRA should recommend 2^{o}C, or perhaps 3^{o}C *along with* other recommendations for changes in other phenomenon.

I do appreciate this is challenging and that APRA might not want to get into the details. However, by specifying 4^{o}C you mislead business with one key exception. If you are able to show that business is resilient to 4^{o}C in the global mean this highlights the very useful outcome that the implementation of the stress testing is fundamentally flawed. If that is your intent, that might be useful.

#41a is a misunderstanding of physical climate risk. It is hard to imagine a business that could robustly assess this risk using decadal scale data. Similarly, it is hard to think of physical risks on a seasonal timescale for most sectors – what physical risks are realised at a seasonal timescale (maybe some in agriculture?). Physical climate risk is realised at weather scales – a severe storm, a severe wind, hail, a flash flood, a heatwave. Thus, I would suggest that there are very few

businesses that could assess the physical risks without using daily data or higher temporal resolution data (which is, of course, available via climate models and reanalyses).

By way of example, take a 90 day period (a season) at 35^{o}C with a 3 day heatwave of 40^{o}C within that 90 days. Compare this to the same 90 days but with a 3 day heatwave of 50^{o}C. The different in the seasonal average is 0.3^{o}C (trivial) but the difference in the impact of the heatwave would be phenomenal. In short, businesses are rarely vulnerable to changes in the *averages* and assessing business vulnerability to averages hides risk. Rather, business risk needs to be assessed against their risks to *extremes*.

#41b I absolutely agree, but this is not possible. I mean, it is not possible to know how climate will change at scales of an institution. It is not that it is hard, or that climate science can be useful, or anything – it is simply impossible and to suggest geographic specificity at a level that is actually technically impossible is not appropriate. I am, of course, aware that there are organisations providing data at an institutional level but as described in Fiedler et at. (2021) this has no validity whatsoever.

#41c There is a new and emerging area of research focussed on compound events[2] – the concurrent occurrence of extremes. It is in the very early stages. We have some knowledge of the *climatology* of some compound events[3], and an awareness that some of the very latest climate models have some skill in simulating them[4]. A paper currently under preparation is examining, for the first time, how these skilful models predict the risk of some compound events to change in the future. There is therefore next to no capacity to provide advice to business on how the joint probability of multiple extreme weather events will change in the future. Asking businesses to assess this risk is therefore not appropriate although I would agree that asking business to be *aware* of these risks might be sensible.

In summary, I note that my comments above are largely technical and critical. I am, however, very supportive of APRA leading in this area, and advising businesses of the need to examine climate risk. However, I think there is *at least* a decade between what you are suggesting businesses do, and what climate science can usefully inform them about. It may be beyond APR's remit but advising businesses to do what is now possible, encouraging them to be more ambitious in assessing risk, while actively lobbying Government to resource the national research community to close the gap between what is wanted and what is currently possible would be hugely beneficial.

I am, of course, quite willing to explain or fully defend my statements above as some would be contradictory to advice you may have received.

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[2] Zscheischler, J., S. Westra, B.J.J.M. van den Hurk, S.I. Seneviratne, P.J. Ward, A.J. Pitman, A. AghaKouchak, D.N. Bresch, M. Leonard, T. Wahl, X. Zhang, 2018, Future climate risk: The challenge of compound events, *Nature Climate Change*, 8, 469–477, doi: 10.1038/s41558-018-0156-3.

[3] *Ridder, N.*, A.J. Pitman, *A. Ukkola*, L. Alexander, M. Bador, H. Do, J. Evans, A. Hirsch, A. di Luca, J. Zscheischler and S. Westra, 2020, Global hotspots for the occurrence of compound events, *Nature Communications*, 11, 5956, doi: 10.1038/s41467-020-19639.

[4] *Ridder, N.N.,* A.J. Pitman and *A. Ukkola*, Do CMIP6 climate models simulate global or regional compound events skillfully?, *Geophysical Research Letters*, 48, e2020GL091152, doi: 10.1029/2020GL091152.