



Legislative Council Environment and Planning Committee

Inquiry: Inquiry into Climate Resilience

Hearing Date: 9 October 2024

Question[s] taken on notice

Directed to: The ARC Centres of Excellence for Climate Extremes and the Weather of the 21st Century

Received Date: 30 October 2024

1. **Wendy LOVELL, page 20**

Question Asked:

I just want to go back to the solar panels. Gaelle talked about the proposal at Colbinabbin, a huge proposal. We have also had them built within the irrigation area. Every time one of these goes in there is significant concern in communities about the heat island effect. In Colbinabbin there are a number of wineries that are close by. They are really concerned about it changing their microclimate and the effect that that would have on their grape growing. We have had it in places just out of Shepparton where it has been in amongst orchards and things like that. You said there is no evidence that there is a heat island effect in regional areas, but have you looked at the microclimate effect on horticulture and agriculture in the areas?

Ailie GALLANT: No. There is no evidence because there is no research on it. It is not that there is no evidence. There is simply no research on these things, as I am aware. I am happy to take it on notice and go and look for some, but I am not aware of anything at this stage.

Response:

The question on notice asked about the existence of heat islands over solar farms and possible effects near to the solar farm.

We note that this is not the core area of expertise of either Associate Professor Gallant or Dr Kimberley Reid. However, Associate Professor Gallant has some research experience with urban heat islands, which are caused by similar physical processes. Associate Professor Gallant undertook a brief literature survey to provide this information.

Only a relatively small number of studies in the peer-reviewed literature have measured or modelled the effects of solar farms on the overlying microclimate. The results from these studies are now summarised.

Do solar farms create heat islands?

They create both heat islands and cool islands depending on where you are measuring temperature.

- Heat islands exist *above* solar arrays and are comparable in magnitude to urban heat islands (1 – 4°C)^{1,2,3}.
- Heat islands exist at heights of 5m – 18m above the solar panel structure but dissipate thereafter^{1,4}.
- Cool islands exist *below* solar arrays as the ground is shaded, with soil temperatures and land temperatures lower than surrounding environments^{3,4,5}.
- Heat and cool islands associated with solar farms are strongest during the day compared to night^{1,3}. This contrasts with urban heat islands which are typically stronger at night. This is because solar panels don't "store" heat like concrete structures.

Do the effects from heat islands over solar farms exist beyond the solar farm itself?

There is no evidence that these effects exist beyond solar farms to any appreciable distance. No effects have been measured beyond several hundred metres from the edge of solar farms. The effects get smaller as you move further away from the farm.

- One modelling study² estimated the heat island influence above a solar farm to extend to approximately 300 m from the edge of the solar farm.
- One observational study¹ showed no heat island effect at a distance of 1km from the solar farm.
- One study showed that solar farms in China and the US had a cooling effect of land surface temperatures up to 730 m distance from the farm⁵.

¹Barron-Gafford, G. et al. (2016) The photovoltaic heat island effect: larger solar power plants increase local temperatures. *Scientific Reports*, 6, 35070, <https://doi.org/10.1038/srep35070>

² Fthenakis, V. and Yu, Y. (2013) Analysis of the potential for a heat island effect in large solar farms. *IEEE 39th Photovoltaic Specialists Conference (PVSC)*, Tampa, FL, USA, 2013, pp. 3362-3366, doi: 10.1109/PVSC.2013.6745171.

³Yang, Y. et al. (2017) Study on the local climatic effects of large photovoltaic solar farms in desert areas. *Solar Energy*, 144, 244-253, <https://doi.org/10.1016/j.solener.2017.01.015>

⁴ Xu, Z. et al. (2024) A global assessment of the effects of solar farms on albedo, vegetation, and land surface temperature using remote sensing. *Solar Energy*, 268, 112198, <https://doi.org/10.1016/j.solener.2023.112198>

⁵Guoqing L. et al. (2021) Ground-mounted photovoltaic solar parks promote land surface cool islands in arid ecosystems. *Renewable and Sustainable Energy Transition*, 1, 100008, <https://doi.org/10.1016/j.rset.2021.100008>

2. **Melina BATH, page 22**

Question Asked:

I have got another question, which you might take on notice for me. Have ARC scientists looked into the volume of CO₂ emissions that occur in a broadscale, large-scale bushfire? I would say, for example, in 2019–20 across all of Australia, but you can use Victoria. Have you done any quantifiable assessment on that? Then I guess my other question would be in relation to what ARC's view is on the practical application of reducing that, broadscale. Reducing to net zero is great, but what else? That is one facet, but we need to have operations on the ground that are working now to mitigate bushfire.

Kimberley REID: There has been research into the carbon emissions coming from bushfires. I do not have the numbers off the top of my head, but we can take that on notice.

Response:

We refer the committee to the report published by the federal Department of Climate Change, Energy, the Environment and Water who quantified the carbon emissions from bushfires in Australia¹. They estimate that the 2019-2020 Black Summer fires led to about 800 million tonnes of equivalent CO₂ emissions directly and an estimated similar value of lost CO₂ sequestration in the following decade i.e. The reduction in vegetation caused by the fires decreased the amount of CO₂ that could be sequestered by the land system over the following decade, further impacting CO₂ levels. For

context, Australia's CO2 emissions in 2022 were approximately 464 million tonnes CO2 equivalent².

For more details on how bushfire emissions are calculated, I refer the committee to the University of Tasmania's report on Measuring and Reporting Bushfire Emissions³.

The extent and intensity of the Black Summer fires were unprecedented in the historical record, which is consistent with anthropogenic climate change projections⁴. The frequency of very high fire danger days is expected to increase in Victoria during the 21st Century⁵.

As for mitigating bushfire hazards beyond reducing emissions, that question should be directed to the Country Fire Authority or Forest Fire Management Victoria, as that is not our area of expertise.

¹<https://www.dcceew.gov.au/climate-change/publications/estimating-greenhouse-gas-emissions-from-bushfires-in-australias-temperate-forests-focus-on-2019-20>

²<https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-gas-inventory-quarterly-update-december-2022>

³https://www.utas.edu.au/_data/assets/pdf_file/0009/1697841/Measuring-and-reporting-bushfire-emissions.pdf

⁴Anjana Devanand *et al.*, Australia's Tinderbox Drought: An extreme natural event likely worsened by human-caused climate change. *Sci. Adv.*10,eadj3460(2024).DOI:[10.1126/sciadv.adj3460](https://doi.org/10.1126/sciadv.adj3460)

⁵Clark Scott, Mills Graham, Brown Timothy, Harris Sarah, Abatzoglou John T. (2021) Downscaled GCM climate projections of fire weather over Victoria, Australia. Part 2*: a multi-model ensemble of 21st century trends. *International Journal of Wildland Fire* 30, 596-610.