



Supporting Information

Supplementary material

**This appendix was part of the submitted manuscript and has been peer reviewed.
It is posted as supplied by the authors.**

Appendix to: Beggs PJ, Woodward AJ, Trueck S, et al. The 2024 report of the *MJA–Lancet* Countdown on health and climate change: Australia emerging as a hotspot for litigation. *Med J Aust* 2025; doi: 10.5694/mja2.52616.

Appendix: The 2024 report of the *MJA-Lancet* Countdown on health and climate change: Australia emerging as a hotspot for litigation

This Appendix includes details of the data, methods, and caveats for each of the 25 indicators assessed in the 2024 *MJA-Lancet* Countdown. It also includes additional figures and tables that further illustrate some of the indicators. Finally, it includes, for several indicators, current thoughts regarding the potential future form of the indicator. This is provided in the context of this being the seventh *MJA-Lancet* Countdown annual report and the acknowledgement that its indicators, like those of the *Lancet* Countdown, will likely continue to develop in future annual assessments.

Section 1: Health hazards, exposures, and impacts

1.1 Exposure of vulnerable populations to heatwaves

Data

The heatwave dataset employed for this calculation is the Bureau of Meteorology's national Excess Heat Factor (EHF) heatwave analysis (Nairn and Fawcett 2013; Nairn and Fawcett 2015).

Methods

0.25°-resolution national grids of EHF were extracted for three-day periods containing days during the heatwave seasons (November-March) of 1974-1975 to 2023-2024, with tapered down-weighting for the four three-day periods (two at each end) which are only partially within the November-March season. The data from each season were accumulated over the season to create grids of annual heat load. Only positive values of the EHF (positive values indicating the presence of heatwave, negative values its absence) are included in the accumulation. The annual grids were area-averaged to produce a time series of nationally averaged annual heat load. Ordinary least squares linear regressions were calculated over the last 50 heatwave seasons (1974-1975 to 2023-2024); and 20 heatwave seasons (2004-2005 to 2023-2024).

Additional calculations were performed, replacing the area weighting in the area averaging process with a population-weight matrix grid obtained from gridded population data released by the Australian Bureau of Statistics from its 2011 national census. The population

weighting in the calculation assumes that the relative population distribution across the country remains unchanged, without assuming explicitly that the national-total population remains unchanged.

Future form of the indicator

No changes proposed at this time, but it is anticipated that the underlying daily temperature analysis data set will have been upgraded by the time of the next report.

1.2 Heat and physical activity

Data

Data for this indicator are the same as those used for “Indicator 1.1.2: heat and physical activity” in Romanello et al. (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 1.1.2: heat and physical activity” in Romanello et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 1.1.2: heat and physical activity” in Romanello et al. (2024).

Future form of the indicator

Results will be updated using each new year of available climate data and, as sports authorities issue their updated threshold guidelines, they will be expressed according to the latest policy developments. Subsequent versions of the indicator will integrate seasonal changes in solar radiation to overcome the current assumption of summertime levels of solar radiation intensity year-round. Future versions will also explore the derivation of different heat stress risk thresholds for different subpopulation groups, eg, acclimatised, unacclimatised, elderly, young children.

1.3 Bushfires

Data

Data for this indicator are the same as those used for “Indicator 1.2.1: Wildfires” in Romanello et al. (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 1.2.1: Wildfires” in Romanello et al. (2024). Trend lines through the annual wildfire exposure and wildfire risk data were calculated using ordinary least squares linear regressions.

Caveats

Caveats for this indicator are the same as those for “Indicator 1.2.1: Wildfires” in Romanello et al. (2024).

Future form of the indicator

In subsequent years this indicator may evolve to include mean annual exposure to fire smoke fine particulate matter (fire PM_{2.5}).

1.4 Drought

Data

We used data from the Standardised Precipitation Evapotranspiration Index (SPEI) Global Drought Monitor near real-time database of drought conditions at the global scale (Beguería et al. 2024). The data were at a 1×1 degree spatial resolution and six monthly time resolution.

Methods

Methods for this indicator are the same as those used for the Drought indicator in Beggs et al. (2024).

Caveats

In the previous *MJA-Lancet* Countdown reports we used our own calculations from the Australian Water Availability Project (Australian Bureau of Meteorology) gridded data at higher spatial resolution (0.05×0.05 degree). Due to resource constraints this year we used the lower spatial resolution data available online, and this decreased the resolution from 0.05 degrees (approximately 5 kilometres) to 1 degree (approximately 100 kilometres). There is a degradation in the specificity of the indicator due to this, with a smoothing effect as the variability in the data is reduced by the aggregation.

In addition, and as explained in the previous *Lancet* Countdown reports, this indicator does not reflect population exposure adequately. It is not clear how to improve the exposure measure because droughts can affect human populations in a variety of ways both in proximity to their residence (especially at the location of farms, for example) or at a large distance (through the impact on fresh food availability felt at urban locations).

Future form of the indicator

No future modifications are planned for this indicator unless resources become available to do so.

Section 2: Adaptation, planning, and resilience for health

2.1 Health adaptation plans and assessments

Data

Data for this indicator are largely the same as those used for “Indicator 2.1 Health adaptation plans and assessments” in Beggs et al. (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 2.1 Health adaptation plans and assessments” in Beggs et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 2.1 Health adaptation plans and assessments” in Beggs et al. (2024).

Future form of the indicator

Future versions of this indicator will focus on the development and implementation of the National Adaptation Plan and Health National Adaptation Plan, as well as state and territory adaptation and health adaptation plans.

2.2 Detection, preparedness, and response to health emergencies

Data

Data for this indicator are the same as those used for “Indicator 2.2.5 Detection, preparedness, and response to health emergencies” in Romanello et al. (2023). Data obtained from the World Health Organization International Health Regulations Capacity Progress website (World Health Organization 2019). Description of the International Health Regulations capacities can be found in World Health Organization (2018).

Methods

Methods for this indicator are the same as those used for “Indicator 2.2.5 Detection, preparedness, and response to health emergencies” in Romanello et al. (2023).

Caveats

Caveats for this indicator are the same as those for “Indicator 2.2.5 Detection, preparedness, and response to health emergencies” in Romanello et al. (2023).

Future form of the indicator

The future form of this indicator is the same as that for “Indicator 2.2.5 Detection, preparedness, and response to health emergencies” in Romanello et al. (2023).

2.3 Migration and displacement

Data

Data for this indicator are the same as those used for “Indicator 2.4 Migration and displacement” in Beggs et al. (2024).

Data sources:

Internal Displacement Monitoring Centre (2024)

World Bank (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 2.4 Migration and displacement” in Beggs et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 2.4 Migration and displacement” in Beggs et al. (2024).

Future form of the indicator

As newer and higher spatial resolution and more precise datasets become available, methods will be updated to produce more robust estimates of population exposure to sea-level rise and weather-related population displacement.

2.4 Bushfire adaptation**Data**

This indicator reports two sets of data related to bushfire adaptation, as detailed below.

Number of Australian National Aerial Firefighting Centre (NAFC) aircraft contracts/Services per year on behalf of state and territory governments. Data for the period 2007-08 to 2022-23 were obtained from NAFC Annual Reports, a NAFC Booklet, and a NAFC Poster via the NAFC website (NAFC 2023), the Parliament of Australia (2020), as well as through a direct request to NAFC which provided the datum for a missing year (2017-18) and confirmation of the data from other years. NAFC aircraft Services represent the number of aircraft in Australia available to fight bushfires. It should be noted that some aircraft double up for the north and south of the country, for example, an aircraft may run in Queensland then move to Tasmania as a separate Service. A Service is usually exclusive to NAFC’s use, mostly for 84 or 96 days each summer (some Services run longer).

The numbers of volunteer firefighters and support staff in Australia per year from 2009-10 to 2022-23 were obtained from the Australian Government Productivity Commission's Report on Government Services 2024 (Australian Government Productivity Commission 2024). Specifically, data were obtained from Part D (Emergency management), Section 9 (Emergency services for fire and other events), Table 9A.4 (Fire service organisations human resources). Volunteer data were used because bushfire fighting and bushfire mitigation are primarily conducted by volunteers in Australia.

Methods

To track progress on bushfire adaptation in Australia this indicator analyses aerial and terrestrial firefighting capacity.

Caveats

While the two areas examined in this indicator are important with regard to bushfire adaptation in Australia, there are many other important aspects of bushfire adaptation in Australia, including those described and recommended in the Royal Commission into National Natural Disaster Arrangements Report (Royal Commission into National Natural Disaster Arrangements 2020).

Future form of the indicator

The indicator could evolve through the development of a bushfire adaptation index which integrates the two separate aspects considered here into a single annual number.

Section 3: Mitigation actions and health co-benefits

3.1 Energy system and health

Data

Data for this indicator are the same as those used for "Indicator 3.1.1 Energy systems and health" in Romanello et al. (2024). Data for Australia were added.

Methods

Methods for this indicator are the same as those used for "Indicator 3.1.1 Energy systems and health" in Romanello et al. (2024).

Caveats

Caveats for this indicator are the same as those for "Indicator 3.1.1 Energy systems and health" in Romanello et al. (2024).

Future form of the indicator

Future reports can offer a more detailed analysis of changes in the energy mix of Australia, as well as the pace of the transition to a lower-carbon energy system, also as compared to other countries. Decarbonisation efforts can be tracked in greater detail to assess their effect on the carbon intensity of energy systems within Australia and across different countries.

3.2 Clean household energy

Data

Data for Australia were sourced from Clean Energy Council (2024).

Methods

This indicator offers a descriptive summary.

Caveats

Caveats for this indicator are the same as those for “Indicator 3.2 Clean household energy” in Beggs et al. (2024).

Future form of the indicator

This indicator can be expanded by incorporating measures of air pollution impacts resulting from clean household energy transitions. As we already pointed out in previous assessments, persistent gaps in data collection for Indigenous and remote communities continue to hinder a comprehensive understanding of energy use as well as associated environmental and health consequences.

3.3 Exposure to particulate matter air pollution in cities

Data

Data preparation for this indicator was improved since the method used for indicator 3.5.1. “Exposure to air pollution in cities” in Beggs et al. (2024). In brief, we used information on PM_{2.5} pollution obtained for 2000-2022 from the validated monitor observations from the National Air Pollution Monitor Database, along with data for 2023 obtained from the un-validated data from a web-scraping tool. We have calculated air pollution exposure for spatial boundaries for cities with populations greater than 100 000 obtained from the Australian Bureau of Statistics (2016). This year we included more up-to-date validated monitoring data to fill gaps for the years prior to 2023 with additional data from the Centre for Safe Air’s National Air Pollution Monitoring Database (NAPMD) via new sharing agreements made with State and Territory Governments (Centre for Safe Air 2024). However, national data for the most recent year (2023) were only available from a database of un-validated data developed by the University of Tasmania and CSIRO for the AQVx near-real-time Bushfire

smoke forecasting project. That database is derived from web scraping unvalidated data from the APIs of the regulatory monitor data from New South Wales Department of Climate Change, Energy, the Environment and Water, Environment Protection Authority Victoria, Queensland Government Department of Environment, Science and Innovation, Environment Protection Authority South Australia, Government of Western Australia Department of Water and Environmental Regulation, Environment Protection Authority Tasmania, Northern Territory Environment Protection Authority, and Australian Capital Territory Health (AQVx and Centre for Safe Air 2024).

Methods

Methods for calculating the monthly and annual exposure estimates are the same as those for indicator 3.5.1. “Exposure to air pollution in cities” in Beggs et al. (2024), except we did not impute missing hours for the new validated data for 2021 and 2022.

Caveats

Caveats for this indicator are the same as those for indicator 3.5.1. “Exposure to air pollution in cities” in Beggs et al. (2024).

Future form of the indicator

No future modifications are planned for this indicator unless resources become available to do so.

3.4 Sustainable and healthy transport

Data

State of Electric Vehicles: July 2023 - Electric Vehicle Council (2023).

Australian Electric Vehicle Industry Recap 2023 - Electric Vehicle Council (2024).

VFACTS 2023 - Federal Chamber of Automotive Industries (FCAI) (2024).

Australian Energy Update 2023 – Australian Government Department of Climate Change, Energy, the Environment and Water (2023).

Methods

Methods for this indicator are the same as those used for “3.3: Sustainable and healthy transport” in Beggs et al. (2024).

Caveats

Caveats for this indicator are the same as those for “3.3: Sustainable and healthy transport” in Beggs et al. (2024).

Future form of the indicator

As the electric vehicle fleet begins to grow over the next decade, there is the potential to add electric vehicles that do not require registration like electric bikes and scooters. Other valuable data could include details of trip exposure specific to electric vehicles (eg, average km travelled per trip, total km per year, the share of total km driven, etc.).

3.5 Emissions from agricultural production and consumption

Data

Data for this indicator are the same as those used for “Indicator 3.3.1: Emissions from agricultural production and consumption” in Romanello et al. (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 3.3.1: Emissions from agricultural production and consumption” in Romanello et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 3.3.1: Emissions from agricultural production and consumption” in Romanello et al. (2024).

For this indicator, emissions from palm oil are included in “other crops” as they do not represent a substantial proportion of the total in Australia.

It should be noted that while Australian results are in good agreement with national government estimates, the results for New Zealand are overall higher - total for New Zealand in our analysis is 52 MtCO_{2e} and for New Zealand government estimates is 42 MtCO_{2e} (New Zealand Government Ministry for the Environment 2024). Differences such as this are due to the *Lancet* Countdown analysis having been developed with global estimates in mind, and there will be nuances that are captured in national estimates that are not captured in the *Lancet* Countdown analysis. However, our analysis enables comparison across countries and, for each country, over time.

Future form of the indicator

It is hoped that future iterations of this indicator will include the contribution of emissions from food transport.

3.6 Diet and health co-benefits

Data

Data for this indicator are the same as those used for “Indicator 3.3.2: Diet and Health Co-Benefits” in Romanello et al. (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 3.3.2: Diet and Health Co-Benefits” in Romanello et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 3.3.2: Diet and Health Co-Benefits” in Romanello et al. (2024).

Future form of the indicator

The indicator may evolve and be improved over time (ie, in subsequent years) as described for “Indicator 3.3.2: Diet and Health Co-Benefits” in Romanello et al. (2024).

3.7 Health-care sector emissions

Data

Data for this indicator are the same as those used for “Indicator 3.5: Healthcare sector emissions and harms” in Romanello et al. (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 3.5: Healthcare sector emissions and harms” in Romanello et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 3.5: Healthcare sector emissions and harms” in Romanello et al. (2024).

Future form of the indicator

A future form of the indicator could include updated sector-level estimates of health sector’s indirect emissions.

Section 4: Economics and finance

4.1 Economic losses due to climate-related extreme events

Data

Reported data is based on figures on total insured economic losses from disaster events provided in the Historical Catastrophe Data of the Insurance Council of Australia (ICA 2024). The database includes recorded data from the ICA on disaster events that have occurred over the last 50 years in Australia.

Cumulative annual insured losses arising from bushfires, cyclones, flooding, hail storms, storm flooding, tornados and other climate-related extreme events are considered. Extreme

events related to earthquakes, arson, gas disruptions, etc. (that are also reported in the ICA database), have been excluded.

Methods

Methods for this indicator are the same as those used for indicator “4.1. Economic losses due to climate-related extreme events” in Beggs et al. (2024).

Caveats

Caveats for this indicator are the same as those for indicator “4.1. Economic losses due to climate-related extreme events” in Beggs et al. (2024).

Future form of the indicator

An ideal form of this indicator would allow attribution of the total economic losses (instead of total insured economic losses) to events induced by climate change. However, such attribution is unlikely to be feasible. As such, it is not envisaged that this indicator will significantly alter.

4.2 Clean energy investment

Data

The data for this indicator are sourced from the annual State of the Energy Market reports by the Australian Government Australian Energy Regulator (AER 2023) and the Australian Energy Market Operator (2024a) Generation Information page. Numbers are reported as generation of MW capacity and not as investment in AUD.

Methods

Methods for this indicator are the same as those used for “Indicator 4.2 Coal and clean energy investment” in Beggs et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 4.2 Coal and clean energy investment” in Beggs et al. (2024).

Future form of the indicator

It is not envisaged that the form of this indicator will change over time.

4.3 Employment in low-carbon and high-carbon industries

Data

Data for this indicator are provided by the Australian Bureau of Statistics.

Data for Full-Time Equivalent (FTE) employment in renewable energy activities are sourced from:

<https://www.abs.gov.au/statistics/labour/employment-and-unemployment/employment-renewable-energy-activities-australia/latest-release>

FTE employment in mining operations is taken as a proxy for employment in high-carbon industries. The data for FTE employment in mining operations are sourced from:
<https://www.abs.gov.au/statistics/industry/industry-overview/australian-industry/latest-release#data-download>

This indicator includes the sub-categories 06 Coal mining, 07 Oil and gas extraction, 08 Metal ore mining, 09 Non-metallic mineral mining and quarrying, 10 Exploration and other mining support.

Methods

Methods for this indicator are the same as those used for “Indicator 4.4. Employment in low-carbon and fossil fuel energy industries” in Beggs et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 4.4. Employment in low-carbon and fossil fuel energy industries” in Beggs et al. (2024).

Future form of the indicator

It is not envisaged that the form of this indicator will change over time.

4.4 Funds divested from fossil fuels

Data

The data for the first indicator are collected from the Global Fossil Fuel Divestment Commitments Database (2024). Organisations are committed to divestment if they fall into any of the following five categories:

Fossil Free: An institution or corporation that does not have any investments (direct ownership, shares, commingled mutual funds containing shares, corporate bonds) in fossil fuel companies (coal, oil, natural gas) and committed to avoid any fossil fuel investments in the future.

Full: An institution or corporation that made a binding commitment to divest (direct ownership, shares, commingled mutual funds containing shares, corporate bonds) from any fossil fuel company (coal, oil, natural gas).

Partial: An institution or corporation that made a binding commitment to divest across asset classes from some fossil fuel companies (coal, oil, natural gas), or to divest from

all fossil fuel companies (coal, oil, natural gas), but only in specific asset classes (eg, direct investments, domestic equity).

Coal and Tar Sands: An institution or corporation that made a binding commitment to divest (direct ownership, shares, commingled mutual funds containing shares, corporate bonds) from any coal and tar sands companies.

Coal only: An institution or corporation that made a binding commitment to divest (direct ownership, shares, commingled mutual funds containing shares, corporate bonds) from any coal companies.

More details on the list of organisations, including banks, pension funds, local governments, universities, and corporations is available from the following website:

<https://www.divestinvest.org/>.

Data for the second indicator is sourced from the 2024 Integrated System Plan of the Australian Energy Market Operator (2024b) and the Generation Information page of the Australian Energy Market Operator (2024a). Numbers are reported in MW of generation that have been retired, placed into cold storage or mothballed.

Methods

Methods for this indicator are the same as those used for “Indicator 4.4. Funds divested from fossil fuels” in Beggs et al. (2024).

Caveats

Caveats for this indicator are the same as those for “Indicator 4.4. Funds divested from fossil fuels” in Beggs et al. (2024).

Future form of the indicator

Future forms of this indicator should report the actual value of funds divested from fossil fuels by an organisation. The ideal future form of this indicator would have two elements. The first element would track the value of institutional investments in fossil fuel assets, both in absolute terms and as a proportion of their total portfolios. This would also allow for tracking of associated funds that are moved out of fossil fuels but are not explicitly advertised as ‘divesting’. However, such data are unlikely to be available in the near future. The second element of this indicator would more explicitly track the value of funds divested from fossil fuels by for profit organisations and educational, government, healthcare etc. institutions. It is not envisaged that the form of the second indicator (historical and announced withdrawals of coal- and gas- fired power plants) will change over time.

4.5 Net value of fossil fuel subsidies and carbon prices

Data

Data for this indicator are the same as those used for “Indicator 4.2.4 Net value of fossil fuel subsidies and carbon prices” in Romanello et al. (2023) except that the data available are taken only for the more recent year of 2024 and are reported in AUD. The CO₂ emissions data are taken from the Australian Greenhouse Emissions Information System compiled by the Australian Government Department of Industry, Science, Energy and Resources.

Methods

Methods for this indicator are the same as those used for “Indicator 4.2.4 Net value of fossil fuel subsidies and carbon prices” in Romanello et al. (2023).

Caveats

Caveats for this indicator are the same as those for “Indicator 4.2.4 Net value of fossil fuel subsidies and carbon prices” in Romanello et al. (2023).

Future form of the indicator

Updates in the World Bank Dashboard information for Australia would be beneficial to improve this indicator.

Section 5: Public and political engagement**5.1 Media coverage of health and climate change****Data**

Data for this indicator are the same as those used for “Indicator 5.1: Media coverage of health and climate change” in Beggs et al. (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 5.1: Media coverage of health and climate change” in Beggs et al. (2024). The search methods for the major Australian newspapers and ABC online programs were the same as we did previously, except for adding new data up to the end of 2023.

Caveats

Caveats for this indicator are the same as those for “Indicator 5.1: Media coverage of health and climate change” in Beggs et al. (2024).

Future form of the indicator

It would be better to include social media engagement in further assessment.

5.2 Scientific engagement in health and climate change

Data

Data for this indicator are the same as those used for “Indicator 5.2: Coverage of health and climate change in scientific journals” in Beggs et al. (2024).

Methods

Methods for this indicator are the same as those used for “Indicator 5.2: Coverage of health and climate change in scientific journals” in Beggs et al. (2024). The search methods were the same as last year, except for adding the data from 1 January 2022 to 31 December 2023 for the Australian analysis, and adding a search for articles from New Zealand covering the same period.

Caveats

Caveats for this indicator are the same as those for “Indicator 5.2: Coverage of health and climate change in scientific journals” in Beggs et al. (2024).

Future form of the indicator

No change is expected for next year to keep the continuity of the indicator.

5.3 Health and climate change research funding

Data

The Australian National Health and Medical Research Council’s (NHMRC’s) Research Grants Management System (RGMS) was analysed by NHMRC personnel for research funding applications with a focus on health and climate change over the years 2000 to 2023.

Methods

The indicator tracks the annual number of health and climate change grant applications that are funded and not funded, and the corresponding success rate.

Caveats

The number of applications is likely to be an underestimate due to the choice of category descriptors for areas of research in the RGMS (Australian Government NHMRC 2019).

Future form of the indicator

There is potential to develop this indicator by also reporting the annual dollar amounts funded and not funded, funding by funding program, funding by broad research area, funding by field of research, and other more detailed analysis of the data. In the future, this indicator could also track health and climate change research grant applications to the other major Australian Government funder of research, the Australian Research Council (ARC).

5.4 Government engagement in health and climate change

Data

This indicator sought to identify the extent to which Australian governments were working on climate change as a health issue, and/or health was being addressed as an issue affected by climate change. The data used for this report were derived from the Parliamentary websites of the Commonwealth of Australia and its eight States and Territories.

Jurisdiction	Parliamentary website
Commonwealth of Australia	https://www.aph.gov.au
Queensland	https://www.parliament.qld.gov.au/
New South Wales	https://www.parliament.nsw.gov.au/
Australian Capital Territory	https://www.parliament.act.gov.au/
Victoria	https://www.parliament.vic.gov.au/
Tasmania	https://www.parliament.tas.gov.au/
South Australia	https://www.parliament.sa.gov.au/
Western Australia	https://www.parliament.wa.gov.au/
Northern Territory	https://nt.gov.au/

The data collected were as follows: for the Commonwealth of Australia we looked for Bills and Legislation, Committees and Inquiries, and Chamber documents that included a consideration of climate change and health. For the States and Territories, we looked for relevant Bills and Legislation, Committees and Inquiries and overall Hansard records. Hansard is the report of proceedings and verbatim record of what was said in Parliament.

Methods

National

The datasets of the Parliament of Australia public website were searched (https://www.aph.gov.au/Parliamentary_Business) for records from 1 January 2023 to 31 December 2023.

Bills & legislation were searched by whole document and included all current and previous Bills sponsored by Government and Private Members/Senators. Committees & inquiries were searched using titles and summary and included all Senate, House and Joint committees, inquiries and hearings. Chamber documents were searched by whole document and included notice papers, tabled papers, votes and proceedings from the House and journals of the Senate.

Datasets were searched using each key search term for (a) climate change and for (b) health, as listed below. Searches were then conducted for (c) climate change AND health. Terms have been updated to reflect the changing terminology used to discuss climate change and the key health issues facing Australians.

(a) climate change:

“climate change”, “changing climate”, “climate energy”, “climate action”, “climate decay”, “global warming”, “temperature”, “extreme weather”, “global environmental change”, “climate variability”, “greenhouse”, “low carbon”, “ghge”, “renewable energy”, “clean energy”, “carbon emission”, “co2 emission”, “carbon dioxide”, “carbon-dioxide”, “decarbonisation”, “decarbonization”, “carbon neutral”, “carbon-neutral”, “carbon neutrality”, “carbon-neutrality”, “net-zero”, “net zero”, “climate pollutant”, “air pollution”, “drought”, “flood”, “bushfire”, “heat”, “cyclone”.

(b) health:

“malaria”, “dengue”, “diarrhoea”, “infection”, “disease”, “pneumonia”, “epidemic”, “pandemic”, “public health”, “health care”, “epidemiology”, “healthcare”, “health”, “mortality”, “morbidity”, “nutrition”, “illness”, “infectious”, “ncd”, “non-communicable disease”, “noncommunicable disease”, “chronic disease”, “communicable disease”, “malnutrition”, “mental disorder”, “mental health”, “depression”, “suicide”, “obesity”, “death”, “injury”, “food”, “active travel”, “urban design”, “bicycle”, “alcohol”.

(c) climate change AND health

“climate health”, “‘climate change’ AND ‘health’”

Any Bills & legislation identified through searches (a) and (b) were further analysed for overlap between climate change and health by key word searching within the legislation and explanatory memorandum. Documents identified through (a) climate change were searched using the term “health” and documents identified through (b) health were searched using the term “climate change”.

States and Territories

Parliamentary websites were searched for records from 1 January 2023 to 31 December 2023 using the datasets Bills & Legislation and Committees & Inquiries, as well as a total Hansard search. State and territory websites were searched using terms (c) only: ie, “climate health”, “climate change” AND “health”. Documents identified were hand searched for relevance.

Caveats

We have used a number of new climate and health terms that were not used in Indicator 5.3 in Beggs et al. (2024). The following new terms were added: “pollution”, “clean energy”, “active travel”, “urban planning”, “bicycle”, “alcohol”.

Documents that did not use health in the context of human health (eg, ecosystem, ecological or reef health) were excluded.

Due to time constraints we only used terms in category (c) for the states and territories. State and territory websites search tools are quite variable and many do not have advanced search functionality, thereby requiring hand searching of all Bills introduced and Committee Inquiries held in 2023.

At the national level, search (c) did not yield many results (Table A1). As such, (a) and (b) results for Bills were hand searched to identify documents that referenced climate change and health.

Due to the large number of search results, we did not hand search chamber documents from the Parliament of Australia to remove duplicates.

Future form of the indicator

The indicator could be improved over time by using (a) and (b) search terms in state and territory parliaments. However, search functionality of state and territory parliament websites is problematic, requiring hand searching of all Bills introduced and Committee Inquiries held that year.

5.5 Health and climate change litigation in Australia

Data

Data used for this indicator were records of Australian climate change litigation raising health issues located using The University of Melbourne's Australian and Pacific Climate Change Litigation Database, <https://law.app.unimelb.edu.au/climate-change/index.php>. This database records litigation (including settled cases and court orders) on issues of climate change in Australia, New Zealand and the Pacific Islands from 2000 to the present. It is maintained and regularly updated with new litigation records by Melbourne Climate Futures at The University of Melbourne. The database provides summaries of the litigation included, with links to the full text of court-issued judgments or orders in those proceedings.

Methods

A key word search was performed using the Australian and Pacific Climate Change Litigation Database's general search function. The terms used for this search were 'health', 'injury', 'illness', 'death', 'heat', 'air quality', 'air pollution', and 'life'. Terms needed to be searched one by one as the database cannot search for multiple terms simultaneously. The database categorises litigation by the nature of the legal claim involved, including 'human rights' claims. Cases in this category of litigation were also included in the raw data set given the links between health impacts and the limitation of human rights.

The database returned:

- 20 instances of cases mentioning the term ‘health’
- 5 instances of cases mentioning the term ‘injury’
- 1 instance of a case mentioning the term ‘illness’
- 4 instances of cases mentioning the term ‘death’
- 9 instances of cases mentioning the term ‘heat’
- 5 instances of cases mentioning the term ‘air quality’
- 2 instances of cases mentioning the term ‘air pollution’
- 28 instances of cases mentioning the term ‘life’
- 28 instances of cases categorised as ‘human rights’ cases

This dataset was screened to remove:

- Cases decided outside the period 2014-2023.
- Cases filed and pending but for which no court decision was issued in the period 2014-2023.
- Cases from jurisdictions outside Australia.
- Duplicate entries including more than one of the search terms.
- Cases where references to health or related terms were merely incidental rather than indicating any meaningful engagement with health issues in the case.

Some of the database case records included more than one decision, as for instance, if there were prior procedural rulings in a case or if the original decision was appealed to a higher court. In these instances of a linked series of litigation, each was treated as a single case record.

This methodology yielded a dataset of 11 case records of climate litigation raising health or related issues.

The full text judgments of court decisions or orders in each case record were read and analysed to determine the nature and significance of the health arguments made.

Caveats

The database provides a summary of cases but not the full text of relevant judgments. By searching the database with key terms, it may be that some relevant case records are missed. In this instance, the authors used their expert subject matter knowledge to verify that all relevant cases had been included.

While useful for indicating future trends, pending cases — where no court decision had yet been issued — were removed from the dataset.

Future form of the indicator

A capacity to include AI natural language processing to screen full text judgments for references to health could improve the comprehensiveness of the data set analysed over time. We would expect over time that additional categories of climate cases raising health issues will emerge as the energy transition proceeds. This could include cases where communities raise health impacts in opposition to renewable energy/zero emissions energy projects despite the climate benefits of such proposals. The case law database records examples of cases of this kind in Australia pre-2014 associated with the early development of wind farms.

Contributions: PJB is the Director of the *Lancet* Countdown Oceania Regional Centre and leads the *MJA-Lancet* Countdown. Section introductions and conclusions were drafted by: AJW, Section 1; HB, Section 2; MKL, Section 3; ST, Section 4; and AGC, Section 5. AJW contributed the section on New Zealand. Author contributions of indicators were as follows: AM, 3.7; CM, 2.3; DG, 4.5; HK, 3.5; ICH, 1.4, 3.3; JP, 5.5; KB, 5.5; MH, 5.4; MKL, 3.1, 3.2; MS, 3.4; NBA, 1.3; OJ, 1.2; PJB, 2.2, 2.4, 3.6, 5.3, 5.5; SF, 3.6; ST, 4.1-4.4; SV, 2.1; TJC, 1.2; YZ, 5.1, 5.2. ZL-T contributed the text boxes on the nursing response and digital health-care. PJB drafted the manuscript and all authors contributed to reviewing it critically for important intellectual content. All authors provided final approval of the version to be published and agreement to be accountable for all aspects of the work. PJB, MBR, and YZ made substantial contributions to the overall conception and design of the work.

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Table A1. Total number of national Parliament of Australia documents related to climate change, health and climate change and health

		(a) Climate change	(b) Health	(c) Climate change AND health
Bills & legislation	Passed	8	15	0
	Not passed	2	6	0
	Before parliament	3	3	1
	Sub-total	13	24	1
Committees & inquiries	Committees	1	3	0
	Inquiries	5	5	0
	Hearings	7	41	0
	Sub-total	13	49	0
Chamber documents*		2557 (129 title only)	4942 (509 title only)	443 (0 title only)

Note: * The Bill identified using (c) search terms was also identified using both (a) and (b) search terms – [Climate Change Amendment (Duty of Care and Intergenerational Climate Equity) Bill 2023]. There were 13 separate issues discussed in the included inquiries and hearings. The number of chamber documents may contain duplicates across different search terms

Table A2. Total number of bills, committees and inquiries, and Hansard results related to climate change and health in Australian State and Territory Parliaments

Jurisdiction	Bills	Committees & Inquiries	Total Hansard results
Queensland	3	4	44
New South Wales	1	10	117
Australian Capital Territory	3	6	74
Victoria	4	7	98
South Australia	2	1	93
Tasmania	0	1	85
Western Australia	2	7	94
Northern Territory	0	1	50
All States and Territories	15	37	655

Table A3. Climate health related bills and inquiries before Australian State and Territory Parliaments

Jurisdiction	Bill or Inquiry title	Sponsor/ Committee*
QLD	Emergency Services Reform Amendment Bill 2023	Minor party (GNS)
	Agriculture and Fisheries and Other Legislation Amendment Bill 2023	Government (ALP)
	Queensland Climate Transition Bill 2023	Government (ALP)
	Inquiry into the impact of climate change on Queensland agricultural production	Health, Environment and Agriculture Committee
	2023-24 Budget Estimates	Health and Environment Committee
	Inquiry into the economic and regulatory frameworks for Queensland island resorts	Transport and Resources Committee
	Report No. 45, 57th Parliament - Queensland Climate Transition Bill 2023	State Development and Regional Industries Committee
NSW	Climate Change (Net Zero Future) Bill 2023	Government (ALP)
	Inquiry Climate Change (Net Zero Future) Bill 2023	Planning and Environment Committee
	2024 review of the annual reports and other matters of the Office of the Advocate for Children and Young People and the Office of the Children's Guardian	Committee on children and young people
	Inquiry into the feasibility of undergrounding the transmission infrastructure for renewable energy projects	Select Committee on the Feasibility of Undergrounding the Transmission Infrastructure for Renewable Energy Projects

	Budget Estimates 2023-2024	Premier and Finance Committee, Health Committee, Education Committee, Regional NSW Committee, Justice and Communities Committee, Transport and Arts Committee, Planning and Environment Committee
	Inquiry into Planning system and the impacts of climate change on the environment and communities	Planning and Environment Committee
	Inquiry into Current and future public transport needs in Western Sydney	Transport and Arts Committee
	Inquiry into Protecting Local Water Utilities from Privatisation	Joint Select Committee on Protecting Local Water Utilities from Privatisation
	inquiry into current and potential impacts of gold, silver, lead and zinc mining on human health, land, air and water quality in New South Wales	Health committee
	Inquiry into Equity, accessibility and appropriate delivery of outpatient and community mental health care in New South Wales	Health committee
	Electric and hybrid vehicle batteries	Joint Standing Committee on Road Safety
ACT	Circular Economy Bill 2023	Government (ALP/ GRN)
	Human Rights (Healthy Environment) Amendment Bill 2023	Government (ALP/ GRN)
	Urban Forest (Consequential Amendments) Bill 2023	Government (ALP/ GRN)
	Inquiry into the ACT environment's bushfire preparedness	Standing Committee on Environment, Climate Change and Biodiversity

	Inquiry into climate change and a just transition	Standing Committee on Environment, Climate Change and Biodiversity
	Inquiry Into Annual and Financial Reports 2022-2023	Standing Committee on Environment, Climate Change, and Biodiversity
	Inquiry into Annual and Financial Reports 2022–2023	Standing Committee on Health and Community Wellbeing
	Inquiry into the Human Rights (Healthy Environment) Amendment Bill 2023	Standing Committee on Justice and Community Safety
	Inquiry into the Territory Plan and other associated documents	Standing Committee on Planning, Transport and City Services
VIC	Environment Legislation Amendment (Circular Economy and Other Matters) Bill 2023	Government (ALP)
	Regulatory Legislation Amendment (Reform) Bill 2023	Government (ALP)
	Energy Legislation Amendment (Energy Safety) Bill 2023	Government (ALP)
	Mineral Resources (Sustainable Development) Amendment Bill 2023	Government (ALP)
	Inquiry into the industrial hemp industry in Victoria	Economy and Infrastructure Committee
	Inquiry into Climate Resilience	Environment and Planning Committee
	Inquiry into the 2022 Flood Event in Victoria	Environment and Planning Committee
	Inquiry into food security in Victoria	Legal and Social Issues Committee
	Inquiry into the rental and housing affordability crisis in Victoria	Legal and Social Issues Committee
	Inquiry into the 2023-24 budget estimates	Public Accounts and Estimates Committee

	Inquiry into the 2021-22 and 2022-23 Financial and Performance Outcomes	Public Accounts and Estimates Committee
SA	Hydrogen and Renewable Energy Bill 2023	Government (ALP)
	Petroleum and Geothermal Energy (Energy Resources) Amendment Bill 2023	Government (ALP)
	Inquiry into Recycling of Soft Plastics and Other Recyclable Material in South Australia	Select Committee on Recycling of Soft Plastics and Other Recyclable Material
WA	Climate Change Bill 2023	Government (ALP)
	Local Government Amendment Bill 2023	Government (ALP)
	Inquiry into the WA Domestic Gas Policy Inquiry	Economics and Industry Standing Committee
	Inquiry into how the Western Australian Government's progress towards achieving Environmental, Social and Governance (ESG) outcomes is assisting to secure international investment Inquiry (15/08/2023)	Public Accounts Committee
	2023-24 Budget estimates Inquiry	Estimates and Financial Operations Committee
	New bite – How alternative proteins could improve dietary and planetary health	Education and Health Standing Committee
	Inquiry into Western Australia's bilateral trade relationship with the Republic of Indonesia	Economics and Industry Standing Committee
	Petition No. 029 – Request for an independent review of the Department of Biodiversity, Conservation and Attractions prescribed burning practices	Environment and Public Affairs Committee
	Overview of Petitions 1 January 2023 - 30 June 2023	Environment and Public Affairs Committee

TAS	Inquiry into Energy Prices in Tasmania	Joint Select Committee on Energy Prices and Related Matters
NT	Estimates Committee 2023	Estimates & Government Owned Corporations Scrutiny Committee

* ALP: Australian Labor Party; LP: Liberal Party; NP: National Party; GRN: Greens Party.

Figure A1. Annual hours per person from 1990 to 2023 across Australia that exceeded the moderate, high and extreme heat stress risk threshold as defined by the 2021 Sports Medicine Australia Extreme Heat Policy (Jay et al. 2021) for light (A) and moderate (B) physical activity

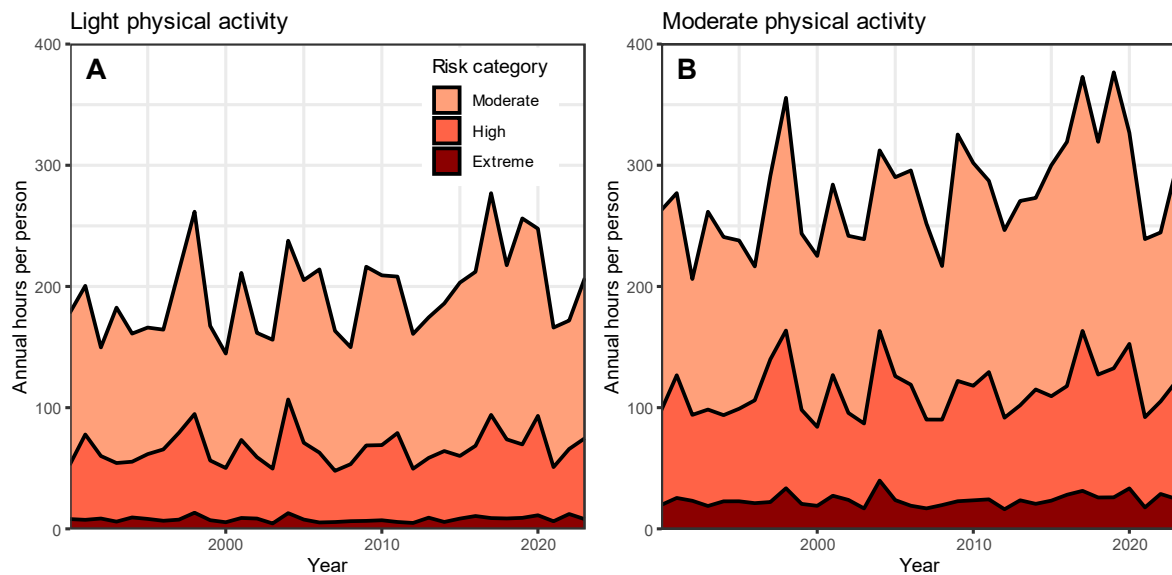


Figure A2. Annual time-series plot of drought affected area in Australia shown as A) percentage of area in “excess severe drought”, “excess extreme drought” and “excess exceptional drought” where an excess event is classified as exceeding 2 standard deviations above the mean annual count of months in each drought class (1950-2005 baseline); and B) annual average Standardised Precipitation-Evapotranspiration Index (SPEI) showing hotter/drier months as scores below zero and wetter/cooler months as scores above zero

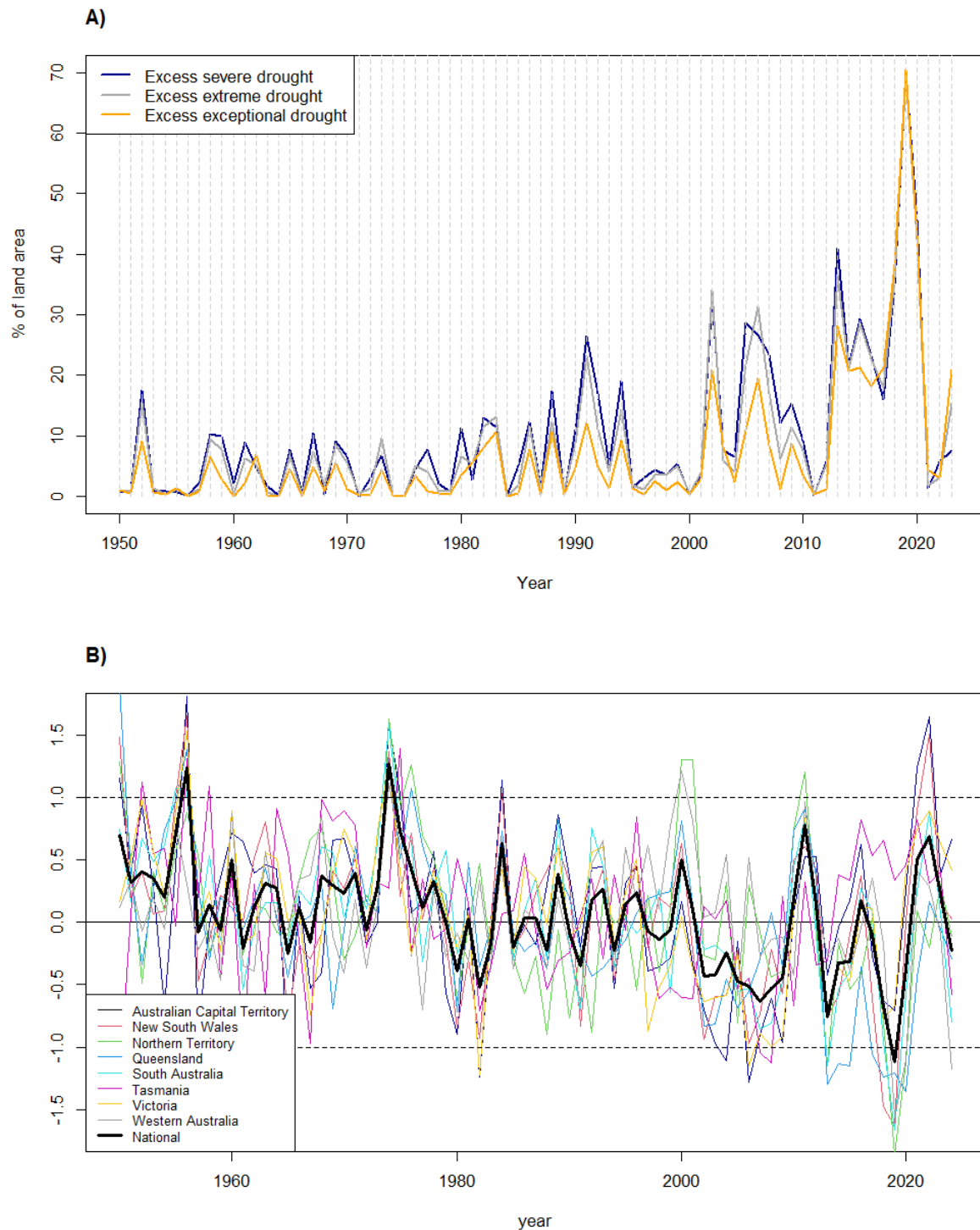


Figure A3. Average of monthly standardised precipitation evapotranspiration index (SPEI) values from August to October 2023, the driest three-month period since 1900. Positive values indicate severity of wet periods compared to the standardised baseline climate, while negative values indicate drier conditions. Levels below -1.3 are considered droughts

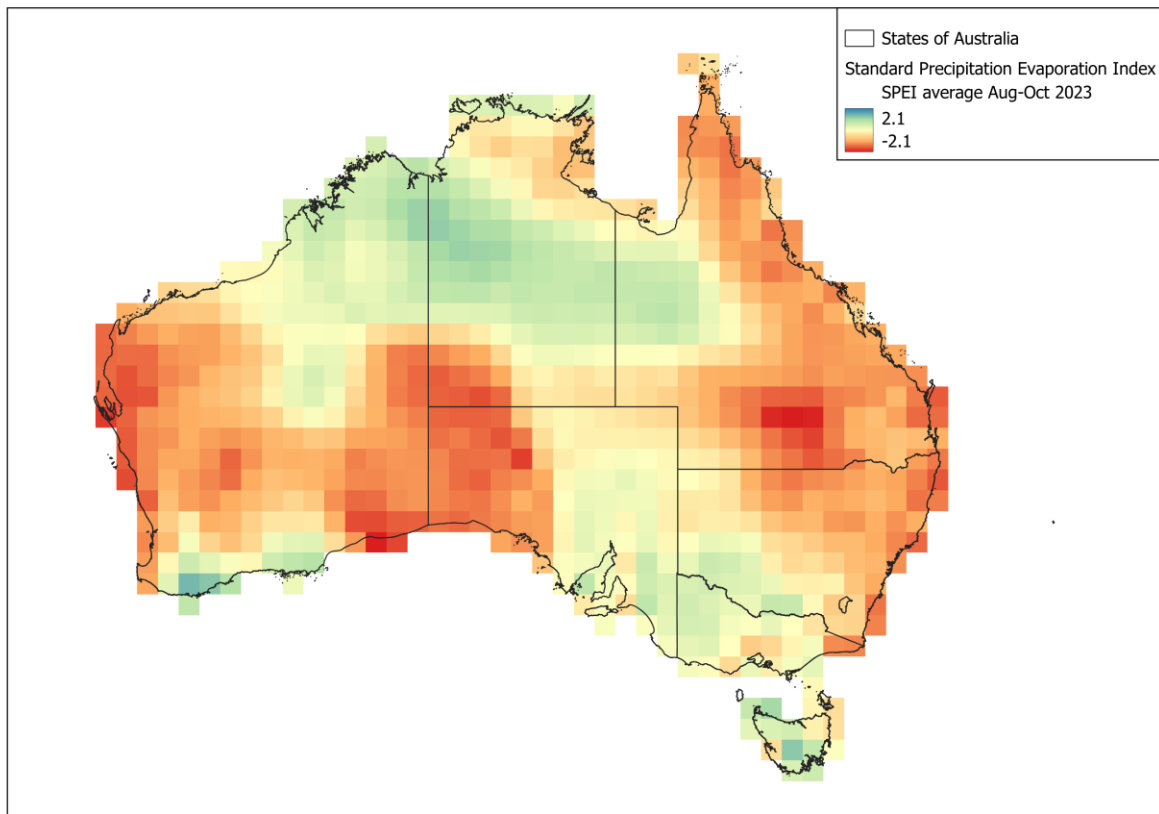
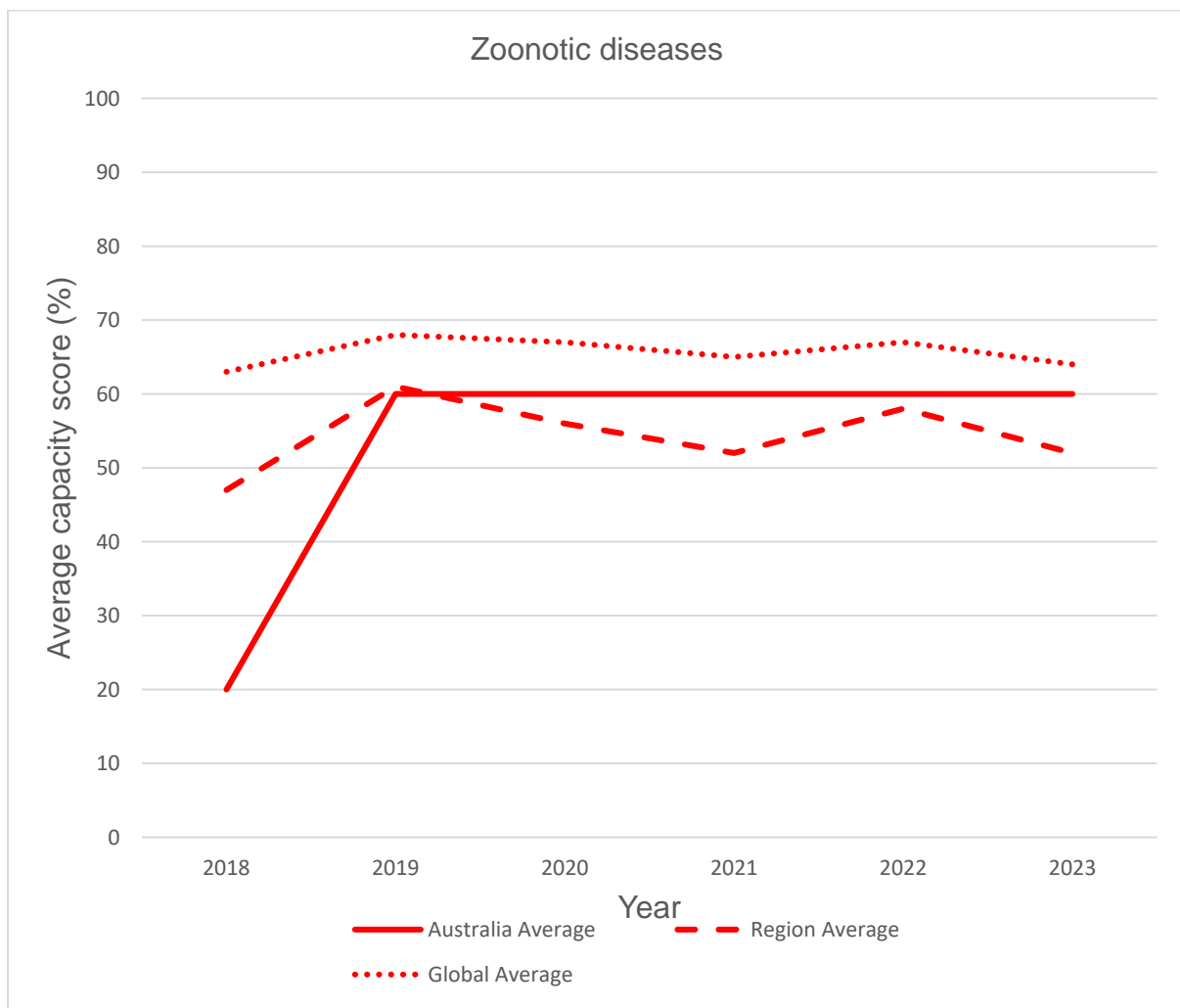
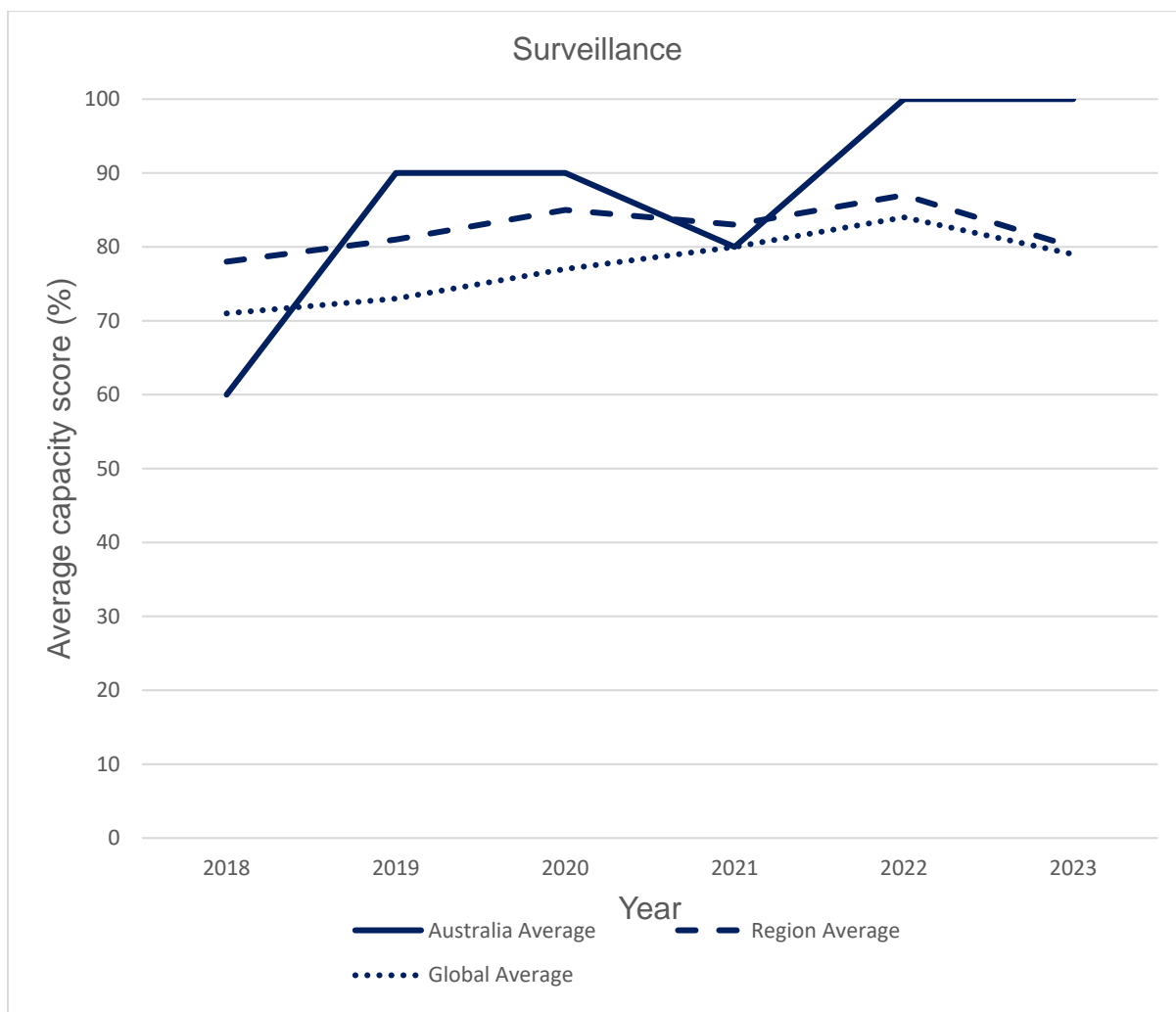
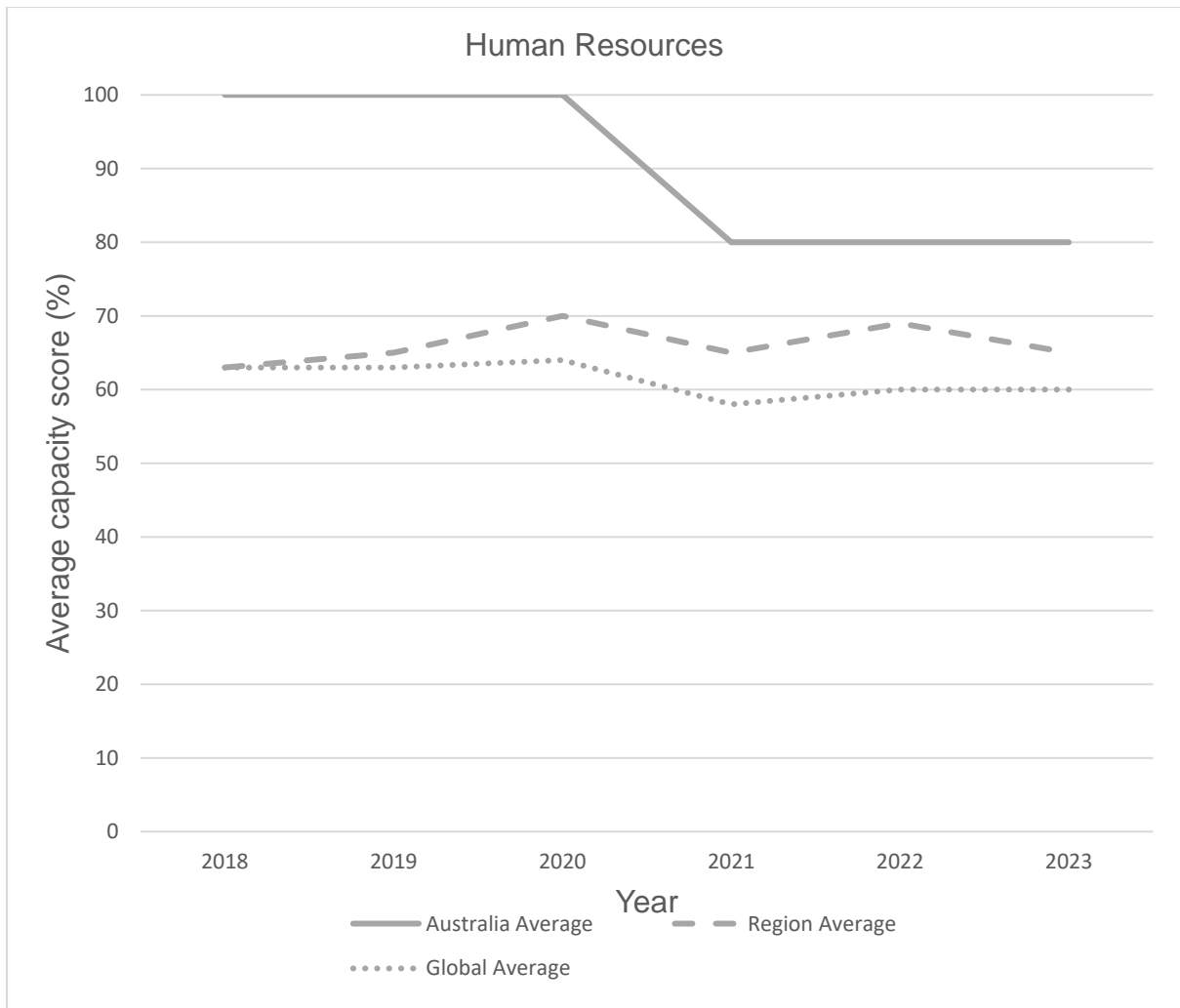


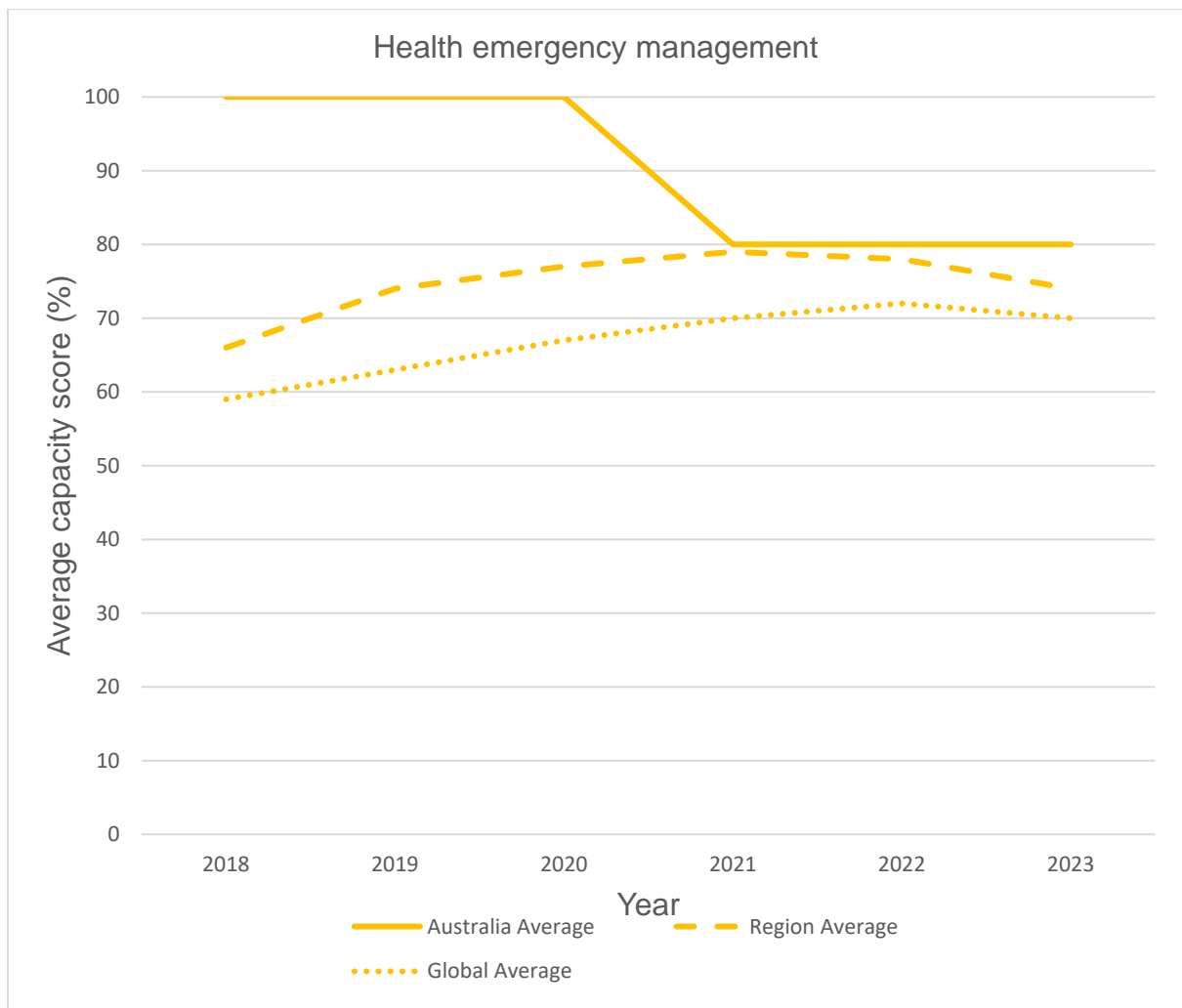
Figure A4. International Health Regulations (2005) monitoring framework annual average capacity scores for Australia, the WHO Western Pacific Region and the globe, for zoonotic diseases, surveillance, human resources, health emergency management, and health services provision, 2018–2023

Data source: World Health Organization (2019).









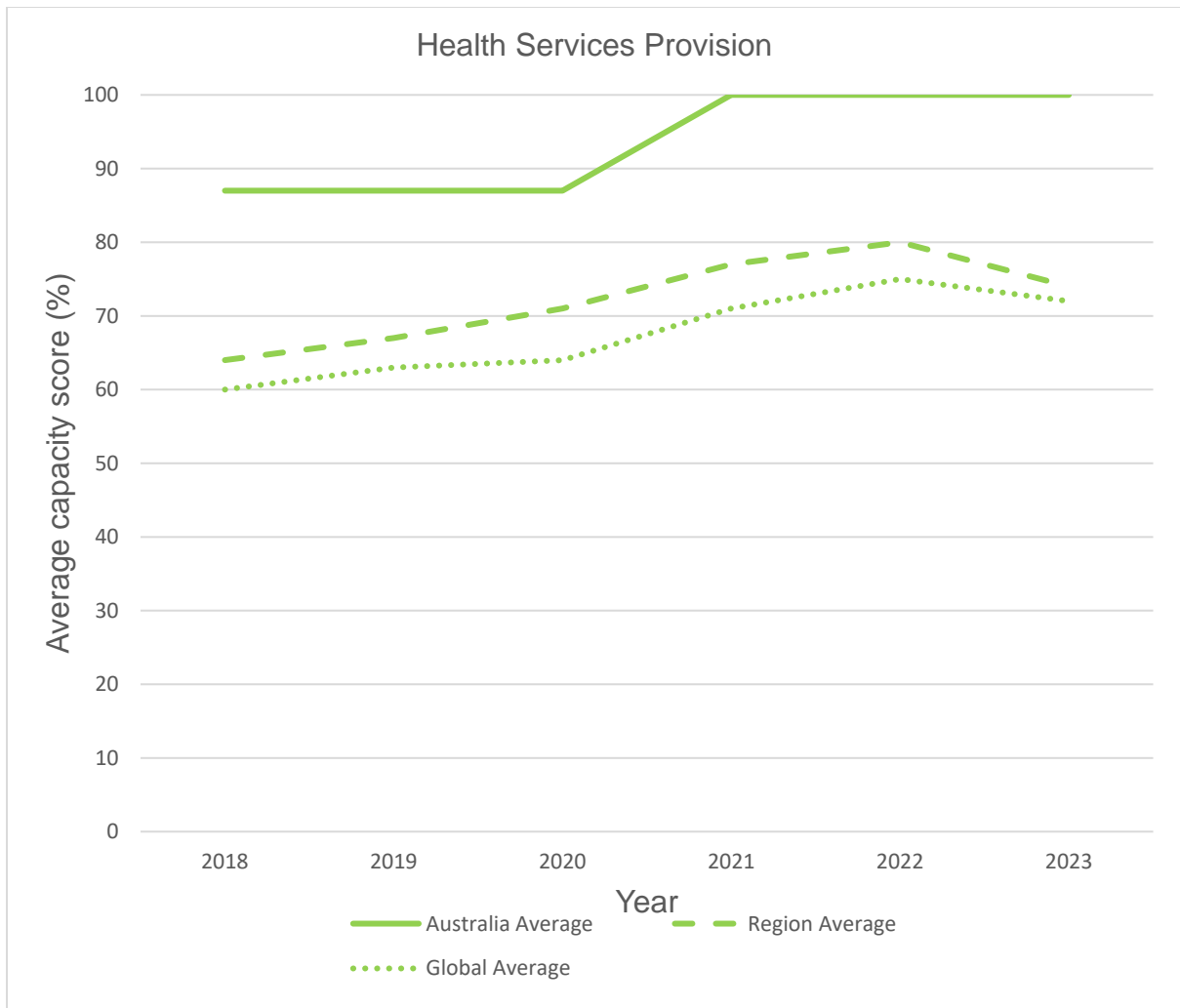


Figure A5. Carbon intensity of total primary energy supply for Australia, selected countries and the world, and corresponding total carbon dioxide (CO₂) emissions, 1971–2022

Data source: International Energy Agency (2024).

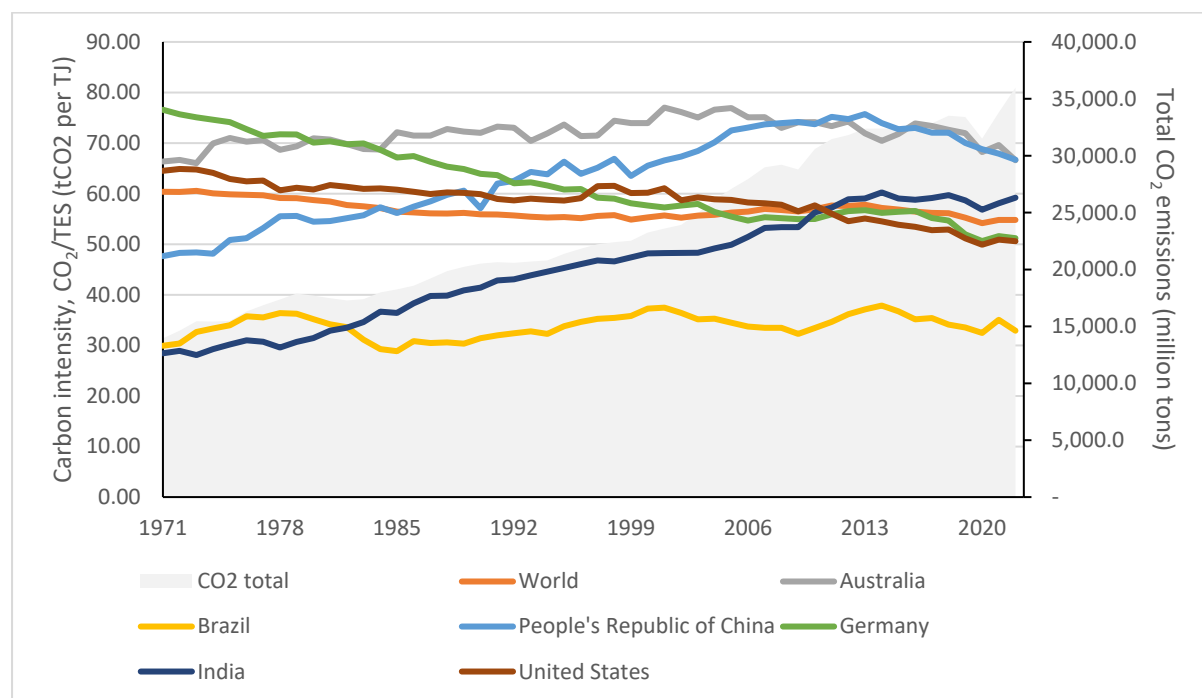


Figure A6. Annual and monthly averages of PM_{2.5} ($\mu\text{g}/\text{m}^3$) 2000-2023 for large cities in each State and Territory. All cities with greater than 100,000 people in each state/territory contributed to the annual average. There are two datasets overlaid together: one is a time-series plot of annual averages (thick black lines) and the other displays the contribution of each month to the annual averages (thin grey lines)

