Bushfires and Climate Change

Latest Science

John Shiel, PhD(Eng)
PhD in adapting houses for climate change and scarce resources

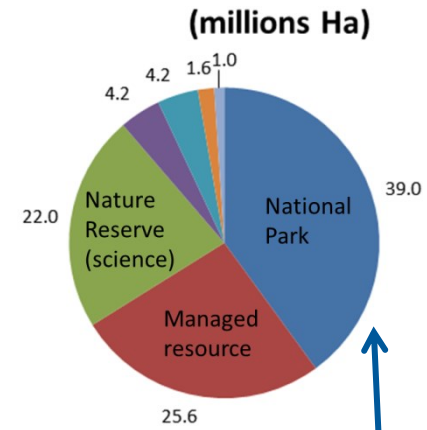
Thx to input & feedback from Dr Dennys Angove, Nigel Stace, Brian Tehan & Jacqui Svenson

I acknowledge the Awabakal people as the Traditional owners of this land,
pay my respects to their Elders, past and present,
and to any Elders from other communities who may be here today.

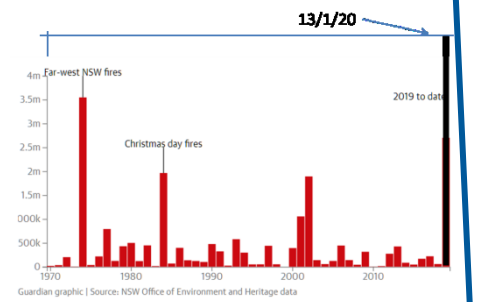
Agenda

1. Bushfire Impact
2. Why? – latest science
3. Bushfire measures to lower risks
4. The Climate Emergency Challenge
5. How we can get to zero carbon in 10 years
6. Q&A

1. Bushfire Impact



- Huge 100 million Ha to protect
  - Oz has worst bushfires of any country in world (mainly grass)
- Halfway thru the 2019-20 bushfire season
  - 11/1/2009
    - 10-15 million Ha (NSW 4.9m – highest ever)
    - 6,000 buildings incl. 2,200 Homes
    - 29 deaths
  - Human
    - Fire deaths, heat stress deaths, respiratory illnesses
  - Biodiversity/Habitat Loss
  - Animal Deaths (stock, horses & other mammals, birds and reptiles)
    - Around 1.25bn animals dead
      - 800m in NSW alone (Chris Dickman, an ecologist at the University of Sydney)
      - www.huffingtonpost.com.au/entry/billion-animals-australia-fires_n_5e13be43e4b0843d361778a6?
    - 15% of 30,000 flying fox colony near Melb dead of heat stress in 3 hot days
    - Species Extinction



- Budget cuts for National Parks
  - more than $200m in 3 years (Davis, J 2019) including fire management

Animal Deaths, Habitat Loss

www.sbs.com.au/news/the-australian-bushfires-have-killed-an-estimated-1-25-billion-animals

www.nationalgeographic.com/animals/2020/01/flying-foxes-are-dying-en-masse-in-australias-extreme-heat/

Dehydrated Koala at Port Macquarie Hospital

Flying Fox Carnage
4,500 dead at Yarra Bend Near Melb
3 days 43°C in Dec 2019

Kangaroo with ash to eat – Kangaroo Island

Major Australian Bushfires (>1 Mha) 13/1/20 (most grass)

https://en.wikipedia.org/wiki/Bushfires_in_Australia#Major_bushfires_in_Australia

Name	Start date	Area burned (approx.) Ha	State(s) /territories	Fatalities	Homes Lost
2019–20 Australian bushfire season – so far	**05/09/19**	**10,700,000**	**NSW, Qld, SA, Tas, Vic, WA**	**29**	**2,400**
Carnarvon bushfire complex	27/12/11	800,000	WA	**173**	2,030
Black Saturday bushfires	07/02/09	450,000	Vic		
The Great Divides bushfire	01/12/06	1,048,000	Vic		
2006–07 Australian bushfire season	01/11/06	1,360,000	NSW, SA, Tas, Vic, Wa	5	83
Tenterden	01/12/03	2,110,000	WA		
2003 Eastern Victorian alpine bushfires	01/01/03	1,300,000	Vic		
2002 NT bushfires	**01/08/02**	**38,000,000**	**NT**		
Black Christmas bushfires	01/11/01	300,000	NSW		
1994 Eastern seaboard fires	01/11/93	400,000	NSW		225
1985 Cobar bushfire	15/01/85	516,000	NSW		
1984 Western New South Wales grasslands bushfires	25/12/84	500,000	NSW		
1984/85 New South Wales bushfires	01/11/84	3,500,000	NSW	5	
Ash Wednesday bushfires	16/02/83	418,000	SA & Vic	**75**	2400
1980 Waterfall bushfire	03/11/80	1,000,000	NSW	5	
1974 Cobar bushfire	01/12/74	1,500,000	NSW		
1974 Moolah-Corinya bushfires, Far West NSW	01/12/74	1,117,000	NSW		
1974 Balranald bushfire	01/12/74	340,000	NSW		
1974–75 New South Wales bushfires	01/11/74	4,500,000	NSW	6	
1974–1975 Northern Territory bushfires	**01/11/74**	**45,000,000**	**NT**		
1974–1975 Queensland bushfires	01/11/74	7,500,000	Qld		
1974–1975 South Australia bushfires	**01/11/74**	**17,000,000**	**SA**		
1974–1975 Western Australia bushfires	**01/11/74**	**29,000,000**	**WA**		
1969-70 Dry River-Victoria River fire	**01/10/69**	**45,000,000**	**NT**		
1968-69 Killarney Top Springs bushfires	**01/10/68**	**40,000,000**	**NT**		
Tasmanian "Black Tuesday" bushfires	07/02/67	264,000	Tas	**62**	1,293
1965 Gippsland bushfires	01/02/65	315,000	Vic		
1961 Western Australian bushfires	01/01/61	1,800,000	WA		160
1951–52 bushfires	**01/11/51**	**4,000,000**	**Vic**	**11**	
1944 bushfires	14/01/44	1,000,000	Vic	18	500
Black Friday bushfires	01/12/38	2,000,000	Vic	**71**	
Black Thursday bushfires	**6/2/1851**	**5,000,000**	**Vic**	**12**	

2. Why?

Causes of Bushfires from latest science

Climate Council. (2019). *This is not normal*

Ignition
- Lightning
- *Deliberate (?)*
- Public utilities
- Agriculture burns

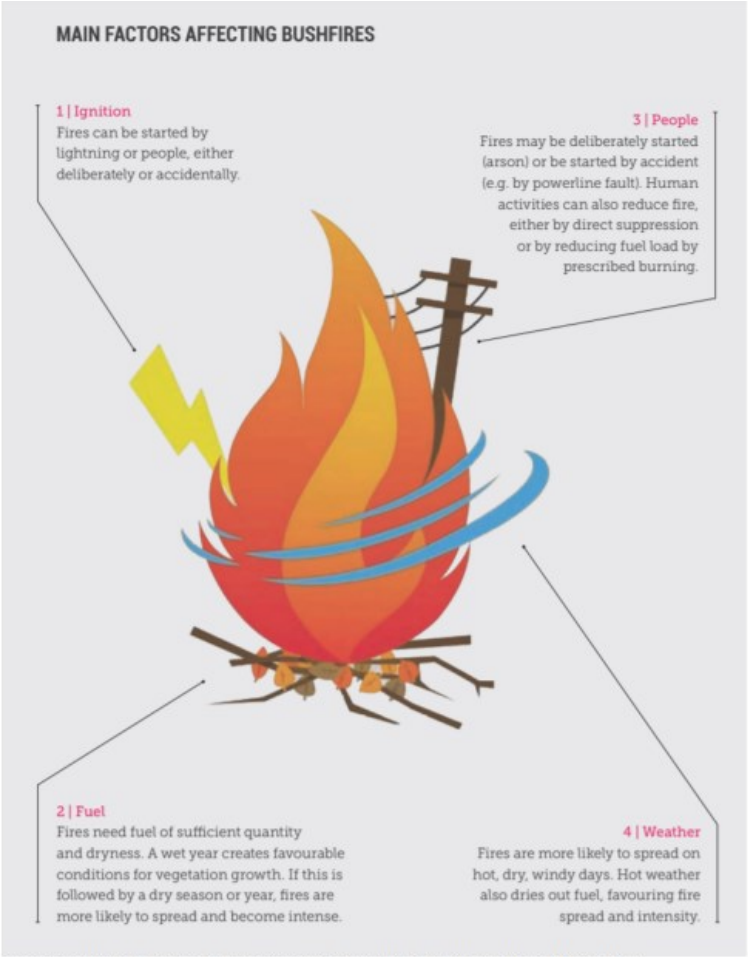


Figure 2: Main factors affecting bushfires: ignition, fuel, people and weather.

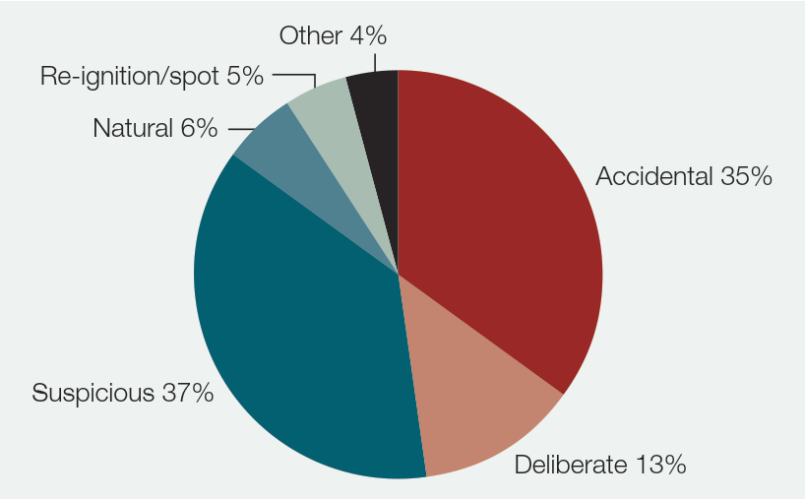
People
- *Deliberate (?)*
- Accidental
- Can reduce risk too

Fuel
- Enough Qty
- Dry
- Budget cuts?

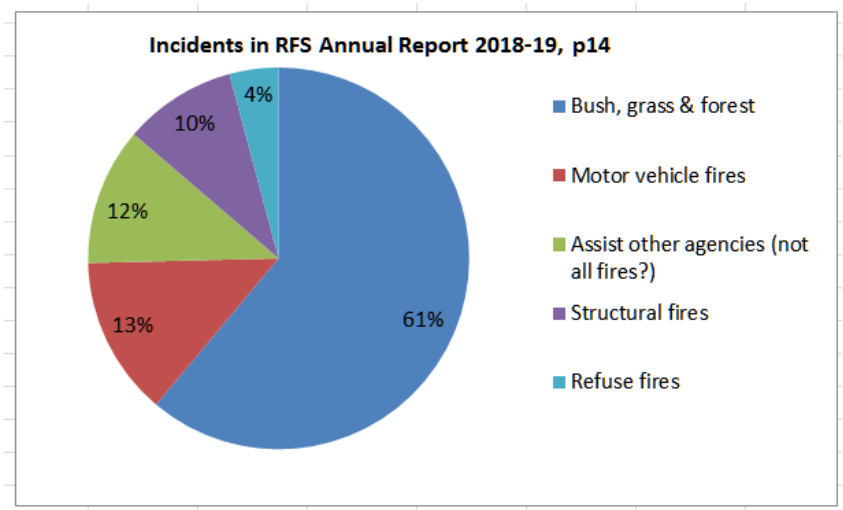
Weather – more days
- **Dry**
  - **Low humidity**
- Hot
- Wind – speeds it up

Climate change has increased temperature by 1.1°C since 1850, but **1.8°C in Australia**

Causes and Types of Bushfires



Australian Institute of Criminology's classification of bushfires
Willis, M. (2004). *Bushfire arson: A review of the literature*. AIC

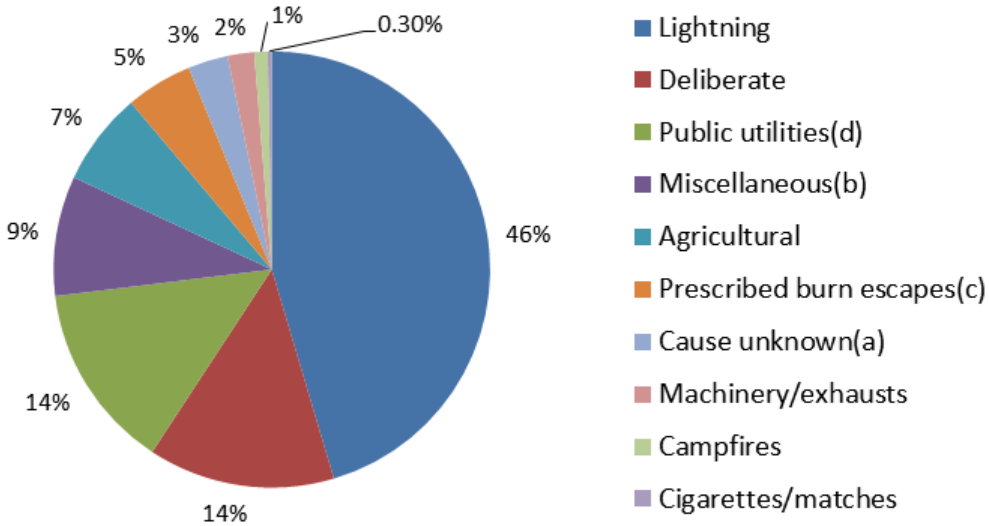


NSW RFS list of 30,000 incidents – all fires (no by type) from Annual Report 2018-19
NSW RFS. (2019). *Annual Report*.

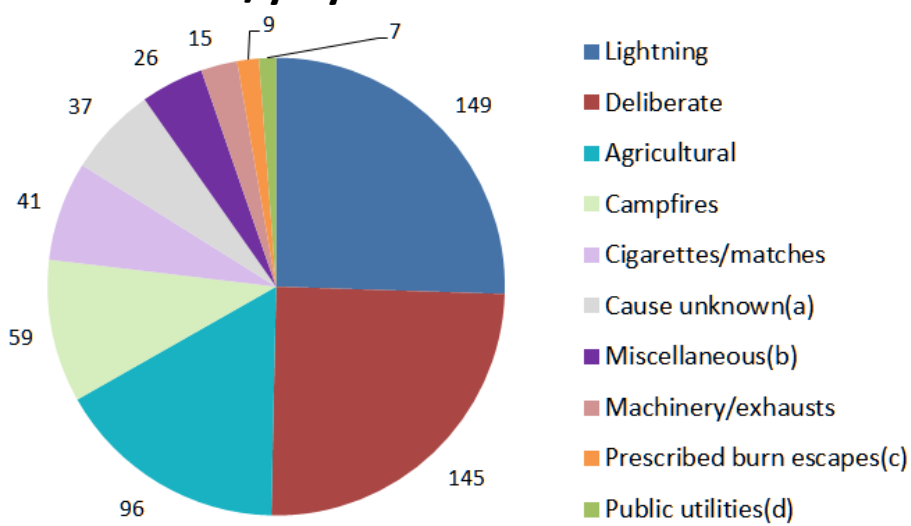
Area and Av. Number/yr by Ignition Cause

of 115,000 Ha/yr Vic Bushfires over 20 years

% of Area burned by Cause



Number/y by Cause



CAUSE & **Av. no. per year**

- **Lightning 149/yr**
  - Some fires create their own
- **Deliberate 145/yr**
- **Public utilities 7/yr**
  - a tree falling/blown on power lines
- Miscellaneous **26/yr**
- **Agricultural 96/yr**
  - burning
- Prescribed burns **9/yr**
  - Hazard reduction
- Unknown **37/yr**
- Machinery **15/yr**
  - Grinders, cars
- Campfires **59/yr**
- **Cigarettes 41/yr**

4 causes are 80% of area burnt

Weather – Seasonal Fire Patterns

Harris (2019, p16). Variability of Australian fire

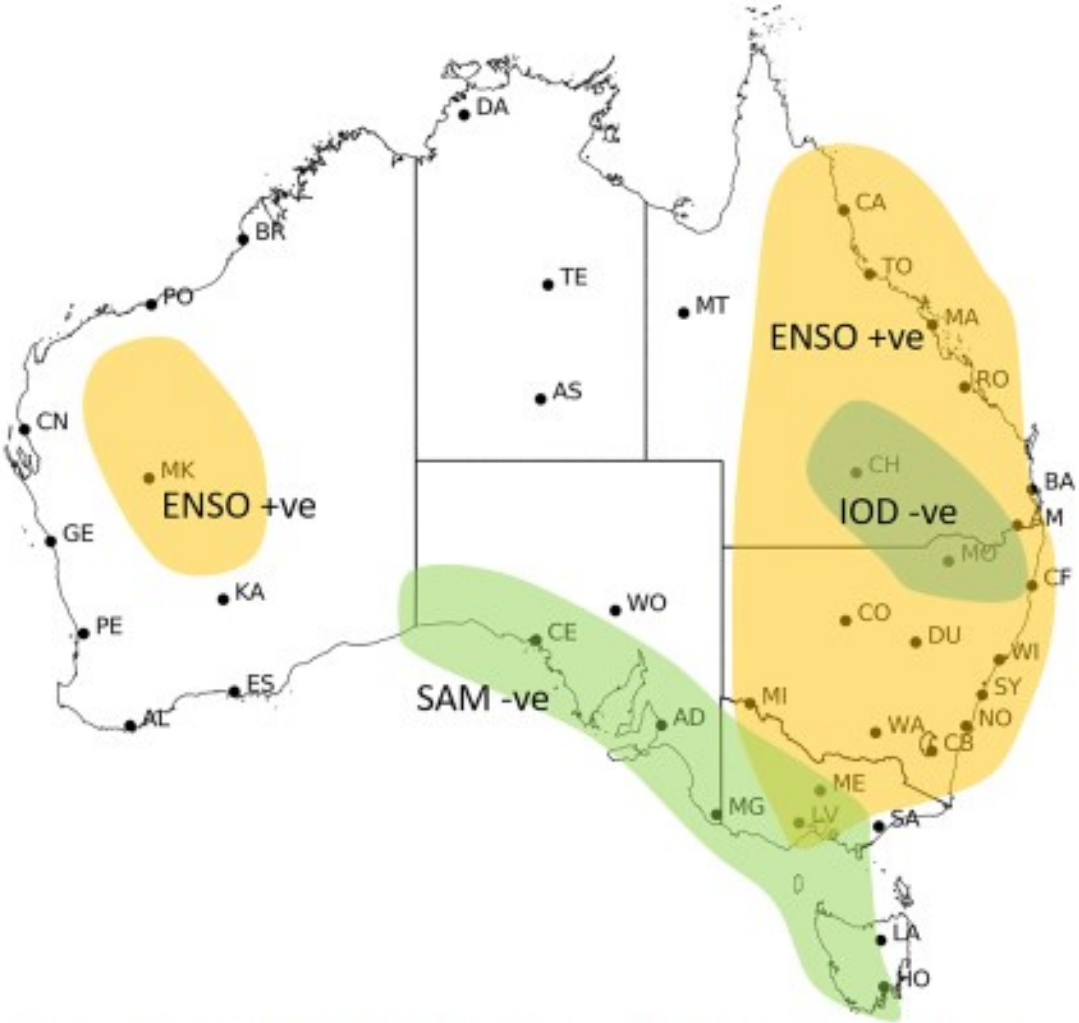
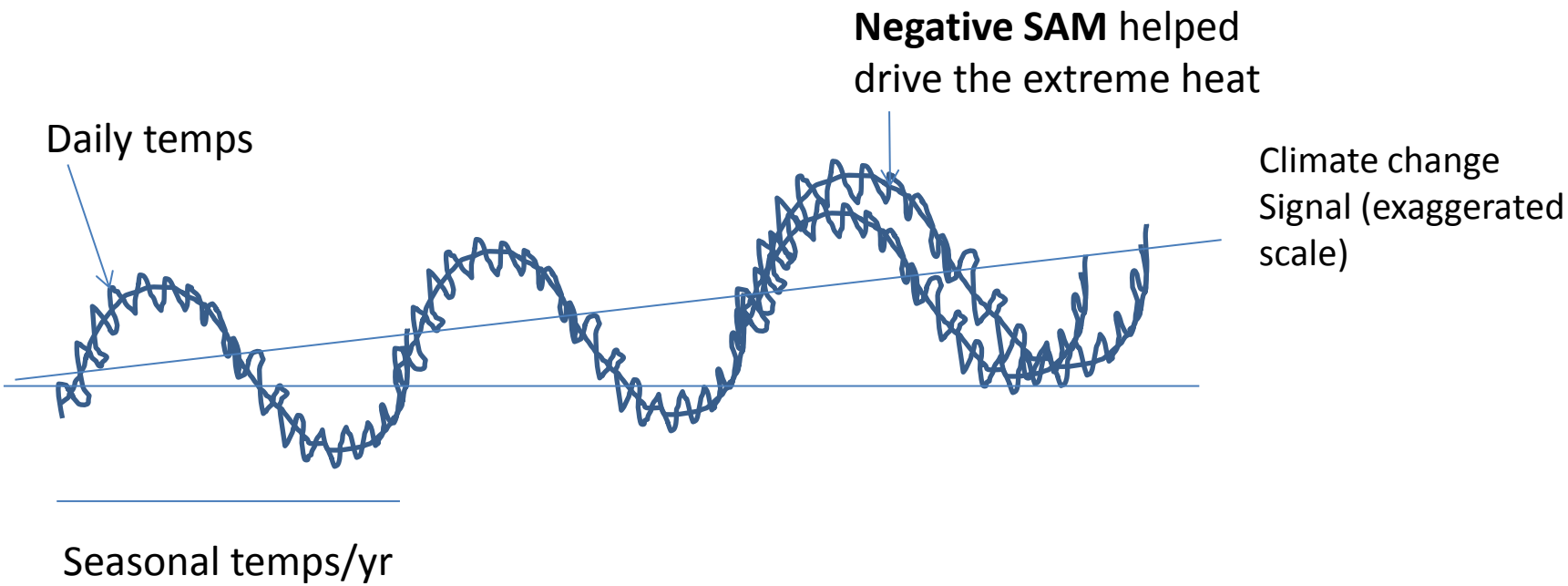


Fig 11. Subjectively produced regions with one season lag relationship between summer 90th percentile FFDI and spring climate drivers with statistically significant partial correlation ($p>0.05$) at 39 stations grouped in spatially coherent patterns 1972/73 to 2016/17. ENSO (N34) is orange, SAM (SAM) is green and IOD (DMI) is blue.

- This last winter and spring
  - Strong + Indian Ocean Dipole - dry
  - Negative SAM - heat
- Big drought
  - Primed forests, including rainforests

Weather and Climate
& Weather with Climate Change signal



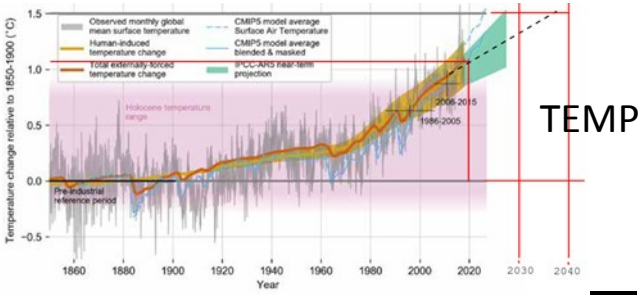
- **Drought (& low humidity)** in Winter & Spring
  - We have just had strongest Indian Ocean Dipole (IOD) events on record.
  - When the **IOD is positive**, the waters off Australia's north-west are cooler, dragging moisture away from the continent and leaving very dry conditions.

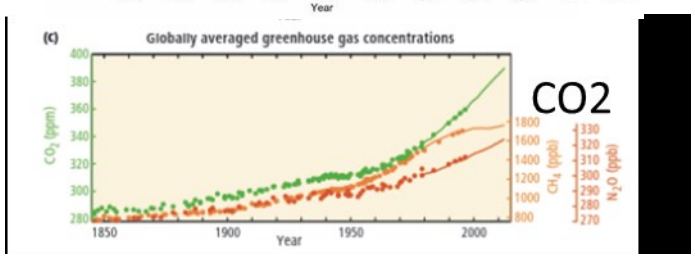
Latest IPCC Climate Change

Scientific Evidence

IPCC. (2018). *Global warming of **1.5°C***
IPCC-**AR5**-WGI, II & III. (2014). *Climate Change 2014: Synthesis Report.*

- Lots of factors affecting the weather and climate
  - Historical
  - Current meteorological effects
- What was the CO2 level in the past
  - More recent ones were measured
  - Ice cores
  - Tree rings
- Climate Change – 2 certain findings (latest science)
  - Global temperature is increasing (& rapidly recently)
  - Man is the cause
    - burning plant fuels increases CO2 (Carbon isotope) and that traps the sun's radiation from escaping the earth



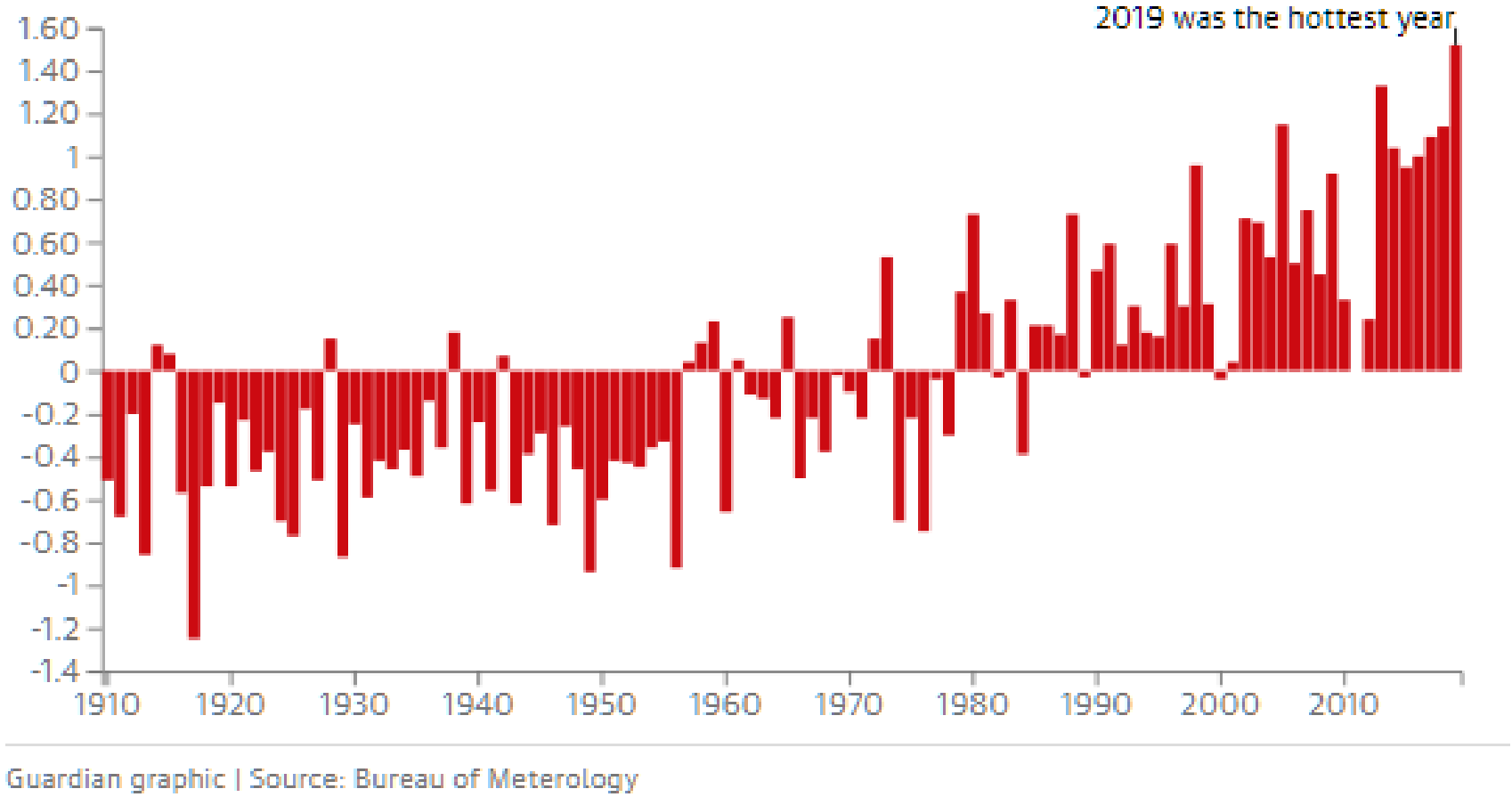


Australia's hottest year ever - 2019

1.4°C above 1961-1990 average

www.theguardian.com/australia-news/2020/jan/09/bushfires-crisis-more-than-75-of-australia-had-worst-weather-conditions-on-record-last-month

Source: BoM via Guardian



Records halfway thru Summer

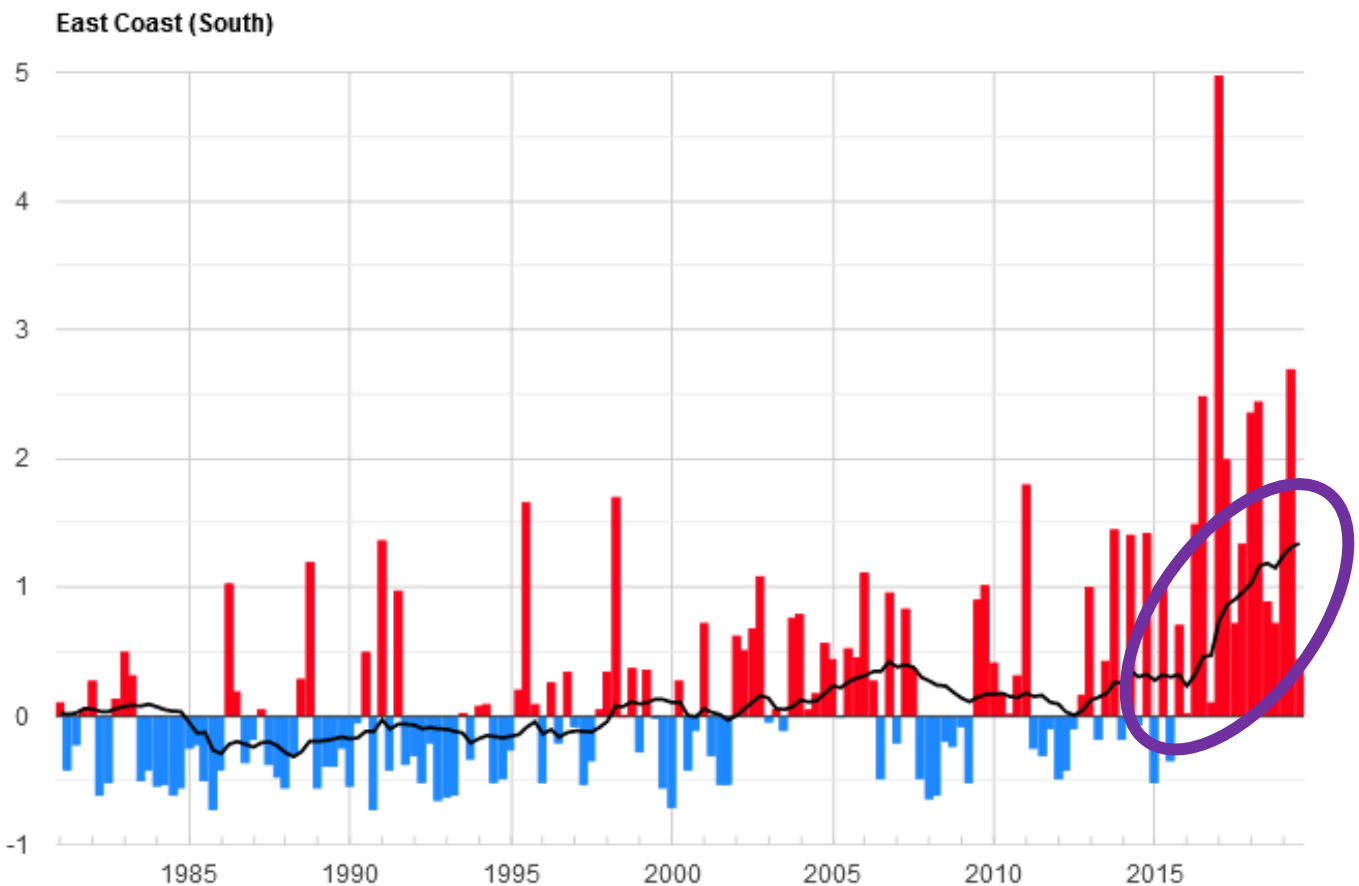
www.theguardian.com/australia-news/2020/jan/09/bushfires-crisis-more-than-75-of-australia-had-worst-weather-conditions-on-record-last-month

- Karl Braganza - Manager of Climate Monitoring at the Australian Bureau of Meteorology
  - **Average rainfall** across the country in December was the **lowest on record.** Across the year it was 277.6 millimetres, about 40% below average. It was **11% lower than the previous record**, set in 1902.
  - **Hottest Day**
    - Australia's **six hottest days on record** were all in December 2019.
  - **Extremely Hot Days**
    - **The average maximum temperature across the continent was above 40C** on **11 days** in the month, smashing the **previous annual record of seven**, set in 2018.
    - Only **four days between 1910 and 2017** averaged more than 40C, two in 1972-73 and two in 2013.

Australian Actuaries Climate Index

South East Coast - Warm Temperature Index

www.actuaries.asn.au/microsites/climate-index/explore/regions



- Summer 2017
  - **5 Std** Deviations **above** mean
- Autumn 2019
  - **2.7** Std deviations above mean
- Winter 2016, Summer 2018, Autumn 2018
  - **2.4** Std Deviations **above** mean

Fire Danger forcast

- FDDI
  - A Forest Fire Danger Index (FDDI) combines
    - expected wind speed,
    - humidity,
    - temperature and
    - a measure of vegetation dryness
  - Best for forests in South and East of Australia
  - An FFDI of 25 is very high

Historical Australian fire risk

Harris, S., & Lucas, C. (2019). *Understanding the variability of Australian fire weather between 1973 and 2017*

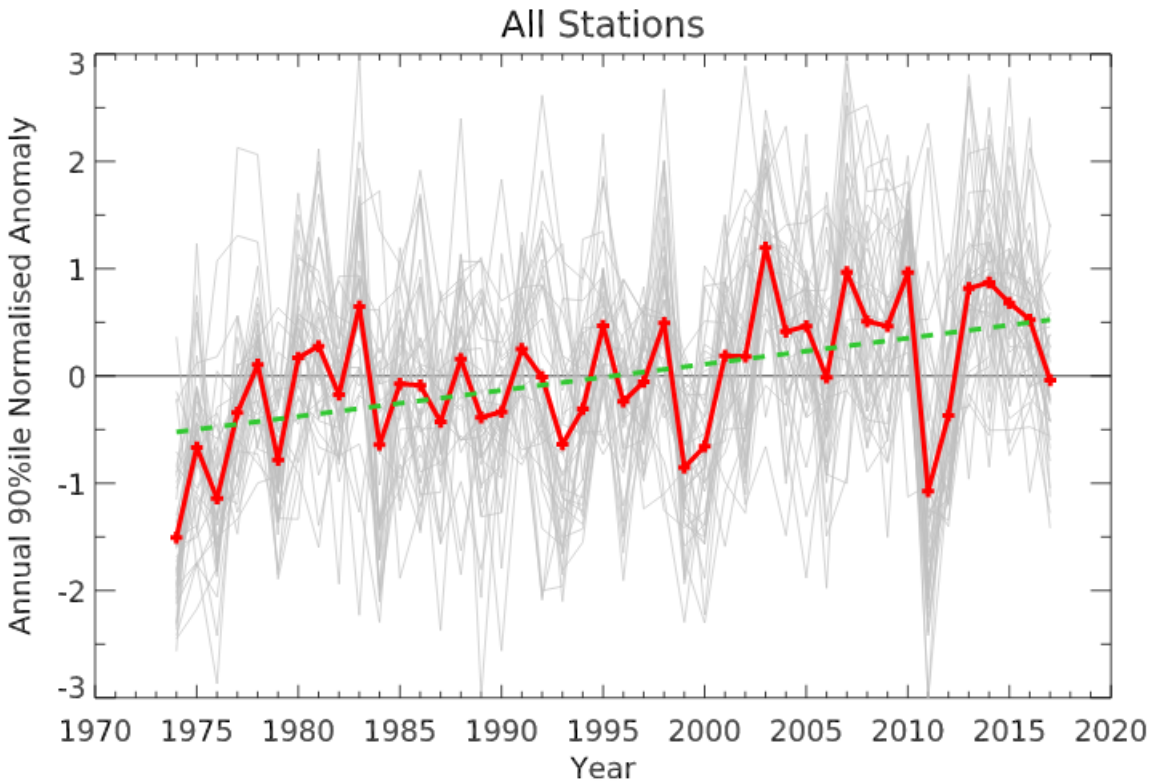


Fig 12. Time series of 90th percentile FFDI annual anomaly (July-June) at each station (1973–2017). The thick line indicates the multi-station mean. The thick dotted line indicates the linear trend.

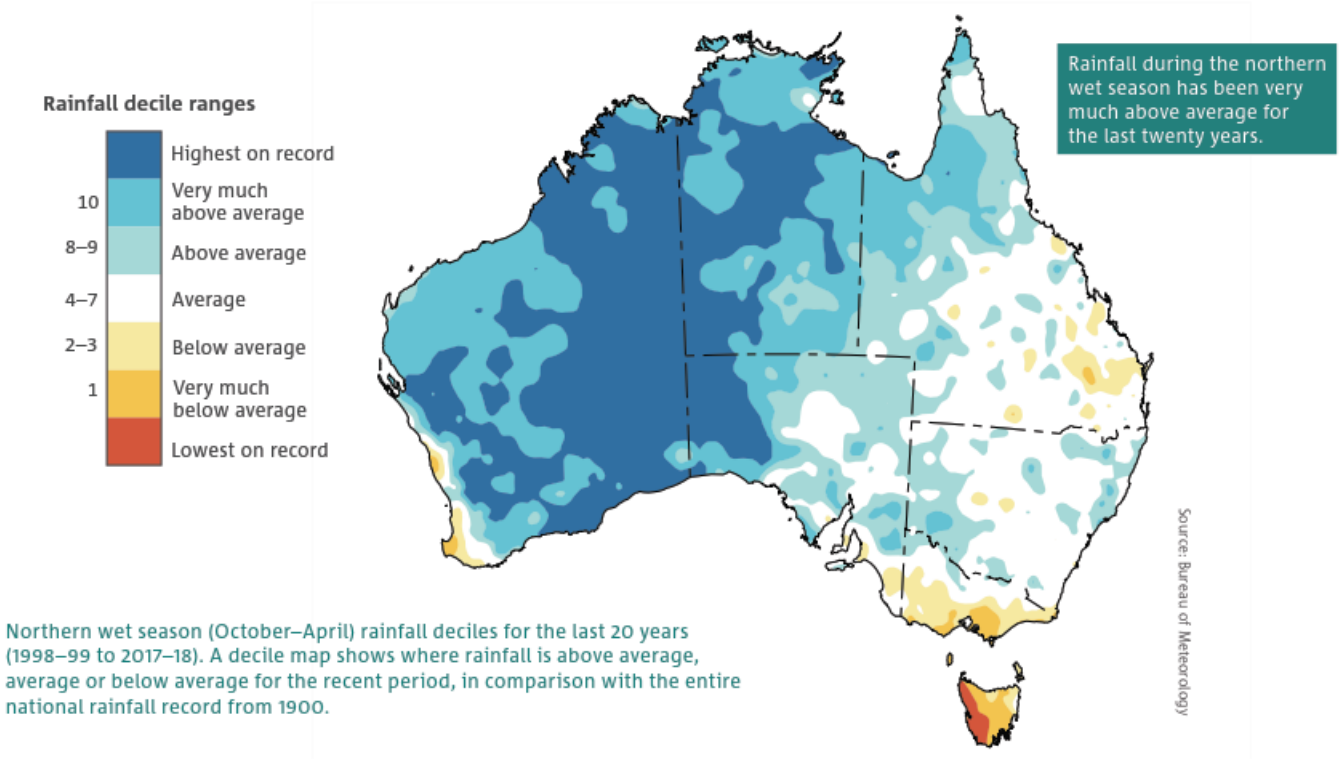
https://doi.org/10.1371/journal.pone.0222328.g012

- Harris & Lucas examined 39 stations for daily Forest Fire Danger Index (FFDI) records from 1973 to 2017 (44 years)
  - Most extreme records
- The positive trend suggests "**anthropogenic climate change is the primary driver**" through
  - Higher mean temperatures and
  - Less large-scale rainfall patterns

Australia Rainfall Map

1998-2018 (20 yrs) compared to average 1900 – 1969 70 yrs before

CSIRO, & BoM. (2018, p7). *State of the Climate*



Northern wet season (October–April) rainfall deciles for the last 20 years (1998–99 to 2017–18). A decile map shows where rainfall is above average, average or below average for the recent period, in comparison with the entire national rainfall record from 1900.

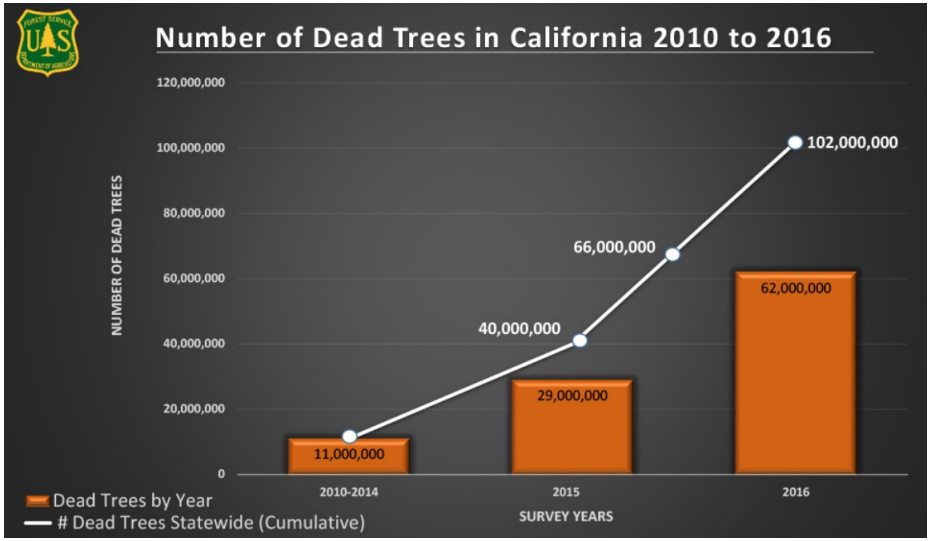
Driest areas are

- 1) SW WA decreasing 26% since 1999 compared to the average 1900-1969, and
- 2) SE decreasing 11% in same period

High fire danger ratings combined with bushfires can generate their own thunderstorm lightning strikes (Canberra 2003, and Black Saturday 2009 fires).

Drought & Bushfires – US data

- **Drought & high temperatures**
  - **lead to dry ecosystems/forests & more bushfires**
  - Four consecutive years of **severe drought** in California, a dramatic rise in bark beetle infestation and **warmer temperatures** are leading to **historic levels of tree die-off**
    - U.S. Forest Service. (2016). *Forest Service Survey Finds Record 66 Million Dead Trees in Southern Sierra Nevada | US Forest Service*. www.fs.usda.gov/news/releases/forest-service-survey-finds-record-66-million-dead-trees-southern-sierra-nevada



California Department of Forestry and Fire Protection

2010 6,554 **wildfires** burned 109,529 acres

…

2015 8,745 **wildfires** burned 893,362 acres

2016 **7,349** fires burned 669,534 acres

Wiki. (2019). 2016 California wildfires. In *Wikipedia*. https://en.wikipedia.org/w/index.php?title=2016_California_wildfires&oldid=914930201

Video clip

- Animation

- 1 million Ha bushfires
  - Correlated with Hot & Dry decades

3. Bushfire measures to lower risks

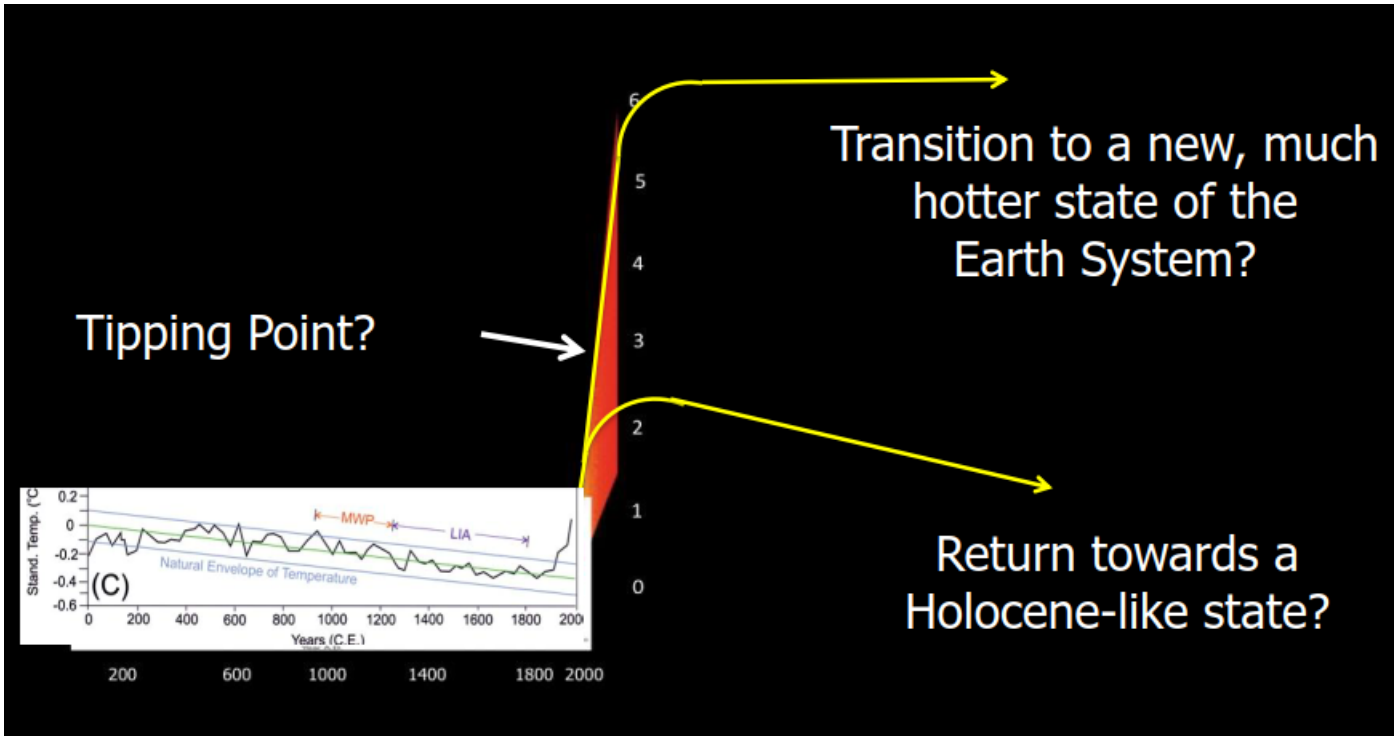
- Landowners & Householders
  - prepare properties
  - Hazard reduction
    - clearing, fire-resistant plants, fuel removal, gutters
- Businesses
  - Allow employees time off to volunteer
- Builders & Designers
  - Design against fire, heat stress (cool retreats)
- All
  - Volunteer to help RFS, WIRES, National Parks
    - Donate goods, help with logistical support, donate money

Governments need to act urgently on Climate Change

- Fed
  - 26-28% on 2005 levels by 2030
  - **"We need urgent emissions reductions, and a coordinated national effort on coping with worsening extreme weather disasters**". **Greg Mullins**, Climate Councillor, member of the Emergency Leaders for Climate Action and **Former NSW Fire and Rescue Commissioner** (Climate Council 2019).
  - The government has repeatedly failed to heed these calls. In 2013, **Mr Gary Morgan**, **CEO Bushfire CRC**, told the Senate Inquiry into Recent trends in and preparedness for extreme weather events **"current practices will not sustain [fire agencies] into 2020"** (Climate Council 2014a).
- State
  - All states have targets of zero emissions by 2050
  - Increase fire prevention budget of agencies e.g. National Parks
- Local
  - Many councils have a zero emissions target level or renewable energy target
  - Ensure hazard reduction approvals are balanced with losses to biodiversity, danger to human lives and property

4. The Climate Emergency Challenge

We have only 20 years left to lower our impact to keep to a 2°C increase (IPCC – latest report)

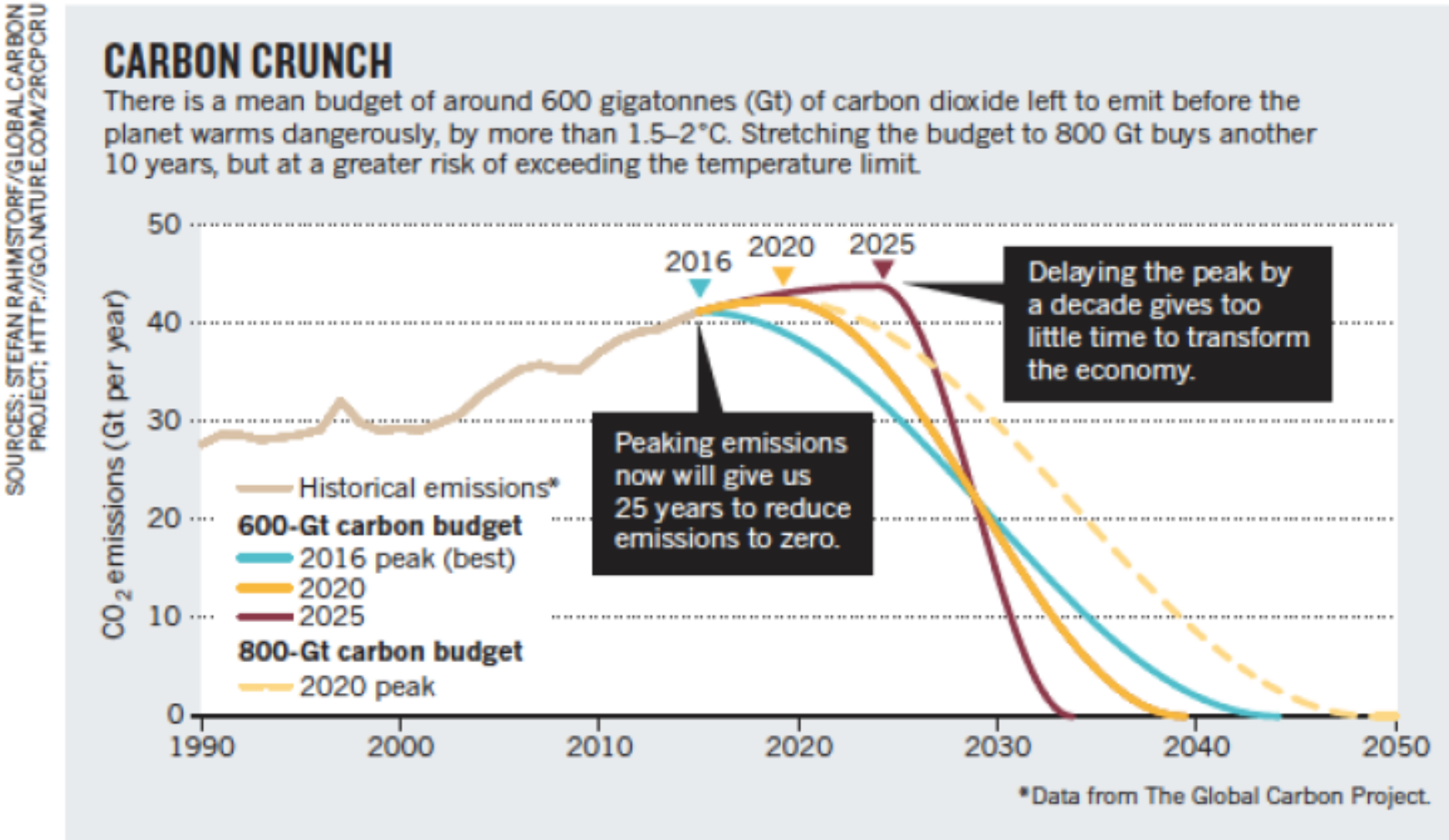


If we don't keep to 2°C, then much harder to stop 6°C rise – 20m to 40m rise in sea level.

Prof Will Steffen (& Climate Council), 2017 NZ Presentation

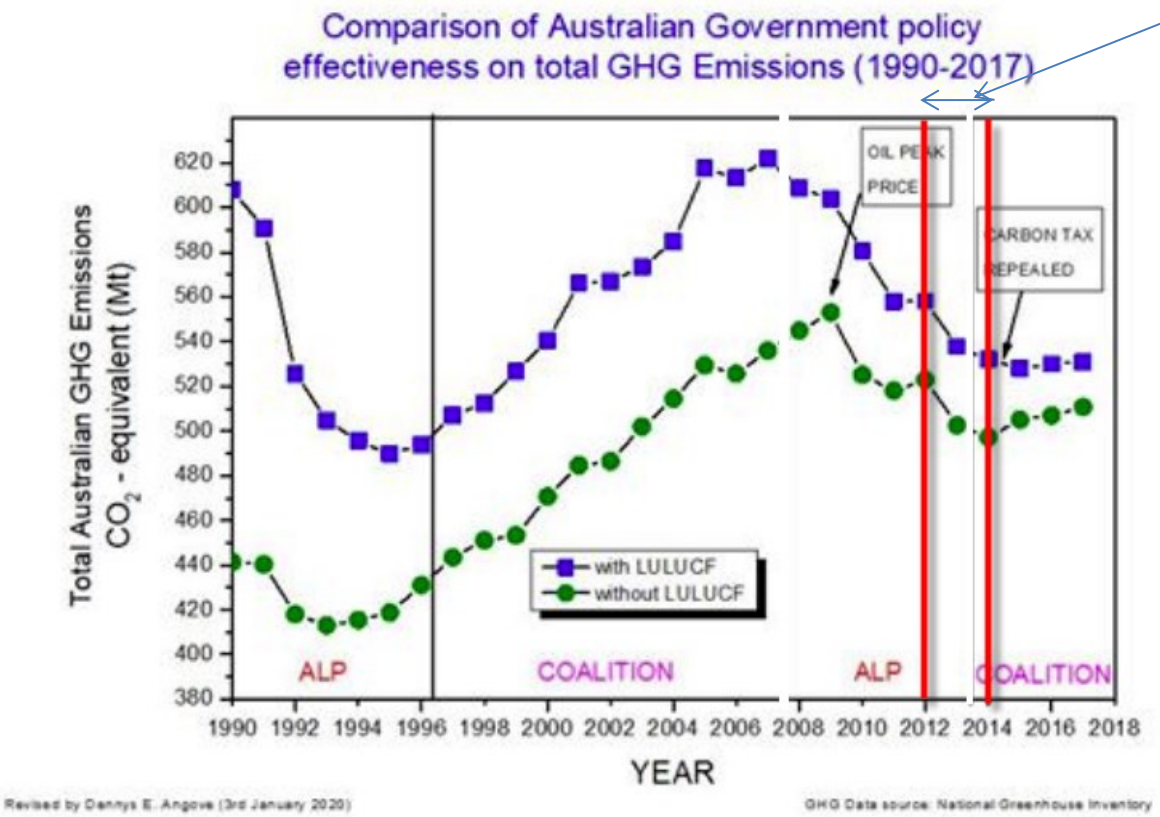
- We need to stop 6°C rise by 2100 – act **now** to lower impact

We must get onto the yellow curve & rapidly reduce our impact



Source: Figueres et al. 2017

Oz Carbon Emissions over time



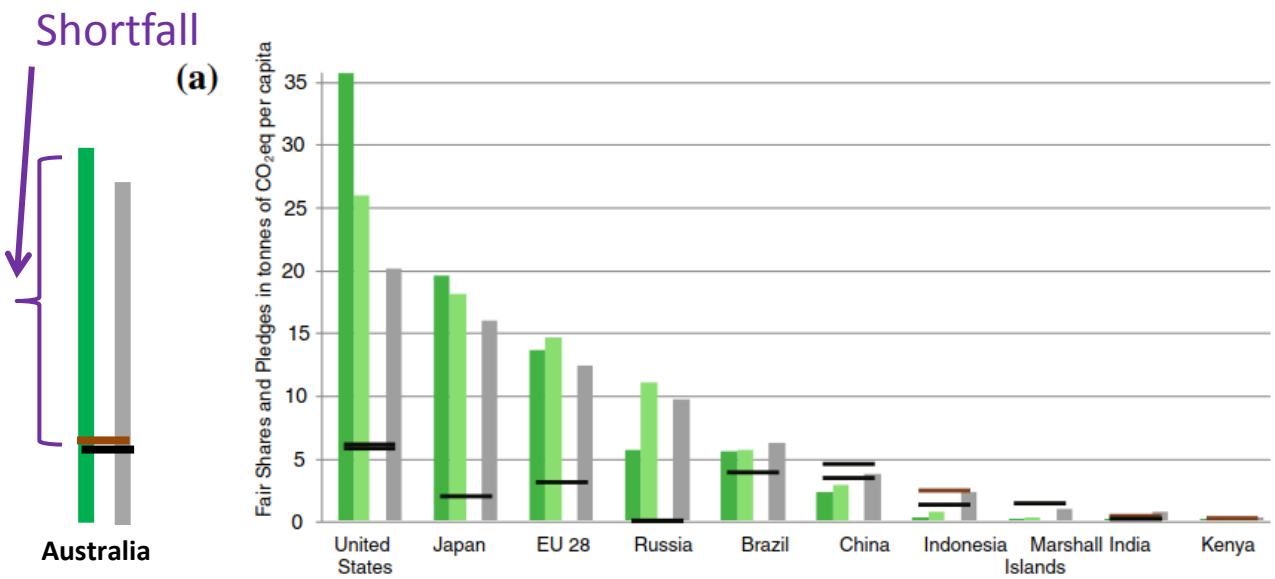
- Carbon Price period

Carbon Emissions are **rising** since Coalition took office.
They may be trying to say they are lowering from peak in 2006

Coalition **Coalition**

Fair share (green & grey bars) of the emission lowering effort per country (Holtz et al, 2018)

Actual pledges (**black line** – unconditional, **Brown line** – conditional)



Per Capita Fair Shares and Pledges in 2030 (tonnes of CO_2eq per capita below baseline)										
1850 / High Progressivity	35.7	19.6	13.6	5.6	5.5	2.3	0.2	0.09	0.04	0.05
1950 / Medium Progressivity	25.9	18.0	14.6	11.0	5.7	2.8	0.8	0.27	0.24	0.14
1990 / Low Progressivity	20.1	15.9	12.4	9.6	6.1	3.8	2.2	0.95	0.73	0.28
INDC Pledge	5.8	1.9	3.1	0	3.9	3.4	1.2	1.40	0.20	0.20
INDC Pledge	6.1					4.5	2.4		0.30	

"Progressivity" defn
- degree of effort needed to do your fair share

Fair share depends on

- Wealth of the citizens (high, medium or low income)
- Cumulative amount of emissions
- Date emissions are counted from e.g. 1850, 1950, 1990

- Fair share of the mitigation effort, expressed in tonnes of CO2eq per capita of mitigation in 2030 for selected countries, showing the amount that would be required for each equity benchmarks (green bars) and the additional reference benchmark (grey bars), as well as the actual mitigation pledged in the country's NDC (unconditional, black; or conditional, brown).

What this means

- Global emissions of greenhouse gases (currently ~50b tonnes per year) need to drop by 45 percent from 2010 levels by 2030 to stay on a 1.5 degrees path;
- Equivalent to a roughly 60 percent drop from today's levels, in 12 years
- Coal power **down** 60-80 % from 2010 levels
- Renewable energy (RE) sources:
  - **Need to ramp up** RE 100-500 % by 2030
    - 50% of total global electricity generation
    - Then go to 70-90% RE by 2050

5. How we can get to zero carbon in 10 years

What can we do – hard options

Climate Change – NOT ON MY WATCH?

(Based on Prof Gabor Zovanyi)

- Buy Greenpower now – boycott coal power stns
- Contact political reps – council, state, fed (all parties - apolitical)
  - Real power is media, those donating & those in the network
- Champion local immigration & population reform
  - Have 0-1 children; one species can only benefit at expense of another
- Public not private transport – 0-1 cars – sell ALL 4 wheel drives
- Eat locally (locavores), seasonal, organic, no meat (twice/week)
- Ecologically responsible consumption
  - Buy secondhand, quality
  - Buy in bulk/ minimise packaging/ eliminate plastic, Al foil, cans
  - Recycle; help in a repair café
- Take responsibility for local area, don't move every 5 years
- Stop intensively managing natural world
  - Slow or negative growth for regeneration (all have part-time work)

Main Refs

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