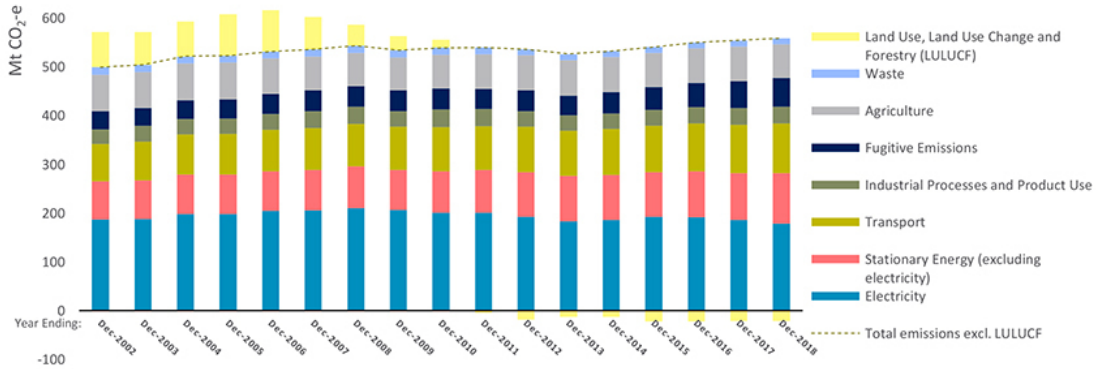

Figure 1[1] Emissions – the lemon yellow bars confirm a large body of evidence that fuel reduction in Australia fell drastically from 2010 – less than 1% pa in states & territories except WA & the NT. This apocalyptic drop showed no insight into the Victorian royal commission 2010 recommendation for a sharp increase - a minimum of 5% pa[2] or that less than 1% gives almost zero protection. From 1939, the foremost recommendation of parliamentary & coronial inquiries, inquests & four other royal commissions was for more fuel reductions. But, particularly in the last 30 years, bushfire services showed no remorse for the consequent death & destruction - increasingly flouting recommendations & diverting government cash injections after bad fires to grow infrastructure to enforce their authority to continue operations inquiries found will worsen fires[3]. Bushfire services now net about $5billion pa, but little trickles to volunteers to protect their own. In 2019/2020, while ineffective multi-$million aerial operations breached CASA safety guidelines, volunteers reported paying for their own petrol. For decades volunteers have paid for vital equipment with fundraisers like sausage sizzles.

1. Causes & factors contributing to the frequency, intensity, timing & location of bushfires in NSW in the 2019-20 season, including weather, drought, climate change, fuel loads & human activity.

Bushfire hierarchy has a track record of pocketing extra tens of millions after bad fires and then ignoring recommendations from government inquiries into those same fires. This culminated in the worst bushfire season in NSW history in 2019/20. Nationwide, 81 years of coronial and parliamentary inquiries and four royal commissions[4] in the main faulted bushfire operations at the senior level. Foremost, inquiries recommended more fuel reduction, followed by more aggressive attack of potentially dangerous fires to stop them growing to

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[1] See ndevr (2019) Tracking 2 Degrees FY2019 Q2 Quarterly report Australia's Quarterly Emissions retrieved April 1 2020 from https://ndevrenvironmental.com.au/tracking-2-degrees-fy2019-q2/

[2] See New South Wales Rural Fire Service Library Catalogue Retrieved March 08 2020 Retrieved

[3] See s.128, 1997 NSW Rural Fires Act which removes liability for an act or omission & State of New South Wales v West & Anor (2008) retrieved April 2 2020 from http://classic.austlii.edu.au/cgi-bin/sinodisp/au/cases/cth/HCATrans/2008/353.html?stem=0&synonyms=0&query=title%28west Anor and State of New south Wales %29

[4] See New South Wales Rural Fire Service Library Catalogue Retrieved March 08, 2020 http://nswrfs.intersearch.com.au/cgi-bin/koha/opac-showpage.pl?pageid=Bush+Fire+Post+Event+Reviews
& Commonwealth Of Australia (2009) The Senate Select Committee on Agricultural and Related Industries *The incidence and severity of bushfires across Australia* retrieved March 24 2020 from https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Former_Committees/agric/completed_inquiries/2008-10/bushfires/report/c02

unstoppable intensity; more use of local knowledge, and improved communication and logistics. After pocketing extra funds to purportedly fix the problem, bushfire and other responsible hierarchy then showed disinterest in implementing the crucial recommendations in the way they were intended, even refusing to participate in the 2003 House of Representatives and 2009 Senate bushfire inquiries[5]…

> Given the devastation of the Summer 2003 wildfires in New South Wales, Victoria and the Australian Capital Territory, it is regrettable that we did not hear from the agencies with responsibilities for land management, fire prevention and fire suppression in those states and territory. Their respective political leaderships chose not to contribute to the inquiry, claiming a lack of resources.
>
> It was noted however, by Committee members and witnesses to the inquiry, that resources were available from many of those agencies to attend and take notes at much of the public hearings.
>
> One can only hope that those notes accurately captured and recorded the anger, frustration and sense of betrayal felt by so many people in affected communities.
>
> And of course, if those very same notes are not considered and acted upon by the policy makers and decision takers of the various non-participating state agencies, that would indeed be the greatest tragedy of all.

This refusal to cooperate shows no remorse or insight into expensive operations that caused death and destruction. This pattern of ineffective and dangerous operations, worsening fires then bigger budgets culminated in a 2020 record of $46 million extra Federal Government money to the National Aerial Firefighting Centre or NAFC, for four retired passenger jets for aerial water bombing – despite decades of passenger jets' firefighting failure and crashes. In the jets' previous roles, the Civil Aviation Safety Authority would criminally prosecute for flying low over fires – to be effective, waterbombing must be at about 100 feet. Passenger jets lack the manoeuvrability to safely maintain this height or to accurately drop water on moving targets. These old jets must drop their toxic loads to land safely, posing another problem, if they fail to discharge on targets. Their frames also lack the strength to fly in fire's turbulence, high temperatures and the updrafts and downdrafts, so this $46million expansion is set to fail. Now retired bushfire service heads, Phil Koperberg and Len Foster registered NAFC as a public company with ASIC in 2003 with Koperberg director and Foster secretary. They appointed other emergency paid bushfire hierarchy to the board.

Briefly, although it is a public company, NAFC's website states it manages government aerial bushfire operations at a national level. In doing so it acts as centralised air traffic control without meeting CASA's air traffic control requirement for an Air Operator's Certificate (AOC). The NSW Rural Fire

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[5] See Parliament of Australia (2003) *A Nation Charred: Inquiry into the Recent Australian Bushfires* Retrieved April 2 2020 page *x* & Parliament Of Australia (2010) Senate Committee Report (2010) *The incidence and severity of bushfires across Australia.*

Service and the Victorian Country Fire Authority also act as air traffic control - without the required AOC to comply with CASA legislation and regulations. Bushfire service hierarchy has a track record of dropping aerial contractors who go public about such breaches of CASA legislation and orders that set up operations to fail and pilots to die.

To supply goods and services, aerial contractors must successfully tender to NAFC. By failing to renew contracts of aerial contractors who have gone public, NAFC suppresses incriminating and expert eyewitness reports. Nothing has changed since the House of Representatives 2003 inquiry, apart from the fact that pilots who went public were blacklisted, setting up a culture of fear in aerial firefighting. Helicopters are much less stable in bushfire conditions than fixed wing aircraft, but their pilots will still risk crashing in updrafts and downdrafts as they use winched cable to routinely scoop water from lakes, dams and the ocean to dump it on fires. A few weeks after orders to fight a pyrocumulonimbus fire tornado killed a volunteer firefighter in Jinjellic, Snowy Mountains, a C-130 crashed nearby in the Snowy on January 23 2020, killing its three crew. The C-130 left Richmond Airport just after noon under orders to dump water in extreme turbulence and heavy smoke[6]. It crashed as it banked left, when its left wing hit a tree at about 1.16pm. About half of its load was still onboard with its voice recorder switched off after it left the United States. The many deaths show the effects of bushfire hierarchy orders for aircraft to stay on the ground until fires are becoming dangerously too intense for effective attack as was reported to *A Nation Charred* in 2003[7]…

> There was nil cloud, there was no smoke and the fire started spotting (note, spotting indicates increasing fire intensity and spread, so the fire was on the verge of becoming unstoppable)… The aircraft were kept on the ground… This happened on quite a few occasions.
> The pilots objected very strongly…
> …I heard of an instance where the Premier went up to Mount Beauty and they called the aircraft across there, put on a massive demonstration to satisfy him and they all came back again. They did not bother doing any firefighting; they were not allowed to.

Only pilots' skills and remarkable reflexes keep more from dying. Aerial contractors confirm that contrary to *A Nation Charred's* 2003 recommendations, safety measures and effectiveness have deteriorated, but as anyone speaking out has been targeted, I confirm these reports here with my own observations. Former CFA senior staffer, Richard Alder is NAFC's current head.

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[6] ATSB Publications/Investigations Investigation: AO-2020-007 - Collision with terrain involving Lockheed EC130Q, N134CG, 50 km north-east of Cooma-Snowy Mountains Airport (near Peak View), NSW, on 23 January 2020 retrieved May 27 2020 from https://www.atsb.gov.au/publications/investigation_reports/2020/aair/ao-2020-007/

[7] Parliament of Australia (2003) *A Nation Charred: Inquiry into the Recent Australian Bushfires*, page 219, my bracketed insertion.

In 2003, following the ACT/NSW fire tornado, Alder gained funding to set up the nation's bushfire research headquarters, sandwiched together on the same floor with NAFC and AFAC. AFAC is another Federally funded public company Koperberg and Foster set up in 2001 that amalgamated this year with neighbouring NAFC. Sandwiched together with these two public companies, the nation's research headquarters was in effect an appendage of the bushfire hierarchy. With senior staff and board mainly bushfire hierarchy, the CRC began its campaign against a huge body of historical, tree-ring and earth core evidence that there is no evidence of intense bushfires in Australia before whites' arrival[8]. This is 100% hard evidence of a conflict of interest, justifying forensic audits of the hierarchy responsible for an entrenched pattern of seeking cash injections after bad fires; refusal to carry out recommendations of government inquiries; and, after consequent worsening fires, senior bushfire and other hierarchy growing new infrastructure to administer $billion operations that continue to fail at every level while targeting critics who go public. Not only do media footage and CASA guidelines show it is too dangerous to waterbomb intense fires, the last decades reinforce well-evidenced, CSIRO guidelines developed in field tests in the 1980s (see Figure 3 following pages). Bushfire hierarchy effectively suppressed this knowledge by cutting funding to this CSIRO unit in 2009, forcing its closure. The closure also acted as a warning to other researchers to toe bushfire hierarchy line.

As firefighting hierarchy campaigned to blame climate change for worsening fires, it funded researchers to do the same - as if proto-hominids did not control fire 250,000 years ago[9] after discovering the relationship between fuel and fire behaviour, and as if like volcanoes, bad fires do not change long term weather patterns, causing drought and fuel loads as dangerous as before or even more dangerous[10]. It is self-evident that bad fires are causing long-term change to the biosphere to produce conditions more conducive to bad fires – more drought as effectively deforested, inland forest transpiration drops[11], and, with higher levels of carbon particles in clouds, more lightning to start bad fires in the apocalyptic fuel loads of vast alpine forests that intense fires killed.

It is increasingly recognised that in the short-term, bushfires gradually make weather hotter, drier and windier to intensify flames. If fuel loads are above about 7.5 t/ha, as the fire makes it hotter, drier and windier, the fire will build into an intense fire. Embers and lightning will spread the flames, and if a

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[8] See Eisha Gupta (2020) *WRITTEN IN KING BILLYS' TREE RINGS: 1700 YEARSOF CLIMATE HISTORY* University of Melbourne PURSUIT retrieved May 22 2020 from https://pursuit.unimelb.edu.au/articles/written-in-king-billy-s-tree-rings-1700-years-of-climate-history

[9] James, Steven R. (1989*). "Hominid use of fire in the Lower and Middle Pleistocene: a review of the evidence" (PDF). Current Anthropology*. University of Chicago Press. 30 (1): 1–26. doi*:*10.1086/203705.

[10] Barker, J. W.*, and* O. F. Price (2018) *Positive severity feedback between consecutive fires in dry eucalypt forests of southern Australia.* Dryad Digital Repository. http://dx.doi.org/10.5061/dryad.4qh45 & see Plates 1 & 2 following pages.

[11] See McAlpine, Clive A, Syktus J, Deo RC, Lawrence PJ, McGowan HA, Watterson IG, Phinn SR (2007) *Modelling the impact of historical land change on Australia's regional climate* Geophysical Research letter 34, L22711, doi: 10.1029.

weather change does not put these out, fires will intensify until there are multiple bad fires such as pyrocumulus (pyroCu) or pyrocumulonimbus (pyroCb)…

…the fire-breathing dragon of clouds.

A pyrocumulonimbus storm combines smoke and fire with the features of a violent thunderstorm. Pollutants from these storms are funneled into the stratosphere.
A cumulonimbus without the "pyre" part is imposing enough -- a massive, anvil-shaped tower of power reaching five miles (8 km) high, hurling thunderbolts, wind and rain.

Add smoke and fire to the mix and you have pyrocumulonimbus, an explosive storm cloud actually created by the smoke and heat from fire, and which can ravage tens of thousands of acres. And in the process, "pyroCb" storms funnel their smoke like a chimney into Earth's stratosphere, with lingering ill effects.

Global Impact
Researchers believe these intense storms may be the source of what previously was believed to have been volcanic particles in the stratosphere. They also suggest pyroCbs happen more often than thought, and say they're responsible for a huge volume of pollutants trapped in the upper atmosphere.

"An individual pyroCb can inject particles into the lower stratosphere as high as 10 miles," says Dr. Glenn K. Yue, an atmospheric scientist at NASA Langley Research Center in Hampton, Va.

Yue is one of eight authors of a paper on pyrocumulonimbus in the September 2010 Bulletin of the American Meteorological Society (BAMS) titled "The Untold Story of Pyrocumulonimbus."

A pyrocumulonimbus cloud tower(ed) over thick smoke from fires burning near Canberra… The cloud's strong winds caused the fires to explode into the… city.

The paper reevaluates previous data to conclude that many stratospheric pollution events erroneously have been attributed to particles from volcanic eruptions.

Three "mystery cloud phenomena" were cited as examples that were actually the result of pyrocumulonimbus storms, including one initially attributed to the 1991 eruption of Mount Pinatubo in the Philippines. The plume thought to have been from Pinatubo was, it turns out, from a pyrocumulonimbus storm in Canada.

One reason for the misinterpretation, Yue said, is that scientists believed nothing less energetic than a volcanic eruption could penetrate Earth's "tropopause" in so short a period of time. The tropopause is the barrier between the lower atmosphere and stratosphere.

"At the time, the thinking was that it was unlikely," said Yue.

SAGE II Data
Yue reevaluated data he'd analyzed years earlier from NASA Langley's SAGE II instrument on the Earth Radiation Budget Satellite. SAGE II was launched in 1984 and turned off in 2005.

"Our paper also shows that pyroCbs happen more often than people realize," Yue added. In 2002, for example, various sensing instruments detected 17 distinct pyrocumulonimbus events in North America alone.

Humans have been responsible for many pyrocumulonimbus storms, says Mike Fromm, lead author on the BAMS paper.

The worst fire in Colorado history was set by a forestry officer "and within 24 hours there was a pyrocumulonimbus storm," says Fromm, a meteorologist at the Naval Research Laboratory in Washington, D.C. Whipped by the storm it had sparked, the 2002 fire swept across 138,000 acres (558.5 sq km) in four counties, drove more than 5,000 from their homes and killed six people.

Michael Finneran
NASA Langley Research Center[12]

NASA satellite data from 2019/20 shows that Australia had one of the biggest pyroCb systems in history. Until 2019/20 when pyroCbs reached 16km, the world's biggest pyroCb was the 10.6km 2003 Canberra fire tornado.

[12] Finneran Michael (2010) Fire-Breathing Storm Systems in *The Earth Observer* Nov-Dec Vol 22 Issue 6 page 43.

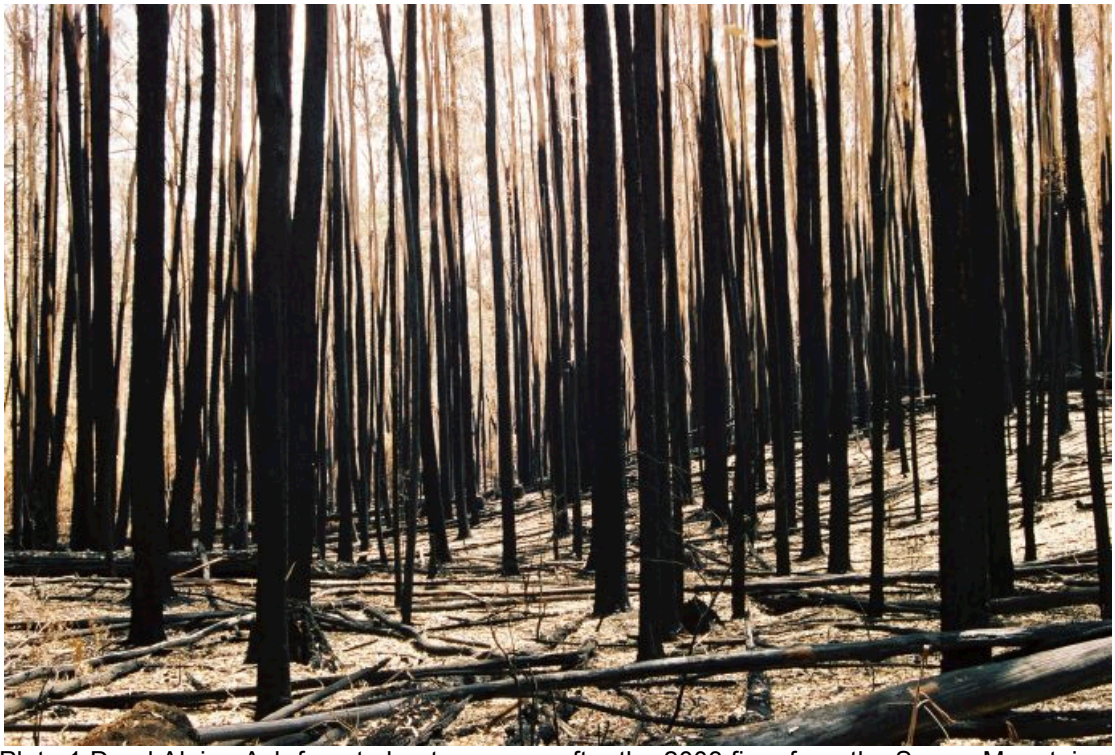

Plate 1 Dead Alpine Ash forest about one year after the 2003 fires from the Snowy Mountains NSW hit Canberra. I rode for a day & a half through one corner of the 700 square kilometer dead forest, in a powerful stench resembling an arsenal of oil refineries. Dead trees stood in a thick glossy crust of charcoal that was as waterproof as a Teflon pan, so even gentle rain caused flash floods of brown sludge, stripped topsoil & ruined drinking supplies. Apart from a ground cover of yellow & white everlasting daisies, there was not a living thing, not an ant, fly, earthworm, lizard or bird. This towering dead forest once transpired profusely to make inland rain & was the alpine region's principal rainmaker, acting like a giant sponge to hold moisture in the ground & the air around it. In 2003, the ash's moist micro-climate knocked back intensity so flames could not crown, but the heat still killed the forest. It took 17 years for a dense understorey of 2-6m tall juvenile trees to grow beneath the giant skeletons. These trees weigh about 2,000 tonnes per hectare. It is self-evident why the region is locked into ever worsening drought/firestorm/drought…

NASA analysis of the Amazon dry season shows that low intensity fires remove clouds and that heavy smoke reflects less sunlight than clouds. Smoke reflected 28 Watts m^2 to cloud's 36 Watts[13]. However, this NASA analysis did not examine the properties of smoke-laden cloud. Zhu, Rosenfeld, Yu and Li found smoke will make cloud more reflective and heavy smoke will delay rain[14]. This knowledge gap aside, the NASA satellite data enabled tracking of 2019/20 smoke round the world to return to Australia. Similar to questioning bushfire hierarchy operations, questioning climate change theory also equates to career suicide in academic circles, which could explain why this NASA research leaves many knowledge gaps about Australian fires' impact on long-term weather patterns. NASA did not measure the reflected heat of the blackened stumps of Australian alpine forest after the

[13] See NASA (2020) *Smoke Clouds* retrieved May 19 2020 from https://earthobservatory.nasa.gov/features/SmokeClouds/smoke_clouds4.php & *When Smoke Kills Cloud* https://earthobservatory.nasa.gov/features/SmokeClouds/smoke_clouds3.php

[14] Zhu Yannian, Rosenfeld Daniel, Yu Xing & Li Zhanqing (2015) Separating aerosol microphysical effects and satellite measurement artifacts of the relationship between warm rain in Journal of Geophysical Research: Atmosphere 10.1002/2015 pages 7725-34.

2019/20 fires. How far and where the smoke travelled and its impacts also remained knowledge gaps.

However, other analysis of Amazonian satellite data suggests that Australia's bad fires profoundly changed long-term weather to make future fires more frequent and more intense, particularly in inland regions where fires burn the hottest. Prior to their recent transformation to charcoaled wastelands, Australian forest was similar to Amazonian rainforest in density and height but with less carbon. Satellite data analysis shows that inland deforestation causes inland drought, with the finding that air passing over inland tropical and sub-tropical forests produces about 60% more rain than air passing over land with little vegetation[15]. This Amazonian study differentiated the hydrogen isotope of clouds from ocean evaporation from the hydrogen isotope of clouds from forest transpiration. It used images of the two different hydrogen isotopes to track rain's origins, finding rain from inland forest transpiration began the Amazonian wet season. After forest transpiration fell as rain, it transpired and then fell again in a cycle that repeated many times. This atmospheric turbulence of rising and falling water acted like a pump to bring in more water-laden clouds from the ocean for a wet season deluge[16]. Besides vast tracts of dead or charred bush lowering rainfall, there is evidence that bad fires cause heatwaves to induce more bad fires (see Figure 2).

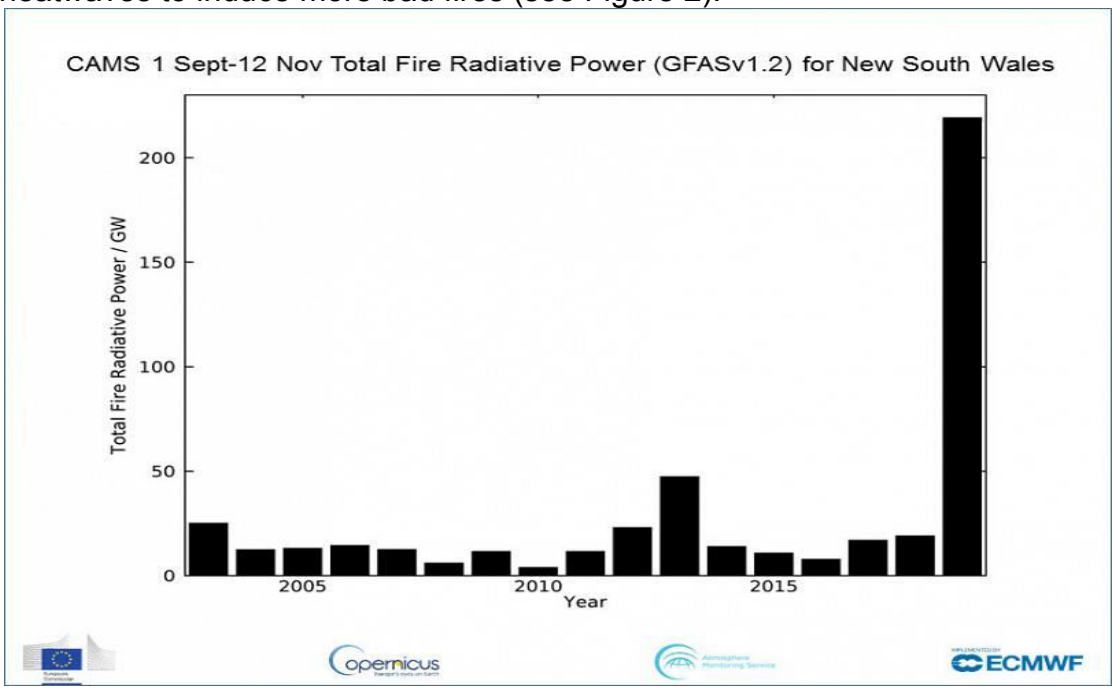

Figure 2 Satellite data shows NSW bushfire's massive heat output. As it grew hotter and drier, it became more conducive to bad fires. This is more evidence to disprove bushfire hierarchy claims that climate change caused the bad fires. CAMS data is part of a large body of evidence showing that bad fires cause climate & fuel load change, &, this change increases the frequency & intensity of future bad fires.

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[15] See Spracklen, D., Arnold, S. & Taylor, C. Observations of increased tropical rainfall preceded by air passage over forests. *Nature* **489,** 282–285 (2012). https://doi.org/10.1038/nature11390

[16] See Chakraborty, Sudip; Clinton, Nicholas; Risie, Camille; Sunc, Ying & Yin, Lei (2017) *Rainforest-initiated wet season onset over the southern Amazon* in Proceedings of National Academy of Sciences Vol 114 10.1073/pnas.16215161

The Copernicus Atmosphere Monitoring Service (CAMS) also left knowledge gaps – it stopped public release of satellite data that disprove bushfire hierarchy claims that fossil fuel induced climate change caused the intense fires. CAMS data shows that the September-November fires caused massive heatwaves and massive injections of heavy carbon-laden smoke into the atmosphere; and, as bad fires are another pandemic in NSW, long-term climate change. CAMS fails to mention that only fuel could generate NSW's record 240GW of radiated bushfire heat in 2019 in Figure 2. 240GW is huge compared to the state's previous years. NSW has around 7GW(e) of coal units running at around 25% thermal efficiency, making a total output of 30GW(t) in one day. In other words, NSW bushfire heat was equivalent to eight days of the thermal energy of its coal-fired power stations. As for comparing carbon emissions, I think it obvious that unlike power stations, there are no filters on bushfire emissions - all go straight into the atmosphere and that only burnt, carbon-laden fuel could be the source of these massive amounts of heavy smoke. Smoke clouds modify weather by increasing the frequency of drought and storms - another empirically proven fact disproving bushfire hierarchy claims that fossil fuel induced climate change causes intense fires.

Empirical analysis of bad fires shows that when cloud bases are warm, heavy smoke with small carbon particles will reduce cloud water droplet size[17]. This delays rain until the top of a cloud is 5.5 kilometres or more above the cloud base. This delay builds storm clouds. So not only is rain less frequent and less gentle, but when it rains, there are more storms with heavier rainfall. These smoke laden clouds will also rain once their bases cool – and here rainfall will be heavier and last longer than clouds unaffected by heavy smoke, because the cloud has gathered more water. However, with giant carbon particles where fires are particularly intense, the threshold for clouds to rain is lowered and there can be a storm and rain within weeks of the fire such as Canberra's 2020 January hail storm and the Sydney region's cyclonic storm November 2019, with a dust storm following[18]. Clouds formed by bad fires also need to gain sufficient water before they can rain as clouds with high water content rain more than clouds with low water content. This explains the May 2020 monsoon-like heavy rain that fell outside the wet season in Queensland. Clouds of bushfire smoke gathered water in their travels over the earth's oceans and forests and then cooled in Queensland's winter producing monsoon-like rain. Bad fires also bring other severe negative effects to long-term weather. As mentioned previously, smoke laden clouds are more reflective than ordinary clouds, meaning that they reflect more of the sun's heat than ordinary clouds. So like volcanic eruptions that initially heat the atmosphere, in the long-term bad fires are cooling, until another system of

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[17] See Chakraborty et al ibid.

[18] Noyes Jenny, Bunged Matt with Grubb Ben (2019) The Sydney Morning Herald November 27 retrieved May 27 2020 from Sydney weather: Thunderstorms hit Sydney as bushfire smoke lingers https://www.smh.com.au/national/nsw/sydney-wakes-to-more-bushfire-smoke-after-storms-20191126-p53e2p.html Trees and power lines fall, trains stop as thunderstorms lash Sydney

bad fires brings more heatwaves. That high fuel loads produce record levels of smoke and heat is no great scientific revelation.

Humans developed fuel loads to create intense flames to make bronze about 6,000 years ago and iron about 4,000 years ago. It would be laughable to claim that hot or cold weather are important in anyway whatsoever in metallurgy, but this is what researchers have been paid to say about intense Australian bushfires. Despite hard evidence in his data, scientists like Scott Mooney have attempted to cast doubt that Indigenous Australian cultural burning practices even existed. Although Mooney's data of an earth core sample clearly shows thin layers of fine carbon particles pre-whites indicating cool burns about every four years, he claims his evidence casts doubt on Indigenous cool burning claims, suggesting they might be a white myth[19]. Nor is it a scientific revelation that intense fires will predictably bring agonisingly painful death and injury - this attack strategy is historically well-known. Elizabeth I used it to destroy a massive Spanish armada as it neared London. The Vikings and Indigenous Australians and many others used flaming weapons in their attacks. In World War II, Allied defence analysts[20] gathered a large body of data from theatres of war to establish intense fire's dependence on fuel load for its use as a highly controllable weapon[21].

There was a huge amount of data for British analysts to examine; the Germans dropped about 1,000,000 incendiary devices during the war…

> … predicting fire entrapment areas is presented. It is concluded in the investigation that major parameters and constraints affecting the initiation and development of firestorms include fuel loading, initial fire density, size of initial fire area, surface wind, and topography and configuration. Factors, which in general appear to determine the extent and nature of firestorms, as opposed to their possible existence, include combustibility, fire intensity buildup rate, atmospheric stability, temperature, humidity, and precipitation.

This strategy developed after Defence analysts such as Sir Arthur Harris saw the reasons for Germany's failure to destroy London with firebombing in the 1941 Blitz – not enough bombers made it to target for fires to be unstoppable. In Harris's 1947 war memoirs, *Bomber Offensive*, Harris also known as the Butcher, describes watching the Blitz and his realisation of how deadly firebombing strategies could be.

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[19] See Mooney Scott, Radford Kate & Hancock Gary (2001) Clues to the burning question: Pre-European fire in the Sydney coastal region from sedimentary charcoal and palynology *Ecological Management & Restoration* Vol 2 no 3 December pages 203-12.

[20] See Rodden, Robert M; John, Floyd I & Laurino, Richard (1965) Exploratory Analysis of Fire Storms SRI Project MU-5070 Stanford Research Institute California. Recommendations are given for further investigations to improve the state of knowledge in those areas "where valid information is lacking."

[21] Rodden, Robert M; John, Floyd I & Laurino, Richard (1965) *Exploratory Analysis of Fire Storms* SRI Project MU-5070 Stanford Research Institute California, page 2.

> I was convinced having watched the burning of London, that a bomber offensive of adequate weight and the right kind of bombs would, if continued for long enough, be something that no country in the world could endure…
> Harris, Arthur (2005). *Bomber Offensive : Marshal of the R.A.F Sir Arthur Harris*. Pen and Sword, Havertown, page 52.

Hurriedly, the British developed an improved version of the Blitz. After initial success, their operational capabilities improved. Detailed calculations produced spreadsheets to forecast the number of deaths, including when the heat will vaporise corpses; structural damage such as when glass and other metals will melt; and a ghoulish analysis to forecast the frequency, type and severity of injuries. They learnt to reliably create firestorms, mass infernos and fire tornadoes. Catastrophically high urban fuel loads were crucial – providing a weapon more deadly than the atomic bomb. Tokyo and other Japanese cities had densely packed buildings with papered windows and doors, tatami floors, oiled and lacquered timber and bamboo. German cities like Dresden had lower fuel loads, but there was also a high density of old wooden structures.

"Collateral damage" or the massive count of civilian death and injury was seen as a necessity to destroy Axis morale and cripple production. Dropping hundreds of firebombs in a concentrated attack on large areas was also crucial. Intense firebombing crippled flammable Axis cities. Explosive bombs, but in the main incendiary devices won the war, but, as the Allies wanted to test their new nuclear technology, Hiroshima went down in history as the final blow. The analysts' data showed that first and foremost, strategies to cripple the enemy depended on high fuel loads – something less available in modern cities with concrete and steel structures and firewalls, but freely available in the Australian bush.

Eminent bushfire scientist, David Packham said his CSIRO Forestry Division studied Allied firebombing about 60 years ago after seeing the potential for firestorms if cool burning was not fully understood. The unit was looking for a way to safely reduce fuel loads as high fuel loads were increasingly causing bad fires[22].

> We were concerned our research on cool burning could result in firestorms and so contacted Reg Taylor, a meteorological physicist, then world renowned as the foremost authority on the subject.
> We flew aircraft through cool-burning fires to measure turbulence, atmospheric movement and temperature. This gave us the cut off points in flame intensity when aircraft become ineffective and unsafe for firefighting.

With decades of data gathering from fieldwork, CSIRO's Forestry Division found that aerial water bombing and ground crew attack are ineffective in fires

[22] Personal communication David Packham, March 12, 2020

burning over 7.5 tonnes/hectare (t/ha) of fuel in extreme conditions. Ground crew may also lose their lives and overhead aircraft may crash. Despite this and decades of self-evident media footage showing aircraft waterbombing to no avail and crashing, bushfire hierarchy routinely divert government funding to deploy aircraft to bad fires.

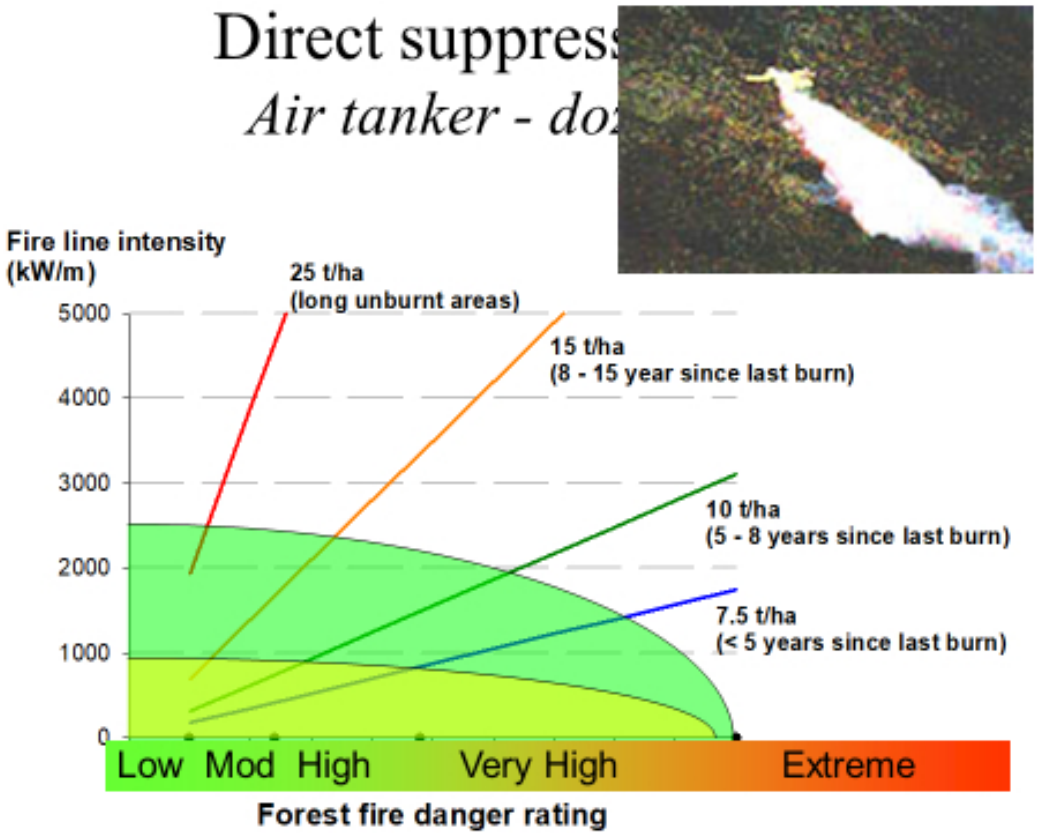

Figure 3 Courtesy Phil Cheney, developed from research with David Packham beginning in the 1980s, CSIRO's Division of Forest Research with Ingram Loane & Jim Gould research leaders. Fieldwork compared aerial water bombing and ground crew attack in different fuel loads and flame intensities[23]. The lighter lime green zone shows when fire tankers or dozers are safe & effective. The darker green represents the safety & effectiveness zone for aerial waterbombing. The study found little difference, concluding ground crew are more economically viable for slightly less extreme fires. The study found aerial waterbombing effective for rapid response, particularly for difficult terrain that is too dangerous for rapid response from ground crew ie national park with its typically rough terrain & impenetrable understorey. NAFC's track record of paying contractors to waterbomb far outside these self-evident & empirically well-proven limits culminated in ordering aerial attack of fires burning a record 200-400 tonnes of fuel per hectare & flame intensity of around 5,000kW/m. Only a weather change can put out fires allowed to build to these levels. The Forestry Division's research also found that to be effective, aerial attack must be done with ground crew support. Fire intensity can be measured in kilowatts per metre (kW/m), which is the amount of energy released from one metre of a firefront. A low intensity fire produces up to 350 kW/m. An intense fire produces 2,000 kW/m or more.

In alpine terrain, fires burn the hottest because the cold, dry conditions slow microbial activity that turns leaf litter layers to non-combustible soil. It takes up

[23] See Loane IT & Gould JS (1986) *Aerial Suppression of Bushfires: Cost Benefit Study in Victoria* National bushfire Research Unit CSIRO Division of Forest Research.

to 28 years for a fallen alpine leaf to decompose into mineral soil and alpine forest drops about 1t/ha of fuel a year.

If inquiry after inquiry found that standard operations were responsible for ever-escalating state of emergency crime, and a national consortium of police hierarchy set up public companies to divert national finances to choose contractors to supply goods and services for an ever-growing need for more guns, vehicles, helicopters, uniforms etc, targeting those who spoke out... there would be a public outcry. Imagine if that same consortium diverted research funding in criminology and blocked funding to researchers and staffers who, like the former CSIRO Forestry Division, presented a large body of evidence showing a pattern - a strong positive correlation between crime, associated police infrastructure and standard procedures. But this has not happened with police – a low crime rate is particularly important and well understood where the bulk of Australian voters live - cities. But few city dwellers understand bushfire behaviour. Because bad bushfires mainly affect rural Australia, about 5% of the population, NAFC and AFAC slip under the radar for doing the same as this hypothetical police scenario.

Plate 2 (Photo courtesy of Mel Gillespie) shows the fuel loads that fed the 60-70m flames in the Snowy Mountain region in 2019/20 - near where the C130 Hercules crashed & a fire tornado developed over Mt Coree. The 2003 fires killed the bleached dead trees in the background and about 700 square kilometers of rainmaking, air conditioning ash forest – Alpine Ash are the lungs and water supplying life source for local farmers now struggling with no fences or income and trauma. After 2003, the 2-6m high understorey grew under the vast dead forest – forming 700 square kilometers of fuel loads of around 200-400 t/ha. The 2019/20 fires vaporized wildlife and this historic shepherd's hut. The vast, dead forest with its oil-laden understorey, stretched as far as the eye could see. The stinking blackened stumps of this forest are now locked into cyclical firestorms because the skins of the future juvenile understorey are too thin to withstand a cool burn until about 15-years-old. This is a similar scenario to the aftermath of the 1987 & 1939 fires. Local farmers saved the forest then with mosaic burning combined with grazing, to protect their vital water supply. The forest's

transpiration acts as a pump to draw rainmaking clouds from the ocean[24]. Rural people complain bitterly that because they are locked out of grazing the area, bad drought follows each bad fire season.

There is now a large body of evidence showing a pattern of ever more frequent and intense fires; ever lessening fuel reductions and the continuation of strategies inquiries recommended should end - absolute, 100% hard evidence that the bushfire paid hierarchy uses post disaster government cash to strengthen their power bases to act in ways that clearly 81 years of inquiries did not intend. As bushfire service budgets, power bases and infernos grow, so do the suppression of large bodies of empirically proven and re-proven knowledge of how to prevent bad fires on a modest budget[25]. This strongly suggests that bushfire paid hierarchy ran operations for corrupt purposes and that those involved should be forensically audited for conflicts of interests. Except for WA, the NT and First Nation managed land, bushfire and national park red tape and legislation have made it almost impossible to prevent apocalypses like coastal NSW 1993/94, the Snowy Mountains and Canberra 2003, Dubbo NSW 2013, Yarloop WA 2016, Australia 2019/20 etc...

The 2003 House of Representatives and the 2009 Senate inquiries recommended reform of aerial operations after hearing evidence that bushfire hierarchy hold aircraft on the ground until fires are becoming unstoppable. The House of Representatives Inquiry recommended evaluation of effectiveness after each aerial operation. The inquiries also recommended more Federal Government control of operations to ensure essential recommendations like the development of databases to enable maintaining fuel loads at safe levels across different terrain. Despite these recommendations to build databases to stop bad fires[26], about two weeks after the announcement of the Victorian royal commission, the bushfire hierarchy controlled Bushfire Cooperative Research Centre cut funds to close and so suppress the analysis of CSIRO's Forestry Division – the only unit in the country with the pre-existing expertise to compile databases to comply with inquiries' recommendations to hazard reduce different topographies and to inform operations with well-evidenced analysis. Tenaciously attempting to save lives and protect the biosphere, after having its doors closed, its library archived and its librarian and researchers sacked, bushfire scientists from the former Forestry Division put in a submission to the Victorian royal commission with a large body of empirical evidence explaining why the bad fires happened

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[24] See Chakraborty, Sudip; Clinton, Nicholas; Risie, Camille; Sunc, Ying & Yin, Lei (2017) *Rainforest-initiated wet season onset over the southern Amazon* in Proceedings of National Academy of Sciences Vol 114 10.1073/pnas.16215161

[25] See Luke RH & McArthur AG (1978) *Bushfires in Australia* Australian Government Publishing Service Canberra; Cheney Phil & Sullivan Andrew (2008) *GRASSFIRES Fuel, weather and fire behaviour* CSIRO Publishing; Gould JS, McCaw WL, Cheney NP, Ellis PF, Matthews S (2007) *field Guide fuel Assessment and Fire Behaviour Prediction in Dry Eucalypt Forest* Bushfire CRC; Gould JS, McCaw WL, cheney NP, Ellis PF, Knight IK, Sullivan AL (2007) *Project Vesta – fire in Dry Eucalypt forest: fuel structure, fuel dynamics and fire behaviour* Ensis-CSIRO, Canberra; McCarthy GJ, Tolhurst KG, Chatto K (1999) *Overall fuel hazard guide natural Resources and Environment, Victoria Report no 47.*

[26] See Parliament of Australia (2003) *A Nation Charred: Inquiry into the Recent Australian Bushfires*.

and how they could have been prevented. The unit's now suppressed encyclopaedic research enabled me to predict the current ever worsening apocalypses.

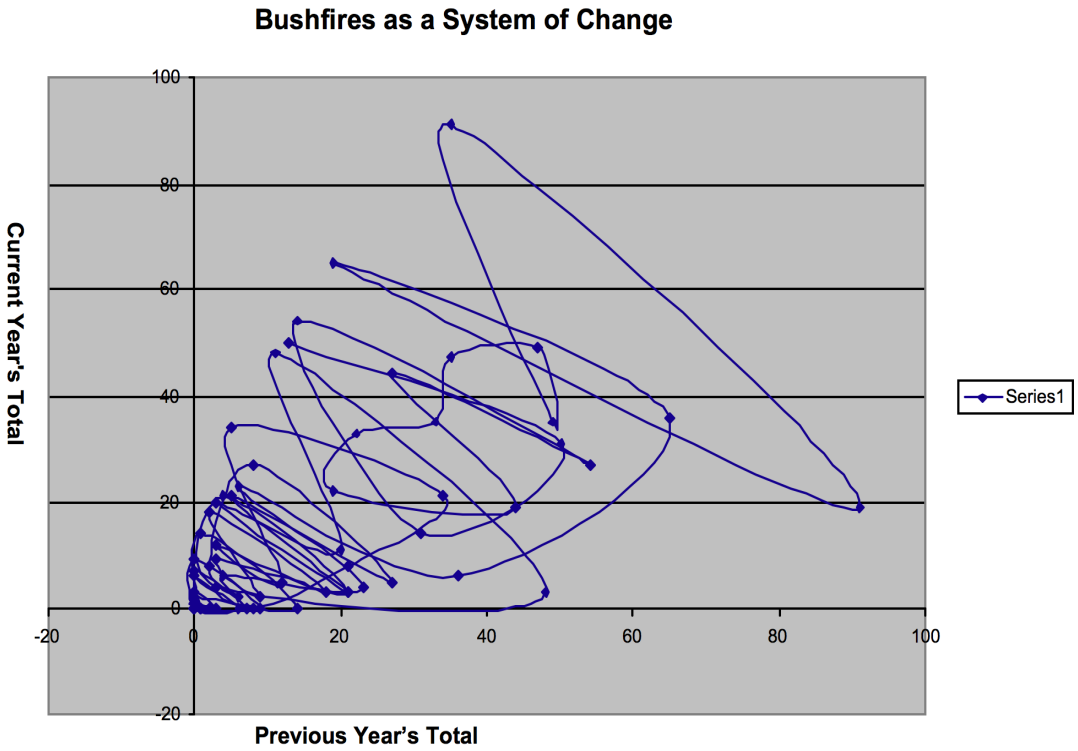

Figure 4 illustrates the relationship between bushfire operations and the frequency of firestorms between 1881 and 1981. It charts system memory, the relationship strength between operations before and after[27]. Prior to 1919 or between 0 and 38 on the horizontal axis, the graph is shaped like the tip of a cone. After 1919, bushfire operations increasingly move away from traditional Indigenous practices and the graph takes a cyclonic shape. It plots "before" or the year before on the horizontal axis against "after" or the year after i.e. at 0, 1881's data on the horizontal axis is plotted against 1882's data on the vertical, 1882 (horizontal) against 1883 (vertical) etc… through to 100, which represents 1981 (horizontal). This measurement tool is known as a system of change and made it possible to forecast firestorms' dramatic increase into the 21st century. This graph plots the explosive growth of disastrous fires and as a projection, predicts the current spate of apocalypses. It also shows the impacts of systemic bad fires on the weather, topography and fuel, producing long-term weather & fuel load structure increasingly more conducive to bad fires. Bad fires will leave fuel loads that are the same or worse than before – unlike cool burns. Killing the rainmaking alpine forests also makes drought worse[28] so the 1,000,000s of tonnes of dead forest with their 2-6m tall understorey of dense oil-laden juvenile growth fed flames 70m tall

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[27] See Ormerod, Paul (1994) *The Death of Economics* 1st edn England: Faber & Faber pages 153-161, Pagano, Robert R. (2003) *Understanding Statistics in the Behavioural Sciences* 8th edn Belmont CA: Wadsworth Publishing; Strauss, Anselm L & Corbin, Juliet M (1998) *Basics of Qualitative Research Techniques and Procedures for Developing Grounded Theory* 2nd edn United States of America: Sage; Bourdieu, Pierre; Chamboredon, Jean-Claude & Passeron, Jean-Claude (1968, 1991) *The Craft of Sociology Epistemological Preliminaries* Berlin/New York: Walter de Gruyter.

[28] See Chakraborty, Sudip; Clinton, Nicholas; Risie, Camille; Sunc, Ying & Yin, Lei (2017) *Rainforest-initiated wet season onset over the southern Amazon* in Proceedings of National Academy of Sciences Vol 114 10.1073/pnas.16215161

with fuel loads conservatively around 200-400 tonnes per hectare (t/ha). Fuel loads over 7.5 t/ha will produce unstoppable bad fires in extreme conditions. The combination of operations flouting recommendations of those inquiries and bad fires modification of the biosphere make it possible to forecast the current apocalypses.

I borrowed this graphing concept from agent based modeling theorist, Paul Ormerod[29], to model systems of change in my PhD[30]. My cyclone-shaped system of change model (Figure 4) used data from a century's archival records of bushfires when they were disastrous - painstakingly put together in my PhD. For years, I energetically sent this predictive model to government agencies, in particular bushfire services; the media, coronial and parliament inquiries etc etc... Horribly ignored, it proved horribly accurate.

I began researching bushfires shortly after the 1993/4 NSW fires. Evidence of shambolic paid hierarchy directives emerged from my first interviews of volunteer firefighters protecting their own, and rapidly mounted. Red tape making fuel reduction almost impossible was a common complaint. If the red tape could be satisfied, compared to easy to do First Nation methods, fuel reduction methods were almost impossibly arduous and logistically difficult. Several fire trucks needed to be present (- today in NSW six are required, with some crews put up at motels). Rugged up in overalls under thick woollen long coats, boots and heavy socks, we hauled 38mm thick water filled fire hoses (weighing about 3kg per metre) up and down ridges to extinguish fuel reduction fires. Others raked leaf litter into the fires to keep a fuel-free buffer zone around the fire. I took part in two and realised that a day's back-breaking, hot dirty work was so labor-intensive it was set up to fail. In one day, a large team reduced fuel in an area the size of three football fields. Working so hard, the need to breathe heavily in the smoke, left me with burnt out lungs and feeling as if I had smoked 100 cigarettes even though I wore a mask. Other paid hierarchy rules were also unnecessarily dangerous.

Orders placed five local fire trucks in the path of a firestorm – luckily the teams escaped, but one firefighter developed chronic PTSD after the event[31]. Brigades were also ordered to attend a bogus emergency call, leaving their region undefended. Other brigades with orders to stand down, were forced to carry out illegal midnight backburns thereby saving their communities. NSW Deputy State Coroner[32] John Hiatt found the NSW Bushfire Service hierarchy's strategies shambolic throughout the 1993/94 fires.

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[29] See Ormerod, Paul (1994) *The Death of Economics* 1st edn England: Faber & Faber pages 153-161.

[30] Finlay, Christine (2005) *Smokescreen: Black/White/Male/Female Bravery and SE Australian Bushfires* PhD UNSW.

[31] See Finlay, Christine (2005) *Smokescreen: Black/White/Male/Female Bravery and SE Australian bushfires* PhD UNSW, pages 104, 108.

[32] Westmead Coroners Court (1995) New South Wales Bushfire Inquiry: findings. Inquiry into the cause and origin of the bushfires occurring in New South Wales between 31st December, 1993 and 14th January, 1994 and Inquests into the manner and cause of death of Norman John Anthes, Robert Eglinton Page, William John Roach and Pauline Mary O'Neil.

He recommended changes to make operations more cohesive; removing local government involvement and an eventual absorption of the service into the urban NSW Fire Brigades. Phil Koperberg, who led the 1993/94 bushfire response, proved more persuasive than the coroner. Koperberg boasting an army of 6,000 volunteers proved untouchable, parliament chose not to merge the services, giving him more power than ever before. Koperberg's intense lobbying campaign convinced NSW Parliament that bushfirefighting would move from "steam power" to "post-nuclear", with new legislation, the Rural Fires Act 1997 (NSW). Section 128 of the act exempts anyone with the newly formed NSW Rural Fire Service's authority from liability for an act or omission.

S.128 cost landholders dearly after the 2003 fires where the cumulative effect of ten days of shambolic hierarchy acts and omissions predictably caused a firestorm that killed four, destroyed a swathe of properties and killed 700 square kilometres of rainmaking ash forest in the Snowy Mountains. Beginning in 2007, a group of NSW landholders tenaciously brought four separate class actions after judgement after judgement went against them.

They won at common law with a large body of evidence proving their losses were preventable so bushfire and national park services were negligent. With composure, Koperberg admitted negligence. In one hearing, counsel stated s.128 gives immunity for fire officers to ignore a fire call to sit in a fire shed watching the football on TV drinking a can of beer[33]. The seven-year court battle ended in 2014 with High Court judgement against the landholders and an order to pay costs where both sides used QCs and SCs[34]. While s.128 of the new statute removed liability, ordinary citizens automatically face prosecution for arson if they are even suspected of lighting fires. Unlike the bushfire class actions, in a case where a woman died after falling from a window of a blood-spattered apartment, the High Court dismissed the dead woman's estranged boyfriend's appeal against a murder verdict through reckless indifference under s.19A of the Crimes Act 1900 (NSW)[35]. The landholders defeat hinged on s.128 and a precedent for a civil action where two ambulance crew failed to hospitalise a suicidal man who subsequently killed himself. The suicide precedent has few parallels to a case where a leading CSIRO bushfire scientist, local brigade captains and landholders pleaded with the Rural Fire Service for seven days to put out trickling January fires burning high fuel loads. The slowly intensifying fires started to change

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[33] West, Wayne (2020) personal communication April 1.

[34] See *West & Anor v State of New South Wales & Anor* (2007) ACTSC retrieved austlii April 1 2020 http://classic.austlii.edu.au/cgi-bin/sinodisp/au/cases/act/ACTSC/2007/43.html?stem=0&synonyms=0&query=title%28west Anor and State of New south Wales %29; *State of New South Wales v West & Anor* retrieved austlii April 1 20020 from http://classic.austlii.edu.au/cgi-bin/sinodisp/au/cases/act/ACTCA/2008/14.html?stem=0&synonyms=0&query=title%2528west%20Anor%20and%20State%20of%20New%20south%20Wales%20%2529 & State of New South Wales v West & Anor (2008) retrieved April 2 2020 from http://classic.austlii.edu.au/cgi-bin/sinodisp/au/cases/cth/HCATrans/2008/353.html?stem=0&synonyms=0&query=title%28 west Anor and State of New south Wales %29

[35] See Royall v The Queen (1991) HCA 27; 172 CLR 378.

the weather and it became hotter, drier and windier. On the ninth day, before the fires hit Canberra, the RFS decided to finally take action, ignoring locals' warnings against a midday backburn along the almost dry Goodradigbe River. Conditions were too intense and the riverbank's fuel loads were too high so the backburn would intensify flames. Backburns should be done as a last resort when fires have died down – usually around midnight to dawn. It was around midday and the fire was starting to crown when crews lit up the record high fuel loads of thick dry vegetation along the river's banks. The backburn was doomed to blow up like a bomb in such conditions and to the landholders' horror turned into a fire tornado.

Despite considerable uniformity in state and territory statutes on reckless indifference to causing death, dishonestly destroying property etc, and destroying evidence (the RFS has a track record of telling courts and inquiries it lost emergency call tapes) to the best of my knowledge, only once did a bushfire inquiry broach government hierarchy criminality for this pattern. Maria Doogan, the ACT Chief Coroner recommended criminal investigations of four ACT senior bureaucrats during the 2003/4 bushfire inquest. Unlike the High Court case of a woman who fell from a window, instead of acting on Doogan's recommendations, the ACT Government hired a Macquarie Street legal team to try to sack her, forcing Doogan to stand down for close to a year.

She faced accusations of bias and exceeding her jurisdiction – based on her examination of the fires' unchecked origins in a NSW alpine national park and treating an ACT fire controller's evidence as dubious[36]. The Australian Federal Police raided the office of (CSIRO bushfire scientist) Phil Cheney, who was acting as Doogan's adviser and confiscated his computer and files. The AFP found one statement to attack Cheney - bias when he messaged a colleague that they were finally going to nail those b….s. In addition to the failure to criminally investigate reckless indifference of government hierarchy as Coroner Doogan recommended, it is unlikely changes to Australia's building code were what Mr Nairn intended in his recommendations for national standards to make buildings safer in his House of Representatives inquiry into the same 2003 fires.

Bushfire services then used a botanist's classification of ACT and NSW vegetation[37] for a new national risk model that the Building Code of Australia made mandatory for building on bushfire-prone land[38]. In 2011, alarmed that the new standards were dangerously wrong[39], I warned David Keith the botanist and Standards Australia of dangerous inaccuracies. Keith's vegetation classifications fail to reflect a large body of empirical evidence of

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[36] See The Queen v Coroner Maria Doogan; Ex Parte Peter Lucas-Smith & Ors & The Queen v Coroner Maria Doogan & Ors; Ex Parte Australian Capital Territory [2005] ACT SC 74 (5 August 2005).

[37] See Keith, DA (2004) *Ocean Shores to Desert Dunes; the native vegetation of New South Wales and the ACT* NSW Department of Environment and Conservation

[38] See Standards Australia 2009, construction of buildings in bushfire-prone areas AS 3959-2009.

[39] See BC Lewis (2019) *Tathra torn apart by building codes and ratings after bushfire* Blue Mountains Gazette October 25 retrieved April 10 2020 from https://www.bluemountainsgazette.com.au/story/6458389/coastal-towns-headaches-after-fire/

different bushfire behaviour in different topographies[40]. [redacted] Standards Australia ignored the evidence proving my risk analysis.

I explained that most building occurs in coastal regions, where on flat low lying ground close to the ocean, near surface groundwater keeps vegetation green, acting as a bushfire buffer. The high coastal humidity and moist ground also encourage microbial activity to break down fallen vegetation into non-combustible soil. Wet and dry rainforest often surrounds these flat, coastal areas, which the new standard classifies as forest with twice the "fire danger index" or fire intensity potential as alpine forest. This is despite a mountain of evidence from bushfires like Black Friday Victoria 1939, Kinglake and Marysville Victoria 2009, Snowy Mountains 2003 and 2019/20 that alpine fires are more intense than those on low lying coastal regions.

For no evidenced reason whatsoever, the building code claims forests in inland alpine regions pose half the risk of coastal forests[41]. This classification is however lucrative for bushfire hierarchy and government at state and local government with power bases that administer and process building development applications that are more expensive in coastal areas where urban development is most concentrated. People building on the coast above near surface groundwater must spend tens of thousands protecting against firestorms under Keith's one-size-fits-all classification that both areas are forested.

The new building code's also abandoned an easy to use empirically developed method to calculate flame intensity, replacing it with eight pages of calculus based on assumptions developed from observations of burning heathland[42]. These eight pages are contentious because they are based on the assumption that flame slope and burning heath intensity are universal constants in bushfires. Fire tornadoes are an obvious exception where flames burn downhill. Flame slope is also hard to measure and can only be done using a scientific team during a fire. The eight pages of calculations replaced the easy to do formula, I=Hwr[43], confirmed over decades of empirical data

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[40] See Byram, GM 1959, Combustion of Forest Fuels, In forest fire Control and Use McGraw Hill NY, where I= flame intensity of fire front in kiloWatts/metre; R=rate of spread in km/hr; W= weight of fuel in tonnes/hectare and H= heat measurement ie calories kilojoule; Luke RH & McArthur AG (1978) *Bushfires in Australia* Australian Government Publishing Service Canberra; Cheney Phil & Sullivan Andrew (2008) *GRASSFIRES Fuel, weather and fire behaviour* CSIRO Publishing; Gould JS, McCaw WL, Cheney NP, Ellis PF, Matthews S (2007) *field Guide fuel Assessment and Fire Behaviour Prediction in Dry Eucalypt Forest* Bushfire CRC; Gould JS, McCaw WL, Cheney NP, Ellis PF, Knight IK, Sullivan AL (2007) *Project Vesta – fire in Dry Eucalypt forest: fuel structure, fuel dynamics and fire behaviour* Ensis-CSIRO, Canberra; McCarthy GJ, Tolhurst KG, Chatto K (1999) *Overall fuel hazard guide natural Resources and Environment, Victoria Report no 47*.

[41] See Standards Australia 2009, construction of buildings in bushfire-prone areas AS 3959-2009 Table 2.1 p 15.

[42] See Standards Australia 2009, construction of buildings in bushfire-prone areas AS 3959-2009 pages 85-93.

[43] See Byram, GM 1959, *Combustion of Forest Fuels*, in Forest Fire Control and Use McGraw Hill NY, where I= flame intensity of fire front in kiloWatts/metre; R=rate of spread in km/hr; W= weight of fuel in tonnes/hectare and H= heat measurement ie calories kilojoule.

gathering, where the easily determined rate of spread replaces slope. The eight pages of calculus based on assumptions[44] are even more dangerous by contradicting a second bushfire hierarchy risk model. After spending tens of thousands to protect against intense fires, landholders wanting hazard reduction are told the risk is small and there is no need to reduce fuel loads. "Buffer zones" around the new bunker-like buildings would be laughable if they were not lethal.

Rather than protecting the nation, the new almost impossible eight pages of calculus based on assumption ignore the large body of research from World War II beginning with Allied defence analysts' observation that being unstoppable, intense fires can spread rapidly to inflict massive injuries and death on an enemy. Ignoring this evidence, the fact that humans first learnt to manage fires 250,000 years ago and centuries of knowledge of how to cook, heat, and make steel, bronze and pottery[45] etc… bushfires in current fuel loads burn up to 1100-1600°C with buffer zones of 6-100 metres purportedly protecting buildings. Steel melts at 1200°C, and starts to sag at lower temperatures. Firestorms burn so hot, they kill onlookers 120 metres from the flames in a few minutes and cook survivors' flesh so they need massive surgery to regain the use of body parts. Buffer zone requirements ignore evidence presented to the 2010 Senate Select Committee Inquiry, the Nairn inquiry and the ACT Chief Coroner that a catastrophically wrong backburn of dense, dried vegetation along the almost dry Goodradigbe River when the fire was starting to crown, predictably intensified rather than diminished flame intensity to form a downhill burning fire tornado that jumped roads and a highway to cover about three kilometres of ground with almost no vegetation from the Brindabella Ranges to the Canberra outer suburb of Duffy. Only a weather change put it out.

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[44] See Standards Australia 2009, construction of buildings in bushfire-prone areas AS 3959-2009.

[45] It is generally agreed proto-humans learnt to control fire about 250,000 years ago, according to Steven James in his review of archaeological evidence fire James, Steven R. (1989). *"Hominid use of fire in the Lower and Middle Pleistocene: a review of the evidence"* (PDF). *Current Anthropology*. University of Chicago Press. 30 (1): 1–26. *doi*:*10.1086/203705. Retrieved 2012-04-04.* Fuel's importance to making bronze was known 6,000 years agoJames E. McClellan III; Harold Dorn (2006). *Science and Technology in World History: An Introduction*. JHU Press. ISBN 978-0-8018-8360-6. p. 21. About 4,000 years ago humans developed fuels to make iron James E. McClellan III; Harold Dorn (2006). p. 21.and in the 5th century"The Earliest Use of Iron in China" by Donald B. Wagner in *Metals in Antiquity*, by Suzanne M. M. Young, A. Mark Pollard, Paul Budd and Robert A. Ixer (BAR International Series, 792), Oxford: Archaeopress, 1999, pp. 1–9