CLIMATE COUNCIL

BE PREPARED: CLIMATE CHANGE AND THE ACT BUSHFIRE THREAT

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Introduction

Residents of the Australian Capital Territory (ACT) have experienced the serious consequences of bushfires. In 2003 large and uncontrollable fires devastated several suburbs in Canberra, claiming five lives and destroying over 500 properties.

Australians have always lived with fire and its consequences, but climate change is increasing fire danger weather and thus the risk of fires. It is time to think very seriously about the risks that future fires will pose.

We first describe the background context of fire and its history in the ACT and the surrounding region. We then outline the link between bushfires and climate change, before considering how bushfire danger weather is increasing in the ACT and what this means for the immediate future. We explore the impacts of fire on people, property, water supply and biodiversity, before considering the future influence of climate change on bushfires, and the implications for ACT fire managers, planners and emergency services.

Key Findings

1. **Climate change is already increasing the risk of bushfires in the ACT.**
   - Extreme fire weather has increased over the last 30 years in southeast Australia, including the ACT and surrounding region.
   - Hot, dry conditions have a major influence on bushfires. Climate change is making hot days hotter, and heatwaves longer and more frequent, with increasing drought conditions in Australia's southeast. 2013 was Australia's hottest year on record and in the summer of 2013/14 Canberra experienced 20 days of at least 35°C. These conditions are driving up the likelihood of very high fire danger weather in the Territory.
   - Australia is a fire prone country and the ACT has always experienced bushfires. Today hotter and drier conditions are increasing the risk of high fire danger weather.
2. **In the ACT the fire season is starting earlier and lasting longer.**
   - During spring in the southeast of Australia, fire weather has been extending into October, and in the autumn, into March. The fire season will continue to lengthen into the future, further reducing the opportunities for safe hazard reduction burning. This has significant implications for fire services and complicates the management of bushfires in Australia.
3. **Severe fires in the ACT have already been influenced by record hot, dry conditions with significant consequences for life and property.**
   - Record breaking heat and a continued warming trend in the ACT has worsened fire weather and contributed to an increase in the frequency and severity of bushfires in the Territory and surrounding regions.

- In 2003 abnormally high temperatures and below-average rainfall in and around the ACT preceded bushfires that devastated several suburbs, destroyed over 500 properties and claimed five lives. This also had serious economic implications for the Territory with insured losses of $660 million ($2011).

4. In the future, the ACT is very likely to experience an increased number of days with extreme fire danger.

- Fire severity across southern Australia has been persistently higher than the long-term average, and the concept of a 'normal' bushfire season is rapidly changing as bushfires continue to increase in number, burn for longer, and affect larger areas.
- Fire frequency and intensity is expected to increase substantially in coming decades.
- This will have far reaching implications for ACT properties, agriculture, emergency services and lives.

5. It is crucial that ACT communities, emergency services, and health services prepare for the increasing severity and frequency of extreme fire conditions.

- As fire risk increases, disaster risk reduction will play a critical role in reducing risks to people and their assets. Increased resources for our emergency services and fire management agencies will be required.
- By 2030, it has been estimated that the number of professional firefighters in Australia will need to approximately double (compared to 2010) to keep pace with increased population, asset value, and fire danger weather.

6. This is the critical decade

- To reduce the risk of even more extreme events, including bushfires, in the future, Australia must cut greenhouse gas emissions rapidly and deeply to join global efforts to stabilise the world's climate.

1. The nature of bushfires

Fire has been a feature of the Australian environment for at least 65 million years (Cary et al., 2012). Human management of fires also has a long history, starting with fire use by indigenous Australians ("fire-stick farming") up to 60,000 years ago. Today between 3% and 10% of Australia's land area burns every year (Western Australian Land Information Authority 2013).

Fire is a complex process that is very variable in space and time. A fire needs to be started (ignition), it needs something to burn (fuel) and it needs conditions that are conducive to its spread (weather and topography) (see Figure 1). Fire activity is strongly influenced by weather, fuel, terrain, ignition agents and people. The most important aspects of weather that affect fire and fuels are temperature, precipitation, wind and humidity. Once a fire is ignited, very hot days with low humidity and high winds are conducive to its spread.

The type, amount, and moisture level of fuel available are also critical determinants of fire behaviour, extent and intensity. The relationship between rainfall and fuel is complex. Wet seasons can lead to increased plant growth and therefore increase fuel buildup in the months or years before a fire is ignited (Bradstock et al. 2009). Warmer temperatures and low rainfall in the period immediately preceding an ignition, however, can lead to drier vegetation and soil, making the existing fuel more flammable. Warmer temperatures can also be associated with a higher incidence of lightning activity (Jayaratne and Kuleshov, 2006), increasing the risk of ignition.

The concept of "fire regimes" is also important for understanding the nature of bushfires in Australia, and for assessing changes in fire behaviour caused by both human and climatic factors (Figure 1). A fire regime describes *a recurrent pattern of fire*, with the most important characteristics being the frequency, intensity, and seasonality of the fire. Significant changes in any of these features of a fire regime can have a very important influence on its ecological and economic impacts (Williams et al. 2009).

In Australia's southeast, fires are common in the heathlands and dry sclerophyll forests, typically occurring about every 5 to 30 years, with spring and summer being peak fire season (Clarke et al. 2011; Bradstock et al. 2012). Canberra is no stranger to bushfires. The 'Bush Capital' has been affected by bushfires throughout history and much of the native vegetation is fire prone, particularly the dry forest, grassland and woodland. For example, in 1982–83, bushfires broke out amidst a severe drought, burning 33,000 hectares of land.

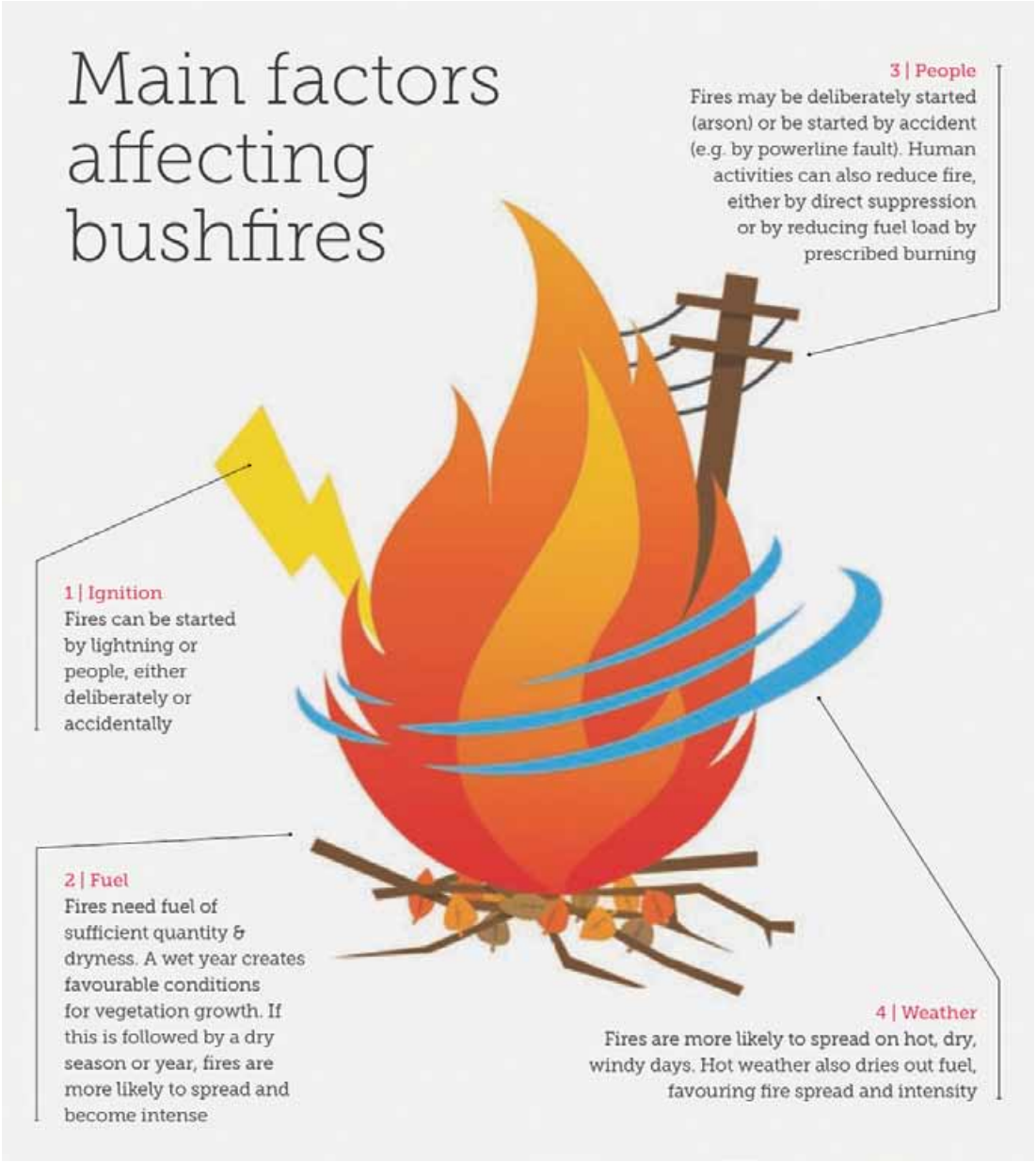

Figure 1: Main Factors Affecting Bushfires

The Black Christmas bushfires in NSW and the ACT in 2001 caused $131 million ($2011) in insured costs and burned 753,314 hectares of land (Deloitte Access Economic 2014). The major bushfires of 2003 were preceded by one of the worst droughts in history, burning nearly 70% of land in Canberra, damaging 90% of Namadgi National Park, destroying over 500 houses and damaging a further 315 (ACT RFS 2011; ABS 2006).

2. Observations of changing bushfire danger weather in the ACT

In Australia, the Forest Fire Danger Index (FFDI) is used an indicator for extreme fire weather (Luke and Macarthur 1978). The Bureau of Meteorology (BoM) and fire management agencies use the FFDI to assess fire risk and issue warnings. The index was originally designed on a scale from 0 to 100, with a value between 75 and 100 considered 'extreme'. The unprecedented weather conditions that triggered the 2009 Black Saturday bushfires in Victoria saw a new 'catastrophic' category added to the FFDI for weather conditions exceeding the existing scale.

The FFDI has already increased significantly at 16 of the 38 weather stations across Australia that routinely measure the index, between 1973 and 2010, with most of these stations in southeast Australia (Clarke et al. 2013). In the ACT and surrounding region, increasing hot days, heatwaves and rainfall deficiencies are driving up the likelihood of very high fire danger weather.

While hot weather has always been common in Australia's southeast, it has become more common and severe over the past few decades, including in the ACT. The southeast of Australia has experienced significant warming during the last 50 years (Timbal et al. 2012). The number of heatwave days in Canberra has doubled since 1950 and the increase in hot weather that was observed in the 2000–2009 decade has already reached the level previously projected for 2030 in Canberra (BoM 2013a; Climate Council 2013b).

Increasing heat persisted into 2013. Last year was Australia's hottest year on record and the mean maximum temperature during the year was 1.45°C above average (BoM 2014a; Climate Council 2014a). Temperatures soared in the ACT and during the summer of 2013/14 Canberra experienced 20 days of at least 35°C (Climate Council 2014b). The IPCC projects with virtual certainty that warming in Australia will continue throughout the 21st century and predicts with high confidence that bushfire danger weather will increase in most of southern Australia, including the ACT (IPCC 2014). The direct effects of a 3–4°C temperature increase in the ACT could more than double fire frequency, increasing average fire intensity by 20% (Cary and Banks 2000; Cary 2002).

The direct effects of a 3–4°C temperature increase in the ACT could more than double fire frequency and increase average fire intensity by 20%.

Much of eastern Australia has become drier since the 1970s, with the southeast experiencing a drying trend due to declines in rainfall combined with increased temperatures (BoM 2013b; Climate Commission 2013). Since the mid-1990s, southeast Australia has experienced a 15 percent decline in late autumn and early winter rainfall and a 25 percent decline in average rainfall in April and May (CSIRO & BoM 2014). This long-term rainfall deficit across southern Australia, coupled with above average temperatures, has reduced soil moisture and has lead to the drying of heavy fuels in forests, increasing bushfire potential in the ACT (Bushfire CRC 2014). It is very likely that an increased incidence of drought in the southeast—coupled with consecutive hot and dry days—will result in longer fire seasons and an ever larger number of days of extreme fire danger in coming decades (e.g. Clarke et al. 2011; 2013).

The concept of a 'normal' bushfire season is rapidly changing as bushfires continue to increase in number, burn for longer and affect larger areas of land (Bushfire CRC 2014). There has also been a lengthening of the fire season across southern Australia, with high fire danger weather extending into October and March.

The ACT RFS Chief Officer Andrew Stark recently raised concern at the elevated bushfire risk in the ACT as fire seasons in the territory have become longer in recent years (ABC 2014). The lengthening fire season means that opportunities for fuel reduction burning are decreasing (Matthews et al. 2013). The Southern Australia Seasonal Bushfire Outlook for 2014/15 projects that due to the hotter, drier weather in southeast Australia, above normal fire activity can be expected in the ACT. Specifically, strong grass growth into early winter, above average temperatures projected for summer, and a reduction in rainfall in recent months could contribute to a more severe bushfire season for Canberra (Bushfire CRC 2014).

The Southern Australia Seasonal Bushfire Outlook for 2014/15 projects that due to the hotter, drier weather in southeast Australia, above normal fire activity can be expected in the ACT.

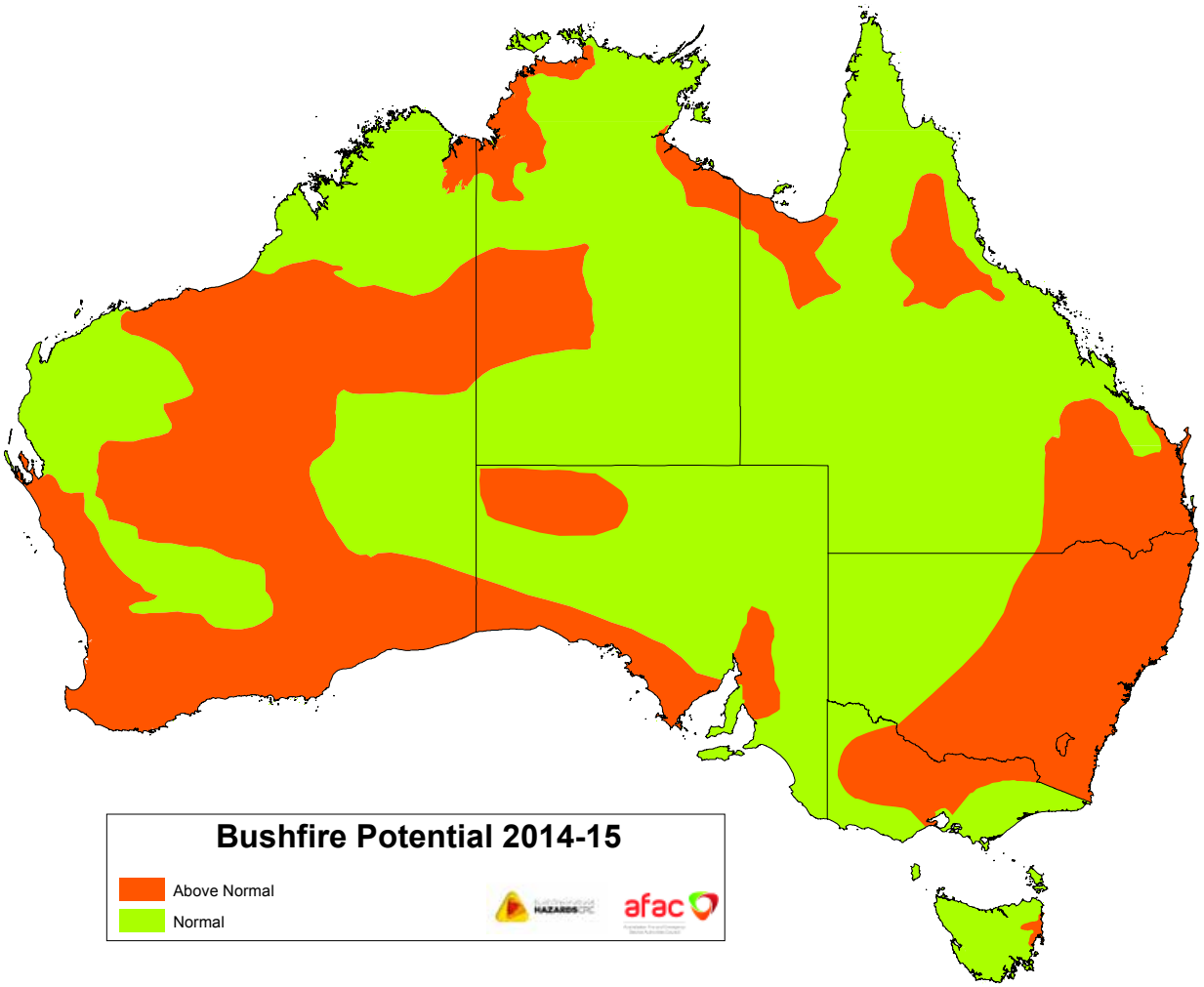

Figure 2: Southern Australia Seasonal Bushfire Outlook (Bushfire CRC 2014)

3. Impacts of bushfires in the ACT

In the ACT, bushfires have had a very wide range of human and environmental impacts, including loss of life and severe health effects, damage to property, devastation of communities and effects on water and natural ecosystems (Stephenson 2010).

3.1 Health Impacts

Tragically, in Australia bushfires have accounted for more than 800 deaths since 1850 and fatalities have also occurred in the ACT with the 2003 fires claiming five lives and causing 52 major injuries (Cameron et al. 2009; King et al. 2013; ACT RFS 2011). In addition to fatalities, bushfire smoke can seriously affect health. Smoke contains not only respiratory irritants, but also inflammatory and cancer-causing chemicals (Bernstein and Rice 2013). Smoke can be transported in the atmosphere for hundreds or even thousands of kilometres from the fire front, exposing large populations to its impacts (Spracklen et al. 2009; Dennekamp and Abramson 2011; Bernstein and Rice 2013). For example, during the Blue Mountains bushfires in October 2013, air quality levels in the Sydney region were measured at 50 times worse than normal. NSW Health recorded that 228 people attended hospital with breathing difficulties; 778 other individuals were treated by ambulance staff and there was a 124 percent increase in patients with asthma conditions seeking hospital treatment (AEM 2013). Data specific to the ACT remains limited, but the health impacts of bushfire smoke have implications for individuals living in all states and territories across Australia.

In addition to physical health impacts, the trauma and stress of experiencing a bushfire can also increase depression, anxiety, and other mental health issues, both in the immediate aftermath of the trauma and for months or years afterwards (McFarlane and Raphael 1984; Sim 2002; Whittaker et al. 2012). In the wake of the Canberra 2003 bushfires considerable assistance with emotional recovery was required, including for post-traumatic stress disorder, as the community attempted to come to terms with the devastating effects of the fires (Robinson 2003).

3.2 Economic Costs

The economic cost of bushfires—including loss of life, livelihoods, property damage and emergency services responses—is very high. The 2003 Canberra and Alpine bushfires caused significant economic damage; 500 properties were destroyed and insured losses were $660 million ($2011) (Climate Council 2013a; Insurance Council of Australia 2013). A substantial proportion of these costs was borne by home owners as 27%–81% of households affected by the 2003 Canberra fires were either uninsured or underinsured (by an average of 40% of replacement value) (ASIC, 2005).

Figure 3: The 2003 Canberra bushfires spread in Dunlop

The 2003 Canberra and Alpine bushfires caused significant economic damage; 500 properties were destroyed and insured losses were $660 million ($2011)

Bushfires can cause particularly significant losses in the farming areas of the ACT and the surrounding region. For example, the 2003 Alpine and Canberra bushfires killed over 13,000 sheep, nearly 4000 cattle and destroyed over 300 agricultural buildings (Stephenson 2013). Stock that survives the initial bushfires can face starvation in the post-fire period, as well as threats from predators due to the destruction of fences around properties. For example the 2003 fires destroyed nearly 4000 kilometres of fencing. Bushfires also have implications for the timber industry. Losses were $1.494 billion after the 2003 Canberra fires and only 39 percent of the plantation area burnt was able to be salvaged (Stephenson, 2013).

It is important to note that these economic losses do not account for the full range of costs associated with bushfires—few attempts have been made to account for loss of life, social disruption and trauma, opportunity costs for volunteer fire fighters, fixed costs for bushfire fighting services, government contributions for rebuilding and compensation, impacts on health, and ecosystem services (King et al. 2013).

3.3 Environmental Impacts

Fire can affect the quality and quantity of water in catchments and have significant impacts on ecosystems.

3.3.1 Impact on water quality and quantity

Large-scale, high intensity fires can remove vegetation, expose topsoils to erosion and increase runoff after subsequent rainfall (Shakesby et al., 2007). This can increase sediment and nutrient concentrations in nearby waterways, potentially making water supplies unfit for human consumption (IPCC 2014). The 2003 Canberra bushfires devastated almost all of the Cotter catchment, causing unprecedented levels or turbidity, iron and manganese and significantly disrupting the city's water supply (White et al 2006).

3.3.2 Impact on Ecosystems

Fire is a regular occurrence in many Australian ecosystems, and many species have evolved strategies over millions of years to not only withstand fire, but to benefit from it (Crisp et al. 2011, Bowman et al. 2012). Fire does not "destroy" bushland, as is often reported; rather, it acts as a major disturbance with a range of complex impacts on different species and communities. Particular fire regimes (especially specific combinations of fire frequency and intensity) can favour some species and disadvantage others. If fires are too frequent, plant species can become vulnerable to local extinction as the supply of seeds in the soil declines. Conversely, if the interval between fires is too long, plant species that rely on fire for reproduction may be eliminated from an ecological community.

Animals are also affected by bushfires. For example if they are restricted to localised habitats and cannot move quickly, and/or reproduce slowly, they may be at risk from intense large-scale fires that occur at short intervals (Yates et al. 2008). Bushfires also disturb aquatic ecosystems; the 2003 bushfires affected communities of benthic aquatic algae and macroinvertebrates in the Cotter and Goodradigbee Rivers by destroying their aquatic habitat (Peat et al. 2005).

Figure 4: burnt trees, Black Mountain Canberra.

4. Implications of increasing fire activity

The population of the ACT is expected to reach 400,000 by 2017 and 500,000 by 2033 (ACT Government 2014). The increasing population and built assets, coupled with increasing fire danger weather, presents significant and growing challenges for the territory. This challenge is exemplified in Canberra, where over 9000 Canberra homes are located 400–700 metres from bushland, exposing residents to greater bushfire risk (Risk Frontiers 2004).

The economic, social and environmental costs of increasing bushfire activity in the ACT are potentially immense. The 2003 Canberra and Alpine bushfires caused significant economic damage; 500 properties were destroyed and insured losses were $660 million ($2011) (Climate Council 2013a; Insurance Council of Australia 2013).

As bushfires in the ACT increase in frequency and intensity, a detailed cost benefit analysis of bushfire mitigation and adaptation is needed.

The economic, social and environmental costs of increasing bushfire activity in ACT are potentially immense.

There is increasing interest in how adaptation to an increasingly bushfire-prone world may reduce vulnerability. Current initiatives centre on planning and regulations, building designs to reduce flammability, burying powerlines in high risk areas and retrofitting electricity systems, fuel management, fire detection and suppression, improved early warning systems, and community education (Preston et al. 2009; Buxton et al. 2011; O'Neill and Handmer 2012, King et al. 2013).

Responses to bushfires can be controversial, particularly the practise of prescribed burning, where fires are lit in cool weather to reduce the volume of fuel. Fire managers are constantly faced with the challenge of balancing the need to reduce risk to life and property whilst simultaneously conserving biodiversity and environmental amenity, and controlling air pollution near urban areas (Penman et al. 2013; Williams and Bowman 2012; Adams 2013; Altangerel and Kull 2013). The increasing length of the fire season will reduce the window of opportunity for hazard reduction at the same time that the need for hazard reduction becomes greater.

Australia's premier fire and emergency services agencies have recognised the implications of climate change for bushfire risk and fire-fighting resources for some time (AFAC 2010).

Longer fire seasons have implications for the availability and costs of fire-fighting equipment that is leased from fire fighting agencies in the Northern Hemisphere. As fire seasons in the two hemispheres increasingly overlap, such arrangements may become increasingly impractical (Handmer et al. 2012). Substantially increased resources for fire suppression and control will be required. Among these resources are professional firefighters, the number of whom in Australia will need to grow by an estimated 20% (that is, by about 2300) by 2020 (compared to 2012) just to keep pace with increased population and asset growth (NIEIR 2013). When the increased incidence of fire-related extreme weather is also taken into account, the estimate is that a further 1200 fire fighters will be needed.

Australia's premier fire and emergency services agencies have recognised the implications of climate change for bushfire risk and fire-fighting resources for some time.

Figure 5: Firefighters conducting a hazard reduction burn in Canberra

5. This is the Critical Decade

The impacts of climate change are already being observed. Sea levels are rising, oceans are becoming more acidic, and heatwaves and the bushfire season have become longer, hotter and more intense. We are now more confident than ever that the emission of greenhouse gases by human activities, mainly carbon dioxide from the combustion of fossil fuels, is the primary cause for the changes in climate over the past half-century (IPCC 2013; 2014).

Projections of future climate change and its impacts have convinced nations that the global average temperature, now at 0.9°C above the pre-industrial level, must not be allowed to rise beyond 2°C– the so-called '2°C guardrail'.

Societies will have to adapt to even more serious impacts as the temperature rises. For the ACT, these impacts include increased fire danger weather and longer bushfire seasons. Ensuring that this guardrail is not exceeded will prevent even worse impacts.

The evidence is clear and compelling. The trend of increasing global emissions must be halted within the next few years and emissions must be trending downwards by 2020. Investment in renewable, clean energy must therefore increase rapidly. And, critically, most of the known fossil fuel reserves must remain in the ground.

This is the critical decade to get on with the job.

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IMAGE CREDITS

'Cover Photo: "After the Fire: burnt trees, Black Mountain, Canberra" by Flickr user Peter Ostergaard licensed under CC by-NC 2.0'

Page 8: Figure 2 "Southern Australia Seasonal Bushfire Outlook 2014–15" by the Bushfires and Natural Hazards Cooperative Research Centre (2014).

Page 10: Figure 3 "2003 Canberra fire and wind in the trees at Dunlop" by Flickr user Spelio licensed under CC by –NC 2.0.

Page 11: Figure 4 "After the Fire: burnt trees, Black Mountain, Canberra" by Flickr user Peter Ostergaard licensed under CC by –NC 2.0.

Page 13: Figure 5 "Controlled burning on the west edge of Canberra. Done to minimise the risk of another fire like occurred in 2003" by Flickr user Ryan Wick licensed under CC by 2.0.

Preparing for a Bushfire in ACT

IN AN EMERGENCY, CALL TRIPLE ZERO (106 FOR PEOPLE WITH A HEARING OR SPEECH IMPAIRMENT) 000

What can I do to prepare for a bushfire?

INFORM YOURSELF

The ACT Rural Fire Service and the ACT Emergency Services Agency has the resources available to help you prepare for a bushfire. Use these resources to inform yourself and your family.

ASSESS YOUR LEVEL OF RISK

It is vital to assess you level of risk from bushfire, whether you live in a suburban or rural area in the ACT. You can read information about bushfire risks in the suburbs here: http://esa.act.gov.au/community-information/bushfires/in-the-suburbs/. For those living in the rural areas of the ACT, the ACT Farm Firewise Program has been developed to assist with prevention, preparedness, response and recovery: http://esa.act.gov.au/community-information/bushfires/in-the-rural-areas/

MAKE A BUSHFIRE SURVIVAL PLAN

Even if your household is not at high risk from bushfire (such as suburbs over 1 km from bushland), you should still educate yourself about bushfires, and take steps to protect yourself and your property. Read the ACT Emergency Services Agency report on how to make a bushfire survival plan: http://esa.act.gov.au/wp-content/uploads/ACT-Bush-Fire-Survival-Plan-2013.pdf

PREPARE YOUR PROPERTY

Regardless of whether you decide to leave early or to stay and actively defend, you need to prepare your property for bushfire. An important consideration is retrofitting older houses to bring them in alignment with current building codes for fire risk and assessing the flammability of your garden.

PREPARE YOURSELF AND YOUR FAMILY

Preparation is not only about the physical steps you take to prepare—e.g., preparing your house and making a bushfire survival plan. Preparing yourself and your family also involves considering your physical, mental and emotional preparedness for a bushfire and its effects. Take the time to talk to your family and to thoroughly prepare yourself on all levels

Key Links

ACT Rural Fire Service: http://esa.act.gov.au/actrfs/ (02) 6207 8609

Fires Near Me App: http://esa.act.gov.au/community-information/bushfires/fires-near-me/ (Available on iOS and Android)

ACT Farm Firewise Program: http://esa.act.gov.au/community-information/bushfires/in-the-rural-areas/