Climate Change and Bushfire

In terms of prevention and mitigation, the scale of the increasing fire management problem, compounded by the impact of climate change, means we must adjust our focus and invest more in mitigation and prevention, but it also has to accompany our recognition that some fires, simply put, will not be suppressed. Our only option is to do more in the way of prevention, mitigation and community engagement to get as much groundwork done before the fire season starts.814

Introduction

Term of reference number ten requires the Committee to consider the impact of climate change on bushfires and public land management practices.

Over recent years, Australia, particularly the south east, has experienced significant fire events. The 2002/03 and 2006/07 Victorian bushfires are prime examples. The evidence provided to this Inquiry and others, has highlighted that there is a growing awareness of bushfires in Australia. As Lucas (et al) notes, growing community awareness has been accompanied by a general perception that bushfire seasons are becoming more extreme, with an increase in the number of ‘very high’ and ‘extreme’ fire danger days, and therefore and increased risk of larger, more frequent and less controllable bushfires.815 Some commentators also argue that climate change is one the principal drivers behind the “mega fire" phenomenon that has reportedly been occurring around the world over recent years.816

While Australia is a relatively small greenhouse gas emitter by international standards, the impacts of climate change still pose a significant risk to Australians. For example, scientific evidence suggests that climate change

816 The term mega-fire typically refers to fires of extraordinary size, complexity and resistance to control. Such fires are frequently long-lived and require a large sustained resource commitment.
in Australia may lead to an increase in the frequency and intensity of fires.\textsuperscript{817} Similarly, Professor Andy Pitman notes that climate change will “increase the risk of forest and grassland fires, and that the higher emissions the higher the increase in the fire risk”.\textsuperscript{818}

The CSIRO confirm the effect of climate change on fire risk, noting that as a result of climate change on the south east of Australia the region is likely to become hotter and drier in the future.\textsuperscript{819} Studies also suggest that the window available for prescribed burning may shift and narrow, and that it is likely that higher fire-weather risk in spring, summer and autumn will increasingly shift periods suitable for prescribed burning toward winter.\textsuperscript{820}

This chapter initially provides an overview of climate change, highlighting the observed and projected impacts of climate change at the international, national and state levels. An examination of the debate surrounding climate change, highlighting stakeholder views will also be illustrated. The chapter concludes by examining the adequacy of the Government's response in relation to climate change and forwards recommendations aimed at improving the incorporation and consideration of climate change into fire management planning processes.

What is Climate Change?

The greenhouse effect refers to the naturally occurring process whereby the energy from the sun warms the surface of the planet. The land and water then re-radiates this heat, some of which is trapped by naturally occurring greenhouse gases in the atmosphere, resulting in a warming of the surface and the atmosphere. As such, the surface of the earth is warmer than it would be without greenhouse gases.

However, a variety of human activities, or anthropogenic activities, particularly the burning of fossil fuels such as coal, oil or gas, result in an increase in greenhouse gas concentrations. It is argued that increasing concentrations of greenhouse gases result in a reduction in outgoing radiation thereby causing the surface temperature to rise. This is commonly referred to as the enhanced greenhouse effect and is believed to be responsible for global warming or climate change.

} For example, if emissions of $\text{CO}_2$ were 50 tonnes, and emissions of $\text{N}_2\text{O}$ were one tonne, total $\text{CO}_2$-e emissions would be 360 tonnes – that is $(50 \times 1) + (1 \times 310)$.

Greenhouse gases covered by the National Greenhouse Gas Inventory include: carbon dioxide ($\text{CO}_2$); methane ($\text{CH}_4$); nitrous oxide ($\text{N}_2\text{O}$); perfluorocarbons (PFC); hydrofluorocarbons (HFC); and sulphur hexafluoride ($\text{SF}_6$).\footnote{Australian Government, \textit{National Greenhouse Gas Inventory 2005}, Australian Greenhouse Office, Canberra, 2007, p. 3.} Figure 7.1 shows the contribution to Australia’s net $\text{CO}_2$-e emissions by greenhouse gas.

\textbf{Figure 7.1: Contribution to total net $\text{CO}_2$-e emissions by greenhouse gas, 2005.}\footnote{Australian Government, \textit{National Greenhouse Gas Inventory 2005}, Australian Greenhouse Office, Canberra, 2007, p. 2.}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure7.1.png}
\caption{Contribution to total net $\text{CO}_2$-e emissions by greenhouse gas, 2005.}
\end{figure}

In 2005, Australia’s national greenhouse gas emissions were over 559 million tonnes.\footnote{Australian Government, \textit{State and Territory Greenhouse Gas Inventories 2005}, Australian Greenhouse Office, Canberra, 2007, p. 2.} Twenty-eight percent of these gases were from New South Wales, 28% from Queensland, 22% from Victoria, 12% from Western Australia, five per cent from South Australia, two per cent from the Northern Territory, two per cent from Tasmania and less than one per cent from the Australian Capital Territory.\footnote{Australian Government, \textit{State and Territory Greenhouse Gas Inventories 2005}, Australian Greenhouse Office, Canberra, 2007, p. 2.}
Australia’s energy sector, comprising stationary energy, transport and fugitive emissions\(^7\), contributes 69% of Australia’s greenhouse gas emissions.\(^8\) Industrial processes, agriculture, land use change and forestry, and waste comprise the remainder.

It is worth noting that Australia’s *State of the Forests Report 2008* reported that in 2005, Australia’s CO\(_2\)-e emissions from bushfire and prescribed burning totalled 1.3 million tonnes.\(^8\) In comparison, the 2006/07 Victorian bushfires reportedly emitted 40 million tonnes of CO\(_2\)-e.\(^9\) While 2006/07 greenhouse gas inventory figures are not available, based on the 2005 emissions figure of 559 million tonnes CO\(_2\)-e, the Victorian bushfires would have contributed approximately seven per cent to Australia’s greenhouse gas emissions for that year.

### Climate Change Trends and Predictions

While issues surrounding the debate and contentions regarding climate change will be addressed later in the chapter, it is worth highlighting some of the trends and projected impacts of climate change.

#### International

The International Panel on Climate Change (IPCC) is a scientific intergovernmental body established by the World Meteorological Organization to “assess on a comprehensive, objective, open and transparent basis the latest scientific, technical and socio-economic literature produced worldwide relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation.”\(^9\) A 2007 report prepared by one of the IPCCs working groups noted that:

- the average temperature on the Earth’s surface has risen by about 0.7°C since 1900;
- the 11 warmest years on records since 1850 have occurred in the past 12 years;

\(^7\) Fugitive emissions are greenhouse gas emissions other than those attributable to energy use from coal mining and handling, and oil and natural gas production, processing and transportation. Fugitive emissions typically include emissions from combustion where it does not support a productive activity. For example, flaring of natural gases at oil and gas production facilities.


• global sea level has risen 170mm since 1900; and

• the incidence of extremely high temperatures has increased while incidences of low temperature have decreased.\textsuperscript{830}

The IPCC concluded that:

Most of the observed increase in global average temperature since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.\textsuperscript{831}

Based on the work reported by the IPCC, Table 7.1 illustrates a range of projected impacts of climate change.

Australia

Australian temperatures have increased by an average 0.9°C since the 1950s with significant regional variations.\textsuperscript{832} Rainfall patterns during this time period have also changed with rainfall in north west Australia increasing by more than 50mm per decade since the 1950s.\textsuperscript{833} Conversely eastern and south western Australia have seen decreases in rainfall with decreases in rainfall along parts of the east coast exceeding 50mm since the 1950s.\textsuperscript{834} Between 1920 to 2000, estimated average relative sea level rise was 1.2mm/year.\textsuperscript{835}

CSIRO and Bureau of Meteorology models predict that Australia will experience a one degree warming by 2030 (relative to 1990), with warmings of around 0.7-0.9°C in coastal areas and 1-1.2°C in inland areas.\textsuperscript{836} By 2050 annual warming projections range from 0.8-2.8°C, and by 2070 ranges of 1.0-5.0°C degrees are predicted.\textsuperscript{837}


Table 7.1: IPCC key findings regarding projected impacts of climate change. 838

<table>
<thead>
<tr>
<th>Category</th>
<th>Key Findings</th>
</tr>
</thead>
</table>
| **Freshwater resources and their management** | Projected increased water availability in moist tropics and high latitudes.  
Projected decreased water availability and increasing drought in mid-latitudes and semi-arid low latitudes.  
Water supplies stored in glaciers and snow projected to decline.  
Drought-affected areas likely to increase in extent. |
| **Ecosystems**                | Resilience of many ecosystems likely to be exceeded this century by an unprecedented combination of climate change, and associated disturbances (eg. fire, flood, drought) and other global change drivers (eg pollution).  
20-30% of plant and animal species assessed are likely to be at increased risk of extinction if temperatures exceed 1.5-2.5°C.  
Possible changes to ecosystem structure and function, species’ ecological interactions, and species geographical ranges, with predominantly negative consequences for biodiversity and ecosystem goods and services.  
The progressive acidification of oceans due to increasing carbon dioxide is expected to negatively impact marine-shell forming organisms and their dependent species. |
| **Food, Fibre and Forest Products** | Crop productivity at mid to high latitudes is projected to increase slightly for mean temperature increase of up to 1-3°C.  
Crop productivity at lower latitudes is projected to decrease for even small local temperature increases.  
Globally, the potential for food production is projected to increase with increases in local average temperature over a range of 1-3°C, but decrease above this temperature. |
| **Coasts**                    | Coasts are projected to be exposed to increasing risks, including coastal erosion and sea-level rise.  
Increases in sea surface temperatures are of about 1-3°C are projected to result in more frequent coral bleaching events.  
Coastal wetlands are projected to be negatively affected by sea-level rise  
Communities are expected to be flooded every year due to sea-level rise by the 2080s. |
| **Industry, settlement and society** | Costs and benefits of climate change for industry, settlements and society will vary widely by locations and scale, with the net effects will tend to be more negative the larger the change in climate.  
Industries, settlements and societies with close links to climate-sensitive resources will be the most vulnerable. Poor communities may be especially vulnerable due to limited adaptive capacities.  
Where extreme weather events become more intense and/or frequent, the economic and social costs of those events will increase. |
| **Health**                    | Projected climate change-related exposures are likely to affect the health status of millions, particularly those with low adaptive capacity through:  
  • increase in malnutrition and consequent disorders;  
  • increased deaths, disease and injury due to heatwaves, floods, storms, fires and droughts;  
  • the increased burden of diarrhoeal disease;  
  • the increased frequency of cardio-respiratory disease due to higher concentrations of ground level ozone; and  
  • the altered spatial distribution of some infectious diseases. |

Estimates for 2030 of annual precipitation indicate little change in the far north and decreases of two per cent to five per cent elsewhere.\textsuperscript{839} The changes leading into 2050 are more pronounced with models providing figures between -15\% to +7.5\% in central, eastern and northern areas, with a best estimate of little change in the far north grading southwards to a decrease of five per cent for 2050.\textsuperscript{840} In 2070, the range of annual precipitation change is -30\% to +20\% in central, eastern and northern areas, with a best estimate of little change in the far north grading to around -10\% in the south.\textsuperscript{841} Other impacts reported in the CSIRO report include a substantial increase in fire weather, increased wind in most coastal areas and an increase in the occurrence of drought.\textsuperscript{842}

Similar to the impacts reported in the IPCC report, the Garnaut Climate Change Review Interim Report highlights a range of possible climate change impacts for Australia based on a range of temperature increases. For example, as illustrated in Table 7.2, a less than one degree celsius temperature increase may result in the shrinkage of snow covered areas in the Australian Alps by 10-40\%, while a two to three degrees celsius temperature increase could result in a 40\% reduction in livestock carrying capacity for native pasture systems.\textsuperscript{843} Of particular interest to this Inquiry is the increased risk of bushfire damage as a result of a one to two degree celsius temperature increase.\textsuperscript{844} The impact of climate change on bushfires is discussed later in this chapter.

Victoria

The Victorian maximum temperature between 1950 and 2005 increased by 0.71\(^\circ\)C while the minimum temperature increased by 0.44\(^\circ\)C, and the average temperature rose by 0.58\(^\circ\)C.\textsuperscript{845} Greater warming was observed from 1950 to 2005, compared with 1910 to 1950.\textsuperscript{846}
Table 7.2: Possible climate impacts in Australia for a range of temperatures.847

<table>
<thead>
<tr>
<th>Temp Rise above 1990-2000 levels</th>
<th>Biodiversity and Ecosystems</th>
<th>Primary Industries</th>
<th>Human Health</th>
<th>Settlements and Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1°C</td>
<td>Shrinkage of snow-covered area in the Australian Alps by 10-40%</td>
<td>Livestock heat stress leads to decline in milk production</td>
<td>Annual heatwave deaths increase from 134 (today) to 165-189 in Brisbane</td>
<td>Decrease in thermal efficiency of electricity transmission system</td>
</tr>
<tr>
<td>1-2°C</td>
<td>- Between 60-80% of the Great Barrier Reef is bleached every year - Murray-Darling river flows fall by 10-25% - Significant species extinction in internationally significant environments in north Queensland and Western Australia</td>
<td>High annual costs of approximately $12million/yr to manage the southward spread of the QLD fruit fly</td>
<td>Southward spread of malaria receptive zones - 1,200-1,400 more heat related deaths a year in major population centres</td>
<td>- Peak energy demand increases - Increased bushfire damage - Storm winds becomes more intense</td>
</tr>
<tr>
<td>2-3°C</td>
<td>- Almost all of the Great Barrier Reef is bleached every year - 80% of Kakadu’s freshwater wetlands lost to sea level rise</td>
<td>40% reduction in livestock carrying capacity for native pasture systems</td>
<td>Southward spread of dengue transmission zone as far as Brisbane</td>
<td>Increases in sea level expected to exponentially affect storm surge height – causing damage to infrastructure</td>
</tr>
<tr>
<td>3-4°C</td>
<td>Shrinkage of snow-covered area in the Australian Alps by 20-60%</td>
<td>25-50% decrease in generic timber yield in north QLD and the Top End</td>
<td>Up to 200% increase in temperature related mortality among people aged over 65 years in capital cities</td>
<td></td>
</tr>
<tr>
<td>4-5°C</td>
<td>60-90% loss of core habitat for Victorian vertebrate species</td>
<td></td>
<td></td>
<td>Coastal settlements and infrastructure to commence relocation due to anticipated extreme sea level rise</td>
</tr>
</tbody>
</table>

A 2004 report prepared by the CSIRO for the Victorian Government predicted that annual average temperatures in the north and east of the State are projected to be between 0.3°C and 1.6°C higher by 2030 and between 0.8°C and 5.0°C higher by 2070, relative to 1990.848 In the south, the ranges are 0.2°C - 1.4°C by 2030 and 0.7 - 4.3°C by 2070.849 The

relative warming is projected to be greatest in summer and least in winter. The report also projected that annual average rainfalls tend to decrease over most of the state (–15% to +3% in 2030 and –40% to +10% in 2070 in northern Victoria, and –9% to +3% in 2030 and –25% to +9% in 2070 in southern Victoria). The predicted decreases in rainfall are strongest in spring through most of the State. Similar projections are also forwarded in Suppiah (et al).

Based on climate change models by CSIRO and the Bureau of Meteorology, Figures 7.2 and 7.3 illustrate projected Victorian temperature and rainfall in 2030 based on a variety of emission scenarios. Of particular interest to the Committee is the prediction of decreased rain in winter and spring which may contribute to a “drying out” of fuel prior to the summer bushfire season.

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Figure 7.2: Victorian temperature change in 2030 based on low, medium and high emissions scenarios.\textsuperscript{854}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure7.2.png}
\end{figure}

While the exact impacts of changes in the Victorian climate are difficult to determine, the range of possible impacts are likely to include:

- increased likelihood of invasion by exotic plant and animal species;
- increased demand on water resources for irrigation purposes;
- changes to soil characteristics, water and nutrient cycling, plant productivity, species interaction, ecosystem function and composition;

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• increased risk of damage to electricity infrastructure as a result of increased frequency and intensity of rainfall and wind events;

• an increased risk of heat stress to the elderly and vulnerable communities;

• growth in peak summer energy demand, due to air-conditioning use, which may increase the risk of blackouts;

• declines in annual rainfall combined with higher evaporation are likely to reduce run-off into rivers by up to 45 percent in 29 Victorian catchments by 2030;

• more frequent and severe droughts, with a greater fire risk;

• increases in extreme storm events which are expected to cause more flash flooding affecting industry and infrastructure, including water, sewerage and stormwater, transport and communications, and may challenge emergency services;

• frost-sensitive crops, such as wheat, may respond well to some warming however more hot days and less rainfall may reduce yields;

• adverse effects for agriculture include reduced stone fruit yields in warmer winters, livestock stress and an increased prevalence of plant diseases, weeds and pests; and

• CO₂ benefits experienced by forestry may be offset by a decline in rainfall, more bushfires and changes in pests.\textsuperscript{856}

\textbf{Response}

There are two broad approaches to responding to the potential impacts of climate change:

• moderating the rate at which climate change is occurring by reducing greenhouse gas emissions. Such measures are commonly referred to as mitigation measures; and

• adopting measures to “reduce the risks and capitalise on any benefits” of climate change. Such measures are commonly referred to as adaptation measures.\textsuperscript{857}

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\textsuperscript{856} Department of Sustainability and Environment, \textit{Adapting to Climate Change - Enhancing Victoria’s Capacity: Consultation Paper}, Department of Sustainability and Environment, Melbourne, 2004, pp. 16-25.

In response to the threat of climate change, a range of public and private organisations have adopted a suite of measures to: reduce the net level of greenhouse gases in the atmosphere; and adapt to the potential impacts of climate change (both positive and negative). These measures include: fiscal measures such as taxation and financial incentives/subsidies; trading systems such as the Kyoto protocol; regulatory instruments such as housing standards and appliance labelling; Government leadership such as green procurement; partnerships; voluntary agreements; and information dissemination.858

Like many other jurisdictions, Victoria has adopted a range of measures to aid in the climate change transition. For example: mandatory five star requirements for new housing; funding for clean coal research; the Victorian Renewable Energy Target; the EPA Greenhouse Program, and the Electricity Wind Energy Development Act all provide direct and/or indirect greenhouse benefits.859

The Climate Change Debate

As evidenced by the work undertaken by the IPCC, CSIRO and others, a significant amount of scientific research has been undertaken in examining climate change. However, it is important to recognise that climate change still remains a contentious issue, particularly the role of humans in climate change.

As noted above, the majority of academics and institutions across the world now refer to the scientific evidence regarding climate change as “irrefutable” and “overwhelming”. However, as noted by Professor Don Aitkin, former Vice Chancellor University of Canberra “the notion that the science is settled is fatuous”.860 Expressing a similar sentiment, the Heartland Institute, argues that the IPCC reports are far from reliable and ignore, or address imperfectly, other science issues that call for discussion and explanation.861

The Committee is cognisant that though apparently diminishing, there remains a level of scientific debate regarding the extent and causes, anthropogenic or otherwise, of climate change.

However, based on the overwhelming majority of scientific evidence, the Committee supports the notion that the climate is changing. As such, and particularly as fire management necessitates a risk management approach, the Committee feels that it is prudent that the proceeding analysis, findings and recommendations, are developed under the assumption that climate change is occurring, and is predicted to worsen in the future.

**Predicted Climate Change Impact on Bushfire Prevention and Suppression**

Taking some Bureau of Meteorology data from the last fire season — 2006–07 — there were 44 fire weather warnings. The previous highest, no surprise, was in 2002–03 when there were 35. Looking back to 1984, the 22-year average for fire weather warnings was 16 fire weather warning days. In the past seven years that average has increased to 26 fire weather warning days — a 62 per cent increase. Last week the lead author of the intergovernmental panel on climate change, Professor Andy Pitman, told a conference in Sydney that days of extreme fire risk will increase between 25 per cent and 50 per cent by the year 2050 ...regardless of any cuts that may be able to be made to carbon emissions in the future.862

The bulk of the scientific evidence received and reviewed by the Committee argues that the magnitude and intensity of bushfires is expected to rise as a result of climate change. For example, Beer and Hennessey note respectively that:

...(there is) a widespread increase in the forest fire danger index as a result of enhanced greenhouse warming.863

and

There is also evidence for anthropogenic climate change being a driver of this upswing (in fire weather danger).864

Scientific projections indicate that south east Australia is likely to experience warmer, drier and longer summers in the future and that this is likely to increase the frequency and intensity of fire weather and bushfires.865 For example, a 2006 study exploring the impact of climate change on forest and grassland fire risk by Professor Pitman (et al) concluded that there is a “general increase in fire risk over Australia as the climate warms” for both high and low emissions scenarios between the years 2050 and 2100.866

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As noted by Hennessey, an increase in the intensity and frequency of fire weather would:

- alter the distribution and composition of ecosystems;
- lower the yield and quality of water from fire-affected catchments;
- threaten the security of plantation forests;
- increase smoke-related respiratory illness;
- increase greenhouse gases to the atmosphere;
- increase damage to property, livestock and crops;
- increase the exposure of insurance companies to loss; and
- increase the risk of injury, trauma and death to humans. 867

CSIRO have undertaken modelling to provide an indication of fire risk based on temperature, precipitation, humidity and wind speed. 868 Using two different models both with a low and high rate scenario for climate change, Table 7.4 illustrates the average number of days when the Forest Fire Danger Index \(^\diamond\) (FFDI) rating is “very high” or “extreme” under present conditions (1974-2003) for the years 2020 and 2050 for five Victorian locations. The table clearly illustrates that fire risk in all the Victorian towns modelled is likely to increase in the future.

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\(\diamond\) Forest Fire Danger Index relates to the chances of a fire starting, its rate of spread, intensity and difficulty of suppression according to various combinations of temperature, relative humidity, wind speed and both long and short term drought effects in a forest. The FFDI has five intensity categories: low (less than 5); moderate (5-12); high (13-25); very high (25-49) and extreme (at least 50).
Table 7.4: Average number of days when the FFDI rating is “very high” or “extreme” under present conditions (1974-2003) for the years 2020 and 2050 under two differing climate change models for five Victorian locations.869

<table>
<thead>
<tr>
<th>Site</th>
<th>Present</th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2020</td>
<td>2050</td>
<td>2020</td>
<td>2050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(low)</td>
<td>(low)</td>
<td>(high)</td>
<td>(high)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2020</td>
<td>2050</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(low)</td>
<td>(high)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bendigo</td>
<td>17.8</td>
<td>19.5</td>
<td>21.3</td>
<td>21.4</td>
<td>27.3</td>
</tr>
<tr>
<td>Laverton</td>
<td>15.5</td>
<td>16.4</td>
<td>17.3</td>
<td>17.3</td>
<td>21.2</td>
</tr>
<tr>
<td>Melbourne</td>
<td>9.0</td>
<td>9.8</td>
<td>10.7</td>
<td>10.8</td>
<td>13.9</td>
</tr>
<tr>
<td>Mildura</td>
<td>79.5</td>
<td>83.9</td>
<td>89.5</td>
<td>89.9</td>
<td>104.8</td>
</tr>
<tr>
<td>Sale</td>
<td>8.7</td>
<td>9.3</td>
<td>10.0</td>
<td>10.1</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Similarly, a 2007 study conducted by the CSIRO investigating bushfire weather in south east Australia predicted that:

By 2020 the increase in $\sum$FFDI is generally 0-4% in the low scenarios and 0-10% in the high scenarios. By 2050 the increase is generally 0-8% in the low scenario and 10-30% in the high scenario. The number of extreme fire days generally increases 5-25% for the low scenarios and 15-65% for the high scenarios for 2020 and by 2050 increase in the low scenario 10-50% and 100-300% for the high.870

The predicted changes in the FFDI suggest that the fire seasons are likely to become longer and start earlier in the year.871 Coupled with increased dryness and the effects of drought it is likely that this will culminate in an overall increase in fire frequency.

It is important to note that while the weather conditions preceding a fire are vitally important, the weather conditions during a fire also play a major role in the ability of agencies to effectively suppress the fire. For example, a significant contributor to the long period for which the 2002/03 bushfires remained active was the absence of any significant rain for several weeks after the ignition of the fire.872

In addition, as FFDI are used to not only monitor fire risk, but also to assist in the scheduling of prescribed burns, any changes in FFDI levels may impact upon DSE’s ability to conduct prescribed burns. As noted in Hennessey (et al):

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... the window available for prescribed burning may shift and narrow. It is likely that higher fire-weather risk in spring, summer and autumn will increasingly shift periods suitable for prescribed burning toward winter.\textsuperscript{873}

Furthermore, in addition to the impacts previously described, a report modelling lightning occurrence prepared for the Goddard Institute for Space Studies reported that the modelled frequency of lightning double over most of Australia under a doubling of CO\textsubscript{2} concentration scenario.\textsuperscript{874}

The potential impacts of climate change on fire management processes, such as more frequent and more intense fire, clearly pose a significant challenge for land managers. In addressing this challenge, the Committee believes that land managers will need to focus their efforts on developing landscape scale fire prevention strategies to lessen the impact of large conflagrations. In this regard, the Committee finds that a substantial and sustained increased in resources to conduct preventative activities will be needed to mitigate the impacts of future bushfires.

\textbf{Finding 7.1:}

\begin{quote}
That to lessen the impact of more frequent and intense fires, as predicted by climate change projections, a substantial and sustained increase in resources to conduct preventive activities will be needed.
\end{quote}

While as previously noted, stakeholders expressed mixed views on the subject of climate change, stakeholder evidence was overwhelmingly in support of improved land management, particularly the need for an increase in the level of prescribed burning. In this regard, the Committee concurs with those stakeholders who described prescribed burning as a key measure by which to mitigate the risks posed by climate change associated wildfire. The Committee supports this notion and has recommended accordingly in Chapter Two.

Underwood (et al) provide further support for an increase in prescribed burning arguing that as low intensity fires typically only burn fine fuels, the amount of CO\textsubscript{2} released by prescribed burning is smaller than that released by large bushfires.\textsuperscript{875} Therefore, in order to prevent large fires and subsequent large emissions, prescribed burning should be viewed as key component in carbon management policy.\textsuperscript{876}

\begin{itemize}
\end{itemize}
The Committee is aware that prescribed burning should not be viewed as a panacea and agrees with DSE’s submission that in certain circumstances inappropriate prescribed burning may threaten ecosystems already struggling with climate change, alpine, wet forest and riparian ecosystems for example.\textsuperscript{877} However, as noted by Mr Roger Hallam, with similar sentiments expressed by Mr Richard Wea therly, land managers should not be “making allowances because there is climate change”.\textsuperscript{878} The Committee agrees with this sentiment and notes that climate change should not be used as a reason for a lack of active land management, in particular, a lack of prescribed burning. As such, the Committee finds that, in most situations, prescribed burning remains the most effective method by which the impacts of climate change associated bushfire can be minimised.

\textbf{Finding 7.2:}

An increase in landscape scale prescribed burning, as recommended in Chapter Two, represents the key strategy for minimising the fire risks associated with climate change.

\textbf{Stakeholder Views}

While not the dominant theme emerging from the evidence provided to the Inquiry, climate change did emerge as a concern for a range of stakeholders. While a large number of stakeholders argued that climate change posed a threat to the management of public land, a small number of stakeholders strongly disagreed with the notion of climate change, particularly anthropogenic climate change, arguing that the perceived effects associated with climate change are in fact cyclical weather patterns.

Despite this divergence of views on the extent and causes of climate change, a theme which was common to both stakeholder groups was that public land management needed to be improved to mitigate the future impacts of bushfire. The following section highlights some of the concerns raised by stakeholders:

- Mr Athol Hodgson, Forest Fire Victoria, noted that that the warm weather and decreased rainfall predicted under climate change scenarios will enable more prescribed burning.\textsuperscript{879}

- Mr Neil Barraclough and Mr David Evans both questioned the science behind climate change with Mr Barraclough labelling climate

\textsuperscript{877} Victorian Government, \textit{Submission}, no. 168, 4 June 2007, p. 27.
change science as a “pathetic corruption of statistics” while Mr Evans argued that some elements of climate change “don’t stack up”.  

- In a similar vein to Mr Barraclough and Mr Evans, Mr Holmes stated:

  On climate change, people talk about climate change; I think it is just a government fallacy. There is no such thing as a climate change. We are in a dry cycle. If you come to our area you will find that there are many salt lakes down there, fenced. These were fenced at the turn of the [previous] century. We have never seen the fences until [they emerged from the receding waters] the last probably five or six years. These fences appeared in these particular lakes. So all we are doing is going right back into a bit of a dry cycle. It will come again. So it is called climate change. I do not believe that is the case.  

- Mr Kevin Higgins expressed concern regarding climate change, arguing that climate change is a “load of rubbish” and that the problem lay with the build up of fuel.  

- Ms Joanne Butterworth-Gray, Chief Executive, Victorian Wine Industry Association, stated that winters in Gippsland had tended to be dryer over the last 10 years and challenged claims of a narrow window of opportunity to conduct prescribed burning.  

- Mr Fraser Barry highlighted the need for land managers to be prepared, regardless of their views on climate change:

  Living where we live, we are surrounded by the bush. You can see the change in the bush; it has gone. It is that wooding up all the time. The water flows are changing and the riverbeds are changing — everything is changing. We are changing the environment, and I think it is making it harsher. As the place woods up, the fires are going to get more intense. I think we are getting into climate change, but we have also faced a lot of droughts and dry times over the years, and we are going to face them again whether climate change comes or goes, so we need to be prepared.  

- Mr Martyn Paterson expressed similar views to Mr Barry, informing the Committee that:

  But if we are to accept that drought is a symptom of climate change and that fires are a result of drought — certainly the frequency of fires in our region seems to mirror the predictions about climate change — then we must look to the future, I believe, on the consequences to our region, not only of more drought but of more fires, and we must work towards a plan. This inquiry is timely as temperatures are again heating up. The United Nations experts on climate change are predicting increased dangers as a result of climate change.

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882 K. Higgins, Transcript of evidence, Heyfield, 1 August 2007.  
Ms Catherine Murphy, Chief Executive Officer, National Association of Forest Industries, noted a similar concern arguing:

...that climate change is going to be become more of an issue — that we are going to have longer droughts and that we are going to have more lightning strikes, which are the real concern here because, leaving arson aside, most of the fires have been originating through these lightning strikes — governments need to relook at the way our national parks are both created and managed. 886

Mr Bob Adams, Media Officer, Alpine Conservation and Access Group, argued that the impact of climate change on bushfires is minimal intimating that the climate impacts are cyclical. Mr Adams argued that more fuel reduction is needed including grazing, selective logging, autumn, and sometimes winter, fuel reduction burning. 887

Mr Bruce Esplin informed the Committee that the current approach to fire prevention is no longer viable under the influence of climate change and that planning for climate change is a major challenge. Mr Esplin stated:

In terms of prevention and mitigation, the scale of the increasing fire management problem, compounded by the impact of climate change, means we must adjust our focus and invest more in mitigation and prevention, but it also has to accompany our recognition that some fires, simply put, will not be suppressed. Our only option is to do more in the way of prevention, mitigation and community engagement to get as much groundwork done before the fire season starts. 888

Government Response

In its submission to the Inquiry, DSE acknowledged that Victoria’s drought has been “more intense and temperatures hotter from climate change” and that the occurrence of fire is:

... likely to be strongly influenced by climate as drought reduces the presence of usually moist gullies, moisture and water availability, and high temperatures allow fire to ignite more easily and spread. 889

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886 C. Murphy, Chief Executive Officer, National Association of Forest Industries, Transcript of evidence, Melbourne, 19 November 2007.
DSE have also acknowledged that they are aware that a significant change to the way in which fire is managed in Victoria is necessary.\(^{890}\) From the evidence provided by DSE to the Committee it is clear that DSE are beginning to factor climate change into fire prevention and suppression management, though to what extent and rate remains unclear. As stated by Mr King, former Executive Director, Land and Fire Management, DSE:

> As part of our planning now we factor in climate change scenarios to all of it. We had the real life benefit of that during 2002 and 03 and the recent fires in 2006–07 where our traditional firefighting mechanisms and the experience of our staff was that they were not necessarily holding it on the bad days when you are getting spotting going up several kilometres.\(^{891}\)

While as highlighted below, DSE manage a range of policies and programs that provide incidental climate change benefits, the Committee was unable to locate any specific “climate change and bushfire” policy on the DSE website. Indeed, the Committee was unable to find any policy or planning document (the Code of Practice or the draft Wilsons Promontory Ecological Strategy for example) which explicitly stated how DSE incorporates climate change into their fire prevention and/or suppression management processes.

As previously noted, a range of DSE policies and programs provide indirect climate change benefit, particularly adaptation benefits. For example, as the spread of weeds is predicted to increase under climate change, any weed removal programs aimed at mitigating the threat to biodiversity and social or economic assets, are indirectly a form of adaptation measure. Similarly, climate change scenarios predict longer, drier summers which will increase bushfire risk and subsequently require a higher level of resources for a sustained length of time. While seemingly not in direct response to climate change, DSE’s decision to increase the number and contract duration for Project Fire Fighters enables a greater level of resources to be used for prevention and suppression activities.\(^{892}\) Other initiatives highlighted by DSE which illustrate a commitment, direct or indirect, to combating climate change include:

- the use of a risk-based approach targeting high risk communities and value assets – based on the OESC Wildfire Project, and informed through the Integrated Fire Management Planning;
- further increasing community awareness and engagement
- development of a strategic fire break network;

\(^{890}\) P. Harris, Secretary, Department of Sustainability and Environment, *Transcript of evidence*, Melbourne, 7 April 2008.

\(^{891}\) K. King, Executive Director, Land and Fire Management, Department of Sustainability and Environment, *Transcript of evidence*, Melbourne, 4 June 2007.

changing the traditional approach of fire exclusion in Melbourne’s water catchments; and

- reviewing existing land use planning arrangements to better incorporate bushfire considerations.  

DSE’s submission noted the Department has initiated a Land and Biodiversity White Paper (expected in 2009). The aim of the White Paper is to establish the future policy direction for natural resource management, land health and biodiversity. In April, the Government released its Biodiversity Green Paper titled Land and Biodiversity at a Time of Climate Change which synthesised its initial consultation and provided suggested approaches to a range of issues, including bushfire and ecological management. The Green Paper recognises that approaches to fire and ecological management need to be flexible to respond to climate change. Suggestions listed in the Green Paper include:

- implement strategic fire management to better achieve community protection and ecological outcomes as part of planned burning. This may mean a significant increase in fire in the landscape and, in some circumstances, allowing fires to run their course instead of actively suppressing them;
- facilitate community understanding and acceptance of the role of fire in the landscape by improving community preparedness for dealing with wildfire;
- broaden the current approach of undertaking more prescribed burning across the landscape, including in Melbourne’s water catchments. This carries some risks such as reduced water quality and yield but is recognised as important to reducing the significant risk of a severe unplanned event;
- increase fire access and fuel breaks adjacent to high value areas at risk from inappropriate fire;
- consider tighter assessment processes for new and existing settlement growth in areas of high fire risk or biodiversity value;
- integrate fire management into planning processes for landscape rehabilitation; and
- conduct research to better understand the likely effects of climate change on managed and natural fire regimes.

The Committee provides in principle support for these suggestions and looks forward to seeing them incorporated in the White Paper as Government Policy.

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893 Victorian Government, Submission, no. 168, 4 June 2007, p. 27.
894 Victorian Government, Submission, no. 168, 4 June 2007, p. 27.
896 Department of Sustainability and Environment, Land and Biodiversity at a Time of Climate Change: Green Paper, Department of Sustainability and Environment, Melbourne, 2008, p. 55.
897 Department of Sustainability and Environment, Land and Biodiversity at a Time of Climate Change: Green Paper, Department of Sustainability and Environment, Melbourne, 2008, p. 55.
The Committee believes that DSE and its partner agencies recognise and acknowledge the potential threats associated with climate change. However, the Committee notes that DSE has failed to explicitly integrate a requirement for climate change consideration into any major fire planning or fire policy document. This is of concern to the Committee particularly as climate change is likely to require a sustained increase in the level of resources required to conduct prevention and suppression activities in the future. In addition, as previously highlighted, climate change may lead to ecosystem changes which may in turn alter ecosystem fire requirements. For example, climate change may result in plant species with a higher level of fire tolerance becoming prevalent in an ecosystem. As such, the Committee is concerned that the potential impact of climate change has not yet been explicitly considered in Fire Ecology Strategies.

**Finding 7.3:**

In order to minimise the future risk of fire and facilitate the development of appropriate fire regimes, key bushfire management documents, for example, the Code of Practice and Fire Ecology Strategies, need to explicitly consider, and if necessary, incorporate, the potential impacts of climate change on bushfire.

The report was adopted by the Committee on Monday 23 June 2008.