



United
Nations
Association
of Australia

MANAGING CLIMATE CHANGE IN AUSTRALIA

A GLOBAL, LONG-TERM VIEW

DISCUSSION PAPER
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7 AFFORDABLE AND
CLEAN ENERGY



13 CLIMATE
ACTION





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► THIS REPORT

In response to the United Nations 2015 Paris Climate Change Agreement, the United Nations Association of Australia is promoting the development of a national, inclusive climate management framework.

The Paris Agreement requires nations to progressively “mobilise stronger and more ambitious action by all stakeholders, including civil society, the private sector, cities and sub-national authorities, local governments and indigenous people”.

The UNAA’s *Net Zero* Program was launched at the UNAA World Environment Day Awards in June 2016. Since then, the UNAA has hosted a series of events, including a multilateral workshop with representatives from all levels of government, the private sector and non-government organisations; two forums on the results of the 2016 and 2017 annual Conference of Parties (COP) to the UN’s climate convention; and six, concurrent workshops of practitioners to assess opportunities for further collaboration throughout Australia (United Nations Association of Australia, 2018). Inspiring examples of climate action were showcased through the UNAA’s 2017 World Environment Day Climate Action Awards.

This report draws upon these events and the views of the participants. Its purpose is to direct attention to some of the long-term challenges facing Australia as we seek to meet the goals of the Paris Agreement and to suggest how these challenges might be tackled by further nation-wide collaboration.

The UNAA welcomes your comments.

Comments will be taken into account in preparing a final paper by the end of this year. Comments should be sent to office@unaavictoria.org.au with the subject line: Climate Change Discussion Paper.

ACKNOWLEDGEMENTS

The UNAA is grateful to all those who participated in the *Net Zero* events, particularly those who organised and led them. Valuable comments on earlier drafts of this report were provided by specialists in the government and private sectors. The report was compiled by Graham Hunter, National Co-ordinator of the UNAA’s Climate Change Program.

> EXECUTIVE SUMMARY

The almost universal support in 2015 by national governments for the United Nations Paris Climate Change Agreement heralded a new era in climate change management throughout the world. It is the context for Australia's response to climate change. All nations have agreed upon:



The necessary emissions reduction steps to achieve the goal are now understood. They are:

- STEP 1.** Minimise the demand for energy.
- STEP 2.** Convert to an electricity supply system with low and, ultimately, zero emissions of greenhouse gases.
- STEP 3.** Switch from the direct use of fossil fuels to zero emissions electricity.
- STEP 4.** Minimise emissions from other processes.
- STEP 5.** Retain existing carbon sinks.
- STEP 6.** Capture any remaining emissions.

PROGRESS IS BEING MADE FOR EACH OF THESE STEPS THROUGHOUT THE WORLD.

Over the coming decades, governments at all levels will come and go, each with policies relating to the emission reduction steps. The selection of these policies and their associated instruments and programs will be influenced by international expectations, political ideologies and other circumstances of the time.

Irrespective of such continual changes in policy there is an on-going need to anticipate and prepare for the long-term challenges that each step will face, evaluate policies and programs, and assess progress.

In Australia, actions to address the emissions of greenhouse gases have never been so widespread. Yet our emissions continue to rise. While there is a need for increasingly effective policies there is also an opportunity to improve our performance by working better together.

Taking into account the global and local circumstances, collaborative actions are proposed in this paper to enhance the long-term effectiveness of accelerated climate action in Australia.

THESE INCLUDE:

- 1 Adopt for all Australia the common goal of achieving, by no later than 2050, net zero emissions of greenhouse gases. (Page 10)

- 2 Develop and implement a thirty-year strategy for Australia to achieve net zero emissions by 2050 covering all sources of greenhouse gases and all sectors of the economy. (Page 21)
The strategy should provide for:
Nation-wide programs for each emissions reduction step and for key economic sectors. (Page 13)
Actions to encourage the high emissions sectors to develop, implement and report on emission reduction strategies to achieve net zero emissions by 2050. (Page 13)
Continual development, implementation and monitoring of climate change adaptation strategies at a national, state and local level, as well as within specific sectors and organisations. (Page 14)
Alignment of climate legislation throughout Australia. (Page 15)
A robust national reporting regime, including local and state achievements. (Page 17)
A clear and actionable strategy will assist long-term investment certainty. (Page 16)

- 3 Establish an independent Australian Climate Response Commission to measure and report on progress, manage the periodic revision of the strategies and co-ordinate the nation-wide programs. (Page 23)

- 4 Empower communities and stakeholders with the knowledge of what they can do as individuals and communities to reduce their carbon footprints and adapt to negative impacts of climate change. (Page 16)

- 5 Extend the monitoring and assessment of the emissions and of the capture of greenhouse gases to the local scale. (Page 17)

- 6 Use the six emissions reduction programs as a basis for co-ordinating the international marketing and delivery of Australia's climate management expertise and achievements in government and private sectors. (Page 18)

- 7 Continue to develop and enhance Australia's assistance to its regional neighbours, particularly climate vulnerable small island states. (Page 18)

> INTRODUCTION

In Australia, as we seek to ensure affordable and reliable electricity now, the goal of concurrently reducing our emissions of greenhouse gases may be viewed as less important. Yet it is fundamental to our long-term sustainability and wellbeing.

Without a long-term perspective Australia will trip over itself again and again as we try to reconcile the future demands for energy with a changing economy, growing population and threatened environment.

UNITED NATIONS SECRETARY-GENERAL ON CLIMATE ACTION



Last year was once again the hottest on record. The past decade has also been the hottest on record.

Every geo-physical system on which we depend is being affected, from mountains to oceans, from icecaps to forests, and across all the arable lands that provide our food. Sea ice is at a historic low; sea levels are at a historic high, threatening the existence of low-lying island nations and cities.

The seas are also being affected by warmer temperatures, rapid acidification and coral bleaching, endangering the marine food chain on which so many livelihoods and economies depend.

On land, glaciers are retreating almost everywhere – a risk to the breadbaskets of the world as rivers fed by glaciers run dry. The ice caps in the Arctic Ocean are shrinking dramatically. Some even predict that the Arctic Ocean could be ice-free by the summer of 2020. It could alter the Gulf Stream and affect food production, water security and weather patterns from Canada to India. We are already seeing massive floods, more extreme tornadoes, failed monsoons and fiercer hurricanes and typhoons.

But slow-motion disasters are also speeding up. Areas where drought once struck every decade are now seeing cycles of five or even two years between droughts. Moreover, dry spells are lasting longer, from California to the Sahel.

The moral imperative for action is clear. The people hit first and worst by climate change are the poor, the vulnerable and the marginalized. Women and girls will suffer as they are always the most disproportionately affected by disasters. The nations that will face the most profound consequences are the least responsible for climate change and the least equipped to deal with it. Droughts and floods around the world mean poverty will worsen, famines will spread and people will die.

As regions become unliveable, more and more people will be forced to move from degraded lands to cities and to other nations. We see this already across North Africa and the Middle East. That is why there is also a compelling security case for climate action. Last year, more than 24 million people in 118 countries and territories were displaced by natural disasters. That is three times as many as were displaced by conflict. Climate change is also a menace to jobs, to property and to business. With wildfires, floods and other extreme weather events becoming more common, the economic costs are soaring.

Antonio Guterres, United Nations Secretary-General, 2017

Australia's approach to climate change has fluctuated considerably over the last twenty-five years. Our first and only national greenhouse response strategy in 1992 was soon discarded. Under the Kyoto Protocol in 1997 Australia's target actually provided for an increase in the emissions of greenhouse gases.

Total emissions continued to increase despite the introduction of further measures, such as mandatory reporting of emissions, a renewable energy target and energy efficiency schemes. In 2011 the Australian Government introduced a carbon pricing scheme. However, this was abolished three years later. The main measures of the current Government include the Emissions Reduction Fund, the Safeguard Mechanism, the Renewable Energy Target and the National Energy Productivity Plan. Under consideration is the National Energy Guarantee.

Emissions peaked in 2007 and fell back to 1990 levels but have been again increasing over the last three years (Department of Environment and Energy, February 2018).

Yet the range of governments, organizations and individuals actively involved in climate action in Australia is more widespread than ever before. (The Australian Government's recent review of its climate change policies focused on its own activities while noting only some of the actions of sub-national governments and the private sector (Commonwealth of Australia, 2017).)

As well as the Australian Government, most state and territory governments, capital cities and many other local governments have policies and programs for reducing emissions of greenhouse gases, introducing renewable energy, improving energy efficiency and adapting to inevitable changes in the climate. In the private sector many organizations are committed to reducing their emissions of greenhouse gases. There is increasing availability of financial support and a mandatory responsibility for all boards to take climate risks into account. Many research institutions also have relevant programs and projects.



The generations alive right now are at a unique crossroads. We are the first who can end poverty but the last who can act to avoid the dangerous climate change that could undermine the universal wellbeing that lies within our grasp.

Patricia Espinosa, Executive Secretary, UN Framework Convention on Climate Change, 2016

The challenge now is to provide the greatest opportunity for all Australians to contribute to effective and rapid progress towards the emission reduction goals.

When the goals are linked to the steps to be taken along the pathway to reduce emissions of greenhouse gases the main features of Australia's future response to climate change become clearer. Opportunities for better collaboration between all stakeholders also become more apparent. Taking this into account, there is a range of initiatives that could be introduced now to facilitate the journey.

▶ THE UNITED NATIONS PARIS CLIMATE CHANGE AGREEMENT

The United Nations Paris Climate Change Agreement was accepted in December 2015 by almost every one of the world's 195 national governments. This was followed by an ongoing process of formal ratification by those governments. 175 (90%) have now complied. The Agreement entered into force in November 2016 after it had been ratified by 55 parties that account for over 55% of total global emissions of greenhouse gases. Australia's ratification entered into force in December 2016. Only after November 2019 can a party withdraw from the Agreement, after having given one year's notice.



It is worth taking a moment to step back and reflect on the unity that was forged in Paris. It was a remarkable moment in the history of humankind. The world came together to address this global challenge collectively. And it did so at a time of division in so many other areas. There has been nothing like it in terms of enabling the global community to work on an issue together that none of us can solve on our own.

Guterres, 2017

The Paris Agreement provides a context for future action by all nations. It calls on all nations “to mobilize stronger and more ambitious climate action by all Parties and non-Party stakeholders, including civil society, the private sector, financial institutions, cities and other sub-national authorities, local communities and indigenous peoples”. It sets a long-term goal of holding the increase in the global average temperature to well below 2 degrees centigrade above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 degrees centigrade. It establishes a schedule for measures to be taken worldwide with respect to both mitigation and adaptation. It encourages all nations to enhance progressively their targets for reducing the emissions of greenhouse gases. Only then will the risk of catastrophic climate change be reduced.

SUSTAINABLE DEVELOPMENT GOALS



Earlier in 2015, all nations of the world also endorsed the UN’s Sustainable Development Goals. Climate action contributes directly to the greater human wellbeing that is captured in the 17 Goals. It protects lives and livelihoods, improves public health, creates new industries and sustainable farming, cuts costs to governments, business and citizens and opens up new avenues of profitable investing.

Espinosa, 2016

> NET ZERO GOAL

As emphasised in the Agreement, the world is still on track to catastrophic climate change. There remains a gap between the aggregate effect of the mitigation pledges by all nations and a pathway consistent with holding the global average temperature to well below 2 degrees centigrade above pre-industrial levels. According to the World Meteorological Organisation’s 2018 Annual Report on the Global Climate the last three years have been the hottest on record. In 2016 the global temperature was 1.1 degrees centigrade above the pre-industrial period. The Agreement emphasises that much greater emission reduction efforts will be required.

Under the Agreement, in the second half of this century, the world must achieve a balance between the emissions of greenhouse gases due to we humans and the removal of these gases by sinks such as the oceans and forests. This universal goal of net zero emissions ultimately applies to all nations, their organisations and people.

> WHEN?

1 **PROPOSED ACTION 1: Adopt for all Australia the common goal of achieving, by no later than 2050, net zero emissions of greenhouse gases.**

- > *Promote a common understanding about the goal of the Paris Agreement to achieve net zero emissions of greenhouse gases within the second half of this century*
- > *Adopt intermediate goals for Australia that are consistent with achieving net zero emissions by 2050*
- > *Promote these as common goals not only for the nation as a whole but also for all governments and organisations*
- > *Embed these goals in national and state energy planning.*

The world's emissions of greenhouse gases appeared to plateau over the last three years while global economic growth rose by 3%. However, in 2017, energy-related emissions increased by 1.4% (International Energy Agency, 2018). Twenty-two countries, mainly in Europe and including the US, have reduced their emissions while their economies continued to grow (Olivier et al, 2017).

Long term emission reduction targets for developed countries continue to evolve and become increasingly ambitious. Norway, Sweden and New Zealand aim to reach net zero by 2030, 2045 and 2050 respectively. The European Union, representing 28 countries, is reviewing its low-carbon economy roadmap for which a target of 80% reduction relative to 1990 levels by 2050 had been set. Examples of targets for 2050 set by other countries individually are 95% and 80% relative to 1990 levels for Germany and the UK respectively. California's 2050 target is 80% below 1990 levels.



Indeed, all around the world, cities, regions, states and territories are setting their own ambitious targets. Thousands of private corporations, including major oil and gas companies, are taking their own action. They know that green business is good business. It is not just the right thing to do, it is the smart thing to do. Some may seek to portray the response to climate change as a fundamental threat to the economy.

Yet what we are witnessing in these early years of a systemic response is the opposite. We are seeing new industries. New markets. Healthier environments. More jobs. Less dependency on global supply chains of fossil fuels. The real danger is not the threat to one's economy that comes from acting. It is, instead, the risk to one's economy by failing to act.

Guterres, 2017

In Australia, our emissions are increasing. They grew until 2007 then fell back to 1990 levels but have been rising again over the last three years (Department of Environment and Energy, February 2018). Our emissions per capita are declining but remain amongst the highest for developed countries.

The Australian Government has not yet set a time for the nation's emissions to reach net zero. Its current intermediate goal is to reduce emissions by 26-28 % below the 2005 level by 2030. This was submitted in 2015 to the UN as our intended nationally determined contribution (INDC). As shown in Figure 1, if that were to be achieved and we were to continue to reduce emissions at the same rate thereafter we would reach zero only after 2080. The Climate Change Authority recommended a reduction equivalent to 45% below the 2005 level by 2030 (Climate Change Authority, 2015). Zero emissions would then be reached just before 2050.

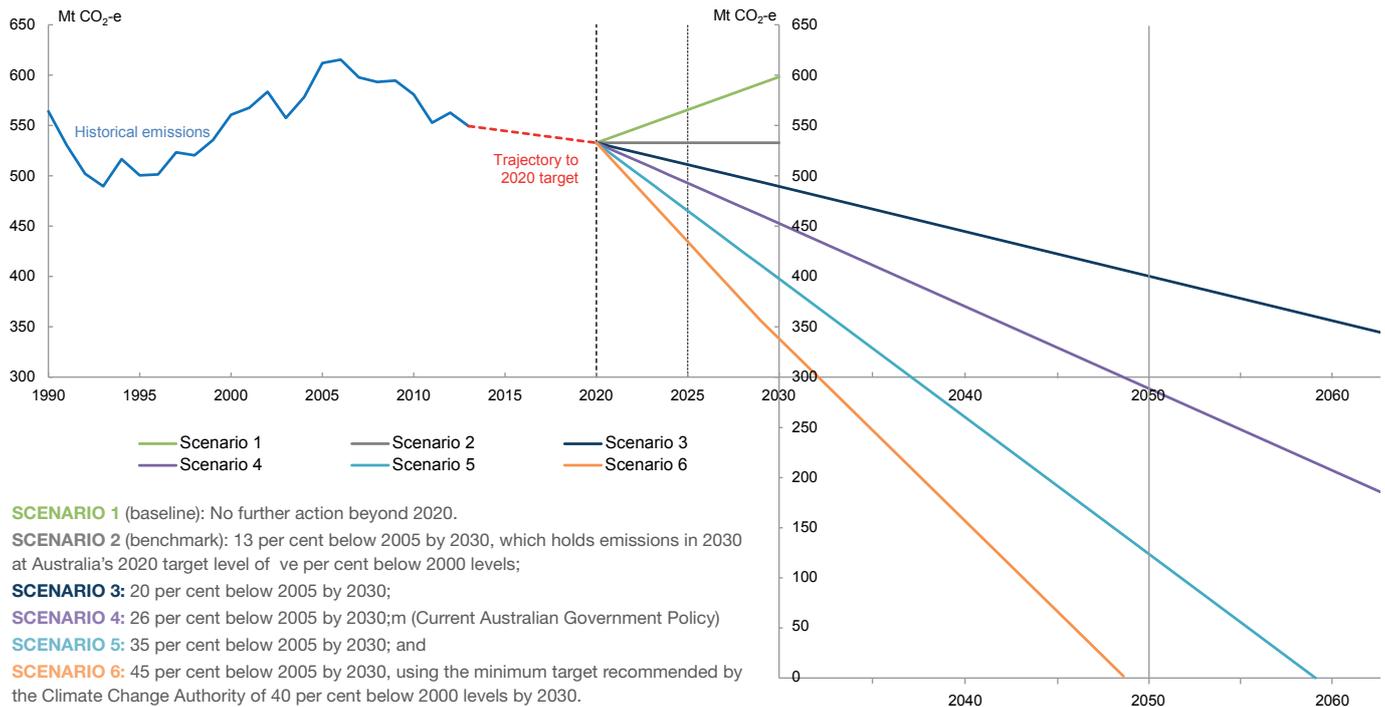


Figure 1: Greenhouse gas emission trajectory scenarios
(Adapted from Figure 5.1, Department of Prime Minister and Cabinet, 2015)

The governments of New South Wales, Victoria, South Australia, Queensland, Tasmania and the ACT, covering 85% of the population and 80% of Australia’s emissions, have committed to the more ambitious goal of net zero emissions by 2050 (DELWP, 2018; Jewel, 2017). Most capital cities have also pledged to reduce their emissions of greenhouse gases with Canberra, Sydney, Melbourne and Adelaide aiming for net zero by 2050 or earlier. Amongst Australia’s other 571 local governments many have agreed to reduce their emissions of greenhouse gases. Increasingly private corporations are adopting a reduction target and are being certified as “carbon neutral”. Individual citizens can sign up to schemes that recognise their personal commitments.

Australia’s total emissions are now about 530 million tonnes of CO₂ equivalent a year. If these emissions were to be reduced to zero at a constant rate from now until 2050, Australia will have emitted a further **8.5 billion tonnes**.

Adapting data from the UN’s International Panel on Climate Change (IPCC) and other sources, the Climate Change Authority assessed the future limits to the emissions of greenhouse gases in Australia (Climate Change Authority, 2014):

- > only a further 1,700 billion tonnes could be emitted worldwide between 2000 and 2050 to have a likely chance of avoiding catastrophic warming
- > allowing for those emissions that had already occurred by 2013 and those for which international aviation and shipping would be responsible, this left about 1000 billion tonnes for the world to emit from 2013
- > assuming the global rate of emissions has been constant at 40 billion tonnes per year over the last five years (CDIAC, 2018), this leaves no more than 800 billion tonnes as the limit for total emissions from 2018 to 2050.

The Climate Change Authority recommended that Australia should be responsible for 0.97% of this total, i.e. **7.8 billion tonnes**, taking into account the principle of equal emissions per person in the future. Since Australia has emitted about 1.1% of global emissions there is also a case for it to be responsible for about 1.1% of the necessary global reduction, i.e. **8.8 billion tonnes**.

With that in mind and given Australia’s wealth, capacity and responsibilities and the widespread adoption of this target already, it is appropriate to aim throughout the nation for net zero emissions by 2050 or earlier.

> HOW?

HOW CAN THIS GOAL BE ACHIEVED?

In Australia last year:



Land use, land use change and forestry resulted in the capture of greenhouse gases exceeding their emissions by an amount corresponding to 4% of total emissions (Department of Environment and Energy, 2018).

Projections by the Department of Environment and Energy of future emissions indicate that, *without further control measures and without taking into account all the initiatives by state and local governments*, annual emissions will continue to *rise* from 530 million tonnes now to 570 million tonnes in 2030. Most of that projected growth in emissions would be in the transport sector, led by increased heavy vehicles activity for freight, and the agricultural sector, driven by increased stocking numbers. Electricity emissions would be flat as demand growth is offset by the effect of existing policies. Emissions in other sectors would stabilise or grow slowly after 2020 (Department of Environment and Energy, December 2017).

The Australian Government's target of reducing emissions by 26-28% of the level in 2005 by 2030, i.e. to 447-435 million tonnes, would not be met. The associated trajectory of emissions would be incompatible with achieving net zero emissions by 2050.

Much more needs to be done. All the sources must be tackled. Lack of progress with one means that the others must compensate.

Possible **pathways to net zero emissions** are being assessed around the world. For developed countries there are six common steps that can be implemented while still contributing to a healthy economy (Jotzo and Kemp, 2015; ClimateWorks Australia, 2014).

They are:

- STEP 1.** Minimise the demand for energy.
- STEP 2.** Convert to an electricity supply system with low and, ultimately, zero emissions of greenhouse gases.
- STEP 3.** Switch from the direct use of fossil fuels to zero emissions electricity.
- STEP 4.** Minimise emissions from other processes.
- STEP 5.** Retain existing carbon sinks.
- STEP 6.** Capture any remaining emissions.

For each of these steps, there is a brief overview in the Appendix to this report of the progress being made internationally and in Australia. Also suggested for each step are the main long-term challenges that will need to be tackled.

There are numerous, technically feasible and economically viable techniques that can be implemented for each step. Some contribute to more than one step. A recent compilation of one hundred of these is provided in Hawken, P, 2017.

> STEPPING UP

2 **PROPOSED ACTION 2: Establish nation-wide programs for each emissions reduction step and for key economic sectors.**

- > Include in these the main measures taken by all levels of government and the private sector
- > Activities within each program could include the on-going assessment of long-term challenges, the actions to be taken in preparing for them, assessment of the need for transitioning and skilling the workforce, and the promotion of best practices and common standards.

The six steps could provide a practicable framework for nation-wide collaboration. A **national program for each step** would recognise contributions by all sectors of the community to the relevant activities and to associated progress towards net zero emissions. There would also be a recognition that some aspects, such as population change, consumption patterns and waste management, relate to more than one step.

Inclusion in each program could be on an opt in basis but with the expectation of involvement by the relevant Australian Government agencies, State and Territory agencies, capital cities, major manufacturers and other businesses.

Such collaborative programs would also help to raise community interest and engagement as well as provide nation-wide leadership.

3 **PROPOSED ACTION 3: Encourage the high emissions sectors to develop, implement and report on emission reduction strategies to achieve net zero emissions by 2050.**

At the same time, **high emission sectors** could be developing and reporting on their strategies to achieve net zero emissions by 2050, taking into account their involvement in each of the six steps.

At the international level the G20 group of countries established the Financial Stability Board which set up the Task Force on Climate-related Financial Disclosures (TCFD). It released guidelines in 2017 on how investors should assess climate risk using different scenarios for how the world may deal with climate change focussing on the Paris Agreement pledge to keep global warming to well below 2 degrees. It already has the support of financial firms responsible for assets of more than \$100 trillion (Vincent, 2018).

In Australia a survey of 73 big listed companies most at risk on climate change found that, so far, only 16% have released a plan to reduce their emissions of greenhouse gases, 40% have an emissions reduction target and fewer than half have identified climate change as a material business risk (Williams, R, 2018).



▶ ADAPTING TO THE CHANGING CLIMATE

4 **PROPOSED ACTION 4: Continually develop and implement climate change adaptation strategies at a national, state and local level, as well as within specific sectors and organisations.**

The Paris Agreement places considerable emphasis on “enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change”. Parties are to develop adaptation plans, strengthen co-operation and help support the most vulnerable.

Countries throughout the world are developing national adaptation plans as climate change becomes increasingly apparent. A survey of fifteen highly vulnerable countries in Africa and Asia identified their main priorities as agriculture and fisheries, access to freshwater, risks to health, risks to the energy sector, particularly where it relies on hydropower, and coping with extreme weather events (IISD, 2017).

In a ranking of the vulnerability of all countries to climate change and of their readiness to improve resilience, Australia has been ranked the 5th “least vulnerable” and the 12th “most ready” nation (University of Notre Dame, 2018). There is a broad range of climate adaptation plans across the nation. The National Climate Resilience and Adaptation Strategy of the Australian Government was launched last year and a National Climate Change Adaptation Research Facility established. Most state and territory governments and many local governments have, or are preparing, plans. Adaptation plans have been prepared for all 56 natural resource regions of Australia. Regionalised climate projections are available.

Meanwhile, the private sector is increasingly accounting for changes to the climate. The international guidelines of the TCFD, referred to above, are again relevant.

In Australia the Prudential Regulation Authority has encouraged the boards of all businesses to assess climate risks.

Long-term challenges:

- > *Early investment in infrastructure.*
- > *Anticipatory land use planning.*
- > *Adequate insurance.*
- > *Adaptive and planned relocation and resettlement of vulnerable homes and communities.*
- > *On-going support for local governments to update and implement their plans.*

> LEGISLATING FOR CHANGE

5 **PROPOSED ACTION 5: Align climate legislation throughout Australia.**

Internationally, the number of climate and climate-related laws supporting the pledges made under the Paris Agreement has grown to 1,200 (Nuttall, 2017). The UK's *Climate Change Act 2008* has been a model for climate legislation in various countries including Denmark, Finland, Norway, France and Mexico (New Zealand Productivity Commission, 2017). It provides for the setting of targets and establishment of carbon budgets, the establishment of the independent Committee on Climate Change, reporting requirements, and adaptation procedures.

Australian Government legislation has included the *National Greenhouse and Energy Reporting Act 2007*, *Building Energy Efficiency Disclosure Act 2010*, *Carbon Credits (Carbon Farming Initiative) Act 2011* and the *Clean Energy Act 2011*. However, much of the *Clean Energy Act* was repealed in 2013.

Meanwhile, state-based legislation has included South Australia's *Climate Change and Emissions Reduction Act 2007*, Tasmania's *Climate Change (State Action) Act 2008*, Victoria's *Climate Change Act 2010* and the ACT's *Climate Change and Greenhouse Gas Reduction Act 2010*.

Most recently, Victoria's 2010 legislation was replaced by the *Climate Change Act 2017*. It sets a long-term emission reduction target of net zero by 2050 and provides for interim targets and the preparation of a climate change strategy and of adaptation action plans. It enables emission reduction pledges by government entities, economic sectors and local councils. It also allows for the formal recognition of carbon sequestration in forests and soil on private and Crown land.

Long-term challenges:

- > *Ensure all legislation takes relevant aspects of climate change into account.*
- > *Ensure compatibility between climate legislation in different jurisdictions.*
- > *On-going update of legislation in response to changing knowledge and circumstances.*

> RESOURCING THE TRANSITION

6 **PROPOSED ACTION 6: Assist long-term investment confidence in Australia by adopting common goals and nation-wide strategies.**

INTERNATIONAL

A major feature of the Paris Agreement is the support for poorer countries to minimise their emissions of greenhouse gases and to prepare for inevitable climate change through funding, technology transfer and training. The goal is to mobilize from public and private sources \$US 100 billion per year. The Green Climate Fund, to which the Australian Government is contributing \$200 million, has already committed over \$3 billion on seventy projects, and attracted substantial co-financing (UNFCCC, 2018b). The International Solar Alliance, signed in 2015 by sixty countries, aims to mobilise \$US 1 trillion to invest in large-scale solar energy in developing countries (UNFCCC, 2018c).

New financial instruments are growing. Green bonds have been issued by countries such as France and China and by companies such as Apple. Investment by both the government and private sectors in renewable energy continues to accelerate.

Markets for carbon trading are expanding. Over 65 nations have implemented, or are considering implementing, an emissions trading program for their respective jurisdictions (Sandor and Marques, 2016).

AUSTRALIA

In Australia, uncertainty in government policy has constrained investment. However, investment by the public and private sectors in clean energy increased by 50% in 2016. Last year the Clean Energy Finance Corporation invested more than \$2 billion in new capital to support renewable energy projects valued at \$6.6 billion (Clean Energy Finance Corporation, 2017). Major banks are also providing loans, while the Victorian Government and some banks have issued Green Bonds.

So far, the carbon market in Australia has been limited to arrangements under the Kyoto Protocol and reverse auctions associated with the Emissions Reduction Fund. Trading in Renewable Energy Certificates contributes to the Renewable Energy Targets.

The emission goals and national programs proposed above would enhance long-term market signals.

Long-term challenges:

- > *Provide strong market signals and adequate investment certainty.*
- > *Capitalise on infrastructure upgrades.*
- > *Full engagement of the financial sector.*
- > *Full pricing of environmental risks and long-term wealth into markets*
- > *Attract finance for slower-onset climate risk adaptation*

> ENGAGING EVERYONE

7 PROPOSED ACTION 7: Empower communities and stakeholders with the knowledge of what they can do as individuals and communities to reduce their carbon footprints and adapt to negative impacts of climate change.

Australia's capacity to respond to climate change is again growing. Following the passage of the *Clean Energy Act* in 2011 state governments wound back their involvement. This changed with the repeal of most of the Act in 2013. It is unlikely that responsibility over the long term for climate action will again depend mainly on one level of government. Diversity provides a more robust, engaging and sustained approach.

Initiatives of the Australian Government now include the Emissions Reduction Fund and Safeguard Mechanism, the Renewable Energy Target, and the National Energy Productivity Plan (Department of Environment and Energy, March 2017).

The National Energy Guarantee relating to the supply of electricity and the control of associated greenhouse gas emissions is under consideration.

As well as the growth in expertise in state and territory governments, most cities and other local governments have active climate change programs, private corporations are setting their own emission reduction targets and participating in government schemes, and the finance sector is increasingly taking climate change into account. There are climate research and teaching programs at most of Australia's universities and many consulting organisations can provide expert advice of international standard.

The initiatives already proposed in this paper should assist all these stakeholders to work more effectively together. However sustained action over the three decades will also depend upon the involvement and support of individual citizens and their local communities. Already there are various means by which they can be informed and engaged. These will need to be developed further.

> MEASURING PROGRESS

8 **PROPOSED ACTION 8:** *Extend the monitoring and assessment of the emissions and capture of greenhouse gases to the local scale.*

9 **PROPOSED ACTION 9:** *In reporting on progress towards the national goals include local and state achievements as well as those at the national level.*

Internationally agreed methodologies for assessing the emissions of greenhouse gases were prepared under the Kyoto Protocol and with the guidance of the Intergovernmental Panel on Climate Change. A priority in the implementation of the Paris Agreement is the confirmation of consistent, transparent accounting procedures covering all categories of greenhouse gas emissions and removals and that are applicable to all countries. National inventory reports are to be submitted at least every two years. Last year, at COP23, a new global standard for measuring and reporting emissions from cities and local governments was launched.

In Australia the Greenhouse Emissions Information System was introduced in 1990 and the National Greenhouse and Energy Reporting Scheme in 2007. Updates of the inventory are prepared each quarter. The reports provide data at the national and state levels.

There would be efficiencies in aligning our domestic reporting and forecasting cycle, along with any legislative or policy adjustments, with reporting requirements under the Paris Agreement.

In order to assist local engagement, information on the emission and capture of greenhouse gases in the local area needs to be available. National reporting should include such local information.

Long-term challenges:

- > *Extend monitoring and assessment to the local scale.*
- > *Provide information and data appropriate to the users.*
- > *Use the results to help engage the community and to inform the national effort.*

➤ INTERNATIONAL OPPORTUNITIES

- 10** **PROPOSED ACTION 10:** *Use the six emissions reduction programs as a basis for co-ordinating the international marketing and delivery of Australia’s climate management expertise from government and private sectors.*
- 11** **PROPOSED ACTION 11:** *Continue to develop and enhance Australia’s assistance to its regional neighbours, particularly climate-vulnerable small island states.*

The Australian Government and a wide range of government and private organisations from Australia are active participants in the continuing **negotiations** to refine the responsibilities and methodologies associated with the implementation of the Paris Agreement. (An Australian is CEO of the Green Climate Fund.) The detailed rules and procedures are being negotiated for agreement at the end of this year.

Of particular importance this year is the process by which nations will take stock of their collective efforts and the adequacy of their emission reduction commitments, the Nationally Determined Contributions. This will be done through a **Talanoa Dialogue**. A Special Report by the Intergovernmental Panel on Climate Change on warming of 1.5°C will inform the Dialogue.

THE TALANOA DIALOGUE

Talanoa is a traditional approach used in Fiji and the Pacific to engage in an inclusive, participatory and transparent dialogue. The dialogue should be constructive, facilitative and solutions orientated. The dialogue should not lead to discussions of a confrontational nature in which individual Parties or groups of Parties are singled out. The purpose of Talanoa is to share stories, build empathy and trust. During the process, participants advance their knowledge through common understanding. The dialogue will be structured around three general topics: Where are we? Where do we want to go? How do we get there?

The dialogue will consist of a preparatory and a political phase. The Presidencies of COP 23 and COP 24 will jointly lead both phases of the dialogue and co-chair the final Ministerial meeting at COP 24. The preparatory phase will comprise technical discussions with the objective of building a strong foundation for the political phase. **Parties and non-Party stakeholders are invited to cooperate in convening national, regional or global events in support of the Talanoa Dialogue and to prepare and make available relevant inputs.**

The Political phase will bring high-level representatives of Parties together to take stock of the collective efforts of Parties in relation to progress towards the long-term goal and to inform the preparation of nationally determined contributions. (UNFCCC a, 2017)

The UN provides a global forum for recognising and responding to **security risks** arising from climate change. In 2011 the Security Council reaffirmed the importance of establishing strategies of conflict prevention and expressed its concern about the possible adverse effects of climate change for international peace and security. In 2016 the topic of “water, peace and security” was debated.

The Australian Government’s 2016 Defence White Paper labelled climate change a “major challenge for countries in Australia’s immediate region”. The ten countries most at risk of sea level rise are adjacent to Australia (Hunter, F, 2017).

Australian **cities** have joined with other cities around the world in supporting climate action. This includes the Global Covenant of Mayors for Climate and Energy to which 7,500 cities are committed. The “Under2Coalition” consists of 205 **state and provincial governments**, whose combined GDP is about one third of the global economy, and who have committed to reducing their emissions by at least 80% by 2050 (DELWP, 2018; Nuttall, 2017).

Similarly, many major **corporations** are members of international bodies. The UN Global Compact to advance corporate sustainability has been signed by 10,000 companies in 160 countries. Australian airlines are part of the International Air Transport Association's agreement to cut worldwide emissions from aviation to half the 2005 level by 2050. The CSIRO, Bureau of Meteorology and Australian universities participate in international monitoring and research initiatives.

Opportunities to trade in international **carbon credits** are expected to increase. Article 6 of the Paris Agreement allows for the mechanisms to be developed. Already, under the Kyoto Protocol's Clean Development Mechanism, organisations could offset their emissions by supporting emission reduction projects in developing countries.

Increasingly nations are **working together** to assist each other achieve their targets under the Paris Agreement. "Powering Past Coal" is an alliance of twenty countries seeking to phase out the generation of electricity from coal by 2030 in developed countries and by 2050 elsewhere. Nineteen nations, including China, Brazil, Britain and Sweden, are working together to increase the generation of energy from wood and other plant matter from sustainable resources.

The wide range of policies, policy instruments and technologies now being applied throughout the world provides remarkable opportunities for countries to learn from each other. The report by the UN's High Level Commission on Carbon Prices is a recent example of learning from international experience.

Global markets for Australia's expertise and products relevant to climate action are expanding. To date the marketing of such expertise has been fragmented. Unlike many other countries, Australian governments have not routinely established information centres at such global events as the annual UN's Conferences of Parties (COPs).

The Paris Agreement emphasises the importance of **helping to build the capacity of countries** to control greenhouse gas emissions and adapt to climate change. This is to include education, training and the transfer of technology. The United Nations Climate Technology Centre and Network helps link the needs of developing countries to expertise elsewhere.

Within our region of the world Australia has the opportunity to collaborate on climate action, involving both mitigation and adaptation, with neighbouring countries. A current example of **bilateral collaboration** is the technical assistance and capacity building for forest management in Indonesia. As New Zealand strives towards its target of net zero emissions by 2050 there will be many opportunities for trans-Tasman co-operation.

Of particular concern are the **small island states** that will suffer from rising sea levels. Australia is providing meteorological expertise in the development of early warning systems.

Of the global target for the contribution by the public and private sectors of developed countries of US\$100 billion a year by 2020, as set in the Paris Agreement, US\$2.4 billion a year has been proposed as Australia's "fair share". To date the Australian Government has pledged \$1 billion over five years to help developing nations combat the adverse effects of climate change. This includes \$200 million over four years for the Green Climate Fund and \$300 million on climate change and disaster preparedness in Pacific Island countries in 2016-2020 (Maclellan, 2018).

We need to continue to develop supportive and collaborative arrangements with neighbouring nations, particularly climate-vulnerable, small island states, and assist poorer countries in the Indo Pacific regions with their adaptation strategies

Long-term challenges:

- > *Provide for international trading in carbon credits to the benefit of all countries and without distracting from the domestic reduction in emissions.*
- > *Sustain effective international co-operation over the decades as governments and circumstances change.*
- > *Increase and extend funding to developing nations consistent with the target set in the Paris Agreement and in proportion to their vulnerability.*
- > *Prepare for the consequences of inevitable climate change for neighbouring nations.*

> INTO THE FUTURE

As outlined above, the pathways to net zero emission will encounter many challenges:

- > How will sufficient land be set aside for the necessary carbon capture?
- > What areas will be reserved for the production of renewable energy?
- > How will the network of charging stations for electric vehicles be established?
- > How will the transition be financed at the rate required?
- > How will the consequences for industries and regions now dependant on fossil fuel operations be managed?
- > What new skills will be required and how will they be assured?
- > Who will be responsible for what?

All these questions need to be answered and resolved satisfactorily in advance of the changes occurring. The recent concerns relating to the National Electricity Market, the cost and reliability of electricity and the reduction in greenhouse gas emissions have reminded us of the importance of long-term planning.

Long-term planning should precede decisions on infrastructure, the lifetime of which can be several decades.

Similarly, the possible co-benefits of the transition should be identified and capitalised upon as effectively as possible.

Over the next thirty years, governments at all levels will come and go. Each with its ideologies and political priorities will address the climate change issue in the context of such factors as global action, economic conditions, markets, technological innovation and community perceptions. Governments will draw on the wide array of policies that can be used to guide the response to climate change. These may include prices on carbon, subsidies, regulations, planning provision, tradeable credits and direct investment. Such policies were the subject of a special review by the Climate Change Authority (Climate Change Authority, 2016).

Having been unable for twenty years to sustain a reduction in emissions we Australians have lost the opportunity to introduce consistent, nation-wide measures that would elegantly, efficiently and effectively follow a gently sloping pathway to net zero emission by 2050. The pathway becomes steeper with each passing year. The emphasis must now be on the effectiveness and rapidity of the selected measures.

> BRINGING IT ALL TOGETHER

12 ***PROPOSED ACTION 12: Adapt for Australia the principles of the 2016 Vancouver Declaration on Clean Growth and Climate Change, relating to the interaction between the national government, provinces and territories.***

Recognising the widespread intention to achieve net zero emissions and the broad range of activities already underway it is now time to seek ways in which all Australians can work together to achieve the goals as effectively and quickly as possible.

Action by all levels of government and by all organisations and individuals should be encouraged and supported. The Paris Agreement stresses the need to involve not only governments but also “civil society, the private sector, financial institutions, cities and other subnational authorities, local communities and indigenous peoples”.

The common goal of net zero emissions by 2050 would help unite these efforts and provide a common measure against which to report progress. The contribution of all sectors to emissions reduction should be recognised and reported as part of the national achievement.

Working collaboratively across all sectors and levels of government in a federation can be challenging. The principles which might apply are exemplified in Canada's 2016 Vancouver Declaration on Clean Growth and Climate Change. The Declaration recognises:

- > the diversity of provinces and territories,
- > the need for an economy-wide approach,
- > the initiatives already taken by the provinces and territories, and
- > the benefits of having flexibility in designing their own policies supported by federal investments and other measures.

Provinces and territories are to complement and support their actions without duplicating them. Collaboration between governments and Indigenous Peoples is to be strengthened.

The Australian Government would help to promote and support the nation-wide programs, other initiatives of national significance and collaboration with other countries and international organizations.

State governments would seek to align their targets and activities as part of nation-wide programs.

Successful initiatives by local governments guide their adoption throughout the sector

Private organisations extend their involvement to include comprehensive reporting and further sector-wide collaboration.

This approach should recognise all the main factors that will influence the emission reduction pathway, take into account the co-benefits, link with initiatives being taken to adapt to the changing climate and integrate action accordingly.

This should all be done in the context of a nation-wide framework.

> A NATIONAL STRATEGY

13 ***PROPOSED ACTION 13: Commence immediately the preparation of Australia's thirty-year strategy to achieve net zero emissions by 2050 covering all sources of greenhouse gases and all sectors of the economy.***

Throughout the world many countries have designed emission reduction pathways. One of the most recent is the 2017 Pan-Canadian Framework on Clean Growth and Climate Change which shows how, for a federation, the initiatives of provincial (state) governments as well as the national government can be taken into account. The European Council, representing the 28 nations of the European Union, recently directed the European Commission to update its 2050 low-carbon economy roadmap by the first quarter of 2019 (Darby, 2018).

Under the Paris Agreement, parties are to submit revised pledges every five years and to explain why they are fair and ambitious in relation to the objectives of the Agreement.

Also under the Paris Agreement nations are invited to communicate by 2020 "mid-century, long term, low greenhouse gas emission development strategies". Guidance for the preparation of such strategies is provided by the UN, the World Resources Institute and United Nations Development Program at www.longtermstrategies.org.

In Australia, the only national strategy to address induced climate change was agreed upon in 1992 by the Australian Government, all state and territory governments and all local governments represented by the Municipal Association (Commonwealth of Australia, 1992). The goal was to reduce emissions by 20% by 2005. Within a few years it was considered ineffective and attention then focused on the Kyoto protocol.

In submitting in 2015 its first “intended nationally determined contribution” the Australian Government not only pledged to reduce emissions of greenhouse gases but also outlined the actions it would take to achieve the goal. However these related only to its own activities with little reference to the contributions of sub-national governments and the private sector.

Recently, the Australian Government accepted Recommendation 3.1 of the Finkel Report that “by 2020, the Australian Government should develop a whole-of-economy emissions reduction strategy for 2050” (Finkel, 2017).

Planning horizons: While a planning horizon of thirty years may seem long, the UN’s Sustainable Development Solutions Network has argued that a shorter time would be inadequate. It could lock in “bridging” approaches such as over-reliance on natural gas, leaving insufficient prospects for reaching deep decarbonisation by 2050. Short-term policy measures need to be nested in long-term pathways. (SDSN, 2015)

Such a national strategy for Australia is now of paramount importance. As recommended by Finkel it should be prepared within the next two years. It should address all sources of greenhouse gases, cover the whole nation and reflect the involvement of all Australians. It should provide a long-term, consistent framework within which, over the next thirty years, the public and private sectors can adopt those policies and policy instruments that they believe will best enable the nation to achieve the net zero goal.

It should include:

- > The goal of reaching net zero emissions by 2050
- > Intermediate goals along the pathway to net zero and associated limits to the emissions of greenhouse gases, the “carbon budgets”
- > Provision for reviewing and revising the strategy every five years, in association with the submission of Australia’s revised NDCs
- > Means of measuring progress across the nation and reflecting the cumulative result
- > Nation-wide component programs covering the six steps of the emissions reduction pathway
- > Sectoral components identifying priority actions for each main sector of the economy
- > A list of priority activities for the next five years with an indication of who will be responsible for them and how they will be resourced
- > Opportunities for co-operative and collaborative action
- > The relationships with climate adaptation
- > International initiatives with which Australia will be involved.

There are several models for such strategies in Australia. They include:

- > The 2015 National Energy Productivity Plan. This identifies key actions for each component. Government and private parties can voluntarily opt in and be recognized for the contributions they will make
- > The National Biodiversity Strategy. This provides an overarching framework and set of principles
- > The 1990 Decade of Landcare Plan. This consisted of a national section prepared by the Australian Government and state and territory sections prepared by their governments using the same format. (This is similar to the method used by the European Union for climate change. The plans of the member countries were brought together to ensure compatibility and consistency and a unified EU approach.)

The preparation of the strategy should be an opportunity for all parties to share a common understanding, contribute information and ideas and develop collaborative arrangements. It could take into account the concurrent international negotiations through the Talanoa Dialogue, as outlined above.

Part of its preparation could be a “national climate management summit” which would involve practitioners representing all levels of government, the private sector, and research and training bodies as well as the key economic sectors.

> WHO WILL BE RESPONSIBLE?

14 **PROPOSED ACTION 14: Establish an independent Australian Climate Response Commission to measure and report on progress, manage the periodic revision of the strategies and co-ordinate the nation-wide programs.**

Over the next three decades, responsibility for developing and implementing the response to climate change will rest with successive governments, their institutions, energy generators, manufacturers, financial institutions and many other private sector organisations. Their responses will depend on their roles and the circumstances, many of which will change periodically.

However, some matters will require constant and consistent attention over time. Whatever the measures are and whoever takes them, there will be a need for ongoing, independent assessment of the effectiveness of the actions and of the need to adjust them. Co-ordination of activities throughout the nation to improve their effectiveness and efficiency would also be beneficial. These need to be done independently of the fluctuations over the thirty years in policies and priorities of successive governments.

An example of an independent body responsible for these functions is the Committee on Climate Change in the UK. The New Zealand Government has announced that it will establish a similar entity (McLachlan, 2017). In Australia, the former Climate Commission had some similar responsibilities. The current Climate Change Authority also has responsibility for advising the Australian Government but has no operational roles. Its future remains uncertain since the current Government announced that the Authority would be abolished.

The Clean Energy Regulator collects data from organisations emitting greenhouse gases and administers aspects of the Australian Government's renewable energy and carbon reduction schemes.

In the future, the proposed functions could be undertaken by a modification of the Authority or Regulator or by a new body, the Australian Climate Change Response Commission, similar in its independence to the Australian Productivity Commission.

This Commission would:

- > Build on the existing greenhouse gas reporting system to develop the capacity to record all relevant emission reduction activities and their cumulative effect.
- > Report on progress in the reduction of greenhouse gas emissions.
- > Manage the periodic review of the proposed thirty-year Emissions Reduction Strategy and the 2017 Climate Adaptation Strategy.
- > Advise on the success of the strategies and associated policies of Australian, state, territory and local governments.
- > Advise on the extent to which the reduction in greenhouse gases should be met by measures within Australia or the use of international carbon credits.
- > Establish and co-ordinate nation-wide programs across all levels of government and the private sector with respect to mitigation and adaptation.
- > Use these programs to identify, communicate and promote best practices.
- > Taking a long-term perspective, assess future pathways for reducing emissions and advise on potential impediments which will need to be addressed.
- > Propose priorities for monitoring, research and innovation.

The Commission would not replicate the functions of any other organisations. It would undertake and develop the emissions reporting role that is currently the responsibility of the Department of Environment and Energy.



Climate change is an unprecedented and growing threat. The arguments for action are clear. So are the immense opportunities for peace and prosperity if we act quickly and decisively. All of us – governments, businesses, consumers – will have to make changes. More than that, we will have to “be” the change. This may not be easy at times. But for the sake of today’s and future generations, it is the path we must pursue. This is my message to all the world’s leaders. If we work together as a global community, we can emerge stronger, safer and more prosperous for our shared future and the future of all of our grandchildren.

Guterres, 2017

> CONCLUSIONS

The UN Paris Climate Agreement provides a context for Australia’s response to climate change. It requires Australia to raise progressively its targets for reducing emissions of greenhouse gases.

Australia’s emissions of greenhouse gases are currently increasing. Further, more effective policies and programs at all levels of government appear to be needed.

Importantly, however, most of Australia’s states and cities as well as other local governments are already committed to the reasonably ambitious goal of achieving net zero emissions by 2050. This could now be extended to apply to all Australians.

This would assist long-term planning, the development of intermediate targets and increased certainty for the necessary long-term investments. It would guide successive governments over the next thirty years as each decides on its preferred policies and policy instruments.

The six steps towards emission reduction are now well understood with progress being made throughout the world. Some progress has already been made in each of them in Australia by all levels of government and the private sector.

The range of such climate actions in Australia’s public and private sectors is now more widespread and diverse than ever before. There would be substantial benefits for them to be part of an inclusive nation-wide effort, as advocated in the Paris Agreement.

One approach could be for each such action to be part of a nationwide program for each of the emission reduction steps. Each program would consist of the main, relevant activities by governments at all levels and by organizations in the private sector.

In support of these programs and the involvement of all Australians, progress in reducing emissions and capturing greenhouse gases will need to be assessed at all levels. This will require the extension of monitoring schemes to the local levels. Reports on Australia’s progress should then include local and state achievements as well as those at the national level. Individuals and communities will then be more empowered with the knowledge of what they can do.

Many international opportunities for collaboration and engagement by Australia will benefit from a more unified, nation-wide effort.

Underpinning this approach should be: the adoption of the principles of the Vancouver Declaration, relating to the relationship between all levels of government; the development of a thirty-year economy-wide strategy for all of Australia; and the establishment of an independent Australian Climate Change Response Commission.

➤ APPENDIX: GREENHOUSE GASES EMISSION REDUCTION STEPS

STEP 1. Minimise the demand for energy

This, the least costly step, is achieved by maximising improvements in the efficiency of energy use and looking for ways of using energy less intensively. Techniques range from improvements to the design of buildings and industrial processes to waste minimisation and changes in consumption patterns.

The International Energy Agency notes that “more than ever before, energy efficiency is central to the achievement of a range of policy goals, including energy security, economic growth and environmental sustainability. However, global progress has become dependent on yesterday’s policies, with the implementation of new policies slowing. If the world is to transition to a clean energy future, a pipeline of new efficiency policies needs to be coming into force” (International Energy Agency, 2017).

Most developed countries have energy conservation programs. Many have already shown that energy use can be reduced without inhibiting economic growth (Nuttall, 2017). In California, where efficiency has been central to that state’s energy strategy, efficiency is responsible for an annual reduction in state-wide electricity consumption equivalent to 30 per cent of current electricity consumption (McAllister, 2017).

In Australia, the Australian and State governments released a National Energy Productivity Plan in 2015 with the aim of increasing energy productivity by 40% by 2030. The Government expects this to deliver one quarter of the savings in greenhouse gases required to meet its 2030 emissions target. Key components include improving the national construction code, improving the overall energy-use rating of buildings and increasing the efficiency of equipment.

The governments of the ACT, NSW, South Australia and Victoria also have energy efficiency targets and schemes relating to energy retailers, commercial and industrial operations, building design and construction, small business and individual households.

There is a range of initiatives by local governments. The City of Sydney has recently released a draft Sustainable Office Building Plan seeking the voluntary adoption of increased building standards for new buildings and refurbishments as part of its goal for office buildings to become net zero by 2050 (Jewell, 2018).

The 2016 International Energy Efficiency Scorecard of the American Council for an Energy Efficient Economy (ACEEE) rates Australia sixteenth out of the world’s 23 largest energy consuming economies, performing only slightly better than Russia and Indonesia (American Council for an Energy Efficient Economy, 2016).

We were strongest in the efficiency of buildings and labelling of appliances and equipment. However, efficiency standards for new residential buildings have not changed since 2010 and not since 2013 for new appliances. Most of Australia’s existing nine million houses would have just “one star” rating (Hannan, 2018).

The National Construction Code is due to be updated in 2019. Combined, cost-effective measures could reduce energy consumption for heating and cooling by up to 51% across a range of housing types and climates (ASBEC, 2018).

Australia is second from the bottom in the transportation sector, according to the ACEEE. Australia has no fuel economy standards for passenger vehicles and heavy-duty trucks. Our percentage of public transit use is low and investment in rail facilities is less than half that spent on roads. The program to support energy efficiency in large, energy-using corporations ceased in 2014.

Energy inefficiency is one of the most urgent issues facing the emissions reduction transition. With each passing day additional, inadequately designed buildings, infrastructure and equipment lock in years of wasted energy and the associated greenhouse gas emissions.

Long-term challenges:

- > *Raise community understanding about, and commitment to, energy efficiency.*
- > *Continuously review and update efficiency standards for appliance and buildings.*
- > *Introduce fuel economy standards for all vehicles.*
- > *Progressively retrofit existing residential and other buildings.*
- > *Modify energy-intensive lifestyles.*
- > *Avoid carbon-intensive infrastructure through long-term urban planning.*

STEP 2. Convert to an electricity supply system with a larger capacity but with low, and ultimately zero, emissions of greenhouse gases

This is a core requirement. Not only must there be sufficient emission-free electricity to meet normal requirements there must also be some available to replace the fossil fuels used for other purposes such as heating and transport.



Eighty percent of the world's energy still comes from fossil fuels – oil, gas and coal. We cannot phase out fossil fuels overnight. We have to engage the energy industry and governments to use fossil fuels as cleanly, sparingly and responsibly as possible, while transforming our energy systems.

Guterres, 2017

The burning of coal is responsible for 40% of global emissions of carbon dioxide. Many electricity generators and several countries have already committed to **discontinuing the use of coal**. The Union of Electricity Industry, an association of 3,500 power companies in Europe, has announced that they will not build new coal-fired plants after 2020. The United Kingdom will phase out all coal-fired power plants by 2025 (Nuttall, 2017).

In Australia, coal-fired power stations are being closed as they reach the end of their operational life and in response to decisions by their owners to cease the use of coal. As we struggle to manage these changes our immediate desire for affordable and secure supplies of electricity must also accommodate the goal of net zero emissions.

The worldwide **transition to renewable energy** is underway. 80% of countries now have clean energy plans. The proportion of global electricity provided by renewables rose from 10.3% in 2015 to 12.1% in 2017. Global investment in renewables in 2017 was \$279.8 billion (UNEP, 2018). The cost of renewables is continuing to fall. The greatest challenge is in the cities of developing countries where 80% of their greenhouse gas emissions are generated and where the focus is still on bringing online more fossil fuel baseload capacity to deal with their rapid urbanisation (Cornish, 2017).



Last year, solar power grew 50 per cent, with China and the United States in the lead. Around the world, over half of the new power generation capacity now comes from renewables. In Europe, the figure is more than 90 per cent. The falling cost of renewables is one of the most encouraging stories on the planet today. In the United States and China, new renewable energy jobs now outstrip those created in the oil and gas industries. China aims to increase its renewable energy by about 40 per cent by 2020. Major oil producers are also seeing the future and diversifying their economies. Even Saudi Arabia announced plans to install 700 megawatts of solar and wind power. And industry experts predict India's solar capacity will double this year to 18 gigawatts.

Guterres, 2017

In Australia, 16% of electricity was generated from renewables in 2016, up from 14.6% in 2015. The proportion again increased in 2017. Investments in renewables in Australia in 2017 jumped by 147% to \$8.5 billion (UNEP, 2018). The mandatory Renewable Energy Target for 2020 is equivalent to 23.5% of total electricity generation.

Meanwhile all state and territory governments are also supporting the development of renewable energy. Almost all have targets for the generation of electricity from renewables ranging from 20% to 100% within the period 2020 to 2030. The cities of Melbourne, Sydney and Canberra have targets as have other local governments. Seventy local governments in Australia are part of the Cities Power Partnership to encourage the use of renewable energy.

NATIONAL ENERGY GUARANTEE

The Australian Government is proposing to introduce in 2020 the National Energy Guarantee as a scheme to provide reliability, affordability and sustainability for the National Energy Market (COAG, 2018). The NEM covers all Australia except Western Australia and the Northern Territory. Emission reduction targets set by the Federal Government would be reflected in the emission limits to be ensured by each retailer of electricity. The scheme would not retain a target for renewable energy. The only emissions target proposed is the INDC commitment of 26% of 2005 levels by 2030. As noted above under "When?" and "How?" this is unlikely to enable net zero emissions to be reached by 2050.

Long-term challenges:

- > *Embed emission goals in energy planning*
- > *Prepare for sufficient emissions-free energy to substitute for all current fossil fuels*
- > *Prepare for the change from a centralised to diversified energy supply system*
- > *Allocate land for energy production and address potential conflicts with other possible uses of the land*
- > *Respond to end-of-life issues associated with energy technology*
- > *Prepare for the closure of fossil fuel facilities*
- > *Provide low-cost energy storage.*

STEP 3. Switch from the direct use of fossil fuels to zero emissions electricity

Low-emission electricity will also have to substitute for the fossil fuels currently used to provide transport and heat

An example of Step 3 is the worldwide transition for motor vehicles. Twelve countries, including China, the UK, France, India and Norway, have announced their intention to limit the sale of petrol and diesel vehicles in the future. Eight states of the USA have set similar goals. Four of the largest manufacturers of cars have recently partnered to develop a fast-charging network in Europe. The electric car fleet could be about one third of the global fleet by 2035 (Nuttall, 2017).

In Australia, out of about one million cars sold each year only 1300 are electric, mainly hybrid (ClimateWorks Australia, 2017). Policy measures that would cancel out the cost premium that still challenges electric vehicles are absent (Macdonald-Smith, 2017). An exception was the South Australian government's decision to waive vehicle registration and stamp duty on new electric vehicles for five years. It was also supporting the installation of forty electric vehicle charging stations this year (Latimer, 2018). Recently the Queensland Government laid claim to the "world's longest electric vehicle superhighway in a single state" with the installation of fast-charging stations in seventeen locations along much of the coast. The energy supplied will be bought through green energy credits or offsets (Vorrath, 2018). A major petrol company has recently announced its intention to develop a fast-charging network as has the NRMA in NSW. The Australian Electric Vehicle Council expects the manufacturing of electric cars to be cheaper than traditional vehicles by 2025 (Electric Vehicle Council, 2017).

Decarbonisation of heat using renewable electricity is more problematic. One alternative is the development of "power to gas" technology such as the production of hydrogen (Eyre and Gross, 2016).

Long-term challenges:

- > *Plan for the transition to electric vehicles throughout Australia, including the development of charging networks using emissions-free electricity.*
- > *Ensure environmental and social sustainability of the future supply chains for vehicle manufacture and end-of-life re-purposing, re-use and recycling*
- > *Prepare for the consequences of reduced income from fossil fuel excises.*

STEP 4. Minimise emissions by replacing or improving production processes in which greenhouse gases are an inherent part

These processes include aspects of farming, refrigeration, waste treatment, the manufacture of cement and fertilisers and leakages from the mining, treatment and transport of fossil fuels.

A recent example of international co-operation is the Kigali Amendment to the Montreal Protocol. This will phase out the use of the types of chemicals that were replacing ozone-depleting substances as refrigerants, but that have a global warming potential that is over 4000 times greater than carbon dioxide.

In Australia, the reduction in emissions from these processes are eligible for support under the Emissions Reduction Fund and Clean Energy Finance Corporation. In some cases, companies work together as industry associations to reduce emissions. For example, Meat and Livestock Australia has set the target of making Australia's red meat industry carbon neutral by 2030 (Country News, 2018).

Long-term challenges:

- > *Identify all relevant facilities.*
- > *Systematically address them.*
- > *Develop alternative products.*
- > *Prepare emission reduction strategies.*

STEP 5. Retain existing carbon sinks

Deforestation itself is responsible for 10-15% of global greenhouse gas emissions, as well as habitat loss and social conflict. The UN's REDD+ program supports the reduction in emissions from deforestation and forest degradation in developing countries (Nuttall, 2017). Further, Article 6 of the Paris Agreement seeks to support sustainable development. This is likely to align with the retention of carbon sinks and provision of co-benefits to local communities.

According to the former Carbon Disclosure Project (CDP), more companies are joining the international initiative under the post-Paris global climate action agenda aimed at deforestation-free commodity supply chains (Nuttall, 2017).

In Australia, 436 thousand hectares of forest land were cleared in 2015-16, an increase of 12% on 2014-15 (Department of Environment and Energy, February 2018). Additional clearing of non-forest vegetation also occurs.

Most states and territories have some form of protection for native vegetation. These require the sourcing and protection of vegetation or biodiversity offsets in response to permitted clearing. However, clearing rates are increasing. In Queensland the rates are now greater than for all the rest of Australia, with "1,500 football fields worth of native woodland and scrub being cleared each and every day". Clearing regulations have recently been relaxed in NSW. In the Northern Territory approval for land clearing has jumped ten-fold in the past two years (Slezak, 2018).

A large proportion of the Australian Government's Emissions Reduction Fund has been devoted to carbon farming and the retention of native vegetation.

Countries are withdrawing their support for the **mining of fossil fuels**. In 2016 the G7 nations (the UK, US, Canada, France, Germany, Italy, Japan and the European Union) set a deadline for ending most fossil fuel subsidies, saying government support for coal, oil and gas should end by 2025 and encouraged all countries to join them. Included are subsidies for exploration and mining. The OECD and World Bank have also called for an end to assistance for fossil fuel projects (Mathiesen, 2016).

Mining is also the focus of the divestment movement. The world's biggest investment fund, Norway's sovereign wealth fund, is starting to withdraw from its 380 oil and gas investments worldwide (The Age, 2017).

In Australia several major banks have decided to restrict lending for coal extraction (Yeats, 2018).

Long-term challenges:

- > *Extend and create greater consistency between policies of no net reduction in vegetation cover throughout Australia.*
- > *Manage consequences for the regional communities affected by the transition from coal.*
- > *In all aspects of land management anticipate the possible impact on the rights and interests of indigenous peoples.*

STEP 6. Capture any remaining emissions

Inevitably some emissions of greenhouse gases will remain. Therefore, the sixth step of the transition is to capture any remaining emissions. This can be done through carbon farming, carbon capture and storage, enhanced weathering, ocean fertilisation and direct air capture and storage.

However, scientists have recently warned that, because of the time required to roll out these measures, their high cost and the possible impact on terrestrial and marine ecosystems, they should not substitute for the direct reduction of greenhouse gas emissions (European Academies Science Advisory Council, 2018).

Carbon farming is farming in a way that reduces greenhouse gas emissions and holds carbon in vegetation and soils. Worldwide there is the potential through farmland restoration to remove 14 billion tonnes of CO₂ from the atmosphere (Burton, 2017). Schemes by which farmers can earn credits for storing carbon or reducing greenhouse gas emissions have been supported by such agencies as the World Bank in China, Brazil and parts of Africa.

In Australia in 2015-16 bush regrowth occurred on 3.6 million hectares of previously cleared land sequestering an estimated 14 million tonnes of carbon dioxide (Department of Environment and Energy, February 2018).

Since 2011 Australia has been implementing its Carbon Farming Initiative and associated schemes. This has attracted international attention for its potential application in other countries (Barbier, 2012). The Carbon Market Institute recently estimated that the land sector could contribute 30-40% of the abatement required in Australia during 2020-2030 (Carbon Market Institute, 2017).

Land management techniques, such as savanna fire management developed in Northern Australia in conjunction with indigenous groups, reduce emissions and enhance carbon sequestration in vegetation and soils. Methodologies similar to those used in Australia are likely to be possible in parts of Africa, Latin America and Asia (United Nations University, 2015).

Underground storage of carbon dioxide that has been separated from the emissions stream of power stations is being trialled in several countries. A pilot scheme has been researched in Victoria and further study is underway off the Gippsland coast. However, the technical and financial feasibility of this method and the potential for long-term leakage remain uncertain. **Carbon capture and use** is also being investigated (Marshall, 2018.)

Long-term challenges:

- > *Reserve land for adequate revegetation.*
- > *Support widespread adoption of carbon farming.*
- > *Understand further the effectiveness of carbon farming techniques.*
- > *Guarantee the technical and financial feasibility of underground storage of carbon dioxide.*

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