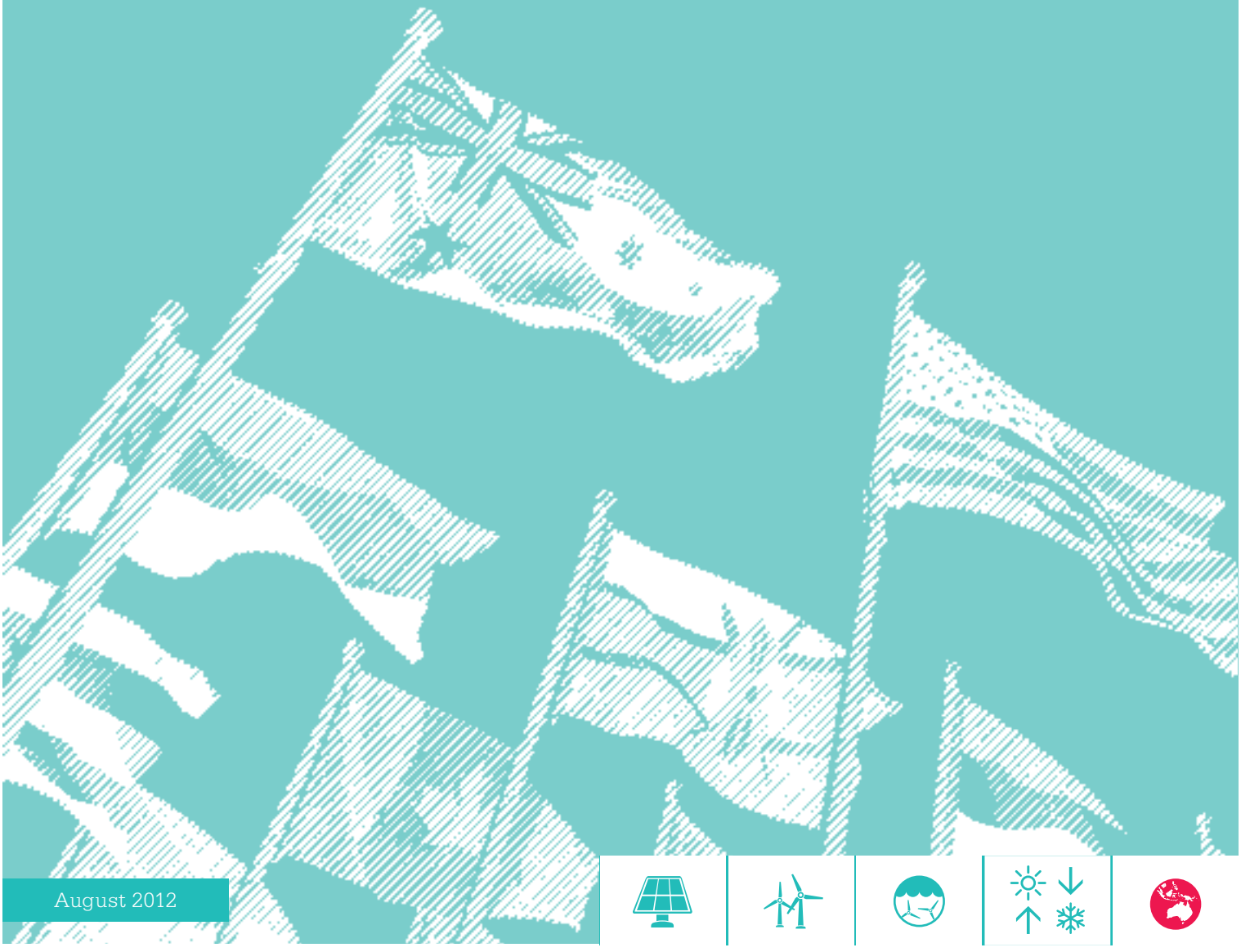
CLIMATE COMMISSION

THE CRITICAL DECADE: INTERNATIONAL ACTION ON CLIMATE CHANGE



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The Critical Decade:
International action
on climate change



Preface

The Climate Commission brings together internationally renowned climate scientists, as well as policy and business leaders to provide an independent and reliable source of information about climate change to the Australian public.

This is the Climate Commission's 12th report and follows a series of reports on the science and impacts of climate change and the opportunities in Australia associated with taking action to reduce greenhouse gas emissions.

In its 2011 report, *The Critical Decade: Climate science, risks and responses*, the Climate Commission set out the clear scientific evidence on the changing climate. It outlined the overwhelming evidence that the climate is changing and that human activities are the main cause. It also highlighted the substantial risks for Australia. The main message in *The Critical Decade* was that, if we are to avoid the most damaging effects of climate change, then the world must take strong, rapid action this decade to reduce greenhouse gas emissions.

What action is being taken to tackle this global challenge, and where does Australia fit?

In our discussions with Australians during the past 18 months, we have found that this is one of the main questions in the minds of many people. This report seeks to respond by outlining how countries around the world are acting to reduce the risks.

The information in this report is compiled from a number of authoritative sources. A list of references is included at the end for those who would like further information on a particular subject.

We would like to thank our fellow commissioners and acknowledge the reviewers who provided advice for this report – Mr Howard Bamsey (United States Studies Centre, University of Sydney), Dr Frank Jotzo (Crawford School of Public Policy, Australian National University), Professor Stephen Howes (Crawford School of Public Policy, Australian National University) and Mr Erwin Jackson, The Climate Institute. We would also like to thank the global authorities who have endorsed the report.

The Climate Commission retains responsibility for the content of the report.

Professor Tim Flannery
Chief Climate Commissioner

Mr Roger Beale AO
Climate Commissioner

Mr Gerry Hueston
Climate Commissioner

KEY FINDINGS

1. The world is moving to tackle climate change. More needs to be done but momentum is growing.

- There is global agreement that to lessen the risks to the economy, environment and society, we must substantially limit the amount of greenhouse gases produced. This will require a transition away from relying on fossil fuels, like coal and oil, to cleaner forms of energy.
- Ninety countries representing 90 per cent of the global economy have committed to limit their greenhouse gas emissions and have programs in place to achieve this. These countries include our trading partners, our competitors and our neighbours, including the world's largest economies, the United States and China.
- Every major economy is tackling climate change. Countries are using a mix of regulation, carbon pricing, renewable energy targets and investment.
- Climate change is a global problem but the world isn't waiting for a global treaty. Instead, success will depend on the sum total of national efforts: that is, what countries are actually doing to limit their emissions.

2. Australia is a major player and is important in shaping the global response.

- Australia is the 15th largest emitter, larger than around 180 other countries. Australia is also the largest emitter per person of any country in the developed world.
- Australia belongs to a group of 20 carbon heavyweights – 20 countries that contribute 75 per cent of the world's greenhouse gas emissions. These countries are the most influential and will shape the global response to climate change.
- Australia's influence abroad will depend on how effectively we implement solutions at home.
- Australia's efforts to reduce its emissions strengthen the global resolve to tackle climate change, supporting those countries that are already acting and encouraging those that lag behind. If countries meet their existing promises, this will build momentum for the necessary deeper cuts in the future.
- Failure to meet our international commitment would damage our international reputation and the global effort to tackle climate change.

3. We already have the technologies we need to tackle climate change.

- Using energy more efficiently could make a huge contribution to avoiding the worst impacts of climate change. The International Energy Agency found energy efficiency could technically deliver 65 per cent of global greenhouse gas emissions reductions needed to 2035. This is illustrative of the important contribution energy efficiency can make in concert with other measures.
- Global investment in renewable power and fuels has increased sixfold since 2004 and was $257 billion in 2011. Renewables are already a significant source of energy in some countries. Meanwhile the costs of many technologies are falling rapidly.
- Countries like China and the Republic of Korea are making strides to position themselves as world leaders in the production of renewable energy technology. Meanwhile, the United States has made major contributions to research, development and implementation of renewable energy.

4. It is in Australia's national interest to tackle climate change.

- There is bipartisan recognition that protecting Australia's prosperity requires Australia to contribute to the global effort to reduce greenhouse gases. The sooner Australia reduces emissions the cheaper those reductions will become.
- The world is changing and Australia needs to be prepared if our economy, society and environment are to prosper in future. This involves making investments now in order to reap increasing benefits in future.
- The global pressure to reduce emissions is only likely to increase as the climate shifts and global action accelerates.
- Australia is a world leader in some areas of clean technology research and development, with immense resources in sun, wind and other renewable energy. As the world moves, opportunities open for Australian business.

5. This is the critical decade.

- The global momentum achieved this decade will set the long-term foundations for tackling climate change effectively.
- This decade must set us up to turn our path around from high emissions to nearly zero emissions by 2050. It is like putting on the brakes in a car; the earlier you apply them the more smoothly you will stop, the later you leave it the more disruptive the stop and the greater the risk that you will stop too late.
- While strong progress is being made, global temperatures are rising rapidly and sea-level rise is tracking to near the highest levels scientists expect. There is evidence that recent extreme weather is linked to climate change. This underlines the urgency of strong Australian and global action.
- Australia's actions are a vital contribution to the global effort to combat climate change.

INTRODUCTION

INVESTING IN TACKLING CLIMATE CHANGE IS AN INSURANCE POLICY AGAINST SERIOUS FUTURE DAMAGE FROM A CHANGING CLIMATE.

It is clear that around the world most countries are now acting on climate change. In fact, some countries have been acting for more than 20 years.

The Climate Commission set out the clear scientific evidence that humans are the main cause of climate change in *The Critical Decade: Climate science, risks and responses*. It pointed out how the risks from a changing climate multiply if emissions of greenhouse gases continue to grow beyond 2020.

We are already seeing the social, economic and environmental impacts of a changing climate including rising sea levels and increasing frequency and intensity of extreme weather such as heat-waves and bushfires (IPCC, 2011).

TO LESSEN THE RISKS TO OUR ECONOMY, THE ENVIRONMENT AND OUR WAY OF LIFE, WE MUST SIGNIFICANTLY REDUCE THE AMOUNT OF GREENHOUSE GASES WE PRODUCE.

To lessen the risks to our economy, the environment and our way of life, we must significantly reduce the amount of greenhouse gases we produce. This will require a progressive move away from relying on fossil fuels, like coal and oil, to cleaner forms of energy.

This report examines the global response to climate change and considers how the world is heading toward reducing emissions of greenhouse gases and meeting the goal of avoiding the most damaging effects of climate change.

A critical decade for action by many countries

Countries have acknowledged that humans are causing climate change and there is a strong need to reduce emissions of greenhouse gases (UNFCCC, 1992). They have agreed to accept the scientific advice that the increase in global average temperature should be kept to below two degrees Celsius (2°C).

An increase of 2°C above pre-industrial levels is widely accepted as a threshold that should not be crossed to avoid the most destructive impacts of climate change. Many in the scientific community argue that it would be safer to keep the temperature rise to below 1.5°C. Global leaders have agreed to consider this by 2015.

Countries also agree that deep cuts in emissions are required to hold the increase in global average temperature below 2°C. Halting the growth of global greenhouse gas emissions requires action in many countries and by all the major emitters.

The longer we delay action, the harder it will be to reach this goal beyond 2020.

To achieve a two in three chance of keeping global temperature rise below 2°C strong action is required by the major emitters, including Australia, to steeply reduce emissions beyond 2020. This would be helped by a broad and ambitious agreement (currently being negotiated) involving these major emitters. This decade is critical for action and for negotiation. Any delays cause additional costs.

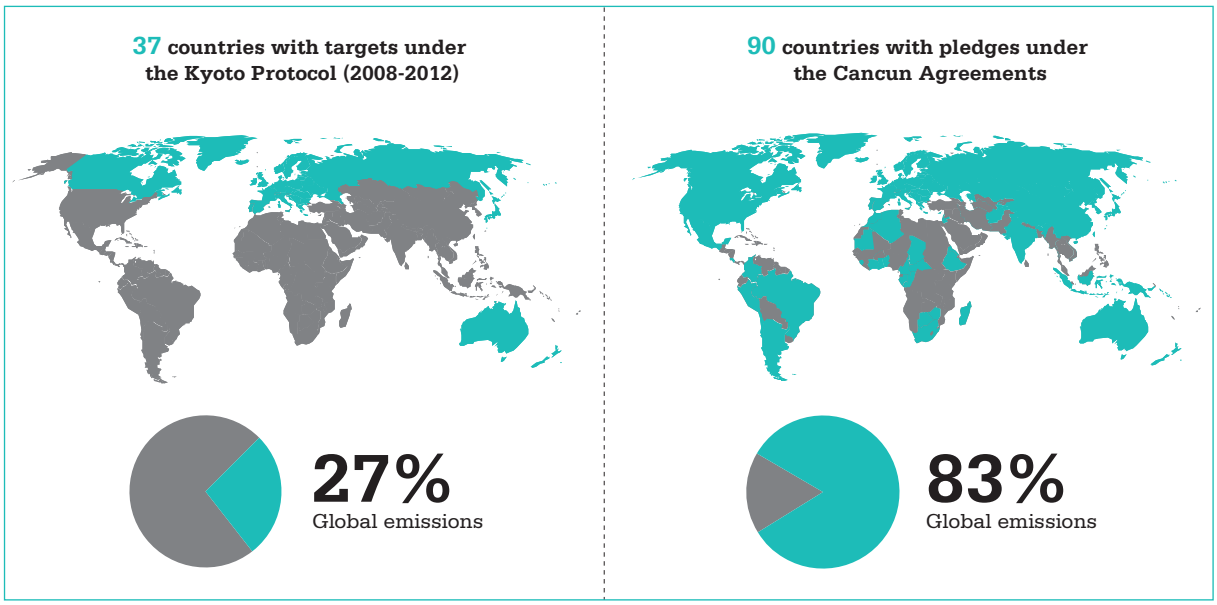
The world is moving...

Our trading partners, our competitors and our neighbours, including the world's largest economies, the United States and China, are all working to reduce their greenhouse gas emissions.

Ninety countries covering around 83 per cent of global greenhouse gas emissions and 90 per cent of the global economy have pledged to limit their greenhouse gas emissions (Figure 1.1).

Australia is particularly vulnerable to a changing climate and most Australians accept that it is in our national interest to protect our way of life from climate change. Australia's major political parties accept that climate change is an urgent issue and have committed to reducing Australia's emissions by 5 per cent by 2020 compared with emissions in 2000 regardless of what the world does. They have also committed to reductions of up to 15 or 25 per cent if there is global agreement on strong action to reduce emissions.

Figure 1.1 – Map of growth in the number of countries pledging action and the portion of global emissions covered under the UN Framework Convention on Climate Change.



(Source: DCCEE)

"There are powerful and convincing reasons to go green besides the science."
Mr Arnold Schwarzenegger, former Governor of California

There is a move towards clean and renewable energy. Modern technology and resource extraction are being designed to be more energy efficient. It is now clear that the world is moving toward economic development that is less greenhouse gas intensive and countries are taking up the opportunities that this presents.

Global investment in renewable power and fuels totalled USD257 billion in 2011, more than six times the level of investment in 2004 (Frankfurt School, 2012). In fact, the average growth of investment in renewable energy (6.5 per cent growth in 2010) is expected to outpace the growth of the global economy which is forecast to grow between 3.5 and 4 per cent between 2012 and 2014 (Pew, 2012; Treasury, 2012).

Between 2000 and 2008, around one third of the countries in the OECD achieved absolute reductions in carbon dioxide emissions while growing their economies (OECD, 2012).

A limited amount of emissions can be reduced at zero or low cost. However, it is simply not possible to achieve the required reduction in greenhouse gas emissions without some cost.

There is widespread acknowledgement by governments across the world that the future costs of climate change outweigh these costs of acting now. Investing in tackling climate change is an insurance policy against serious future damage from a changing climate.

... But more is needed

While the actions of countries to date are important; they are only a start and much more needs to be done. The battle to reduce greenhouse gas emissions will go on for decades. At present, overall emissions are continuing to grow in excess of past rates, with much of the growth occurring in developing countries. In many major developed countries, emissions have declined in absolute terms over recent years.

Most of the world's emissions are produced by about 20 countries around the world, of which Australia is one. It is these countries whose actions matter most. The actions of the United States and China are particularly important because of their size and their leadership role.

"... the world will not be able to avoid global warming of more than two centigrade degrees, beyond which the impacts of climate change become increasingly dangerous, just by taking a series of modest but significant steps forward over the next few years".
Lord Stern

If we wish to avoid the most destructive and dangerous impacts of climate change, countries will need to increase their ambition. More importantly, emissions reductions will need to accelerate progressively up to and beyond 2020.

There is a risk that some countries will not meet their commitments.

For example, the 2011 tsunami and subsequent Fukushima-Daiichi nuclear accident and its consequences have put great pressure on the Japanese power system, which now has to use its gas and coal fired power plants more than intended. Japan is, therefore, reconsidering its specific 2020 target.

But many countries are taking domestic action.

In the United States, Congress has impeded a national carbon trading bill. Nevertheless, regulations being put in place will cover around 70 per cent of the country's emissions from stationary sources (US EPA, 2010). There is a lot of work being done by the Administration through regulations and spending. Many states and large cities are also taking action. In spite of political difficulties, actual greenhouse gas emissions in the United States have dropped since 2006, initially reflecting the impact of the global financial crisis but also with progressive improvement flowing from switching from coal to gas for power generation and warmer winter temperatures (IEA, 2012a).

China appears to be moving steadily toward the actions needed to reach its target reduction in the carbon intensity of its economy. India is another large emitter but one with very low income levels and per person emissions. India has chosen a target that is little better than the expected rate of improvement in business as usual emissions, while Russia is planning to do relatively little.

In the United States and a number of other countries, leaders continue to have to face down a virulent campaign of scepticism. This scepticism is in spite of all major science academies, the World Meteorological Organization and government meteorological authorities agreeing with the climate science which highlights the risks and concerns.

Many countries face continuing challenges in phasing out subsidies for fossil fuels. These subsidies favour consumption of fossil fuels, discourage energy efficiency and hinder the competitiveness of renewable energy. Phasing out fossil fuel subsidies would help reduce demand for these fuels and could deliver a substantial reduction in global greenhouse gas emissions (IEA, 2012b).

Fossil fuels include coal, petroleum and natural gas.

Source: Flickr

It is the Climate Commission's judgement that the international will to maintain and speed up action is most likely to be built through bringing into reality the commitments already agreed. To put it another way, as countries do what they've said they will do by reducing emissions at home, they will in turn build the international will for countries to go further. The good news is that this is already happening, with most major countries taking action to limit their emissions. Collective action will occur through groups of like-minded countries working together and within current international talks that aim to agree legally binding commitments by 2015 and take effect from 2020.

COLLECTIVE ACTION WILL OCCUR THROUGH GROUPS OF LIKE-MINDED COUNTRIES WORKING TOGETHER AND WITHIN CURRENT INTERNATIONAL TALKS THAT AIM TO AGREE LEGALLY BINDING COMMITMENTS BY 2015 AND TAKE EFFECT FROM 2020.

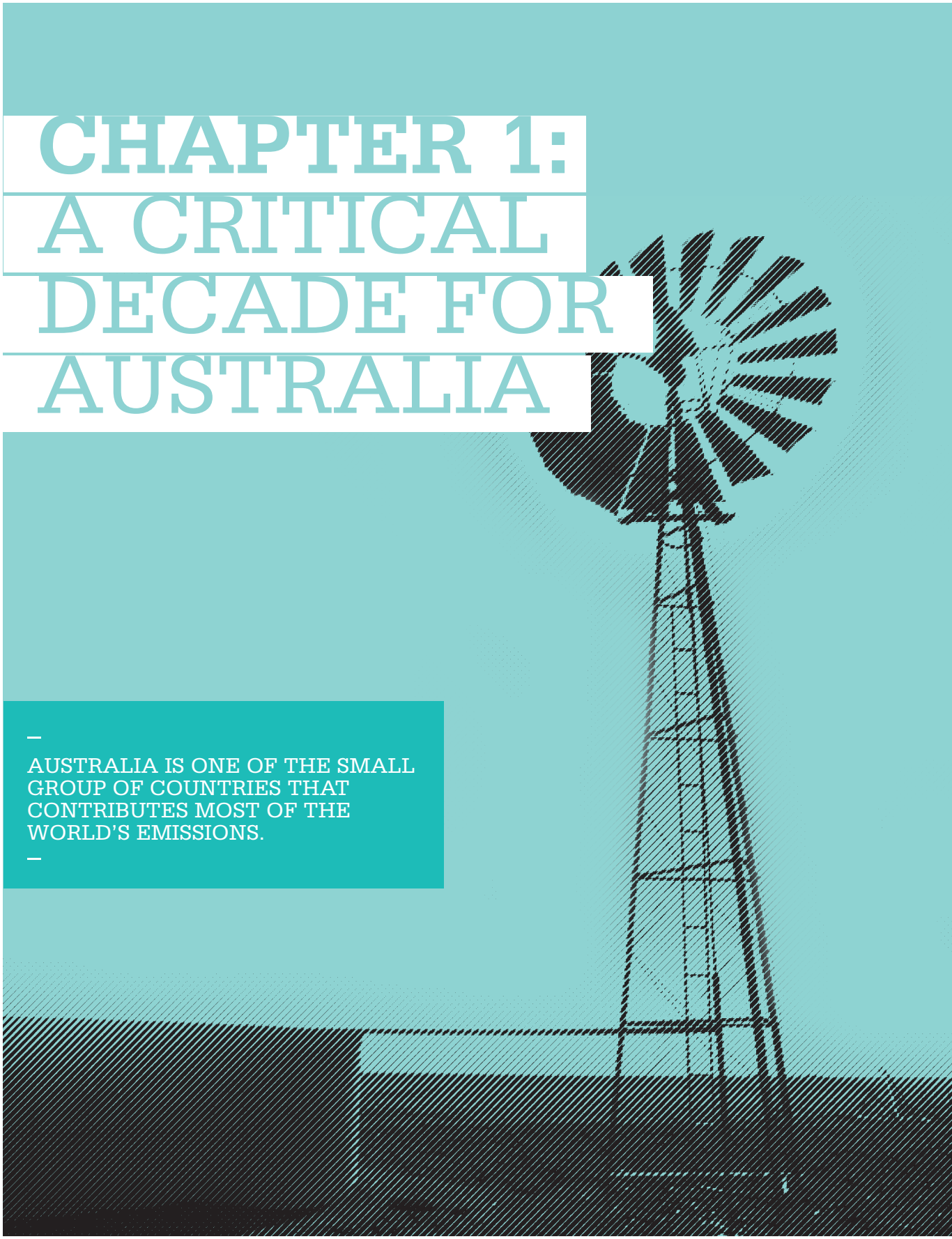
Australia has a clear choice – to support those who are acting or to increase the risk of a loss of confidence in the global talks by failing to achieve the emissions reduction goal it has set itself. The best way to encourage others to meet their commitments is to meet our own.

THE BEST WAY TO ENCOURAGE OTHERS TO MEET THEIR COMMITMENTS IS TO MEET OUR OWN.

Most major countries are taking actions to limit their emissions. Shown below are: solar panels in Charanka, India; electric car charging station in London, UK; and wind power in Horse Hollow, USA.

Sources: Flickr/American Centre Mumbai, Flickr/Alan Trotter, Flickr/Danish Wind Industry Association.

CHAPTER 1: A CRITICAL DECADE FOR AUSTRALIA



AUSTRALIA IS ONE OF THE SMALL GROUP OF COUNTRIES THAT CONTRIBUTES MOST OF THE WORLD'S EMISSIONS.

To reduce the risks to our economy, environment and our way of life, we must substantially reduce the amount of greenhouse gases we produce. This will require a progressive transition away from relying on fossil fuels, like coal and oil, to cleaner forms of energy that allow the economy to grow.

We already have the technologies we need to reverse the growth in greenhouse gas emissions. Put simply, there is no time for delay in implementing strategies for energy generation, built infrastructure, agriculture and transport that produce lower emissions.

Climate change is a global problem and every country has a role to play in contributing to the solution. Emissions generated in one country will contribute to the impacts of climate change in all countries. Solving the climate problem depends on countries around the world taking action to reduce emissions.

The global climate is changing because the amount of heat-trapping gases in the atmosphere, like carbon dioxide, is increasing. The burning of coal for electricity and oil for transport and clearing of forests, as well as other human activities, release carbon dioxide into the atmosphere. As a result of these activities, the amount of carbon dioxide in the atmosphere has increased by more than 40 per cent since the industrial revolution. This substantial increase in carbon dioxide, as well as other greenhouse gases such as methane and nitrous oxide, is triggering large-scale changes in our world.

1.1 It is in Australia's national interest to act on climate change

The risks of climate change to Australia are substantial.

Australia is particularly vulnerable to a changing climate. Australia's climate has always been one of extremes and the evidence suggests that these extremes are getting stronger as the climate warms. In the past 50 years, the number of record hot days has more than doubled across Australia, increasing the risk of heat-waves and bushfires (CSIRO & BOM, 2010).

Australians live mostly in coastal communities, many of which are vulnerable to rising sea levels. Many of Australia's industries, such as tourism, agriculture and fisheries, rely on the natural environment for their prosperity. The effects of climate change on plants and animals, water resources and soils add to other pressures on these industries.

Climate change will affect Australia's industries, such as tourism and fisheries, which rely on the natural environment for their prosperity.

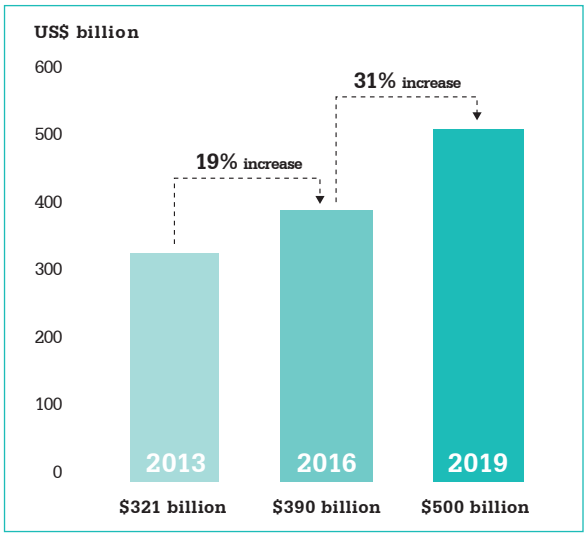
Source: GBRMPA

The longer we wait to act, the more it will cost when we do.

The Australian Treasury conducted analyses in 2008 and again in 2011 which showed that the world will continue to prosper while cutting emissions (Treasury, 2011). Figure 1.2 shows that early global action would be cheaper than delayed action. The Treasury also found that, for economies (such as Australia) which produce large amounts of greenhouse gas emissions, every year of delayed action on climate change will lead to higher long-term costs.

EVERY YEAR OF DELAYED ACTION ON CLIMATE CHANGE WILL LEAD TO HIGHER LONG-TERM COSTS.

Figure 1.2 – Advantages of early action (costs are based on the time action begins).



(Source: Treasury, Strong Growth, Low Pollution, Modelling a Carbon Price 2011)

Both of Australia's major political parties have agreed that Australia must be part of a global solution, and have committed to reducing Australia's emissions by 5 to 15, or 25, per cent by 2020 compared with emissions in 2000.

1.2 Australia matters

While all countries contribute some emissions, some countries make a greater contribution to climate change than others.

Australia is one of the 20 countries that contribute three quarters of the world's emissions. Strong action taken by these countries to reduce their emissions would make a substantial difference to climate change and its impacts.

Australia is the 15th largest emitter in the world (CAIT, 2010). Australia emits more greenhouse gases each year than around 180 other countries that are parties to the United Nations Framework Convention on Climate Change.

Australia produces about the same amount of greenhouse gas emissions each year as Italy, France and the Republic of Korea and only slightly less than the United Kingdom.

China and the United States, the world's largest economies, are also the top two emitters, at 19.1 per cent and 18.3 per cent respectively of total global emissions. The remaining 18 big emitters contribute between around 1 and 5.2 per cent of global emissions each.

Transport is a significant source of emissions in Australia.

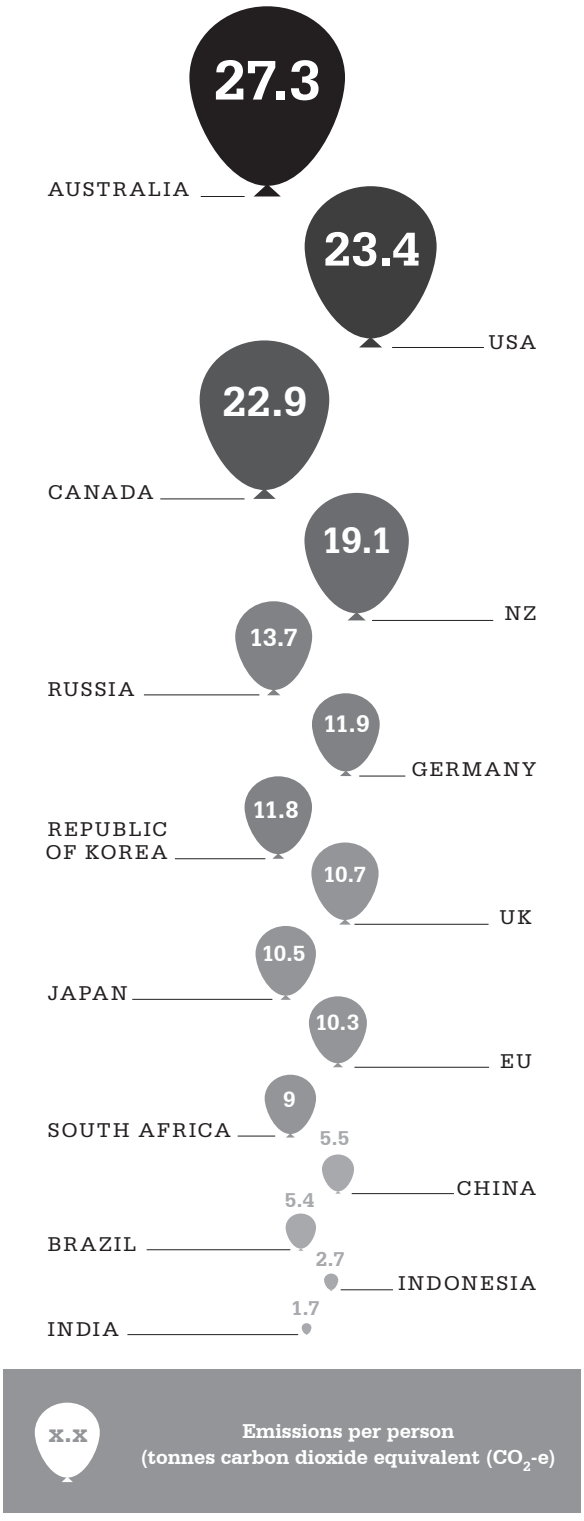
AUSTRALIA IS A MAJOR EMITTER MAINLY BECAUSE THE AUSTRALIAN ECONOMY IS LARGELY DEPENDENT ON FOSSIL FUELS FOR ENERGY.

Despite our small population, Australia is a heavy emitter mainly because the Australian economy is largely dependent on fossil fuels for energy. Coal accounts for around three quarters of Australia's electricity generation, with coal-fired power stations located in every mainland state. Electricity generation is the largest source of greenhouse gas emissions. Producing and distributing fossil fuels also results in emissions. Transport is another significant source of emissions. Other sources include agriculture, waste, land clearing and industrial processes such as metal production. In comparison with other countries, Australia could improve the efficiency of energy use (DCCEE, 2010).

AUSTRALIA HAS THE HIGHEST EMISSIONS PER PERSON OF ANY DEVELOPED COUNTRY.

Because of the nature of the economy, Australia has the highest emissions per person of any developed country (Figure 1.3). The average Australian produces emissions almost five times that of the average Chinese person and 16 times that of the average person from India.

Figure 1.3 - Greenhouse gas emissions by country per person.



(Source: 2005 data. Excludes land use change and forestry. Includes all gases covered by the Kyoto Protocol (CAIT, 2010)).

Australia can contribute to shaping the global solution to climate change.

Australia has a strong reputation around the world as being a responsible international citizen. Our efforts on international cooperation proves this – from environmental protection to freeing up international trade to peacekeeping. Australia already plays an influential role in shaping the global response to climate change. Australia has a reputation as an effective participant in international climate negotiations and has established a strong track record of working with other countries to reduce emissions. These activities help Australia shape the international response to better meet our interests.

However, global influence is reliant on a range of factors, and in particular a country's domestic activity to reduce emissions. A country must demonstrate that it is willing to contribute to the solution to build up the credibility needed to be influential.

Action taken by Australia – such as the introduction of a carbon price and the renewable energy target – is being watched closely by developed and developing countries alike, who will draw lessons both for their own action and for the international climate regime. This is similar to the lessons that Australia has learned from other countries' approaches to tackling the climate challenge. This highlights that action in Australia can have an impact beyond our borders in shaping the global response to climate change.

ACTION IN AUSTRALIA CAN HAVE AN IMPACT BEYOND OUR BORDERS IN SHAPING THE GLOBAL RESPONSE TO CLIMATE CHANGE.

Australia is a party to (that is, it is legally bound by) the United Nations Framework Convention on Climate Change (UNFCCC – see section 2.2). It has agreed to meet legal obligations under the Kyoto Protocol, and it will meet its 2008-2012 Kyoto target. Failure to meet our international obligations to reduce emissions would hinder the global effort to tackle climate change.

AS A DEVELOPED AND PROSPEROUS COUNTRY, AUSTRALIA HAS A RESPONSIBILITY AND CAPACITY TO CONTRIBUTE TO A GLOBAL SOLUTION TO CLIMATE CHANGE.

On a range of economic and social indicators, Australia is one of the most prosperous countries in the world with high per person wealth and income as well as a very high standard of living. It is firmly in the top group of countries on any measure of wealth or emissions (CAIT, 2010). As a developed and prosperous country, Australia has a responsibility and capacity to contribute to a global solution to climate change.

1.3 Strong global action is urgently needed

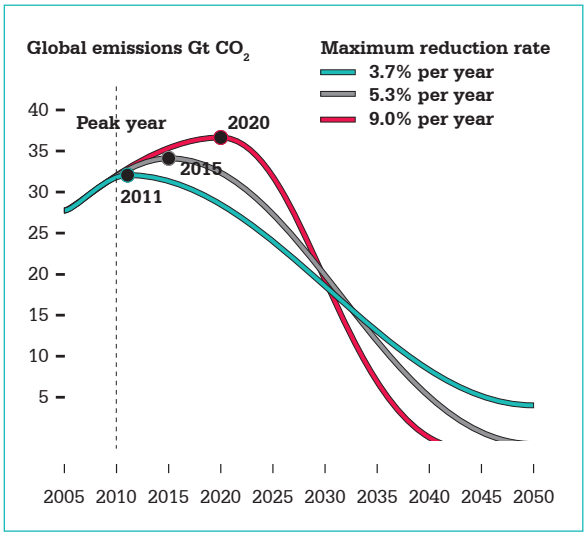
For many years, scientists have highlighted the urgency of acting to reduce emissions.

This is because as emissions continue to rise, it becomes more and more difficult to restrict concentrations of greenhouse gases in the atmosphere to levels that will not radically alter the global climate. Carbon dioxide emissions remain in the atmosphere for many years. Reducing these emissions helps slow the rate of increase in the atmospheric concentration of carbon dioxide. Even while we are reducing emissions, the reality is that the overall atmospheric concentration of greenhouse gases will increase, as there are still greater amounts of greenhouse gases going into the atmosphere than can be absorbed by natural systems. Only by reducing emissions to very close to zero can the concentration of carbon dioxide in the atmosphere be stabilised.

To limit temperature rise to the agreed goal of 2°C or less, there is an upper limit on the amount of additional greenhouse gases we can put into the atmosphere. That is our greenhouse gas 'budget': the amount we can 'spend' before we are in the danger zone.

Figure 1.4 (WBGU, 2009) shows different emissions paths for the world with a carbon budget that gives us a 67 per cent chance of keeping temperatures below 2°C. Two things are clear: one, global emissions will need to be reduced to very close to zero by 2050 to meet this challenge; and two, global emissions must decline rapidly. But, the later we leave it the more sharply we will have to reduce emissions and the more disruptive it will be for the economy.

Figure 1.4 – Three emissions trajectories based on the budget approach and giving a 67 per cent probability of meeting the 2°C goal.



(Source: WBGU, 2009)

Currently, global emissions are increasing rapidly. Emissions will continue to rise and then they must peak before declining. Fossil fuels are such a large part of the way we use energy that we cannot immediately move away from them without major economic disruption. The year emissions peak, that is, the maximum global emissions level, is especially important. For example, delaying the peaking year by only nine years, from 2011 to 2020, changes the maximum rate of emission reduction from 3.7 per cent each year, which is very challenging, to 9.0 per cent each year, which is much more difficult and costly.

It is like putting on the brakes in a car; the earlier you apply them the more smoothly you will stop, the later you leave it the more disruptive the stop and the greater the risk that you will stop too late.

WITH STRONG ACTION UP TO AND BEYOND 2020, IT IS FEASIBLE, ALTHOUGH CHALLENGING, TO LIMIT WARMING TO 2°C.

Several analyses of countries' commitments to reduce emissions, or limit growth in emissions, indicate that even if the most ambitious commitments are met by 2020, emissions in 2020 will be above the level necessary to limit global warming to below 2°C. Some studies have found that even with 2020 pledges temperatures could rise by between 3 and 4°C by 2100, which would have potentially catastrophic consequences (IPCC, 2011). However, analyses indicate that with strong action up to and beyond 2020, it is feasible, although challenging, to limit warming to 2°C (AVOID, 2012). To avoid dangerous climate change we need to speed up the reduction of emissions beyond 2020 by taking strong action now.

Recent International Energy Agency data shows that carbon dioxide emissions from fossil-fuel burning reached a record high of 31.6 gigatonnes in 2011, a 3.2 per cent increase on 2010 levels (IEA, 2012b). Coal accounted for 45 per cent of total energy-related greenhouse gas emissions in 2011, followed by oil (35 per cent) and natural gas (20 per cent) (IEA, 2012a).

Demand for coal is the main driver of emissions increases. Global coal demand increased by a little more than 1 per cent each year between 1980 and 2000 but then grew by more than 4 per cent each year from 2000 to 2009. China and, to a lesser extent, India and other emerging economies are driving this demand growth (IEA, 2012a). In contrast, coal demand in Europe has been declining steadily – in 2010, demand was 6 per cent below peak use in 2007 (IEA, 2012a).

Whether or not the world acts to reduce emissions, to the extent required and in the time frame necessary, will depend on the actions of the top 20 climate heavyweights, of which Australia is one. Australia has an important role in shaping the global response to climate change.

Greenhouse gas emissions and economic growth

Economic growth in many countries has over time been linked with rising greenhouse gas emissions. Following sustained increases in global greenhouse gas emissions from fossil fuel combustion, emissions declined in 2009, largely because of the global financial crisis (Friedlingstein et al, 2010). Growth in global emissions resumed after 2009.

However, recent evidence shows that some countries are separating their economic growth from their emissions.

Between 2000 and 2008, the rate of growth in gross domestic product (GDP) was higher than the rate of growth in carbon dioxide emissions in all 34 OECD countries (OECD, 2012). In 12 of those countries, including the United States, Germany, Japan and the United Kingdom, total emissions actually declined while their economies grew.

One of these countries, Sweden, cut greenhouse gas emissions by more than 10 per cent between 2000 and 2008 – more than any other OECD country. At the same time, Sweden's economy outperformed the seven biggest OECD economies – the United States, Canada, Japan, the United Kingdom, Germany, France and Italy (OECD, 2012).

In the United States, carbon dioxide emissions from fossil fuel consumption have declined in recent years. Although the global financial crisis had a significant effect on emissions, switching from coal to less-polluting natural gas for energy production has also contributed to the reduction in emissions (IEA, 2012b).

China has experienced strong economic growth as well as growth in greenhouse gas emissions. However, the amount of carbon dioxide emissions (from fossil fuel combustion) per unit of GDP declined by 15 per cent between 2005 and 2011 as a result of improvements in energy efficiency and deployment of clean energy (IEA, 2012b).

Sweden has cut greenhouse gas emissions more than any other OECD country while growing its economy.

Source: Flickr/CSLP

CHAPTER 2: INTERNATIONAL ACTION – INDIVIDUAL AND COLLECTIVE ACTION

ALL THE LARGE EMITTERS AND MAJOR ECONOMIES HAVE MADE COMMITMENTS TO REDUCE EMISSIONS.

‘International climate action’ is much more than the annual United Nations climate conferences in cities such as Copenhagen or Durban. In fact, there are many different ways, places and forums in which countries are tackling climate change. Whether in international forums or in their own countries, businesses and communities are moving to tackle climate change and reduce emissions.

Importantly, what really counts is what countries do to reduce their emissions in their own economy. Together this will add up to whether or not we can stay below a 2°C rise in global temperature. Further, the action of countries domestically strengthens the global will to reduce emissions.

> “The rewards of greening the world’s economies are tangible and considerable, the means are at hand for both governments and the private sector, and the time to engage the challenge is now.”
> United Nations Environment Programme, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication

2.1 International action can take many forms

Countries around the world have accepted that climate change is happening and action must be taken. Figure 2.1 shows some of the action being taken throughout the world.

Ultimately, what counts is what every country does in its own economy because these will be the activities that actually reduce emissions. We are seeing most of the top 20 emitting countries working through a number of means to reduce their emissions.

Countries also work together, either through country to country partnerships (bilaterally) or in larger groupings to reduce their collective emissions. These bilateral and group partnerships help to build the confidence necessary to support broader agreements involving the major emitters and other countries. Analyses by economists (Treasury, 2011; Stern, 2006) have shown that coordinated global action – that is, where many or all countries work together at the same time toward a common objective – is likely to be more effective and less costly than fragmented action or action that happens in phases.

Figure 2.1 - Global action on climate change.

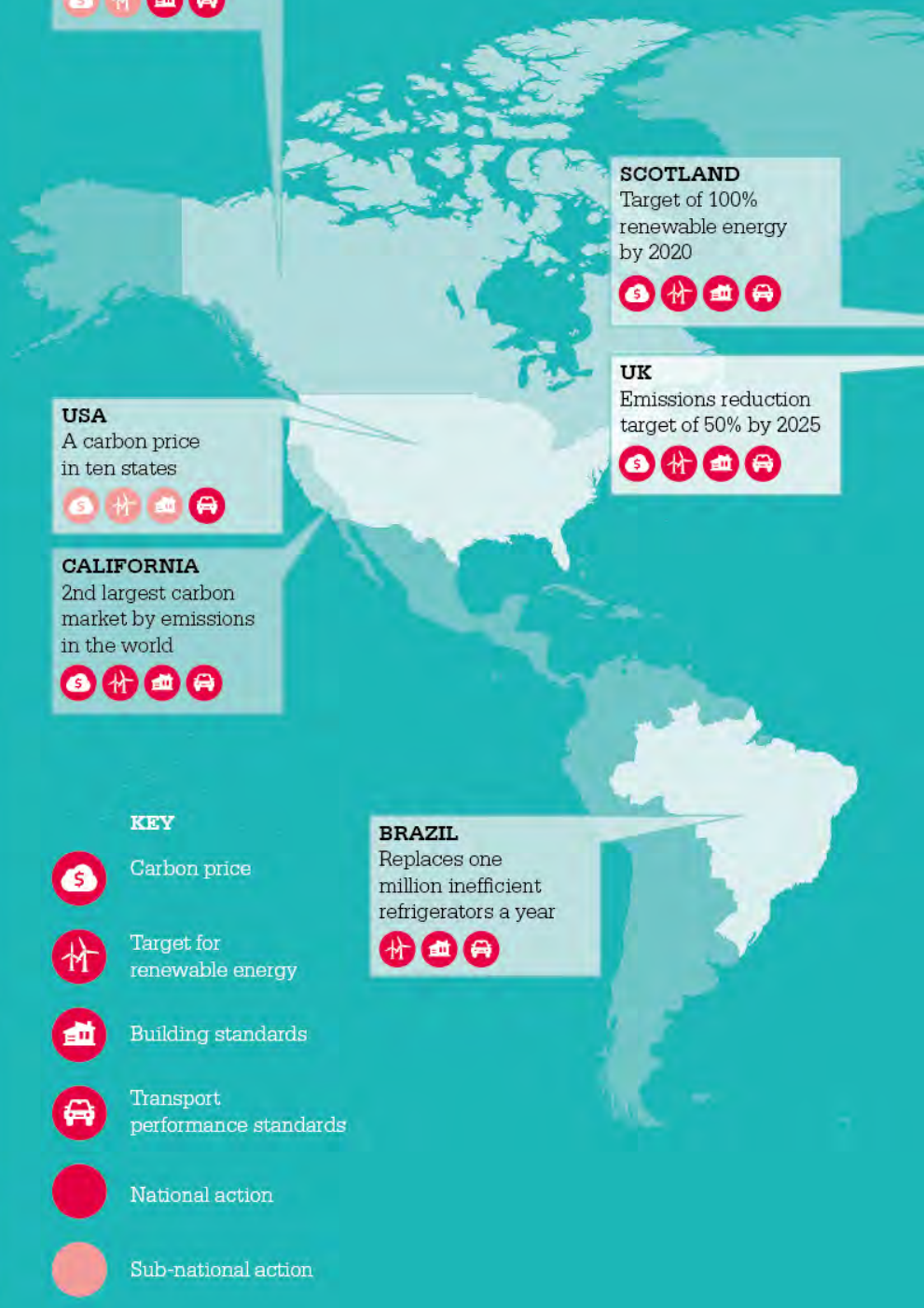
ALL
developed countries have pledged to reduce carbon emissions

Global investment in renewable energy reached
USD257 billion in 2011

850 million people
will be living in countries and states that have a carbon price in 2013

The global carbon market has grown from USD11b in 2005 to
USD176 billion in 2011

1st
China is leading the world in installed renewable energy




EUROPEAN UNION
Has the highest reduction target of 20-30% by 2020
Has the largest emissions trading scheme in the world, covering 500 million people
SWITZERLAND
Tax on all fuel imports
FINLAND
Introduced the world's first carbon price in 1990
CHINA
A carbon price for 250 million people from 2013
The world's largest producer of solar technology
JAPAN
A carbon price for 20 million people in the cities of Tokyo and Saitama
GERMANY
No. 1 solar energy producer in the world
SAUDI ARABIA
Home to the world's largest solar thermal power plant
REPUBLIC OF KOREA
Building a smart grid power system to help regions become self-sufficient with renewable energy
INDIA
Clean energy tax on coal
INDONESIA
Emissions reduction target of 26% from business as usual by 2020
SOUTH AFRICA
Government rebates for energy efficient businesses
AUSTRALIA
Carbon price for 22.3 million people
NEW ZEALAND
Carbon price for 4 million people
Two-thirds of electricity from renewable sources

2.2 What has the world agreed?

International talks on climate change began more than 20 years ago (Figure 2.2). In 1990, the Intergovernmental Panel on Climate Change (IPCC) released its first assessment report calling for a global treaty on climate change. In Rio de Janeiro, Brazil, in 1992, 166 countries signed the international treaty, the UNFCCC, agreeing to work together to avoid dangerous climate change. There are now 195 parties to the UNFCCC.

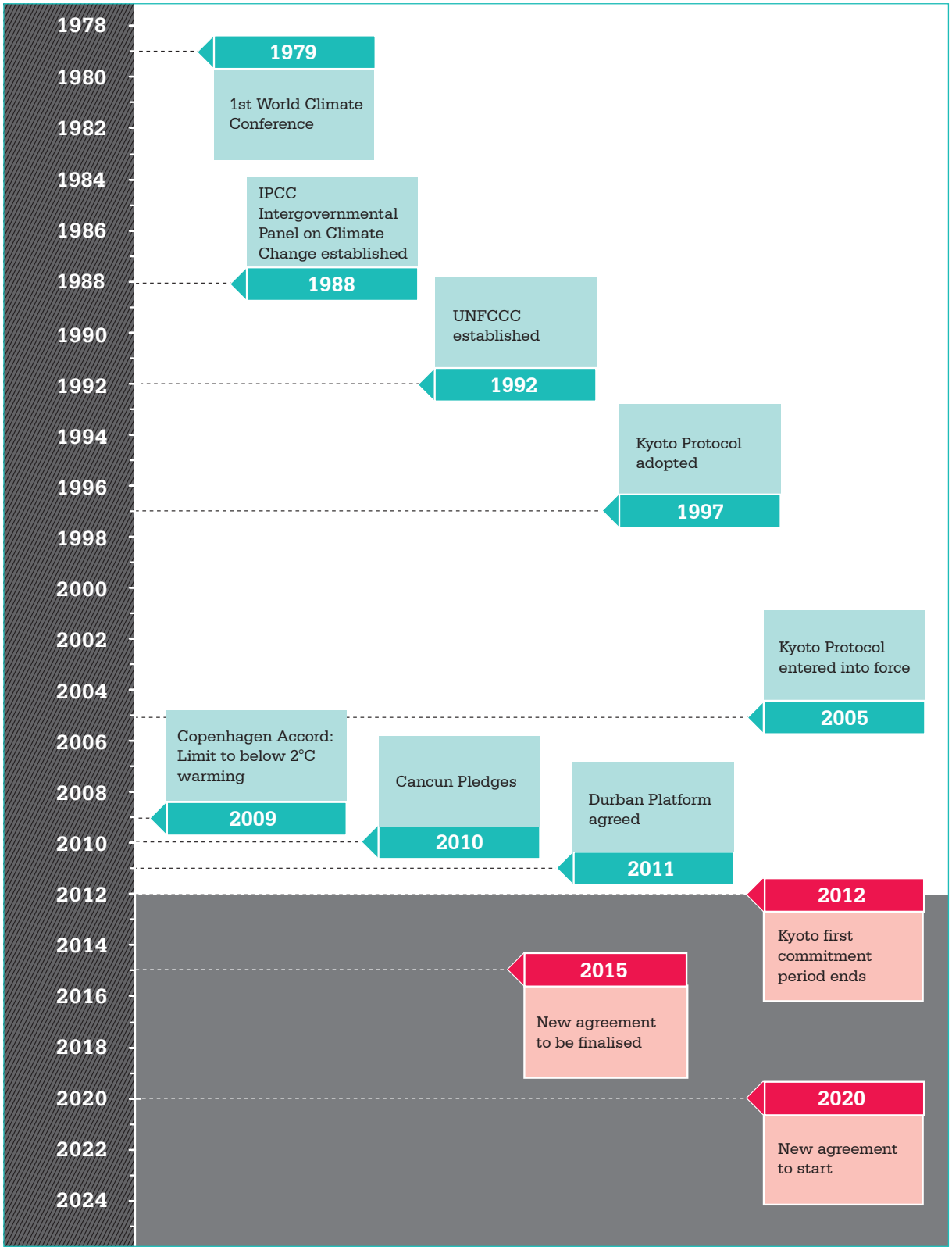
The objective of the UNFCCC is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (man-made) interference with the climate system.

The parties agreed that they would recognise 'common but differentiated responsibilities with respective capabilities' under which developed countries have a greater responsibility in the near term for reducing greenhouse gas emissions.

However, the UNFCCC set no mandatory limits on greenhouse gas emissions for individual countries.

In 1997, the parties adopted the Kyoto Protocol, which set up legally binding obligations for developed countries to reduce their greenhouse gas emissions. Under the Kyoto Protocol, parties collectively agreed to reduce their greenhouse gas emissions by 5 per cent on average for the period 2008-2012 relative to 1990. However, without participation by the United States and in the absence of emissions commitments by the major developing countries, will not have a great effect on global greenhouse gas emissions. In practice, the penalties for failing to reach targets were not effective in encouraging compliance. Nevertheless, the real cooperation that has been achieved under the Kyoto Protocol has helped later international negotiations to be more productive.

Figure 2.2 - Timeline of international climate change negotiations.



Dr Justin Lee, Australia's Ambassador for Climate Change, addressing the plenary at the Bonn 2012 UNFCCC session.

Source: Photo courtesy of IISD

There has been significant progress recently with most countries, including the largest emitters and Australia's international trading partners, now making commitments to limit or reduce emissions. Agreement was reached in Cancun, Mexico in 2010 to recognise the need to limit global temperature increase to less than 2°C and to take a range of actions including pledges by developed and developing countries to take future action. Ninety developed and developing countries have pledged action and 2020 targets in the UNFCCC framework to limit or reduce their emissions.

This agreement which includes the United States and other major developed and developing countries – countries responsible for more than 80 per cent of greenhouse gas emissions – is not legally binding and does not involve penalties for any breaches.

The involvement of so many countries is a productive step forward, as is the agreement reached in Durban, South Africa in 2011 to work toward a new, legally binding

International treaties

Treaties are legally binding commitments between sovereign states (or parties) and set out the rights and obligations of those parties with respect to each other. Under international law, parties to a treaty are bound by its provisions. Countries enter into international treaties for reasons such as international reputation and furthering their national interest.

The UNFCCC and Kyoto Protocol are treaties obliging the parties to take action to reduce greenhouse gas emissions.

Treaties may include compliance action for parties which do not meet their obligations. As a result, countries are more willing to make more ambitious commitments at a political level than in a legally binding commitment.

International treaties help build trust and confidence between countries. Countries comply with international law because it is in their interests to do so, not simply because they may be penalised for breaking it. The domestic action of each country to tackle climate change helps with the process of building trust and confidence internationally which is crucial to finding a global solution.

agreement by 2015 and come into effect by 2020. However, we should not downplay the difficulties of negotiating the emissions reductions needed by 2015 – there is still a deep legacy of distrust between developing and developed countries and many developed country leaders face considerable political challenges in taking a leadership role. Australia can best encourage agreement by meeting its own commitments.

The outcome in Durban is a sign of acceptance that all major emitters should participate in international efforts to reduce emissions and that action only by a limited number of developed countries will not be enough to prevent climate change.

The United States and China, the world's two biggest emitters, have agreed to be part of this global agreement. Furthermore, European countries will most likely agree to further commitments under the second commitment period* to the Kyoto Protocol beginning on 1 January 2013.

Some of these pledges are shown in Figure 2.3.

Figure 2.3 - Pledges by some of the large emitters.

Country/grouping	Terms	Pledged emission reduction by 2020
China	Carbon intensity	40-45 per cent relative to 2005
United States	Absolute emissions	17 per cent relative to 2005**
European Union	Absolute emissions	20-30 per cent relative to 1990
Russia	Absolute emissions	15-25 per cent relative to 1990
India	Emissions intensity	20-25 per cent relative to 2005
Japan	Absolute emissions	25 per cent relative to 1990
Brazil	Absolute emissions	36.1-38.9 per cent relative to business as usual
Canada	Absolute emissions	17 per cent relative to 2005
Indonesia	Absolute emissions	26 per cent relative to business as usual
Republic of Korea	Absolute emissions	30 per cent relative to business as usual
Australia	Absolute emissions	5-15, or 25, per cent relative to 2000***
South Africa	Absolute emissions	34 per cent relative to business as usual

** The Kyoto Protocol first commitment period is 2008-2012 and the second commitment period is 2013-2017/20.*

*** The United States has committed to a reduction in the range of 17 per cent relative to 2005, in conformity with anticipated United States energy and climate legislation, recognising that the final target will be reported to the UNFCCC secretariat in light of the enacted legislation.*

**** Australia has committed unconditionally to reduce its emissions by 5 per cent compared with 2000 levels by 2020. Australia is prepared to adopt a more ambitious target of more than 5 per cent up to 15 per cent under conditions that relate to the extent of global action. Further, Australia is prepared to adopt a target of 25 per cent under strict conditions including comprehensive global action capable of stabilising atmospheric greenhouse gas concentrations at 450 parts per million or lower.*

AUSTRALIA HAS COMMITTED TO CUT ITS EMISSIONS BY 5 PER CENT BELOW YEAR 2000 LEVELS BY 2020 NO MATTER WHAT OTHER COUNTRIES ARE DOING AND BY UP TO 15 OR 25 PER CENT UNDER A RANGE OF STRICT CONDITIONS.

Australia has committed to cut its emissions by 5 per cent below year 2000 levels by 2020 no matter what other countries are doing and by up to 15 or 25 per cent under a range of strict conditions. This is a bipartisan commitment – it is supported by the Government and the Opposition.

It is not easy to compare countries' pledges because different countries have chosen different ways to measure limiting emissions – absolute reductions in greenhouse gases, reductions in carbon intensity or reductions in emissions intensity. Countries have also selected differing base years against which the change in emissions is estimated.

Australia's commitment is comparable to other countries. Separate studies (Jotzo, 2010; McKibbin et al., 2010; den Elzen et al., 2012) provide examples of approaches to comparisons. While these studies used different assumptions, broadly they found that Australia is neither behind nor ahead of the other countries assessed. In terms of reductions in emissions from their 'no further action' growth path, Australia's 5 per cent emissions reduction targets are broadly comparable in emissions reduction to the targets of the United States, Japan, Europe and China, which together make up more than 50 per cent of global emissions. India does not do so well – but it is by far the poorest of the countries assessed and has by far the lowest emissions per person.

AUSTRALIA IS NEITHER BEHIND NOR AHEAD OF THE OTHER COUNTRIES ASSESSED.

2.3 Individual country action

Countries take action to reduce climate risk for various reasons, and are acting in many different ways. Countries act according to their own national circumstances and are also motivated by a variety of goals such as seeking energy security, cleaning up air pollution, encouraging investment in local technologies and preparing the economy for the future. Policies that tackle climate change often help with these issues and vice versa. This is called 'co-benefits' and it is often difficult to tell what is the most important reason for a policy. Some examples of different countries' motivations are provided below. Chapter 3 discusses different types of actions countries are taking. The annex provides details on actions being taken by major emitters and some of Australia's trading partners and competitors.

Germany is embarking on a large reconstruction of its energy market and has positioned itself as a major producer and user of renewable technology.

THE REPUBLIC OF KOREA HAS AMBITIONS TO BECOME THE WORLD'S SEVENTH LARGEST GREEN ECONOMIC POWER BY 2020, AND THE FIFTH LARGEST BY 2050.

The Republic of Korea has ambitions to become the world's seventh largest green economic power by 2020, and the fifth largest by 2050, and to capitalise on the export potential of green technology. *The Framework Act on Low Carbon Green Growth* (enacted January 2010) includes provisions for emissions reductions targets based on other countries' actions and cost benefit analyses. In May 2012, the Government of the Republic of Korea passed legislation for an emissions trading scheme to start from 1 January 2015.

Concerns about energy security, power capacity shortages and air pollution as well as climate risk are adding to pressure on China

to restructure its economy away from heavy, highly polluting industries and switch to renewable energy technologies and nuclear power to increase energy efficiency (Martinot & Junfeng, 2007). China has already moved in this direction with the amount of CO_2 emitted per unit of GDP (carbon intensity) falling by 15 per cent between 2005 and 2011. Had this progress not been made, China's CO_2 emissions would have been a lot higher in 2011.

"What China has done over such a short period of time to improve energy efficiency and deploy clean energy is already paying major dividends to the global environment."
Dr Fatih Birol, Chief Economist, IEA

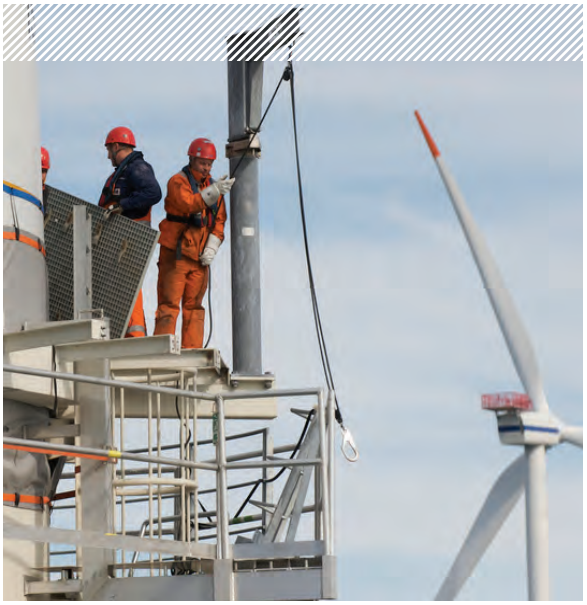
CHINA VIEWS RENEWABLE ENERGY AS A SOURCE OF STRATEGIC ADVANTAGE.

China needs secure, affordable and environmentally sustainable energy for its 1.3 billion people. Over the past ten years, China's demand for energy has been increasing. It is clear that China views renewable energy as a source of strategic advantage.

The United States has also acted to improve energy security through support for renewable and nuclear energy. Switching some coal-fired electricity generation to gas has been influenced by an expansion of economically recoverable domestic gas reserves which has reduced gas prices and regulatory pressure on high-polluting coal-fired power stations (Garnaut, 2011). Generation from natural gas-fired plants is now virtually equal to that from coal-fired plants – each providing around 34 per cent of total generation (EIA, 2012).

RATHER THAN REMAIN DEPENDENT ON FOREIGN OIL AND GAS MARKETS, DENMARK TOOK ACTION TO INVEST IN THE DEVELOPMENT OF RENEWABLE ENERGY.

Denmark has taken action to invest in renewable energy, such as in offshore wind farms.



Source: Flickr/Danish Wind Industry Association

Denmark has had more than 30 years' experience in the development of renewable energy, driven chiefly by its concern for secure energy supplies. The 1973 oil crisis challenged Denmark's heavy reliance on oil for energy. Rather than remain dependent on foreign oil and uncertain global markets, Denmark took action to invest in the development of renewable energy (Rosing, 2011). Denmark is ranked fourth in the European Union for its share of renewable energy – 19 per cent (Danish Energy Agency, 2012). Denmark is a good example of a country that has demonstrated that economic growth can be separated from growth in emissions.

The 1973 oil crisis, as well as a drop in sugar exports, forced Brazil to rethink its energy reliance and in 1975 Brazil began its first large scale ethanol (from sugarcane) program.

It is not always clear or straightforward why countries are acting. Furthermore, national action is not always possible and it may be easier to make progress at a sub-national level. For example, in the United States, Congress has not agreed to the Administration's proposal for a cap and trade scheme but substantial work is under way in many jurisdictions and states (see Chapter 3 and the annex). States like California are large players in the global economy and have had an impact on global momentum to deal with climate change. Similarly, in Canada, provincial and territorial governments control many of the levers for action towards reducing greenhouse gas emissions including electricity generation, buildings, transportation, agriculture, and waste management. This means that the provinces have been much more successful in taking action than the Federal Government.

2.4 Bilateral activity

While individual country action is very important, there are areas where it makes sense for two countries to work together to meet their climate change goals.

Many countries have bilateral agreements on climate change. For example, the European Union has a bilateral Partnership on Climate Change agreement with China; India and China have a climate change agreement; and Norway has agreements with Brazil and Indonesia around reducing forest clearance.

AUSTRALIA HAS PARTNERSHIPS WITH CHINA, SOUTH AFRICA, NEW ZEALAND, THE EUROPEAN UNION, THE UNITED KINGDOM, JAPAN, THE REPUBLIC OF KOREA AND THE UNITED STATES.

Australia is working closely with China, South Africa, New Zealand, the European Union, the United Kingdom, Japan, the Republic of Korea and the United States. These partnerships deal with such issues as economic instruments to tackle climate change; technology demonstration; climate change impacts and adaptation in the agriculture sector; biodiversity; and measurement, reporting and verification of emissions.

In Indonesia, clearing of forests and peat lands is the largest source of emissions and the major opportunity to reduce emissions. Australia is working with Indonesia to develop Indonesia's capacity to reduce emissions and participate in a future market mechanism for forest carbon.

2.5 Group activity

Groups of countries with common interests work together in a number of forums on a range of climate change-related initiatives.

Because these forums are generally built on cooperation or on developing or sharing technologies, they play a particular role in building confidence among participants that emissions reduction goals can be met and that other countries are also making efforts.

Groups of countries are working together through the Major Economies Forum (MEF) on Energy and Climate to consider the way forward for international efforts to combat climate change. The MEF is a group of 17 of the world's major economies including China, India, Brazil, the European Union, the United States and Australia. These economies cover the bulk of global emissions and thus their collective response to the climate challenge will largely define the outcome.

The World Bank Partnership for Market Readiness brings together Australia, Denmark, Japan, Norway, Switzerland, the European Commission, Germany, the Netherlands, the United Kingdom and the United States with China, India, Indonesia, Thailand, Vietnam, Brazil, Chile, Colombia, Costa Rica and Mexico to build on countries' capacity to develop and set up market mechanisms including emissions trading schemes.

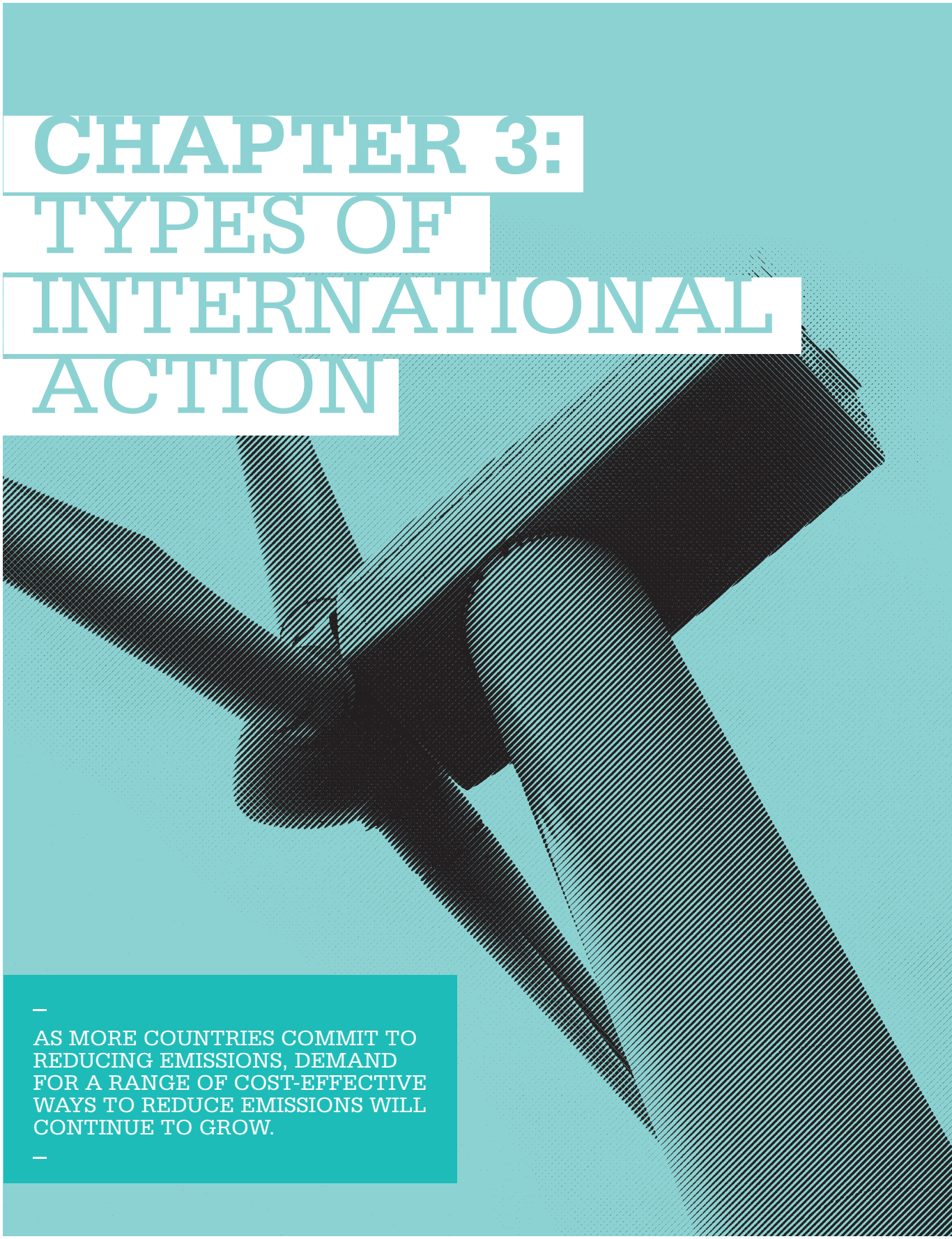
The East Asia Low-Carbon Growth Partnership is part of the East Asia Summit (EAS) and aims to provide information sharing of best practice and knowledge to build and spread low-carbon growth models among the 18 EAS countries.

The Asia-Pacific Economic Cooperation (APEC) Forum, Pacific Islands Forum and G-20 are also groups which discuss climate change and energy security in the course of their wider economic discussions. In 2007, APEC released a leaders' declaration with regional goals to reduce energy intensity by 25 per cent by 2030 from 2005 levels, increase forest cover by 20 million hectares by 2020, and set up an energy research network to focus on clean fossil fuel energy and renewable energy sources.

The European Union countries have come together to develop a common emissions trading scheme. The Community of Andean Nations as well as Mercosur (the southern common market) bring Latin American countries together to work on regional projects related to climate change.

These are some of the many examples of countries working together to achieve their climate change goals.

CHAPTER 3: TYPES OF INTERNATIONAL ACTION



AS MORE COUNTRIES COMMIT TO REDUCING EMISSIONS, DEMAND FOR A RANGE OF COST-EFFECTIVE WAYS TO REDUCE EMISSIONS WILL CONTINUE TO GROW.

Our trading partners, our competitors and our neighbours, including the world's largest economies, the United States and China, are all taking action to reduce their greenhouse gas emissions. More and more countries are taking action to position their economies for the future and to reduce climate risk.

The 90 countries that have committed to reduce or limit their greenhouse gas emissions under the Copenhagen and Cancun agreements have chosen how to define their commitments. Each country also chooses their own policies to meet their pledges.

One way to reduce emissions is to set an explicit price on emissions, for example, through emissions trading schemes or a carbon tax. There are other ways to promote emission reductions without putting a direct price on emissions. These include regulation, subsidies and direct government expenditure. Some examples are shown in Figure 3.1.

All these policies together are driving a shift in the global economy towards a future powered by cleaner, more efficient energy sources.

A recent Productivity Commission study of emissions reduction policies in nine countries identified more than 1,000 such policies: more than 300 in the United States, around 235 in Australia, 130 in Germany, 100 in the United Kingdom, 80 in China, 70 each in the Republic of Korea and India, 65 in Japan, and 30 in New Zealand (Productivity Commission, 2011).

The European Union provides an example of the mix of actions already in place. As well as an emissions trading scheme, emissions are being reduced through, for example, regulations such as building standards and vehicle emission limits, subsidy programs, and feed-in tariffs for renewable energy.

Figure 3.1 - Some of the different ways to reduce emissions.

Policy approach	Examples
Explicit carbon price	Emissions trading scheme Carbon tax
Other approaches	Renewable energy target Feed-in-tariff Energy efficiency standard Fuel content mandate Direct government spending Investment in research and development Subsidy or grant Labelling scheme

Figure 3.2 below shows what is already in place and what is planned in several major emitting economies to reduce greenhouse gas emissions.

Outlined are the actions major emitters countries are taking including carbon pricing, expanding renewable energy production, improving efficiency of energy use, reducing emissions from forests and agriculture, and clean energy technologies. The annex provides further information.

Figure 3.2 – Implemented and planned climate change actions in some major emitting economies.

COUNTRY	CARBON PRICING	RENEWABLE ENERGY TARGET	ENERGY EFFICIENCY-APPLIANCE AND BUILDING STANDARDS	TRANSPORT-VEHICLE PERFORMANCE STANDARDS
China				
USA				
EU				
Russia				
India	COAL TAX			
Japan				
South Africa				
Republic of Korea				
Indonesia				
Australia				

(Source: DCCEE)

Planned nationally
National action
Sub-national action

3.1 Explicit carbon pricing

Putting a price on emissions through emissions trading encourages businesses to reduce emissions and invest in clean energy. Carbon pricing approaches include emissions trading schemes and carbon taxes.

EMISSIONS TRADING IS ABOUT ENCOURAGING BUSINESSES ACROSS THE ECONOMY TO REDUCE EMISSIONS AND INVEST IN CLEAN ENERGY.

Without a carbon price no one pays for the emissions they produce and therefore there is no incentive to reduce emissions. Furthermore, it is very hard to justify investing in cleaner energy like gas, wind and large-scale solar. That means that the full cost of doing business is not factored into production – but someone does pay for the consequences of no price on emissions – all of us do in a deteriorating climate and environment. A carbon price creates an incentive to reduce emissions and invest in cleaner energy – gradually shifting the economy.

"Emissions trading schemes were found to be relatively cost effective, while policies encouraging small-scale renewable generation and biofuels have generated little abatement for substantially higher cost."
Productivity Commission Research Report, Carbon Emission Policies in Key Economies

Under an emissions trading scheme a cap on emissions is set. Permits can be traded and the market sets the price. Some countries put a cap on the total amount of greenhouse gas emissions that can be produced and then require emitters to purchase a permit for every tonne of emissoins they produce.

Under a carbon tax, the price is fixed and the market sets the volume according to supply and demand. The price encourages businesses to reduce emissions and encourages people to use energy more efficiently, as those who are able to reduce their pollution will not have to pay the tax. Simply put, the lower the emissions of a business, the lower the tax it would have to pay.

FROM 2013, CARBON PRICING SCHEMES ARE EXPECTED TO BE OPERATING IN AT LEAST 33 COUNTRIES AND 18 SUB-NATIONAL JURISDICTIONS.

From 2013, carbon pricing schemes are expected to be operating in at least 33 countries and 18 sub-national jurisdictions. These schemes could be expected to cover:

- around 850 million people[#]
- around 30 per cent of the global economy[##] and
- around 20 per cent of global emissions*.

*[#] Population data based on World Development Indicators 2012. [##] GDP based on purchasing power parity (PPP) basis in 2012. *Based on emissions in 2005 for these areas.*

"Our analysis indicates that the European Union emissions trading scheme is working and that emissions covered by the scheme will peak in four years' time and go on to hit the European Union's 2020 emissions target."
Mr Guy Turner, Bloomberg New Energy Finance

The European Union emissions trading scheme is the world's largest and longest running regional emissions trading scheme and is complemented by a broad range of regulatory, subsidy and tax mechanisms. It began in 2005 and covers more than 40 per cent of the European Union's emissions. Current low prices in the European Union emissions trading scheme reflect weak demand due to Europe's continued economic difficulties and an ongoing oversupply of emissions permits. Absolute emissions in Europe have fallen by around 6 per cent since 2007 (EC, 2012).

CALIFORNIA, THE WORLD'S NINTH-LARGEST ECONOMY, INTRODUCED AN EMISSIONS TRADING SCHEME TO START IN 2013.

California, the world's ninth-largest economy, introduced an emissions trading scheme to start in 2013. The scheme is the second largest carbon market in the world after the European Union emissions trading scheme. Alongside the Californian scheme is the broader Western Climate Initiative, which is a partnership of California and Canadian provinces including British Columbia and Quebec. The partnership will cover approximately 62.1 million people in an emissions trading scheme that aims to reduce emissions to 15 per cent below 2005 levels by 2020 (WCI Inc, 2012; CORE, 2012).

New Zealand established an emissions trading scheme in 2008, initially covering forestry. The scheme was extended to stationary energy, transport, liquid fossil fuels and industrial processes in 2010.

THE CHINESE GOVERNMENT PLANS TO DEVELOP EMISSIONS TRADING SCHEMES IN SEVEN KEY CITIES AND PROVINCES FROM 2013.

The Chinese Government plans to develop emissions trading schemes in seven cities and provinces from 2013. These schemes will cover around 250 million people. The Chinese Government aims to work towards a nation-wide approach after 2015.

"The United States and Japan are much better on technology than the European Union, but technology and goodwill are not enough. We need a binding cap on emissions to put a real price on carbon and give the right economic incentives to environmentally-friendly technologies."
Mr Jose Manuel Barroso, President of the European Commission

On 1 July 2012, the Australian carbon price started at AUD23 per tonne of carbon dioxide equivalent emissions for three years, rising by 5 per cent each year. From 1 July 2015, the carbon price will be set by the market and linked to international markets.

A number of other countries are in the process of developing emissions trading schemes, for example, the Republic of Korea will start its scheme in January 2015, and Chile and Turkey are also considering developing emissions trading schemes.

EMISSIONS TRADING SCHEMES DO NOT HAVE TO BE IDENTICAL TO BE LINKED.

Linking schemes that put a price on carbon can lead to a more efficient international carbon market.

The European and Californian emissions trading and the regional cap-and-trade schemes provide potential partners for international linking – emissions trading schemes do not have to be identical to be linked.

When schemes are linked, there is an opportunity to search for the lowest cost of reducing emissions across many countries. In this way, an emissions trading scheme is a search engine for the lowest cost source of emissions reductions. Linking can lead to greater liquidity as it makes the carbon market larger by connecting schemes. Linking also exposes domestic markets to international events. In larger carbon markets, buyers and sellers can find an agreed price more readily and the market functions cost efficiently.

Linking emissions trading schemes can reduce costs for businesses and create economic efficiencies and financial and technological opportunities for developing countries.

In Australia, access to international trading lowers the costs of meeting our 2020 emission reduction target. The Australian Government and the European Commission are engaged in discussions on linking the Australian and European emissions trading schemes. Australia is also sharing expertise and encouraging the development of carbon markets in the Republic of Korea and China.

The global carbon market is a growing market. It has increased in size from USD11 billion in 2005 to USD176 billion in 2011 (World Bank, 2012a). Over the past year alone, the market grew 11 per cent (World Bank, 2012a). The European Union emissions trading scheme dominates the global market with 84 per cent of the total market in 2011 (World Bank, 2012a).

THE VALUE OF THE WORLD'S CARBON MARKETS GREW BY 11 PER CENT IN 2011.

FINLAND INTRODUCED THE WORLD'S FIRST CARBON TAX IN 1990.

A number of countries have put in place taxes on the greenhouse gas emissions associated with certain sectors, such as the use of fossil fuels or resources:

- Finland introduced the world's first carbon tax in 1990 (currently ranges from AUD35 to AUD70 per tonne)
- Norway has carbon taxes on petrol (AUD64 per tonne) and other fossil fuels
- Sweden (up to AUD147 per tonne) and Switzerland (AUD36 per tonne) have carbon taxes on fossil fuels, such as coal, oil and natural gas
- Ireland has a carbon tax (AUD24) as does British Columbia in Canada (AUD28)
- China adopted a nationwide tax on coal, crude oil and natural gas extraction in 2011 (around AUD1.50 per tonne)
- India has a tax on imported and domestic coal with revenue used to fund clean energy technology projects (applied at 50 rupees per tonne; less than AUD1 per tonne of coal) and
- South Africa is planning to introduce a carbon tax after 2013.

(Exchange rates as at 23 July 2012)

NORWAY HAS CARBON TAXES ON PETROL (AUD64 PER TONNE) AND OTHER FOSSIL FUELS.

Carbon pricing must be supported with complementary policies to achieve the level of emission reductions required. For example, it may not be the most efficient way to drive emissions reductions from certain sources. As more countries commit to reducing emissions, demand for a range of cost-effective ways to reduce emissions will continue to grow.

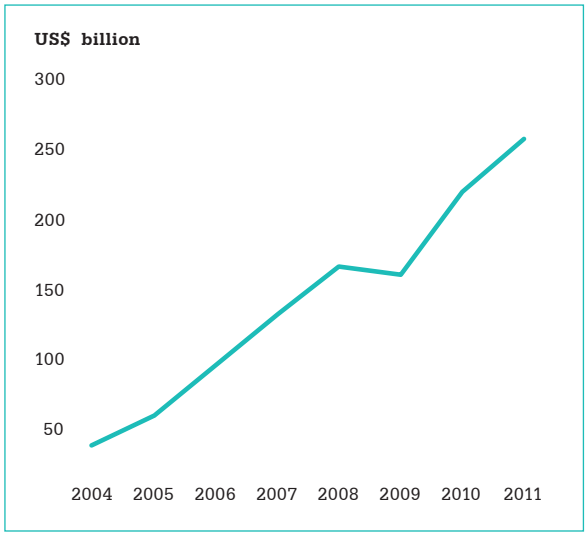
3.2 Renewable energy

Renewable energy comes from natural resources such as sunlight, wind, rain, tides and geothermal heat. These energy types are renewable because they are naturally restocked. Emissions can be lowered by finding better ways to produce energy from these clean sources and by taking advantage of new energy sources.

GLOBAL INVESTMENT IN RENEWABLE POWER AND FUELS INCREASED BY 17 PER CENT TO USD257 BILLION IN 2011.

Global investment in renewable energy has grown rapidly in recent years. Global investment in renewable power and fuels increased by 17 per cent to USD257 billion in 2011 (Figure 3.3). This was more than six times the level in 2004 (Frankfurt School, 2012).

Figure 3.3 – Global new investment in renewable energy from 2004-11 (USD).



(Source: Frankfurt School UNEP Centre, Global Trends Report 2012)

"Now, more than ever, the world needs bold leadership to make the promise of renewable energy a reality."
Mr Ban Ki Moon, United Nations Secretary General

The number of countries with renewable energy targets or policies more than doubled between 2005 and 2011, from 55 to 118, and an increasing number of cities and local governments are promoting renewable energy (REN21, 2012). Again, approaches differ from country to country. For example, Australia has a renewable energy target which is designed to make sure 20 per cent of Australia's electricity supply comes from renewable energy by 2020.

AS NATIONS SUCH AS CHINA AND INDIA CONTINUE TO DEVELOP THEIR ENERGY NEEDS, THE IMPORTANCE OF CLEAN ENERGY TECHNOLOGIES WILL GROW.

Asia is a big potential market for clean energy. It makes up more than two-thirds of the global population, around one-third of global economic output and one-third of global greenhouse gas emissions. As nations such as China and India continue to develop their energy needs, the importance of clean energy technologies will grow. Australia's location in Asia, its role as one of the region's key influencers, and its experience in innovation should allow it to take advantage of this opportunity.

China was second in the world for investment in clean energy at USD45.5 billion in 2011. Wind accounted for a large proportion of these investments at USD29 billion in 2011 (Pew, 2012).

IN 2011, CHINA HAD INSTALLED MORE RENEWABLE ELECTRICITY GENERATION CAPACITY THAN ANY OTHER COUNTRY IN THE WORLD.

In 2011, China had installed more renewable electricity generation capacity than any other country in the world (Pew, 2012). China is now a major manufacturing centre for renewable energy technologies.

"Investment for renewable energy from China almost accounts for half or 50 percent of the global investment in 2010."
Dr Jiang Kejun, Energy Research Institute, National Development Reform Commission, China

CHINA
renewables by numbers

50: percentage of global market for wind turbines

1: global position for total size of renewable energy capacity and for hydropower capacity

1: global position for size of new renewable energy investment in 2011

1: global position for new capacity in solar hot water, wind power, solar power and hydropower in 2011

JAPAN IS CURRENTLY SEVENTH IN THE WORLD FOR INSTALLED RENEWABLE ENERGY CAPACITY.

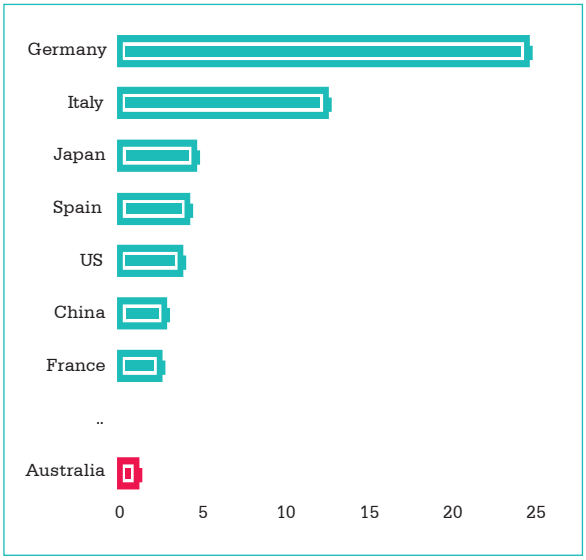
In Japan, USD8.6 billion was invested in the clean energy sector in 2011, 94 per cent of which went to solar (Pew, 2012). Japan is currently seventh in the world for installed renewable energy capacity (Pew, 2012) and a feed-in tariff on renewable energy operating from July 2012 is expected to drive the share of renewable electricity from 9 per cent to 13 per cent by 2020 (Pew, 2012).

"Every country in the world has at least one renewable energy source that is significant."
Mr Paolo Frankl, IEA

India's National Solar Mission aims to set up India as a leader in solar power, encourage sustainable growth, and help manage energy security. Solar energy is well-suited to rural and remote areas. Small scale solar thermal and solar photovoltaic can be set up cost-effectively to off-grid areas in India. The introduction of solar energy (including 20 million solar lanterns) to these areas will help people who currently have no access to light and power to bypass the use of fossil fuels and jump straight to using solar energy (BNEF, 2012a).

Globally, the cost of producing solar photovoltaic cells has dropped 75 per cent in the past four years and 45 per cent in the past 12 months (BNEF, 2012b). Figure 3.4 shows the solar installation capacity of several countries including Australia.

Figure 3.4 - Solar photovoltaic installed capacity.



(Source: REN21, 2012)

Australia has large, widely distributed wind, solar, geothermal, hydroelectricity, ocean energy and bioenergy resources. Renewable energy sources, mainly hydroelectricity, wind and bioenergy, accounted for around 8 per cent of the electricity generation mix in 2009–10. While renewable energy sources are still a small percentage of the total electricity generation mix, solar photovoltaic now provides more than 1,400 megawatts of capacity compared to just 187 megawatts at the end of 2009 (AEMO, 2012).

The Australian Bureau of Resources and Energy Economics has recently dramatically revised its cost estimates, predicting that onshore wind and solar photovoltaic will deliver the cheapest forms of energy by 2030 in Australia (BREE, 2012).

3.3 Other types of action

Using energy more efficiently

The goal of energy efficiency is to reduce the amount of energy used to provide products and services. Many countries focus on energy efficiency in households as well as businesses and factories. The efficient use of energy reduces running costs for heating and cooling as well as for the production of goods and services.

According to the International Energy Agency, energy efficiency could deliver 65 per cent of all the global greenhouse gas emissions reduction needed to 2035 to avoid serious climate change based on a range of scenarios (IEA, 2012c). Brazil, Canada, China, the European Union, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, South Africa, Republic of Korea, the United Kingdom and the United States have all implemented energy efficiency policies (GLOBE, 2011).

IMPROVED ENERGY EFFICIENCY ACHIEVES A NUMBER OF OBJECTIVES AT THE SAME TIME.

This broad support for saving energy is due to the fact that improved energy efficiency achieves a number of objectives at the same time. This includes lowering bills and increasing competitiveness, reducing the demand for energy (thus increasing energy security) and reducing greenhouse gas emissions. Areas in which energy efficiency is being improved for industry and households include transport, heating, hot water, cooling and lighting.

Many countries are moving to more efficient electricity generation through adopting technologies including more efficient power stations and tri-generation. China has become a world leader in the construction of cleaner and efficient coal-fired power stations (Bradsher, 2009). Operating more efficiently means the power plant burns less coal and emits less carbon dioxide for each unit of electricity it generates.

Tri-generation, the production of electricity, heating and cooling at the same time, is being used in cities around the world and can achieve thermal efficiency rates of more than 80 per cent, compared to a coal-fired power station which typically converts only 33 per cent of its input energy to heat (WEF, 2009).

In Singapore, tri-generation is increasing due to its efficiency, environmental performance and economic competitiveness. For example, Pfizer Inc, a large pharmaceutical manufacturer, installed a 4.6 megawatt tri-generation facility in 2006. The facility achieved 83 per cent efficiency in its first year of operation, saves around USD500,000 per year in electricity costs and has cut greenhouse gas emissions by 17 per cent per year (COSPP, 2009).

Smart grids can provide instant information about energy production and usage, allowing more efficient network management, supporting renewable energy and giving businesses and households more control over their energy consumption. The Republic of Korea is developing a smart grid system that will allow more efficient energy production and consumption. The system will allow the variable supply from wind and solar to be better used and manage the production and distribution of power from all sources (UNEP, 2010).

Cities around the world are seeing the benefits of improving public transport and vehicle efficiency standards which can significantly reduce emissions while also improving air quality and access to affordable transport. The city of Copenhagen, Denmark, found that its public transport system saves around AUD1 billion in lost productivity from travel time each year (Mandag Morgen, 2011).

IMPROVEMENTS IN FUEL EFFICIENCY ARE EXPECTED TO SAVE, ON AVERAGE, USD8,000 PER VEHICLE IN 2025, AND CUT MORE THAN SIX BILLION TONS OF GREENHOUSE GASES OVER THE LIFE OF THE PROGRAM.

In the United States, more stringent vehicle fuel efficiency standards aim to improve fuel efficiency in cars and light trucks from the current 24.1 miles per gallon (10.25 kilometres per litre) to 54.5 miles per gallon (23.2 kilometres per litre) by 2025. Improvements in fuel efficiency are expected to save, on average, USD8,000 per vehicle in 2025, and cut more than six billion tons (5.4 billion tonnes) of greenhouse gases over the life of the program (ENS, 2011).

THE UNITED KINGDOM HAS PUT IN PLACE REGULATIONS REQUIRING ALL NEW HOMES TO BE ZERO EMISSION FOR HEATING, HOT WATER, COOLING AND LIGHTING FROM 2016.

Energy efficiency building codes are now in place in many countries. The United Kingdom has put in place regulations requiring all new homes to be zero emission for heating, hot water, cooling and lighting from 2016. Russia has a USD8 billion program to upgrade buildings which includes energy efficiency improvements. In China, the 1,000 largest state-owned enterprises have been directed to improve their energy intensity.

"To deliver a low-carbon economy you have got to have a vision ... we can bring about a Green Consumer Revolution in this country to improve our lives, enrich our economy and protect our environment."
Mr David Cameron, UK Prime Minister

Equipment and appliance performance standards and labelling schemes are now common in many countries including Australia. Mexico has an energy efficiency project distributing up to 47 million energy saving lights to households and Brazil has a program to replace one million inefficient refrigerators each year.

"Californian businesses and householders have saved USD53 billion in the past 30 years due to energy efficiency measures and are looking to save USD1.7 trillion at the gas pump by 2025."
Ms Linda Adams, Chair, Climate Action Reserve Board of Directors

In Australia, government actions to improve energy efficiency include regulation and financial incentives. Specific measures include support for investment in more efficient manufacturing equipment, energy efficiency ratings for buildings, and appliance labelling schemes.

Forests and agriculture

Historically, about 15 to 20 per cent of net greenhouse gas emissions around the world have come from land ecosystems, primarily deforestation (Raupach & Canadell, 2010). Tree trunks, branches and foliage, as well as other plant matter and soils all contain carbon. Therefore, when forests are cut down carbon is released into the atmosphere. Maintaining carbon stores in forests by avoiding deforestation and ensuring that where forests are managed, they are done so sustainably, is a necessary part of a comprehensive global approach to reducing emissions. Storing carbon in new forests helps return carbon to the land from earlier deforestation.

STORING CARBON IN NEW FORESTS HELPS RETURN CARBON TO THE LAND FROM EARLIER DEFORESTATION.

Most deforestation and forest degradation (human activities that drain carbon stocks) occurs in developing countries such as Indonesia and Brazil. Australia and other developed countries are working with these countries to reduce emissions from deforestation and forest degradation. Australia, along with other countries, is working to develop an international market mechanism that will attract the large-scale investment needed to help developing countries protect and rehabilitate their forests. The partnership between Australia and Indonesia is a leading example.

Agriculture is also a major source of emissions globally. For example, livestock, particularly sheep and cattle, produce methane as a by-product when they digest food. Applying fertiliser to crops and pastures results in the release of nitrous oxide to the atmosphere. Cultivating soils for crop production can lead to a decline in the amount of carbon stored in the soil.

New production methods and technologies are needed to enable farmers to reduce emissions and, where practical, increase carbon storage in soils, while also meeting the demand for food and fibre. More than 30 countries have joined a global alliance to collaborate on research, development and extension of technologies and practices (GRAAGG, undated). Australia and the Canadian province of Alberta have set up schemes that allow farmers to generate credits for approved activities to reduce emissions. The credits can be sold to businesses and individuals wishing to offset their emissions.

Other technologies

Carbon capture and storage is a technology to prevent large quantities of CO_2 from being released into the atmosphere from the use of fossil fuel in power generation and other industries. The technology involves capturing the CO_2 produced at large industrial plants using fossil fuel (coal, oil and gas), transporting the CO_2 to a suitable storage site, and pumping it deep underground to be securely and permanently stored away from the atmosphere.

There are currently eight large-scale integrated carbon capture and storage projects in operation – one in North Africa, two in Norway and five in North America. The Gorgon Carbon Dioxide Injection Project in Western Australia is expected to be operational in 2015.

The 342 nuclear power plants across the world provide about 13 per cent of the world's electricity (IEA, 2012a). Some countries, such as China (where more than 25 are under construction), are using more nuclear power to reduce their emissions whereas other countries, such as Germany and Japan, are reassessing the amount of nuclear power plants used in their energy sectors. The United States expects four to six new reactors to be operational by 2020. In the UK, nuclear facilities supplied about 16 per cent of total electricity generation in 2010, and some new plants are proposed (World Nuclear Association, 2012).

3.4 Shifting our economy requires investment

Building new types of industry, reducing emissions and shifting to cleaner sources of energy to power our economy requires investment.

A limited amount of emissions can be reduced at zero or low cost through energy efficiency measures – sometimes these will produce benefits (such as lower energy bills or reduced air pollution) over time that outstrip the initial costs. However, it is simply not possible to reach a realistic emissions reduction target without some cost.

Different countries have different costs associated with reducing greenhouse gas emissions based on how ambitious their target is, their existing economic structure, their natural resources such as renewable energy, and the combination of policies used to reach that target. Put simply, the emission reduction target is the main driver of the costs but the combination of policies can make achieving it more or less costly.

The costs of reducing emissions are met by society through paying higher prices resulting from an explicit carbon price, or paying higher taxes to fund regulation or other forms of incentive, or reduction in choice. The important point is that all policies, whether an emissions trading scheme, a carbon tax, regulations or direct action, have costs.

EVEN THOUGH THERE WILL BE SOME SHORT-TERM COSTS, OVERALL LIVING STANDARDS WILL CONTINUE TO GROW STRONGLY AND THE LONG TERM BENEFIT IS REAL.

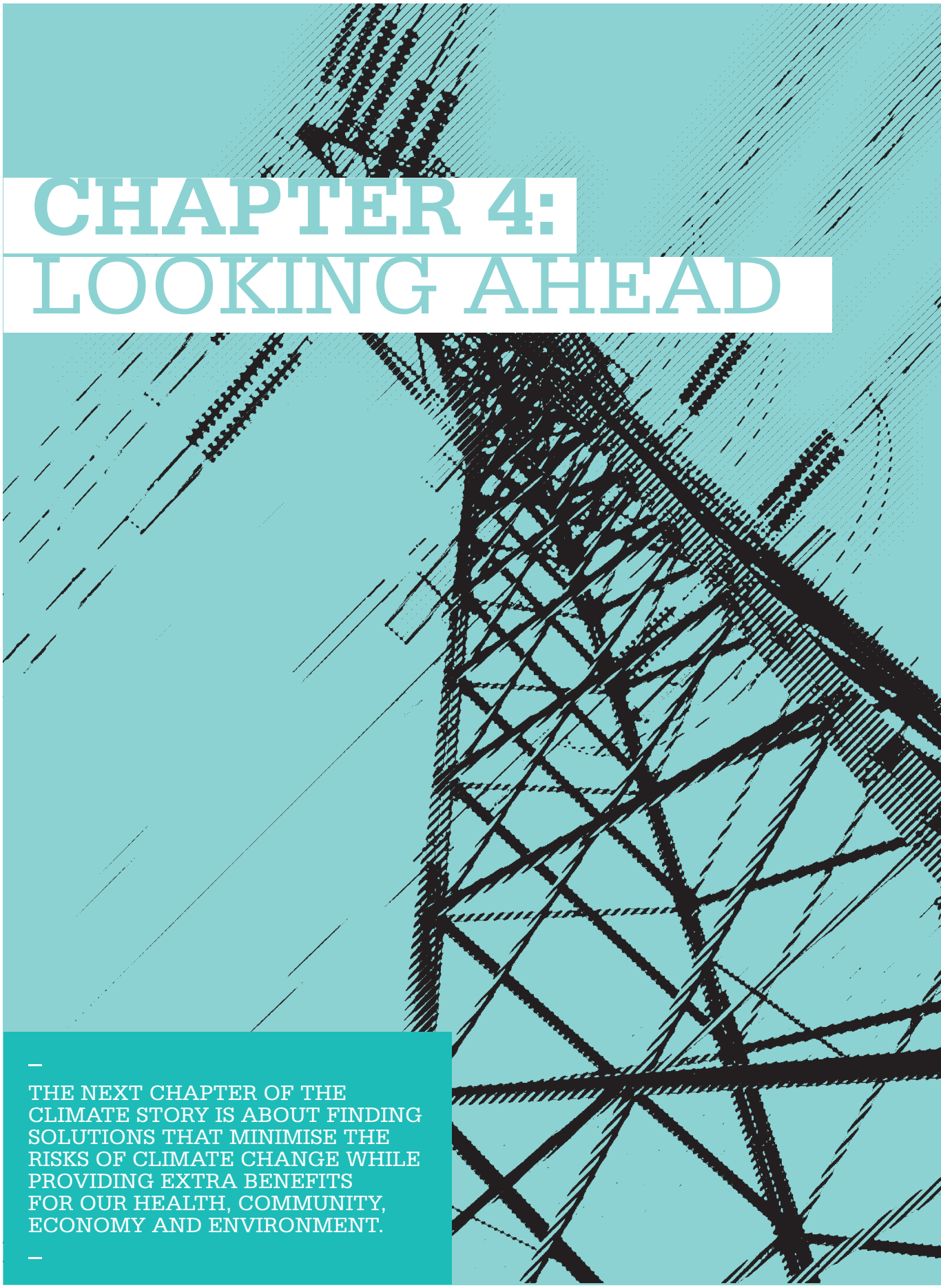
Carefully designed policies can make sure that the poor and vulnerable are sheltered from some of these costs. But even though there will be some short-term costs, overall living standards will continue to grow strongly and the long term benefit is real – reducing the risk of dangerous climate change and positioning the economy more securely for the future.

It is hard to compare the effective carbon prices in different countries. As the Productivity Commission (2011) pointed out, it is difficult to make comparisons about effective carbon prices in different countries because countries use many different policies; many of which do not have an explicit carbon price. The Productivity Commission report is a snapshot of the cost of a number of initiatives in major countries – it does not tell us what carbon prices will be needed in different countries to reach their committed emission reductions by 2020 or increase effort beyond these commitments to achieve the 2°C goal.

Economic studies have consistently shown that a broad-based carbon price (such as a carbon tax or emissions trading scheme) is the most cost-effective way for Australia to achieve the reductions needed to meet its 2020 commitments.

The cost of non-market based policies can be high relative to the cost of carbon pricing. For example, the Productivity Commission concluded that the cost in the electricity sector of Germany's suite of regulatory, subsidy and feed-in tariff schemes was in the order of AUD143 – AUD174 per tonne of carbon dioxide. This was 20 times the cost of emissions reductions through the European Union emissions trading scheme at the time, and these costs were reflected in electricity prices.

CHAPTER 4: LOOKING AHEAD



THE NEXT CHAPTER OF THE CLIMATE STORY IS ABOUT FINDING SOLUTIONS THAT MINIMISE THE RISKS OF CLIMATE CHANGE WHILE PROVIDING EXTRA BENEFITS FOR OUR HEALTH, COMMUNITY, ECONOMY AND ENVIRONMENT.

The challenge of climate change will not go away. In fact, it becomes more urgent as time passes.

Australia has a choice whether to take up this challenge. Like other countries that make a substantial contribution to the climate change problem, Australia has a responsibility to contribute to the global solution. Australia also has the capacity to act. All our major political parties agree that acting on climate change is important and there is bipartisan agreement between our major parties on Australia's unconditional emissions target for 2020 of a 5 per cent reduction below 2000 levels.

Over time, there will be adjustment costs which will differ between Australian states and regions – as the effects of climate change will differ between states and regions – but delaying action only adds to the problem and the associated cost.

"The global economy is moving toward low-emission activity and away from high emission activity. As the world picks itself up from the global financial crisis, many countries agree that green growth is fundamental to rebuilding sustainable economies."
OECD, 'For a Stronger, Cleaner, Fairer World Economy'

For industry to invest with confidence it needs sustainable and predictable climate policy. Without this there is a danger of a continued freeze on new power investment. If we fail to take sufficient action now it also means that when carbon prices rise rapidly after 2020, some investors will be left with investments that may be worthless because they have become obsolete before the end of their planned lifetime. We will lose influence in the global negotiations and the ability to discourage those abroad who are trying to undermine action in other countries. And, of course, we are more likely to face higher damage from climate change.

In contrast, taking action can deliver economic and environmental benefits at modest short-term costs. In forthcoming reports, the Climate Commission will be looking at the new opportunities associated with Australia's transition to a low-emissions economy. There is no shortage of opportunities with the right policy settings. As this report shows, many countries are already investing to take advantage of the opportunities.

THERE IS NO SHORTAGE OF OPPORTUNITIES WITH THE RIGHT POLICY SETTINGS.

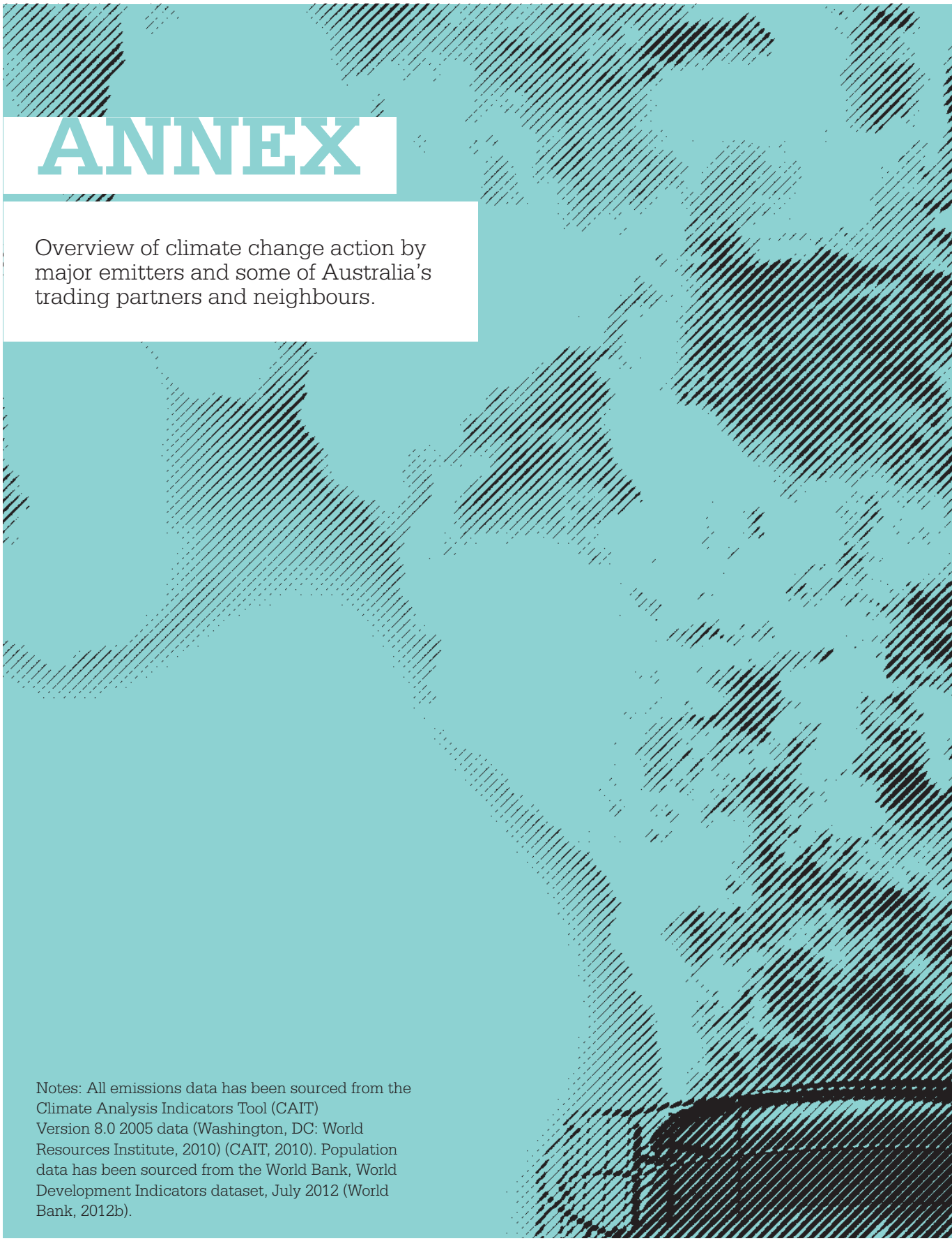
With the impacts and risks clearly set out by scientists across the globe, the next chapter of the climate story is about finding solutions that minimise the risks of climate change while providing extra benefits for our health, community, economy and environment. Harnessing renewable and clean energy and using resources more efficiently will create business opportunities and help some businesses save money and improve productivity.

As you've read in this report and our other reports, we know beyond reasonable doubt that the world is warming and that greenhouse gas emissions are primarily caused by human activity. The impacts of climate change are already being felt in Australia and around the world with less than 1°C of warming globally. The risks of further climate change – to our economy, society and environment – are serious, and grow rapidly with each degree of future temperature rise. Minimising these risks requires rapid, deep and ongoing reductions to global greenhouse gas emissions. While the actions of countries around the world are significant, they are only a start.

We must continue to act now if we are to move to clean energy sources by 2050. This decade is the critical decade.

ANNEX

Overview of climate change action by major emitters and some of Australia's trading partners and neighbours.



Notes: All emissions data has been sourced from the Climate Analysis Indicators Tool (CAIT) Version 8.0 2005 data (Washington, DC: World Resources Institute, 2010) (CAIT, 2010). Population data has been sourced from the World Bank, World Development Indicators dataset, July 2012 (World Bank, 2012b).

PEOPLE'S REPUBLIC OF CHINA

Facts

Population: 1.325 billion

Greenhouse gas emissions as a percentage of world total: 19.1 per cent

Greenhouse gas emissions per person: 5.5 tonnes CO_2-e

Cancun pledge: 40-45 per cent reduction in emissions intensity (emissions per unit of GDP) relative to 2005 by 2020

China's greenhouse gas emissions are higher than any other country, and are growing because of its strong economic development and heavy reliance on coal-fired power generation and petroleum. However, China is taking steps to reduce its growth in emissions.

New actions

China's 12th Five Year Plan (2011-15) places strong emphasis on balancing continued economic growth with environmental sustainability. It provides for reduced reliance on industries with high emissions of greenhouse gases and other pollutants, as well as lowering of greenhouse gas emissions per unit of output, and rapid development and use of clean technologies. The 12th Five Year Plan includes goals to:

- reduce energy per unit of GDP by 16 per cent by 2015
- reduce carbon emissions per unit of GDP by 17 per cent by 2015
- increase forest coverage by 21.6 per cent (40 million hectares) by 2020 from 2005 levels
- increase the proportion of non-fossil fuels in energy consumption to 11.4 per cent by 2015.

China has pledged to reduce its carbon emissions per unit of GDP by 40 to 45 per cent below 2005 levels by 2020. The 12th Five-Year Plan also includes a commitment to gradually introduce market mechanisms to control greenhouse gas emissions.

The Chinese Government plans to develop emissions trading schemes in seven key cities and provinces from 2013. These schemes will cover around 250 million people. The Chinese Government aims to work towards a nation-wide approach after 2015.

The Chinese Government will also require 10,000 companies to meet energy consumption standards. Industries will face penalties of more expensive electricity surcharges if they do not meet these. A nationwide tax on coal, crude oil and natural gas extraction was introduced in 2011.

Progress in the shift to a low-emissions economy

China has been a world leader in clean energy investment, technology manufacturing and installed energy capacity for the past five years but was second to the United States for investment in clean energy at USD45.5 billion in 2011. Between 2006 and 2010, the Chinese Government invested RMB 200 billion (AUD30 billion) in energy saving and emissions reduction projects, generating investment worth an estimated RMB 2 trillion (AUD300 billion).

Renewables accounted for 9 per cent of China's energy consumption in 2010 (REN21, 2011). In 2011, China led the world in installed renewable energy capacity, and by 2014 it will be the largest single market for renewable energy (REN21,

2012; BNEF, 2011; Pew, 2012). National feed-in tariffs support wind power and biomass energy, and a national solar feed-in tariff was announced in July 2011.

China is also investing in smart electricity grids, pure and hybrid electric vehicles and high speed rail (DESA, 2011).

In recent years, Chinese authorities have closed highly emissions-intensive coal-fired power plants, with combined generation capacity greater than Australia's total generation capacity, replacing them with more efficient, less-polluting new plants (Garnaut, 2011).

UNITED STATES

Facts

Population: 304 million

Greenhouse gas emissions as a percentage of world total: 18.3 per cent

Greenhouse gas emissions per person: 23.4 tonnes CO_2-e

Cancun pledge: reduce emissions in the range of 17 per cent relative to 2005 levels by 2020

The United States has the second highest greenhouse gas emissions. The Federal Government and many state and city governments are taking action to reduce greenhouse gas emissions using carbon pricing, financial incentives and regulation.

The United States has committed to a reduction in the range of 17 per cent relative to 2005, in conformity with anticipated United States energy and climate legislation, recognising that the final target will be reported to the UNFCCC secretariat in light of the enacted legislation.

Carbon pricing

The United States Administration has not been able to secure support for legislation to set either a price or a limit on greenhouse gas emissions. However, emissions trading has operated in the power sector in nine states since 2009. California's emissions trading scheme will start in January 2013 and is intended to link with Canadian provincial schemes developed under the Western Climate Initiative.

Renewable energy

President Obama has announced goals of doubling the share of clean energy sources in electricity supply to 80 per cent by 2035, bringing one million electric vehicles on the road by 2015, and ending fossil fuel subsidies.

Around 30 states have mandatory renewable energy standards, most based on a certificate trading system.

The Federal Government provides a variety of tax credits for renewable energy.

As of 2010, 11.8 per cent of domestic energy was produced by renewable technologies and 10.6 per cent by nuclear (REN21, 2012). In 2011, the United States was second globally in total installed renewable energy capacity and had the largest investment in clean energy (Pew, 2012).

Regulation

In July 2011, the United States announced new national fuel economy standards of 54.5 miles per gallon (23.2 kilometres per litre) by 2025 covering 90 per cent of new vehicles.

The United States is progressively introducing regulations covering emissions from large industrial facilities under the Clean Air Act. From July 2011, all facilities emitting more than 100,000 tons CO_2-e per year require permits.

The Environmental Protection Agency has proposed regulations for emissions standards for new power plants.

EUROPEAN UNION

Facts

Population: 500 million

Greenhouse gas emissions as a percentage of world total: 13.3 per cent

Greenhouse gas emissions per person: 10.3 tonnes CO_2-e

Cancun pledges: reduce emissions by 20 or 30 per cent below 1990 levels by 2020 and 80-95 per cent below 1990 levels by 2050

The 27 countries that make up the European Union are collectively the third largest emitter of greenhouse gases. The European Union as a whole, as well as member countries, continue to adopt strong actions to reduce greenhouse gas emissions. The European Union emissions trading scheme is the first scheme of its type, and is complemented by a broad range of regulatory, subsidy and tax mechanisms.

Carbon pricing

The European Union emissions trading scheme began in 2005 and now covers the 27 countries of the European Union, and three non-European Union members: Iceland, Liechtenstein, and Norway. (Switzerland plans to link its emissions trading scheme to the European Union emissions trading scheme).

The European Union emissions trading scheme is being implemented in phases, with each phase becoming tighter and stricter than the last. This phased approach allows for continuous improvement and review.

The European Union emissions trading scheme covers carbon dioxide emissions from the energy and major industrial sectors (around 40 per cent of total European Union emissions). In 2012, the scheme will expand to cover aviation emissions, and from 2013 more greenhouse gases and industrial sectors (petrochemicals, ammonia, aluminium). The cap on emissions is also being reduced over time.

Renewable energy

The European Union directive on renewable energy sets targets for all member states. When averaged across members, the targets represent a 20 per cent share of energy from renewable sources by 2020 and 10 per cent renewable energy in the transport sector by 2020.

Regulation

The European Union has emissions standards for cars that aim for a fleet-wide average of 120 grams CO_2 per kilometre in 2012 and 95 grams CO_2 per kilometre in 2020. Fleet-wide emissions are not on track to reach the 2012 average target but may reach targets in 2013-14.

RUSSIAN FEDERATION

Facts

Population: 142 million

Greenhouse gas emissions as a percentage of world total: 5.2 per cent

Greenhouse gas emissions per person: 13.7 tonnes CO_2-e

Cancun pledge: reduce emissions by 15 to 25 per cent by 2020 relative to 1990 levels

Russia is one of the major emitters. Russia's Cancun pledge of a 15 to 25 per cent reduction from 1990 levels is conditional on appropriate accounting of the potential contribution of the country's forests. Russia is focusing mainly on energy efficiency to reduce its emissions, with some coverage of renewable energy and forestry (GLOBE, 2011).

Renewable energy

Russia has renewable targets for electricity generation (4.5 per cent by 2020 excluding large hydro plants) with subsidy schemes for small-scale renewable energy.

Russia aims to double its nuclear capacity and to reduce the share of its energy generated from natural gas to 46-47 per cent by 2030 (currently more than 50 per cent). Russia has also set a limit on gas flaring.

Energy efficiency

Tax credits are available for investment in energy efficiency. Energy meters have been mandatory in public buildings since 1 January 2011 and will be required in homes and apartments by 1 January 2012, energy audits are undertaken on power generators and large power-consuming organisations, and the use of incandescent light bulbs is restricted.

INDIA

Facts

Population: 1.140 billion

Greenhouse gas emissions as a percentage of world total: 4.9 per cent

Greenhouse gas emissions per person: 1.7 tonnes CO_2-e

Cancun pledge: reduce emissions intensity by 20-25 per cent by 2020 relative to 2005

India is the fifth largest global emitter with ongoing growth in emissions associated with economic development.

India's National Action Plan on Climate Change outlines eight 'Missions' including the National Mission on Enhanced Energy Efficiency (NMEEE) which has an emissions reduction target of 98 million tons CO_2-e by 2014-15.

Carbon pricing

India introduced a clean energy tax on imported and domestic coal and peat in 2010. Applied at 50 Rupees per tonne (less than AUD1). Revenue raised will finance India's national Clean Energy Fund for clean technology development.

India hosts more than 800 registered Clean Development Mechanism projects.

Renewable energy

India has set a target of 20,000 megawatts of solar energy generation capacity by 2022.

State and federal incentives, including feed-in tariffs, encourage renewable energy development, particularly wind power (Pew, 2010). In 2010, India implemented a Renewable Energy Certificate scheme which imposes obligations on power companies to produce renewable energy. Those that produce renewable energy are issued tradeable certificates that can be purchased by those which fail to meet their obligations.

Although coal still dominates in electricity generation, India has a strong and rapidly growing renewable energy sector, including wind, biogas, solar photovoltaic and hydro. As of 2011, India was fifth worldwide in existing wind power capacity and sixth for total renewable capacity (excluding hydropower) (REN21, 2012).

In 2011, India invested USD10.3 billion in clean energy, which is 52 per cent higher than that invested in 2010 (BNEF, 2012a).

In urban areas, solar power is currently more expensive than coal-fired power generation. However, the Indian Government expects the national mission to drive down costs to grid parity by 2022 by promoting and allowing manufacturing capacity, research and development, economies of scale and training (Government of India, 2010).

Solar energy is also being developed in rural areas, including regions that have not previously had electricity supplies.

Energy efficiency

The NMEEE includes an energy efficiency certificate trading scheme – the Perform, Achieve and Trade Mechanism – which will cover facilities in eight energy-intensive sectors (mainly power, steel, iron and cement) that account for one third of India's commercial consumption of fossil fuels. The Indian Government estimates that the market could reach AUD15 billion per year in five years, and is open to extensions of coverage in the future. The scheme was launched in April 2012.

JAPAN

Facts

Population: 127.7 million

Greenhouse gas emissions as a percentage of world total: 3.2 per cent

Greenhouse gas emissions per person: 10.5 tonnes CO_2-e

Cancun pledge: reduce emissions by 25 per cent by 2020 relative to 1990

Japan is a major energy importer and one of the top 10 emitters.

Carbon pricing

Japan has emissions trading schemes operating in the Tokyo and Saitama regions, covering 20 million people. The Tokyo Metropolitan Government's scheme is a city cap-and-trade program covering more than 1,000 facilities including factories, schools, commercial and public buildings.

In April 2012, Japan legislated for a carbon tax of approximately ¥289 per tonne (AUD3.30) by increasing existing taxes on fossil fuels (coal and LPG/LNG) with effect from 1 October 2012. Half the revenue will fund low-emissions technologies.

Japan is developing a bilateral offset credit mechanism with a range of interested country partners. Such a mechanism may produce carbon units for emissions trading schemes in Japan in the future.

Renewable energy

There are subsidy and tax systems to support the uptake of solar power generation and fuel efficiency targets for vehicle manufacturers.

The Japanese Government intends to raise renewable energy to 20 per cent of total generation 'by the earliest possible time' in the 2020s. In 2011, Japan passed a clean energy bill for subsidising electricity from renewable sources (including wind, solar and geothermal).

Japan's clean energy investment totalled USD8.6 billion in 2011, most of which went to solar energy (Pew, 2012). Japan is currently seventh in the world for installed renewable energy capacity (Pew, 2012). A feed-in tariff on renewable energy that started in 2012 is expected to drive the share of renewable electricity from 9 per cent to 13 per cent by 2020 (Pew, 2012).

In the aftermath of the 2011 earthquake, tsunami and the Fukushima-Daiichi nuclear crisis, most nuclear power plants were closed (a small number have since been re-started) and Japan's long term energy plans are being reconsidered. The replacement of nuclear energy with fossil fuel-based energy will increase Japan's emissions in the short term (Norton Rose, 2011).

Energy efficiency

Japan has set a target to improve energy efficiency by 30 per cent by 2030 relative to 2003 levels.

Japan has tax incentives to promote purchases of energy efficient cars and equipment, financial incentives for energy efficient retrofits and construction and wide-ranging efficiency standards.

BRAZIL

Facts

Population: 191 million

Greenhouse gas emissions as a percentage of world total: 2.7 per cent

Greenhouse gas emissions per person: 5.4 tonnes CO_2-e

Cancun pledge: reduce emissions by 36.1-38.9 per cent below business as usual emissions by 2020

Brazil is the largest economy in South America and one of the 10 largest economies in the world.

Brazil's National Policy on Climate Change legislation, passed in 2009, has a target to reduce deforestation to 80 per cent of the annual average between 1996 and 2005 by 2020. This target is expected to account for more than half of Brazil's emissions reduction pledge.

Carbon pricing

The state of Rio de Janeiro is exploring options to implement a state-wide cap and trade system.

Renewable energy

Brazil is the world's second largest biofuels producer and ranked third globally for renewable energy capacity in 2011 (REN21, 2012).

Brazil has legislated for a renewable energy target to maintain at least an 80 per cent share of total generation. It also has a target to increase the energy production from wind, bioenergy and small hydropower plants to 10 per cent over 20 years.

Energy efficiency

Brazil's climate change legislation includes provisions on energy efficiency, seeking to reduce electricity consumption by around 10 per cent in 2030. Measures to improve energy efficiency include a program to replace one million inefficient refrigerators each year to cut three million tonnes of greenhouse gas emissions annually.

GERMANY

Facts

Population: 82.1 million

Greenhouse gas emissions as a percentage of world total: 2.6 per cent

Greenhouse gas emissions per person: 11.9 tonnes CO_2-e

Cancun pledge: Reduce emissions by 40 per cent on 1990 levels

As a major contributor to the European Union's industrial output, Germany has large energy needs, and consequently produces substantial greenhouse gas emissions. Germany has positioned itself as a major producer and user of renewable energy technology, to deliver energy security and emissions reductions for industries and consumers.

Carbon pricing

Germany participates in the European Union emissions trading scheme and is covered by European Union policies and measures. Germany's share of the overall European Union target requires it to reduce emissions by 14 per cent by 2020, compared to 2005, for the non-emissions trading scheme sectors.

Revenue from emissions trading is used for climate protection measures such as campaigns promoting low-emissions transport, low interest loans for small and medium enterprises to access energy efficiency advice, and grants to local municipalities for projects that reduce electricity consumption.

Renewable energy

While Germany relies on coal for the majority of its energy, it already sources around 29 per cent of electricity from renewable sources (Pew, 2010), and is third in the world for installed renewable energy capacity (Pew, 2012).

Germany installed more solar photovoltaic units in 2010 than the entire world in 2009, and produces more electricity from solar photovoltaic than any other country.

Germany is a leading exporter of renewable energy systems, exporting more than 80 per cent of the wind turbines it manufactures.

The renewable energy sector employed more than 370,000 people in 2010 (REN21, 2012). Employment in the energy sector overall has grown, and many jobs have shifted from the non-renewable to the renewable energy sector. The German Government predicts that jobs in its renewable energy sector could reach 600,000 by 2020 (Hedegaard, 2012).

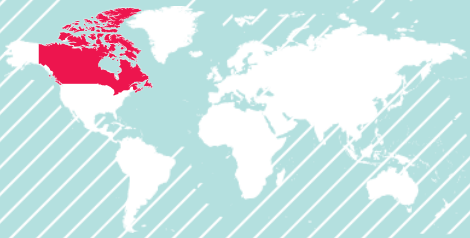
The Renewable Energy Sources Act obliges grid operators to give priority to the purchase of electricity from renewable sources. The Renewable Energies Heat Act promotes the increased use of heat from renewable sources.

After the Fukushima disaster, Germany announced it would abandon domestic nuclear power (17 reactors, approximately 22 per cent of energy), and expand renewables, especially wind and solar.

Chancellor Merkel has announced plans to spend USD263 billion on offshore wind farms.

Energy efficiency

Germany aims to increase the share of highly efficient combined heat and power generation to 25 per cent of electricity generation by 2020. It also aims to reduce heat demand in buildings by 20 per cent by 2020 compared to 2008.



CANADA

Facts

Population: 34.126 million

Greenhouse gas emissions as a percentage of world total: 2 per cent

Greenhouse gas emissions per person: 22.9 tonnes CO_2-e

Cancun pledge: 17 per cent below 2005 levels, to be aligned with the United States' target

Some of the main actions to reduce emissions in Canada are taking place at the provincial level.

Carbon pricing

Two Canadian provinces have existing carbon taxes (Quebec and British Columbia). Alberta implemented emissions trading in 2006 and Quebec's scheme will start in 2013. A further two provinces, British Columbia and Ontario, are considering emissions trading schemes that would be linked with Quebec and California under the Western Climate Initiative.

The Canadian Federal Government has no immediate plans to implement national emissions trading.

Renewable energy

In 2011, renewable energy investment in Canada grew 4 per cent to USD5.5 billion with more than half of this directed to wind generating capacity (Pew, 2012).

There is no national target for renewable energy in Canada but several provinces have targets.

Energy efficiency

Canada aims to establish minimum energy efficiency standards for a broad range of products and equipment.

Regulation

National regulatory tailpipe emissions standards for cars and light trucks are being phased in, harmonised with approaches in the United States. Standards for new heavy vehicles are also being developed. Building on this, Canada is implementing regulations to control carbon pollution from the power sector.

Canada has released proposed regulations to apply a performance standard on coal-fired generation units to begin in 2015, which are estimated to result in a reduction of approximately 175 million tonnes CO_2-e over the period to 2030.

UNITED KINGDOM

Facts

Population: 61.4 million

Greenhouse gas emissions as a percentage of world total: 1.7 per cent

Greenhouse gas emissions per person: 10.7 tonnes CO_2-e

Cancun pledge: reduction in emissions of at least 34 per cent below 1990 levels (50 per cent by 2025)

The United Kingdom Climate Change Act 2008 includes legally binding emission reduction targets to reduce emissions by at least 34 per cent by 2020 and at least 80 per cent by 2050. The United Kingdom sets legally binding five year carbon budgets (caps in emissions over a five year period). The latest of these to become law extends from 2023-2027.

The United Kingdom also aims to produce 40 per cent of its electricity from low carbon sources by 2020.

Carbon pricing

The United Kingdom participates in the European Union emissions trading scheme and is covered by European Union policies and measures. The United Kingdom's share of the overall European Union target requires it to reduce emissions by 16 per cent by 2020, compared to 2005, for the non emissions trading scheme sectors.

The United Kingdom has introduced a price floor (starting in 2013) for the electricity generation sector to provide incentives for investment in low emissions technology. The United Kingdom has a target price floor of £16 in 2013-14 (AUD24) which will increase to a target price of £30 (AUD45) in 2020.

Energy efficiency

Under the European Union's Energy End-Use Efficiency and Energy Services Directive, the United Kingdom must reduce energy consumption by 9 per cent on 2008 levels by 2016. It expects to exceed this target and deliver a reduction of 18 per cent supported by the Carbon Reduction Commitment cap and trade scheme which covers fossil fuels not otherwise covered by the European Union emissions trading scheme and the energy efficiency certificate scheme targeting households.

Renewable energy

The United Kingdom is covered by the European Union Renewable Energy Directive which includes a renewable energy target of 15 per cent by 2020. This is supported by requirements for electricity retailers to purchase renewable energy, feed-in tariffs for small-scale renewable generation, and financial support for renewable heat initiatives.

Regulation

The United Kingdom has put in place regulations requiring all new homes to have zero emissions for heating, hot water, cooling and lighting from 2016.

INDONESIA

Facts

Population: 235 million

Greenhouse gas emissions as a percentage of world total: 1.5 per cent

Greenhouse gas emissions per person: 2.7 tonnes CO_2-e

Cancun pledge: reduce emissions by 26 per cent (up to 41 per cent with finance) relative to business as usual by 2020

Indonesia is a major emitter among developing countries. Indonesia has the third largest forest area in the world but ranks among the highest for deforestation. Most of its greenhouse gas emissions are from this source, although as economic development moves on, greenhouse gas emissions from the energy sector are likely to increase (Ministry of Finance, 2009).

Indonesia has released a National Climate Change Action Plan (2008) and a Climate Change Sectoral Roadmap (2010) which identifies five priority mitigation sectors: forestry and peat land, agriculture, energy and transport, industry, and waste management. Each province is required to develop mitigation plans by September 2012.

Indonesia aims to decrease energy intensity by an average rate of 1 per cent per annum until 2025 and improve energy efficiency by 30 per cent from business as usual by 2025.

Carbon pricing

A Climate Change Green Paper released in 2009 stated that carbon pricing would be possible with a starting carbon tax of Rp 80,000 (approximately AUD8) per tonne CO_2-e.

Renewable energy

Indonesia's development plan for energy cites a target for 15 per cent of the country's electricity to come from renewable sources by 2025.

Indonesia is well placed to use geothermal energy. Its volcanoes provide 40 per cent of the world's potential geothermal resources. Geothermal sources provided 1,200 megawatts of generation capacity in 2010 (REN21, 2012).

Reducing emissions from deforestation and forest degradation in developing countries (REDD+)

Indonesia aims to reduce emissions from deforestation and forest degradation and stabilise carbon stocks through sustainable forest and peat land management.

As part of a USD1 billion Indonesia-Norway REDD+ partnership, President Yudhoyono signed a two year moratorium on issuing new permits to use primary natural forest and peat land in 2011.

REPUBLIC OF KOREA

Facts

Population: 48.6 million

Greenhouse gas emissions as a percentage of world total: 1.5 per cent

Greenhouse gas emissions per person: 11.8 tonnes CO_2-e

Cancun pledge: reduce emissions by 30 per cent from business as usual by 2020

In 2010, the Republic of Korea imported more than 97 per cent of its energy needs. It was the second largest importer of coal and the fifth largest importer of oil in the world. The Republic of Korea is moving to reduce its reliance on energy imports as well as greenhouse gas emissions, and to become an exporter of clean technology to support economic growth.

Carbon pricing

The Republic of Korea passed legislation in May 2012 for an emissions trading scheme to start from 1 January 2015. The emissions trading scheme will cover facilities producing more than 25,000 tonnes of greenhouse gas emissions – expected to be around 450 of the country's largest emitters. The emissions trading scheme is expected to cover 60 per cent of the country's emissions.

Renewable energy

The Republic of Korea plans to increase the share of new and renewable energy in total energy supply from nearly 3 per cent in 2009 to 6 per cent in 2020 and 11 per cent in 2030. Policies to achieve this target include feed-in tariffs for renewable energy (first introduced in 2003), subsidies of up to 80 per cent of the installation costs of eligible renewable generating capacity, and long-term low-interest loans to operate and manage renewable energy systems.

The Republic of Korea is investing around AUD8 billion in renewable energy research and development.

Energy efficiency

The Republic of Korea is developing a smart grid system that will allow more efficient energy production and consumption. The system will allow the variable supply from wind and solar to be better used and manage the production and distribution of power from all sources (UNEP, 2010).

Regulation

From January 2012, companies with factories producing more than 25,000 tonnes of CO2-e each year (around 450 entities) were required to meet energy-saving and greenhouse gas-reduction targets.

AUSTRALIA

Facts

Population: 22.3 million

Greenhouse gas emissions as a percentage of world total: 1.5 per cent

Greenhouse gas emissions per person: 27.3 tonnes CO_2-e

Cancun pledges: 5-15 or 25 per cent reduction in absolute emissions relative to 2000 levels by 2020

Carbon pricing

Australia's carbon price mechanism commenced with a fixed price of AUD23 per tonne on 1 July 2012. A cap and trade emissions trading scheme with a flexible price will start from 1 July 2015. The scheme covers around 60 per cent of Australia's emissions, with obligations applying to large emitters.

The Carbon Farming Initiative is an offset scheme allowing crediting of carbon sequestration and emissions reductions in the land and waste sectors. Credits can be sold to people and businesses wishing to offset emissions.

Renewable energy

Australia has a legislated renewable energy target designed to ensure that 20 per cent of electricity comes from renewable sources by 2020.

An AUD10 billion Clean Energy Finance Corporation will invest in renewable energy, low pollution and energy efficiency technologies.

Energy efficiency

Australia has compulsory minimum energy performance standards and energy labelling covering more than 10 product groups and 30,000 registered models.

Energy efficiency requirements for new buildings and major renovations have also been strengthened, requiring full disclosure of the energy use of commercial and government buildings to buyers and tenants.

SOUTH AFRICA

Facts

Population: 49.3 million

Greenhouse gas emissions as a percentage of world total: 1.1 per cent

Greenhouse gas emissions per person: 9 tonnes CO_2-e

Cancun pledge: 34 per cent below business as usual by 2020

Carbon pricing

South Africa is planning to introduce a carbon tax from 2013, starting at R120 (AUD15) per tonne for emissions above a threshold. Each company will have 60 per cent of its emissions tax exempt, with higher exemption thresholds for cement, iron, steel, aluminium, ceramics and fugitive emissions as well as trade exposed industries. Agriculture, forestry, land use and waste will not be taxed.

South Africa introduced a carbon tax on new vehicle sales in September 2010.

Renewable energy

South Africa has a target of producing 4 per cent of electricity per year from renewable sources by 2013 (currently 1.8 per cent) (REN21, 2012). This is supported by a system of feed-in-tariffs which began in late 2009 and now covers 10 technologies. Rebates are provided for solar water heating by the state-owned electricity company, Eskom.

Energy efficiency

Energy standards for new buildings are voluntary, however rebates are provided for installation of energy efficient equipment in commercial and settings.

NEW ZEALAND

Facts

Population: 4.3 million

Greenhouse gas emissions as a percentage of world total: 0.2 per cent

Greenhouse gas emissions per person: 19.1 tonnes CO_2-e

Cancun pledge: reduce emissions by 10-20 per cent by 2020 relative to 1990

Although a relatively small global emitter, New Zealand has high per capita emissions (ranked 14th globally). New Zealand has been an active and early player in taking action to mitigate climate change.

Carbon pricing

The New Zealand Government set up an emissions trading scheme in 2008. The scheme covered forestry initially, and was then expanded in 2010 to cover stationary energy, transport, liquid fossil fuels and industrial processes.

A 2011 review of the scheme found that the emissions trading scheme was the most efficient method of decreasing greenhouse gas emissions.

New Zealand emissions have declined since the start of the emissions trading scheme, mainly in the forestry sector.

Renewable energy

Hydroelectricity provides 70 per cent of energy generation.

Investment in renewable energy sources is growing, with a sharp increase in applications for renewable power generation since the introduction of the emissions trading scheme (Sinclair, 2011).

GLOSSARY & REFERENCES

Bipartisan	Agreement of two political parties.
CO_2 (carbon dioxide)	A gas that occurs naturally and which is emitted from sources including fossil fuel combustion and deforestation. It is the main greenhouse gas that is influenced by human activities that is causing climate change.
CO_2-e (carbon dioxide equivalent)	A measure used to compare greenhouse gases that have different effects on global warming by converting amounts of the gases to an equivalent amount of carbon dioxide.
Deforestation	The removal of forests from land and replacement with a non-forest land use.
Emissions intensity	Greenhouse gas emissions produced per unit of gross domestic product (GDP).
Energy efficiency	The goal of energy efficiency is to reduce the amount of energy used to provide products and services. The efficient use of energy reduces costs for heating and cooling as well as for the production of goods and services.
Emissions trading scheme	A market-based approach to reducing emissions. Permits are allocated or sold to firms that allow them to emit a certain amount of greenhouse gases. The permits can be bought or sold ('emissions trading') depending on the amount of emissions a firm emits. The number of permits is capped, and generally reduces with time. Firms that reduce their emissions do not have to buy permits and can sell their unused permits.
Greenhouse gas emissions	The release of greenhouse gases into the atmosphere, for example, burning fossil fuels and clearning forests.
Greenhouse gases	Gases that trap heat in the atmosphere, including carbon dioxide (CO_2), methane and nitrous oxide.
Pledge	A specific commitment made by countries to the UNFCCC to reduce their emissions. Pledges differ in the amount of reductions and how they are measured.
REDD+: Reducing emissions from deforestation and forest degradation in developing countries	A system of market and financial incentives to reduce emissions from deforestation and degradation in developing countries. Not only does this reduce greenhouse gases, it also has other benefits, especially in developing countries, for biodiversity and alleviating poverty.

Renewable energy	Renewable energy comes from natural resources such as sunlight, wind, rain, tides and geothermal heat. These energy types are renewable because they are naturally restocked.
Solar photovoltaic	A technology to convert solar energy directly to electricity using solar panels which can be deployed individually or in a large array.
Solar thermal	A technology to convert solar energy into heat energy. On a large scale, the heat energy can be stored and converted to electricity when required, so it can be used day and night.
Target	The level of emissions that will be achieved according to the commitments. Some countries have a low-end and high-end target depending on global action.

References

AEMO (Australian Energy Market Operator) (2012). *National Electricity Forecasting Report*. Retrieved 29 June 2012 from http://www.aemo.com.au/.

AVOID (2012). *Are the emission pledges in the Copenhagen Accord compatible with a global aspiration to avoid more than 2°C of global warming?* A technical note from the AVOID programme. http://www.avoid.net.uk.

BNEF (Bloomberg New Energy Finance) (2011). *Global Renewable Energy Market Outlook*. Bloomberg New Energy Finance. Retrieved 6 March 2012 from http://www.newenergyfinance.com/WhitePapers/view/53.

BNEF (2012a). *India Saw Record USD10.3bn Clean Energy Investment in 2011*. Retrieved 2 February 2012 from http://www.newenergyfinance.com/PressReleases/view/186 .

BNEF (2012b). *China Stars as Quarter Clean Energy Investment Numbers Rebound 24% Over Q1*. Retrieved 11 July 2012 from http://www.bnef.com/PressReleases/view/234.

Bradsher, K. (2009). *China Outpaces U.S. in Cleaner Coal-Fired Plants.* Retrieved 19 July 2012 from http://www.nytimes.com/2009/05/11/world/asia/11coal.html.

BREE (Bureau of Resources and Energy Economics) (2012). *Australian Energy Technology Assessment 2012*. Commonwealth of Australia. Licensed from the Commonwealth of Australia under a Creative Commons Attribution 3.0 Australia Licence.

CAIT (Climate Analysis Indicators Tool) (2010). Version 8.0.2005 data. (Washington, DC: World Resources Institute, 2010).

Climate Institute, The (2012). *Global Clean Energy Investment Boom*. Retrieved 30 July 2012 from http://www/climateinstitute.org.au/verve/_resources/TCI_CleanEnergyinvestmentBoom_MediaBrief_2April2012.pdf.

CSIRO & BOM (Bureau of Meteorology) (2010). *The State of the Climate*. http://www.csiro.au/resources/State-of-the-Climate.html.

CORE (Carbon Offset Research and Education) (2012). *Multi-State Climate Initiatives*. Retrieved 2 March 2012 from. http://www.c2es.org/states-regions/regional-climate-initiatives .

COSPP (Cogeneration & On-Site Power Production) (2009). *Singapore success: CHP and trigeneration in the tropics*. Retrieved 20 July 2012 from http://www.cospp.com/articles/print/volume-10/issue-1/features/singapore-success-chp-and-trigeneration-in-the-tropics.html.

Danish Energy Agency (2012). *Danish Climate and Energy Policy*. Retrieved 20 March 2012 from http://www.ens.dk/en-US/policy/danish-climate-and-energy-policy/Sider/danish-climate-and-energy-policy.aspx .

DCCEE (Department of Climate Change and Energy Efficiency) (2010). *Report of the Prime Minister's Task Group on Energy Efficiency*. Department of Climate Change and Energy Efficiency. Commonwealth of Australia. Canberra.

DESA (Department of Economic and Social Affairs of the United Nations Secretariat) (2011). *World Economic and Social Survey 2011: The Great Green Technological Transformation*. United Nations, New York, USA.

EC (European Commission Eurostat) (2012). Statistics Database. Retrieved 23 July 2012 from http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home.

EIA (US Energy Information Administration) (2012). *Monthly coal- and natural gas-fired generation equal for first time in April 2012*. Retrieved 24 July 2012 from http://www.eia.gov/todayinenergy/detail.cfm?id=6990.

ENS (Environment News Service) (2011). *Obama Raises U.S. Fuel Efficiency Standard to 54.5 mpg*. Retrieved 20 July 2012 from http://www.ens-newswire.com/ens/aug2011/2011-08-02-091.html.

den Elzen, M.G.J, Roelfsema, M., Hof, A.F, Böttcher, H. & Grassi, G. (2012). *Analysing the emission gap between pledged emission reductions under the Cancún Agreements and the 2 °C climate target*. PBL Netherlands Environmental Assessment Agency, The Hague, report no. 500114021.

Frankfurt School (Frankfurt School - UNEP Collaborating Centre for Climate Change & Sustainable Energy Finance and Bloomberg New Energy Finance) (2012). *Global Trends in Renewable Energy Investment 2012*. Frankfurt School of Finance and Management gGmbH. Frankfurt, Germany.

Friedlingstein, P., Houghton, R.A., Marland, G., Hackler, J., Boden, T.A., Conway, R.J., Canadell, J.G., Raupach, M.R., Ciais, P., & Le Quéré, C. (2012). *Update on CO_2 emissions.* Retrieved 19 July 2012 from http://www.nature.com/ngeo/journal/v3/n12/full/ngeo1022.html.

Garnaut, R. (2011). *Update Paper Two: Progress towards effective global action on climate change.* Garnaut Climate Change Review - Update 2011. Commonwealth of Australia.

GRAAGG (Global Research Alliance on Agricultural Greenhouse Gases) (undated). Retrieved 2 April 2012 from http://www.globalresearchalliance.org/.

GLOBE (Global Legislators Organisation for a Balanced Environment) (2011). *GLOBE Climate Legislation Study*. GLOBE, London, UK.

Government of India (2010). *Jawaharlal Nehru National Solar Mission: Towards Building Solar India*. Government of India.

Hedegaard, C. (2012). *Keynote speech at the opening of the "Metropolitan Solutions Conference 2012"*. Transcript. Retrieved 6 March 2012 from http://ec.europa.eu/commission_2010-2014/hedegaard/headlines/news/2012-04-23_01_da.htm.

IPCC (Intergovernmental Panel on Climate Change) (2011). Publications and data. http://www.ipcc.ch/publications_and_data/publications_and_data.shtml.

IEA (International Energy Agency) (2012a). *World Energy Outlook 2011*. International Energy Agency, France.

IEA (2012b). Retrieved 24 May 2012 from http://www.iea.org/newsroomandevents/news/2012/may/name,27216,en.html.

IEA (2012c). *Clean Energy Progress Report*. Retrieved 11 July 2012 from http://www.iea.org/papers/2011/CEM_Progress_Report.pdf.

Jotzo, F. (2010). *Comparing the Copenhagen emissions targets*. CCEP Working Paper 1.10. Centre for Climate Economics & Policy, Crawford School of Economics and Government, The Australian National University, Canberra.

Mandag Morgen (2011). *Copenhagen – Beyond Green: The socioeconomic benefits of being a green city. City of Copenhagen*. Retrieved 30 April 2012 from http://greengrowthleaders.org/wp-content/uploads/2011/11/CPH-Beyond-Green.pdf.

Martinot, E., & Junfeng, L. (2007). *Powering China's Development: The Role of Renewable Energy.* WorldWatch Institute. Washington, DC, USA.

McKibbin, W.J., Morris, A., & Wilcoxen, P.J. (2010). *Comparing Climate Commitments: A Model-Based Analysis of the Copenhagen Accor*d. Discussion Paper 2010-35, Cambridge, Mass.: Harvard Project on International Climate Agreements, June 2010.

Ministry of Finance (2009). *Ministry of Finance Green Paper: Economic and Fiscal Policy Strategies for Climate Change Mitigation in Indonesia.* Ministry of Finance and Australia Indonesia Partnership, Jakarta.

Norton Rose (2011). *Asia Pacific Climate Change Policy Series: Japan*. Issue 1. Norton Rose, Japan.

OECD (Organisation for Economic Cooperation and Development) (2012). Review of the implementation of the OECD Environmental Strategy for the First Decade of the 21st Century. Retrieved 2 May 2012 from http://www.oecd.org/env/50032165.pdf.

Pew (The Pew Charitable Trusts) (2010). *Global Clean Power: A USD2.3 Trillion Opportunity*. Philadelphia, USA.

Pew (2012). *Who's Winning the Clean Energy Race? - 2011 Edition*. Philadelphia, USA.

Productivity Commission (2011). *Carbon Emission Policies in Key Economies*. Productivity Commission Research Report. Commonwealth of Australia. Licensed from the Commonwealth of Australia under a Creative Commons Attribution 3.0 Australia Licence.

Raupach, M.R. & Canadell, J.G. (2010). *Carbon and the Anthropocene*. Current Opinion in Environmental Sustainability. Global Carbon Project, Earth System Science Partnership, Centre for

Atmospheric, Weather and Climate Research, CSIRO, Canberra, Australia.

REN21 (Renewable Energy Policy Network for the 21st Century) (2012). *Renewables 2012: Global Status Report*. Commissioned Report. REN21 Secretariat, Paris, France.

REN21 (2011). *Renewables 2011: Global Status Report*. Commissioned Report. REN21 Secretariat, Paris, France.

Rosing, M. (2011). Speech to Community Conversation – International Forum, Sydney Town Hall, 12 September 2011.

Sinclair, G. (2011). *The New Zealand Emissions Trading Scheme, Off to a Good Start.* In Peetermans, J. (Ed) Asia and Beyond: the Roadmap to Global Carbon & Energy Markets - Greenhouse Gas Market Report 2011. International Emissions Trading Association, Geneva.

Stern, N. (2006). *Stern Review on the Economics of Climate Change*. HM Treasury, London.

Treasury (2011). *Strong Growth, Low Pollution: Modelling a carbon price*. Commonwealth of Australia. Licensed from the Commonwealth of Australia under a Creative Commons Attribution 3.0 Australia Licence.

Treasury (2012). *Australian Treasury Budget 2012-2013*. Retrieved 25 June 2012 from http://www.budget.gov.au. Commonwealth of Australia. Licensed from the Commonwealth of Australia under a Creative Commons Attribution 3.0 Australia Licence.

UNEP (United Nations Environment Program) (2010). *Overview of the Republic of Korea's National Strategy for Green Growth.* United Nations Environment Program, Geneva, Switzerland.

UNFCCC (United Nations Framework Convention on Climate Change) (1992). *The Convention*. http://www.unfccc.int.

US EPA (United States Environmental Protection Agency) (2010). Fact Sheet. Retrieved 1 August 2012 from http://www.epa.gov/nsr/documents/20100413fs.pdf.

WBGU (German Advisory Council on Global Change) (2009). *Solving the Climate Dilemma: The Budget Approach*. Special Report. Berlin: WBGU Secretariat.

WCI Inc (2012). *Program Design*. Retrieved 23 March 2012 from http://www.wci-inc.org/program-design.php.

World Bank (2012a). *State and Trends of the Carbon Market 2012*. World Bank. Washington, DC, USA.

World Bank (2012b). *World Development Indicators*. Dataset as at July 2012. Retrieved from http://data.worldbank.org.

WEF (World Economic Forum) (2009). *Smart Energy Slim City*. Retrieved 19 July 2012 from http://www.driversofchange.com/slimcity/downloads/smart_energy_low_res.pdf.

World Nuclear Association (2012). Retrieved 11 July 2012 from public information service http://world-nuclear.org.