



Australian Government
Climate Change Authority

INTERNATIONAL ACTION ON CLIMATE CHANGE MITIGATION: A STOCKTAKE

MARCH 2019



Published by the Climate Change Authority

www.climatechangeauthority.gov.au

© Commonwealth of Australia 2019

This work is licensed under the Creative Commons Attribution 3.0 Australia Licence. To view a copy of this license, visit <http://creativecommons.org/licenses/by/3.0/au>

The Climate Change Authority asserts the right to be recognised as author of the original material in the following manner:



© Commonwealth of Australia (Climate Change Authority) 2019.

IMPORTANT NOTICE – PLEASE READ

This document is produced for general information only and does not represent a statement of the policy of the Commonwealth of Australia. The Commonwealth of Australia and all persons acting for the Commonwealth preparing this report accept no liability for the accuracy of or inferences from the material contained in this publication, or for any action as a result of any person's or group's interpretations, deductions, conclusions or actions in relying on this material.

CONTENTS

1. INTRODUCTION	1
2. GLOBAL PROBLEM, GLOBAL SOLUTION.....	2
2.1. Global problem.....	2
2.2. Global solution	4
3. COUNTRIES' EMISSIONS REDUCTION TARGETS.....	6
4. COUNTRIES' POLICIES AND MEASURES	8
4.1. China	11
4.2. United States.....	13
4.3. European Union	15
4.4. India	17
4.5. Indonesia.....	20
4.6. Japan.....	21
4.7. Republic of Korea.....	23
4.8. Canada.....	24
4.9. New Zealand	25
5. INTERNATIONAL COLLECTIVE ACTION.....	26
5.1. International cooperation	26
5.2. Climate action by non-state actors	27
6. ASSESSING GLOBAL PROGRESS.....	28
6.1. UN Environment's 2018 Emissions Gap report.....	28
6.2. The International Energy Agency's 2018 World Energy Outlook	29
7. CONCLUSION.....	31
GLOSSARY	32
REFERENCES	34

FIGURES

Figure 1 Countries' contributions to global emissions for 2014.....	2
Figure 2 Fast facts on global climate change action	9
Figure 3 OECD – economic and emissions growth.....	19
Figure 4 Global emissions pathways under different scenarios and the emissions gap in 2030	29

TABLES

Table 1 Coverage of countries who have ratified the Paris Agreement based on 2014 figures.....	4
Table 2 Current emissions targets and emissions data	7

Table 3	UN Environment’s assessment of countries’ progress on meeting targets	28
---------	---	----

BOXES

Box 1	The Intergovernmental Panel on Climate Change – Global warming of 1.5°C Report	3
Box 2	Impacts on trade and international competitiveness	10
Box 3	Decoupling economic growth and emissions	19
Box 4	The Green Climate Fund	27

1. INTRODUCTION

This paper provides an overview of the current state of global climate change mitigation action by identifying countries' pledges and commitments, outlining their policies and measures, and describing their progress. It also outlines international collective action and global progress on reducing emissions and meeting the Paris Agreement's temperature goals.

This document is one of a series of stocktakes the Climate Change Authority is releasing in early 2019. The other stocktakes examine the:

- climate change policies that are currently in place at the Australian and state and territory government levels; and
- actions being taken by industry to position for a carbon constrained future.

The Authority welcomes your input on the accuracy and reliability of the information contained in the stocktakes. The Authority is also interested in receiving any relevant additional information.

The stocktakes, along with other research and analysis, will assist the Authority to update its advice to the Australian Government on policies to meet Australia's emissions reduction commitments under the Paris Agreement. The Authority has not analysed the effectiveness of the policies identified in this document and will consult later in the year as it develops its approach to updating its advice.

2. GLOBAL PROBLEM, GLOBAL SOLUTION

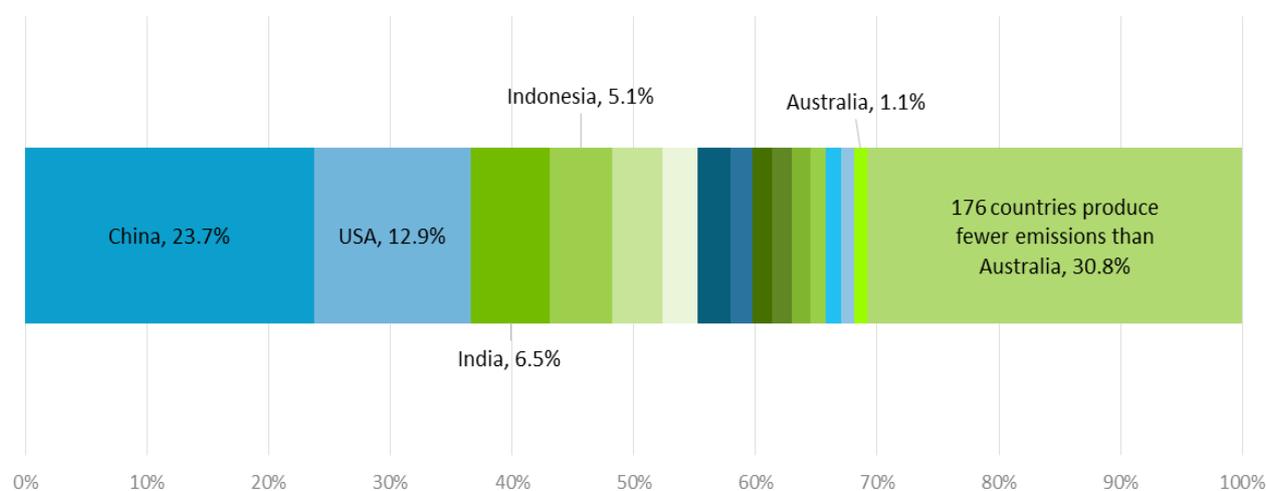
2.1. Global problem

Climate change, driven by anthropogenic greenhouse gas emissions, is a serious global challenge that poses major risks to the global community, economy and environment. According to UN Environment (2018), global emissions are showing no signs of reaching their peak. After levelling off in 2014, global greenhouse gas emissions rose again to a record high in 2017 (UN Environment 2018), and global carbon dioxide emissions from fossil fuels are expected to have set a record high in 2018 (Global Carbon Project 2019). A range of factors are causing emissions to increase, including increasing population and economic growth, and the global energy system's continued reliance on fossil fuels.

According to the Intergovernmental Panel on Climate Change (IPCC) (2018 p6) (Box 1), “[h]uman activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate.” The IPCC (2018) also notes warming from anthropogenic emissions between the pre-industrial period and now will persist for centuries to millennia and will continue to cause changes in the world's climate system.

The profile of global emissions by country is shown in Figure 1. Australia produces around 1 per cent of global emissions and is the world's 15th largest emitter. The two biggest emitters, China and the United States (US), combined produce over 36 per cent of global emissions. The next 12 largest emitters together account for approximately 31 per cent of global emissions and each of these countries is individually responsible for producing more emissions than Australia. There are 176 countries individually responsible for producing less emissions than Australia, which together account for approximately 31 per cent of global emissions. This widespread distribution of emissions means all countries must act and the global problem of climate change can only be solved through a global solution.

FIGURE 1 COUNTRIES' CONTRIBUTIONS TO GLOBAL EMISSIONS FOR 2014



Source: CCA analysis based on CAIT 2014 CO₂-e Emissions Data including LULUCF from Climate Watch (2019)

Note: Estimates of global emissions include emissions from most major sources and sinks, including land use, land-use change and forestry

Box 1 The Intergovernmental Panel on Climate Change – Global warming of 1.5°C Report

The Paris Agreement contains an invitation to the Intergovernmental Panel on Climate Change (IPCC) to provide a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global emission pathways. This report was released on 8 October 2018.

The report finds there are profound differences between worlds with 1.5°C and 2.0°C of warming. Under 2°C, relative to 1.5°C, there will be higher and more frequent high temperature extremes, more frequent and intense heavy precipitation events in most inhabited regions, higher probability of drought in some regions, 0.1m higher sea-level by 2100, up to twice as many people exposed to water shortages, and up to several hundred million more people susceptible to poverty. The report also outlines the expected loss of 70–90 per cent of coral reefs at 1.5°C with larger losses, greater than 99 per cent, at 2°C. It also notes the risk of irreversible loss of many marine and coastal ecosystems increases with global warming, especially at 2°C or more.

The report notes limiting warming to 1.5°C will require rapid and far-reaching transitions in energy systems, land use, urban and infrastructure systems (including transport and buildings), and industrial systems. It states ‘These system transitions are unprecedented in terms of scale, but not necessarily in terms of speed’ (p17). The report notes that the speed of transition necessary to limit global warming to 1.5°C is similar to the shift from incandescent lighting to LED lighting, which has made energy-intensive, incandescent lighting near-obsolete in a short period of time. The report argues the transition to 1.5°C cannot be achieved without government support and necessitates deep emissions reductions across all sectors.

The report finds that collectively, current emissions reduction targets submitted under the Paris Agreement would not limit global warming to 2°C (let alone 1.5°C) and that avoiding temperature overshoot and reliance on future large-scale deployment of carbon dioxide removal can only be achieved if global emissions start to decline well before 2030. Carbon dioxide removal refers to activities that remove carbon from the atmosphere and store it in geological, terrestrial, or ocean reservoirs, or in products. With the exception of tree plantings and the use of carbon for enhanced oil recovery, most of these technologies are currently uncommercial or haven’t been proven on a large scale.

Source: IPCC 2018

Different countries have been producing emissions at different rates over time. Between 1850 and 2014, cumulative emissions from the US were 570,844 million tonnes of carbon dioxide-equivalent (Mt CO₂-e), 462,471 Mt CO₂-e were from the EU28, 335,610 Mt CO₂-e were from China and 40,435 Mt CO₂-e were from Australia. However, China now produces almost twice as many emissions annually as the US and is currently closing the cumulative emissions gap at a rate of over 6,000 Mt CO₂-e per year. If current trends continue, China’s cumulative emissions will exceed those of the US in the 2050s (Climate Watch 2019).

Developed countries produced 54 per cent of cumulative global emissions between 1850 and 2014. However, developing countries now produce more emissions than developed countries, emitting

63 per cent of global emissions in 2014. Based on present trends, their cumulative emissions will exceed those of developed countries before 2040 (based on Climate Watch 2019 and the United Nation's 2017 Human Development Index rankings).

2.2. Global solution

The global community is acting to address climate change by reducing greenhouse gas emissions, with varying levels of ambition and a range of different policies. In addition to mitigating the costs and risks posed by global climate change, countries are acting to reduce emissions to improve air quality and health outcomes in their communities, diversify energy systems and take advantage of the economic opportunities from the low emissions global economy.

The United Nations Framework Convention on Climate Change (UNFCCC) is the main focus of international efforts to agree on actions to address climate change and UNFCCC agreements have progressed over time. For example, the Kyoto Protocol agreed in 1997 placed emissions limits on some developed countries between 2008 and 2012, and the Doha Amendment agreed to in 2012 established the second commitment period of the Kyoto Protocol for 2013 to 2020. The 2010 Cancun Agreements encouraged emissions reduction commitments from all major economies to 2020.

On 12 December 2015 in Paris, Parties to the UNFCCC reached an agreement to combat climate change beyond 2020 and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement, for the first time, brings all nations into a common framework to combat climate change and adapt to its effects. Under the Paris Agreement, countries strengthened previous goals by agreeing to limit global warming to well below 2°C and to pursue efforts to limit the temperature increase to 1.5°C. Countries agreed that global emissions need to peak as soon as possible, to rapidly reduce thereafter, and for net emissions to reach zero between 2050 and 2100. Of the 195 signatories to the Paris Agreement, 185 parties (184 countries and the European Union) have ratified the agreement as of 13 February 2019 (UNFCCC 2019a).¹

Countries which have ratified the Paris Agreement account for most of the world's emissions, population and economy. This is true even without the United States, which has said it will withdraw (country profile provides more detail) (Table 1).

TABLE 1 COVERAGE OF COUNTRIES WHO HAVE RATIFIED THE PARIS AGREEMENT BASED ON 2014 FIGURES

Per cent of:	Including the US	Excluding the US
Global emissions	92	79
Global population	94	90
Global gross domestic product	95	73

Sources: CCA analysis based on countries ratified as of 13 February 2019 and Climate Watch 2019, The World Bank 2019b, UN 2017 and UN DESA n.d.

The Paris Agreement requires Parties to submit Nationally Determined Contributions (NDCs) that outline emissions targets and efforts to reduce emissions (Chapter 3). As of 13 February 2019, 182 Parties have submitted NDCs to the UNFCCC (UNFCCC n.d.). UN Environment's 2018 Emissions

¹ Ratification is the process whereby each state approves the agreement according to its own internal procedures.

Gap Report notes that emissions pathways reflecting current NDCs are estimated to be consistent with global warming of about 3°C by 2100. This report also finds that the level of ambition (in terms of emissions reductions committed to under NDCs) needs to be three times greater to stay within 2°C warming, and increased around fivefold to achieve 1.5°C (UN Environment 2018).

Under the Paris Agreement, countries agreed to communicate or update NDCs every 5 years, with the first submissions due in 2020. The Paris Agreement also includes mechanisms to help scale up global efforts over time and a series of 'global stocktakes' will take place every five years to assess the combined impact of countries' efforts.

3. COUNTRIES' EMISSIONS REDUCTION TARGETS

A founding principle of the UNFCCC system is that countries act on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. The Authority has previously described this arrangement as meaning 'each country should contribute an equitable level of effort that will provide an adequate response to the problem, in light of its respective capacity and responsibility' (CCA 2015 p5).² The Paris Agreement also includes the principle that countries will act in the light of different national circumstances. These principles recognise emissions reduction targets in developing countries may not be as strong in the short term as in developed countries. They also recognise that countries' capacities and circumstances change over time.

Countries have put forward pledges under the Cancun Agreements for emissions reductions to 2020. For some developed countries, these pledges sit alongside targets under the Kyoto Protocol's second commitment period which runs from 2013 to 2020. Countries have also made commitments under the Paris Agreement to 2030 (or in some cases to other years) through their NDCs. Most developed countries have expressed targets as reductions in emissions in a target year against a historic base year, although the base year can differ. Other countries, such as China and India, have expressed targets based on reductions in the emissions intensity of their economies. Others, including Indonesia, have expressed targets as reductions in emissions relative to a business as usual baseline.

Table 2 provides details of targets under the Cancun Agreements and the Paris Agreement for selected countries. For comparison purposes, this table includes a measure of countries' Paris Agreement commitments using a standardised metric, showing an estimate of the implied change in emissions from 2005 to 2030.³ This table also shows countries' current share of emissions and emissions per capita.

² Effort refers to the scale of emissions reductions required to meet a target and can be measured using a number of approaches such as change in total emissions over time, or relative to economic output or population or business as usual. Adequacy refers to the extent to which a target is consistent with the emissions reductions necessary to meet the global goal.

³ The Climate Change Authority's 2015 paper *Comparing Countries' Emissions Targets, A Practical Guide* provides a framework for comparing countries' emissions targets.

TABLE 2 CURRENT EMISSIONS TARGETS AND EMISSIONS DATA

Country/ region	2014 share of global emissions (%)	2014 emissions per capita (t CO ₂ -e)	Cancun emissions reduction pledges (all pledges are to 2020)	Paris Agreement commitments (all commitments are to 2030, unless otherwise indicated)	Paris target implied change in total emissions 2005-2030 (%)
China	23.7	8.3	Carbon intensity 40 to 45 per cent below 2005	Peak carbon dioxide emissions by around 2030, making best efforts to peak early; lower carbon intensity by 60 to 65 per cent compared with 2005	+76 to +101
United States	12.9	19.6	17 per cent below 2005	Reduce emissions by 26 to 28 per cent compared with 2005 levels by 2025	-35 to -39
European Union	7.4	7.2	20 to 30 per cent below 1990 ¹	Reduce emissions by 40 per cent compared with 1990	-34
India	6.5	2.5	Carbon intensity 20 to 25 per cent below 2005	Lower carbon intensity by 33 to 35 per cent compared with 2005 levels	+244 to +254
Indonesia	5.1	9.7	26 per cent below business as usual (BAU)	Reduce emissions by 29 per cent below BAU, or 41 per cent conditional on international support	+14
Russia	4.2	14.1	15 to 25 per cent below 1990 levels	Reduce emissions by 25 to 30 per cent below 1990 levels	+29 to +39
Brazil	2.8	6.7	36 to 39 per cent below BAU	Reduce emissions by 37 per cent compared with 2005 levels by 2025; 43 per cent compared with 2005 levels by 2030	-43
Japan	2.7	10.3	3.8 per cent below 2005	Reduce emissions by 26 per cent compared with 2013 levels	-25
Canada	1.8	24.3	17 per cent below 2005	Reduce emissions by 30 per cent compared with 2005 levels	-30
Mexico	1.5	5.9	30 per cent below BAU	Reduce emissions by 22 per cent below BAU	0
Republic of Korea	1.3	12.5	30 per cent below BAU	Reduce emissions by 37 per cent below BAU	+6
New Zealand	0.1	13.2	10 to 20 per cent below 1990	Reduce emissions by 30 per cent compared with 2005 levels	-30

Sources: Based on CCA 2016. Updated calculations based on data from Climate Watch 2019, OECD n.d., UN DESA n.d..

Notes: BAU is business as usual. Carbon and emissions intensity is carbon dioxide and emissions intensity per unit of GDP. Some countries are likely to convert their point targets, which identify an emissions target and a target year, into carbon budgets that identify the total amount of emissions allowable over a period of time. As such, there is some uncertainty with regard to the total emissions associated with the point targets. Targets may also allow for the use of international units to meet shortfalls in domestic emissions reductions. Some countries have put forward two targets, one they will unconditionally meet regardless of other countries' actions and another they will meet if certain conditions are met. These conditions are usually based on stronger global action.

(1) 20 per cent target is unconditional; 30 per cent target is conditional on comparable action from others

4. COUNTRIES' POLICIES AND MEASURES

Most countries are taking action on climate change through a range of policies and measures to meet their emissions reduction commitments. These include renewable energy targets, carbon pricing, fuel economy standards and subsidies for low emissions technologies. The range of approaches to climate change policy around the world reflects the diversity in economic structures, natural resources, political appetite and emissions profiles. Some of the different approaches being deployed around the world are summarised in Figure 2.

Often policy decisions related to mitigating climate change also consider other factors and benefits, such as taking advantage of the economic opportunities arising from the low carbon economy. In some cases, the primary policy driver for actions that reduce emissions has not been to address climate change directly, but to achieve other outcomes, such as improving air quality in China and India, or gaining a competitive advantage in gas exports in the United States. In other cases, countries have sought to implement climate change policies in ways that generate co-benefits, such as improved land management outcomes and increased biodiversity.

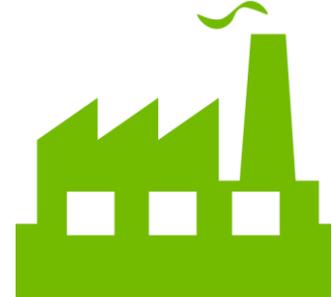
This section provides an overview of some major approaches and discusses their progress for a selection of countries, including Australia's major trading partners in global markets. Actions by these countries could have implications for Australia (Box 2). The Authority's stocktake of Australia's climate change policies provides an overview of the Australian approach.

FIGURE 2 FAST FACTS ON GLOBAL CLIMATE CHANGE ACTION

116 countries have some form of **renewable energy target** – their levels of ambition vary significantly (IEA 2019)



In 2017, **global investment in new renewable energy** was **A\$374 billion**, far exceeding the A\$145 billion invested in fossil fuel generation (Frankfurt School-UNEP Centre/BNEF 2018)



30 countries have committed to **phase-out coal power that does not have technologies to reduce emissions** (PPCA 2018)



21 countries have implemented some form of **carbon tax** – their prices and coverage vary significantly (The World Bank 2019a)



36 countries have implemented some form of **emissions trading scheme** – their level of ambition and coverage vary significantly (The World Bank 2019a)



Nearly **80 per cent** of **new passenger vehicles** sold globally are subject to **fuel efficiency or CO₂ emissions standards** (ICCT 2017a)

Box 2 Impacts on trade and international competitiveness

Climate change policies implemented by individual countries to reduce emissions have implications for other countries by affecting trade patterns. Climate policies affect trade patterns by changing the demand for commodities such as fossil fuels, and also change the relative costs of production between countries. Differences in the costs of production arise from both explicit carbon prices and also regulations that impose costs.

Economic modelling can illustrate the domestic impacts of policies implemented in other countries. For example, Liu et al. (2019) conclude that the economic impacts of the Paris Agreement on Australia would persist even if Australia withdrew from the Agreement because most of the impacts arise through changes in overseas demand for fossil fuels exported from Australia.

Trade competitiveness concerns are a key consideration when developing and implementing climate policies. Understanding how policies are being implemented in other countries, particularly countries that compete in export markets, is an important factor in policy development. International competitiveness concerns arise for sectors that are highly trade exposed, compete in international markets on the grounds of prices, and are subject to significant costs as a result of climate policy not faced by competitor producers.

The Centre for International Economics and CM Group (2017) highlighted the importance of gaining a strong understanding of international climate change policies and how they are implemented to understand implications for Australia and domestic policy development. They noted that:

- emissions reduction targets are not evidence of a carbon cost
- the trade implications of climate policies are sector specific
- there is frequently a gap between announced policies and realised carbon costs at a sectoral level.

The factors listed above arise due to the design specifics of climate policy, including varying sectoral coverage and policy exemptions, implementation progress and opportunities for emissions reductions.

The report also observed that potential trade distortions arising from differences in climate policy are likely to persist given the ability for countries to set emissions reduction targets with varying sectoral coverage, timing and base years under the Paris Agreement (Centre for International Economics and CM Group 2017).

4.1. China⁴



- **Proportion of global emissions (2014):** 24%
- **Annual emissions per capita (2014):** 8.3 t CO₂-e
- **Paris Agreement commitment (by 2030):** Peak carbon dioxide emissions by around 2030, making best efforts to peak early; lower carbon intensity by 60 to 65% compared with 2005
- **Proportion of Australia's exports (2014):** 34%; major exports include iron ore, coal, education, tourism
- **Proportion of Australia's imports (2014)** 21%; major imports include manufactured goods

4.1.1. Fossil fuel use

China is the world's largest consumer of coal and its emissions are primarily driven by its coal consumption (U.S. EIA n.d.). In 2016, China had 1,625 GW of installed power generation capacity. This included 1021 GW of fossil fuel capacity made up of 945 GW of coal-fired generation, 67 GW of gas-fired generation, and 9 GW of oil-fired generation (IEA 2017). China faces serious air pollution issues associated with its coal use (WHO 2018), which it is trying to address by placing restrictions on coal consumption.

China's 13th Five-Year-Plan for Energy Development (2016–2020) sets a directive that coal use will decrease as a proportion of the energy mix from 64 per cent in 2015 to 58 per cent in 2020 (Government of China 2016). China's coal consumption fell in the three years to 2016 though increased again in 2017 — this has prompted some analysts to conclude that while China has not yet reached its peak emissions, this may be achieved as soon as 2022 (Guan et al. 2018, Jiang et al. 2016).

China has also focused on improving energy efficiency and between 2000 and 2015, its energy intensity improved by 30 per cent. Since 2006, a mandatory, target-based energy savings program has been in place for the largest most energy intensive enterprises. The 13th Five-Year-Plan sets a target to improve energy intensity by 15 per cent between 2015 and 2020 (IEA 2016).

4.1.2. Renewable electricity

China is deploying renewable energy at a rapid rate. The 13th Five-Year-Plan sets the following 2020 targets for non-fossil energy capacity: 340 GW of hydropower capacity, 210 GW of wind power, 15 GW of biomass and 110 GW of solar power, as well as 58 GW of nuclear capacity by 2020 (Government of China 2016). To put this in perspective, Australia's National Electricity Market's total installed electricity generation capacity is 54 GW (AEMO 2019).

In 2017, China led the world in clean energy investment, spending a record A\$178⁵ billion, accounting for 45 per cent of global investment in clean energy. Of this investment A\$122 billion was directed to solar. This contributed to China meeting its solar target much earlier than 2020, so the target was adjusted to 213 GW by 2020 (Frankfurt School-UNEP Centre/BNEF 2018). It has been reported that China's investment in solar has since slowed with the government reducing its feed-in tariff rates for new projects (National Development and Reform Commission of the People's Republic of China 2018).

⁴ The following data sources were used for the country statistics: Climate Watch 2019 for emissions data, UN DESA n.d. for population data and UN 2017 for export and import data.

⁵ All exchange rates based on Reserve Bank of Australia as of 22 February 2019.

It is expected that, at current growth rates, wind power will also exceed its 2020 target, which will prompt the government to set a new and more ambitious target (National Energy Administration 2017).

China faces challenges with realising the potential of its investment in renewable energy. Overcapacity and transmission network issues have led to electricity generated from renewable sources not reaching consumers – for example, it is estimated that in the first half of 2016, 21 per cent of China's wind power did not reach consumers (Yi et al. 2018). This means the amount of energy consumed from renewable investments and the emissions reductions achieved may not be as great as they could be.

4.1.3. Emissions trading system

In December 2017, China announced a national emissions trading system, which is expected to be operational from 2020. While the system will initially cover only power generation, the Chinese Government has noted that the scheme will be expanded to other sectors when conditions allow (National Development and Reform Commission of the People's Republic of China 2017). Once the system reaches full coverage, it is expected to cover around 6,000 companies representing approximately 5 gigatonnes (Gt) CO₂ per year and would be the world's largest emission trading system (Jotzo et al. 2018). As part of China's 12th Five-Year Plan for National Economic and Social Development, China trialled pilot emissions trading schemes in five cities and two provinces (Government of China 2011).

4.1.4. Transport

Since 2004, China has had fuel economy standards for light vehicles (Yang & Bandivadekar 2017). China has also introduced measures to incentivise the use of electric vehicles including registration fee exemptions or discounts, purchase subsidies and investment in electric vehicle infrastructure (He et al. 2018). China is the biggest market for electric vehicles – representing over half of global electric vehicle sales in 2017–18 (Denning 2018).

4.1.5. Agriculture

China is the world's largest producer of rice and wheat. In China's 13th Five-Year Plan for Economic and Social Development, the country introduced a target to achieve zero growth in the use of fertilizer and pesticides by 2020 (Government of China 2015). This would have emissions reductions as well as other environmental and economic benefits. According to the Ministry of Agriculture, revised regulations and curbed production have since led to reductions in the use of fertilizer and pesticides and the target was met three years early. Nevertheless, the government plans to continue to implement policies to further reduce fertiliser and pesticide use (Ministry of Agriculture and Rural Affairs of the People's Republic of China 2018).

4.2. United States



- **Proportion of global emissions (2014):** 13%
- **Annual emissions per capita (2014):** 19.6 t CO₂-e
- **Paris Agreement commitment (by 2025):** Reduce emissions by 26 to 28% compared with 2005 levels
- **Proportion of Australia's exports (2014):** 4%; major exports include beef, professional services
- **Proportion of Australia's imports (2014):** 11%; major imports include tourism, motor vehicles

4.2.1. Federal policy

According to the US Environmental Protection Agency (EPA) (2018d), the US' emissions fell by 2.7 per cent between 2016 and 2017. This reduction has been attributed to technology breakthroughs (EPA 2018d) and increasing use of shale gas and renewable energy in place of coal.

The Trump Administration intends to withdraw from the Paris Agreement (The White House 2017) and is in the process of winding back many of the climate change policies implemented by the previous administration. For example, the Clean Power Plan, issued under the Clean Air Act in 2015, aimed to reduce emissions from the power sector by 32 per cent below 2005 levels by 2030 by setting targets for each state. However, in August 2018, the US Environmental Protection Agency proposed a replacement for the Clean Power Plan that would limit the plan to emissions reductions at individual power plants instead of setting a national emissions limit and allow states to set their own rules (US EPA 2018a).

The EPA has proposed relaxing regulations for oil and gas companies to report methane emissions (US EPA 2018b) and rescinding rules prohibiting the use of hydrofluorocarbons in air conditioners and refrigerators (US EPA 2018c). In passenger transport, Corporate Average Fuel Economy standards for light duty vehicles and trucks were to be progressively tightened to improve fuel efficiencies in the years 2017 to 2025, though the EPA has proposed to freeze these standards at 2020 levels (US EPA 2018e). The advisory committee with inter-agency responsibility for examining the impacts of climate change and proposing policy actions was also not extended (NOAA 2019).

4.2.2. Subnational policies

Many climate policy measures in the United States are being implemented at the subnational level. For example, a range of state governments, local governments and private-sector entities have announced pledges to reduce emissions consistent with the Paris Agreement's goals (Martinich et al. 2018). Five US cities have achieved their goals of 100 per cent renewable energy, ten states have zero-emissions vehicle targets, 29 states have mandatory renewable energy standards and nine have voluntary renewable energy targets (Bloomberg Philanthropies 2017). California's cap-and-trade scheme, launched in 2013, is one of the largest in the world. It is expected to lead to emissions reductions in covered entities (electricity generators, industrial facilities and petroleum and gas distributors) of 16 per cent between 2013 and 2020 (Center for Climate and Energy Solutions n.d.a). The US is also home to the Regional Greenhouse Gas Initiative, which was the first mandatory cap-and-trade program in the US and currently covers the power sectors in Connecticut, Delaware, Maine, Maryland, Massachusetts,

New Hampshire, New York, Rhode Island and Vermont. The initiative is expected to reduce power sector emissions in covered states by 45 per cent by 2020, relative to 2005 levels (Center for Climate and Energy Solutions n.d.b). Some states have also implemented policies to incentivise carbon farming. For example, Hawaii has established a Greenhouse Gas Sequestration Taskforce (State of Hawaii Office of Planning 2019).

4.3. European Union



- **Proportion of global emissions (2014):** 7%
- **Annual emissions per capita (2014):** 7.2 t CO₂-e
- **Paris Agreement commitment (by 2030):** Reduce emissions by 40% compared with 1990 levels
- **Proportion of Australia's exports (2014):** 4%; major exports include coal, gold, tourism
- **Proportion of Australia's imports (2014):** 17%; major imports include tourism, motor vehicles, medical products

4.3.1. The European Union (EU) Emissions Trading Scheme

The European Union Emissions Trading Scheme (EU ETS) is the centrepiece of the EU's climate policy. It operates in 31 countries (28 EU countries plus Iceland, Liechtenstein and Norway) and covers approximately 45 per cent of the EU's greenhouse gas emissions from over 11,000 installations, mainly power plants and industrial facilities, and aircraft operators (European Commission n.d.a). Its target is to reduce emissions from covered sectors by 21 per cent relative to 2005 levels by 2020 (European Commission n.d.c).

Since 2009, the EU ETS has experienced relatively low prices due to an oversupply of allowances caused by the economic downturn from the Global Financial Crisis (European Commission n.d.f). However, in early 2018, the EU decided to reform the EU ETS during Phase 4 (2021–2030). These reforms include faster reductions in the emissions cap and transferring some allowances to a Market Stability Reserve. Phase 4 of the EU ETS will include establishment of an "Innovation Fund", to be funded from the auctioning of at least 450 million allowances, to support the development of innovative renewable sources of energy, storage technologies, and "environmentally safe capture and geological storage of CO₂" (European Commission n.d.b, European Commission 2018). These reforms have already affected the price of EU ETS allowances, which rose strongly through 2018 to over A\$40/t CO₂-e with the average to 2030 forecast to be A\$37/t CO₂-e (Fjellheim 2018). In some EU countries, the EU ETS is complemented by an additional carbon tax. For example, the UK has a floor price of £18/t CO₂-e (A\$33/t CO₂-e) (Hirst 2018).

4.3.2. Fossil fuel use

Some EU countries have announced plans to phase out coal from the power sector. Phase out plans are in place in France (by 2021), Sweden (by 2022), the United Kingdom, Ireland, Italy and Austria (all by 2025), and Denmark, the Netherlands, Finland and Portugal (all by 2030). These plans cover 26 per cent of EU coal capacity (Climate Action Network 2017). Countries with the highest share of coal-fired power plants such as Germany and Poland (collectively covering about 50 per cent of EU coal capacity (Climate Action Network 2017)) have not yet taken decisions to phase out coal. However, in January 2019, a government-appointed commission in Germany made recommendations to phase out the country's coal-fired plants by 2038 (BMW i 2019). This is reported to have government support (Reuters 2019). The role of fuel switching from coal to natural gas remains a contentious issue in the EU with some countries wanting to continue to use natural gas while others want to completely phase-out fossil fuels. Some EU members have recently invested in long-lived gas infrastructure. For example, in 2018, construction started on the Nord Stream 2 gas pipeline to increase supply capacity of natural gas from Russia to Germany (Nord Stream 2 2018).

4.3.3. Renewable energy and transport

The EU has also announced a renewable energy auctioning system, which aims to increase the share of energy from renewables to at least 32 per cent of the EU's gross final energy consumption in 2030, with a clause allowing an upwards revision in 2023 (European Parliament 2018). In 2016, the estimated share of renewable energy in the EU's gross final energy consumption was 17 per cent (European Commission n.d.g). The European Union also has carbon dioxide emissions standards for light vehicles (European Commission n.d.d) and plans to introduce standards for heavy vehicles (European Commission n.d.e). As the transport sector (apart from aviation) is not covered by the EU ETS, member states have individual responsibility for reducing their transport emissions in accordance with Effort Sharing legislation. To meet emissions reduction requirements under that legislation, most member states have implemented additional measures to reduce transport emissions such as tax incentives for electric vehicles (ACEA 2018).

4.4. India



- **Proportion of global emissions (2014):** 7%
- **Annual emissions per capita (2014):** 2.5 t CO₂-e
- **Paris Agreement commitment (by 2030):** Lower carbon intensity by 33 to 35% compared with 2005 levels
- **Proportion of Australia's exports (2014):** 3%; major exports include coal, education
- **Proportion of Australia's imports (2014):** 1%; major imports include refined petroleum, tourism

4.4.1. Energy

India's population is growing and by 2024 India is expected to be the world's most populated country (UN DESA 2017). However, India is a long way from meeting its supply and energy security objectives and some 300 million Indians currently lack access to electricity, and about 500 million people are still dependent on solid biomass for cooking (DFAT 2018). Under its 24x7 Power for All program, the Government of India is working with the state and territory governments to achieve a reliable electricity supply by 2019, and with steady population and economic growth, India is expected to be home to the world's fastest growing electricity market over the coming years (IEA 2018a). India's air pollution, including from burning fossil fuels for energy, is among the world's worst (WHO 2018).

In its Nationally Determined Contribution (NDC), India has a target of 40 per cent non-fossil-based power capacity by 2030 (Government of India 2016) and was predicted to be on track to achieve this as early as the end of 2018 (Climate Action Tracker 2019). India released its National Electricity Plan in January 2018. This plan includes a renewable energy capacity target of 175 GW by 2022 (including wind, solar, bio-power and small hydro but excluding large hydro), which is approximately a three-fold increase on the 57 GW renewable energy capacity installed as of 2017 (Government of India CEA 2018).

Between now and 2030, India's coal consumption is expected to increase, although the proportion of energy generated from coal is expected to decline (DFAT 2018). Between July 2014 and October 2018, India installed over 24 GW of grid-connected solar, increasing total solar power capacity by a factor of more than nine (Government of India PIB 2018). Solar prices have dropped rapidly and in 2017, India invested more in renewable energy than in fossil-fuel power (IEA 2018b). This rapid deployment of renewables could provide India with large amounts of renewable energy quickly and India could face a situation where planned coal-fired generators become stranded assets (Climate Action Tracker 2019).

As set out in India's National Action Plan on Climate Change, energy efficiency improvements are a key component of India's energy sector transformation (Government of India MoEF 2008). The Perform Achieve Trade scheme has been in place since 2012 and places energy intensity targets on 621 energy-intensive enterprises. Between 2012 and 2015, it achieved emissions reductions of 31 Mt CO₂-e (Government of India, Ministry of Power BEE 2015).

The Indian Government is currently considering long-term growth strategies over the period 2030–2045 that would result in a decoupling of carbon emissions from economic growth (Climate Action Tracker 2019) (Box 3).

4.4.2. Transport, land use and carbon pricing

In 2015, India adopted fuel efficiency standards for passenger vehicles, which came into effect in 2017–18 (ICCT 2018). Fuel efficiency standards for heavy-duty vehicles commenced in April 2018 (ICCT 2017b). The Indian Government has set a target of increasing its carbon sink by 2.5 to 3 billion tonnes by 2030 (Government of India 2016). It plans to achieve this target through investment in biological means (such as planting vegetation), mechanical means (such as dams) to improve water catchments and prevent soil erosion, and an afforestation fund.

In 2017, India received an A\$11 million grant from The World Bank to design and pilot a carbon market (PMR 2017). It has been reported that a pilot market may be launched for micro, small and medium-sized enterprises and the waste sector in March 2019 (Climate Action Tracker 2019).

Box 3 Decoupling economic growth and emissions

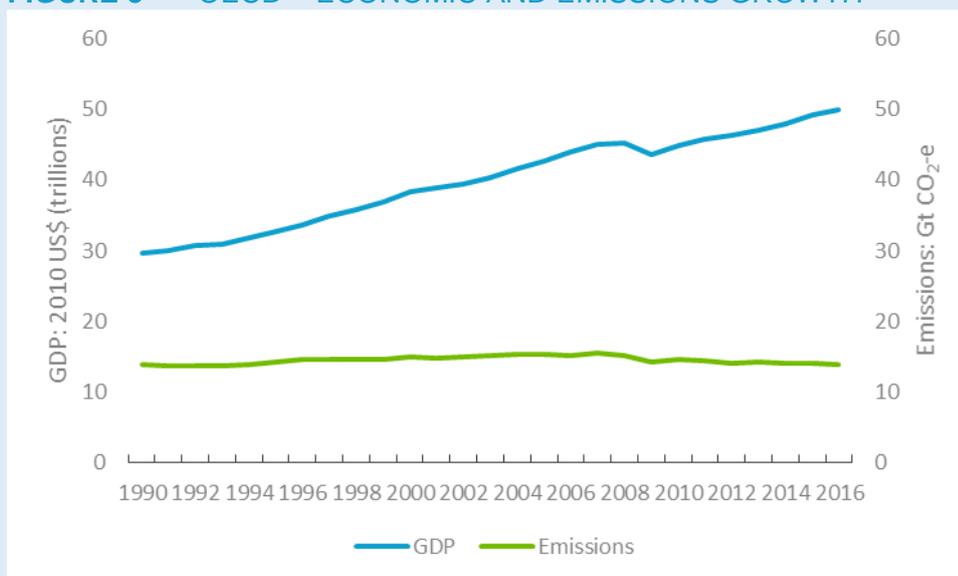
Historically there has been a strong link between economic growth and rising emissions. In recent times, however, the link has weakened. Analysis on the emissions intensity of gross domestic product by the International Monetary Fund (Cohen et al. 2018) concluded that there is evidence of decoupling of emissions from GDP in some countries, driven in part by policy.

The World Resources Institute (2016) notes that in the US, between 2010 and 2012, energy-related emissions fell by 6 per cent, while gross domestic product grew by 4 per cent. In the UK, between 2000 and 2014, energy-related emissions fell from 591 to 470 million tonnes, while gross domestic product grew from AU\$3.0 trillion to AU\$3.8 trillion (World Resources Institute 2016). China has achieved significant decoupling of emissions growth and economic growth. From 1990–2014, the emissions intensity of China’s economy declined by a factor of more than 8 (Climate Watch 2019, OECD.n.d.).

The World Resources Institute (2016) also finds that, since 2000, more than 20 countries have reduced their emissions while growing their economies. These countries are Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, The Netherlands, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, The Ukraine, The United Kingdom, The United States and Uzbekistan. The experiences of these 20 countries reveal that there is not a single formula for achieving this result. Rather, it has been achieved by a broad transition to cleaner modes of economic activity across a range of sectors.

Figure 3 illustrates the relationship between economic growth and emissions in OECD countries since 1990.

FIGURE 3 OECD – ECONOMIC AND EMISSIONS GROWTH



Source: OECD n.d.

4.5. Indonesia



- **Proportion of global emissions (2014):** 5%
- **Annual emissions per capita (2014):** 9.7 t CO₂-e
- **Paris Agreement commitment (by 2030):** 29% below business as usual, or 41% conditional on international support
- **Proportion of Australia's exports (2014):** 2%; major exports include crude petroleum, agricultural products, education
- **Proportion of Australia's imports (2014):** 2%; major imports include crude petroleum, tourism

4.5.1. Land-use, land-use change and forestry

Indonesia's emissions are dominated by emissions related to land, land-use change and forestry (LULUCF) and in 2014, Indonesia was responsible for around half of the world's LULUCF emissions (Climate Watch 2019). Indonesia's forestry-related emissions have increased in recent years as deforestation and land conversion rates increased (Climate Action Tracker 2019).

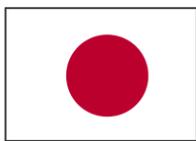
As part of its National Action Plan for Greenhouse Gas Emissions Reduction, Indonesia has identified mitigation actions in the forestry sector, including sustainable peat land management, reducing the deforestation and land degradation rate and developing carbon sequestration projects in forestry and agriculture (Republic of Indonesia 2015).

Indonesia has also introduced a mandate for biofuels use to reduce reliance on fossil fuels. The mandate establishes a target of 30 per cent biofuel blending for transport, industry, and electricity production from 2020 to 2025 (Kharina et al. 2016). This is one of the most ambitious biofuel blending mandates in the world. However, the demand for biofuels may be met by expanding domestic palm oil industries and reducing forest cover, which could have offsetting emissions impacts.

4.5.2. Energy

Indonesia's National Energy Policy includes a target to increase the share of renewable energy as a proportion of total capacity from 6 per cent in 2013 to 23 per cent in 2025 and 31 per cent in 2050. The Plan also aims to reduce the share of electricity from oil from 41 per cent of total capacity in 2013 to 25 per cent in 2025 and less than 20 per cent in 2050. The share of electricity from coal is expected to remain constant at 30 per cent of capacity to 2025 (Republic of Indonesia 2014, Republic of Indonesia Ministry of Energy and Mineral Resources 2017).

4.6. Japan



- **Proportion of global emissions (2014):** 3%
- **Annual emissions per capita (2014):** 10.3 t CO₂-e
- **Paris Agreement commitment (by 2030):** Reduce emissions by 26% compared with 2013 levels
- **Proportion of Australia's exports (2014):** 18%; major exports include coal, iron ore, beef
- **Proportion of Australia's imports (2014):** 7%; major imports include motor vehicles, refined petroleum, tourism

Under its Nationally Determined Contribution (NDC), Japan is striving for the following electricity generation fuel mix in 2030: 20–22 per cent nuclear energy, 22–24 per cent renewable energy and the remaining 56 per cent from fossil fuel sources (Government of Japan Ministry of the Environment n.d.).

4.6.1. Carbon tax and energy efficiency

In 2012, the Japanese Government introduced a carbon tax, which is applied to all domestic and imported fossil fuels (crude oil and petroleum, gas and coal), to curb greenhouse gas emissions by 80 per cent by 2050 relative to 2012. The current tax rate is capped at 289 Yen (A\$3.68) per tonne of emissions, having been increased incrementally since 2012. This scheme is projected to reduce emissions by between 6 to 24 Mt CO₂ in 2020 (Government of Japan Ministry of the Environment 2012).

In 2010, the Tokyo Metropolitan Government implemented a cap and trade program, which applies to large energy users and requires commercial and industrial facilities to reduce their emissions by 17 and 15 per cent respectively between 2015 and 2019 (Tokyo Metropolitan Government 2018).

Energy efficiency has been a key focus in Japan's energy policy. The government has a target to improve energy efficiency by 35 per cent by 2030 compared with 2012 levels (Government of Japan Ministry of Economy, Trade and Industry 2015). It plans to achieve this through a broad range of measures across all sectors including mandatory energy efficiency standards and LED lighting installations.

4.6.2. Renewable energy and hydrogen

Renewable energy, particularly solar, has grown steadily in recent years. Japan is projected to overachieve its 22–24 per cent 2030 renewable energy target with existing policies (Climate Action Tracker 2019).

Renewable energy has been supported through feed-in-tariffs and funding for distribution networks. The feed-in-tariff scheme has led to a twelve-fold growth in addition of solar capacity since its introduction (Kimura 2017).

Japan is also championing the use of hydrogen from low emissions sources and has committed to becoming a 'hydrogen society'. Japan aims to have 1,200 hydrogen fuel cell buses and 800,000 fuel cell passenger vehicles on the road by 2030 (Government of Japan Ministry of Economy, Trade and Industry 2018). Hydrogen is being actively promoted for the 2020 Tokyo Olympics, and it has been dubbed the "hydrogen Olympics" (Government of Japan 2016). An A\$509 million fund has been allocated to encourage the development of hydrogen-based technologies and infrastructure. Japan's

transition to hydrogen is likely to require significant hydrogen imports given its expected reliance on energy imports will continue (Commonwealth of Australia 2018).

4.6.3. Nuclear

After the 2011 Fukushima nuclear disaster, the Japanese Government committed to reducing its reliance on nuclear energy and all reactors were shut down pending safety improvements. However, since then nine reactors have been restarted and another six have been approved for restart (U.S. EIA 2018). Japan's generation mix remains uncertain as operators and the Japanese Government faces ongoing public opposition and legal challenges to the restart of reactors (BNEF 2017). It is unclear how this will develop over the coming years and what the implications will be for Japan's emissions profile.

4.6.4. Transport

Japan has had fuel economy standards for light vehicles since 1979 and standards have been progressively tightened since then. Revised standards will come into effect in 2020, and will apply to passenger vehicles, small freight vehicles, small buses and heavy vehicles (Government of Japan Ministry of Land, Infrastructure, Transport and Tourism 2008).

In 2018, the government set a target that electric or hydrogen fuel cell vehicles should make up 50 to 70 per cent of domestic new sales by 2030 (Government of Japan Ministry of Economy, Trade and Industry 2018). The government has implemented incentives, including subsidies and tax breaks, to encourage uptake and support research and development into electric and hydrogen fuel cell vehicles.

4.6.5. Carbon offsets

Japan has also developed a standard for certifying domestic emissions reductions and creating credits, known as the J-Credit Scheme, from afforestation and forest management as well as emissions reduction projects. These are primarily used for voluntary carbon offsetting and corporate social responsibility activities (Japan Credit 2019). Japan also runs an international system called the Joint Crediting Mechanism where it works with developing countries to reduce their emissions. Japan determines that these emissions reductions are a contribution by both countries and Japan plans to use its contribution against its international targets (Ministry of Foreign Affairs of Japan 2018).

4.7. Republic of Korea



- **Proportion of global emissions (2014):** 1%
- **Annual emissions per capita (2014):** 12.5 t CO₂-e
- **Paris Agreement commitment (by 2030):** Reduce emissions by 37% below business as usual
- **Proportion of Australia's exports (2014):** 7%; major exports include coal, iron ore, beef
- **Proportion of Australia's imports (2014):** 5%; major imports include ships, refined petroleum, motor vehicles

4.7.1. Climate related policy

The Republic of Korea has some of the fastest growing emissions in the OECD, driven largely by growth in manufacturing for export markets (Kim et al. 2015). In 2008, the Republic of Korea adopted a National Strategy for Green Growth (2009–2050), to drive economic growth through the development and deployment of low-carbon technologies and clean energy. Since then, the Republic of Korea has implemented many policies to support these goals. The Republic of Korea has also developed a 2030 roadmap to guide the implementation of its NDC and sets indicative national and sectoral emissions targets at three yearly intervals (Republic of Korea Ministry of Environment 2017).

4.7.2. Emissions trading scheme

The industry sector is expected to deliver the largest share of emissions reductions required to meet the Republic of Korea's Nationally Determined Contribution (NDC) and the national emissions trading scheme is the principal policy to achieve the 2030 target. The scheme was launched in 2015 and covers about 600 of the country's largest emitters and around 68 per cent of national emissions (ADB 2018). For 2017, carbon was trading at approximately 21,000 South Korean Won/t CO₂-e (A\$26.30/t CO₂-e) (Korea Energy Corporation Industrial and Power Generation Emissions Trading Scheme 2017).

4.7.3. Energy

In December 2017, the Korean government released a new 15-year Plan for Electricity Supply and Demand. This plan aims to increase the share of renewable electricity generation from 6 per cent in 2017 to 20 per cent in 2030 and the share of electricity generation from gas from 17 per cent in 2017 to 19 per cent in 2030. It also aims to reduce the share of nuclear electricity generation from 30 per cent in 2017 to 24 per cent in 2030, and phase out nuclear power in the long term. The plan aims to reduce the share of coal-fired generation from 45 per cent in 2017 to 36 per cent in 2030 and does not foresee any additional coal-fired plants being constructed to meet future required capacity (Republic of Korea Ministry of Trade, Industry and Energy 2017).

4.7.4. Transport

The Republic of Korea has emissions standards for light vehicles (ICCT 2015). It is also encouraging the uptake of electric vehicles through subsidies and investment in charging infrastructure (APEC 2017).

4.8. Canada



- **Proportion of global emissions (2014):** 2%
- **Annual emissions per capita (2014):** 24.3 t CO₂-e
- **Paris Agreement commitment (by 2030):** Reduce emissions by 30% compared with 2005 levels
- **Proportion of Australia's exports (2014):** <1%
- **Proportion of Australia's imports (2014):** <1%

4.8.1. Carbon pricing

Canada's Pan-Canadian Framework on Clean Growth and Climate Change, announced in 2016, contains proposals for economy-wide measures to reduce emissions, including a carbon pricing plan. Under the carbon pricing component of the framework, all provinces were required to introduce emissions pricing through a cap and trade scheme or a price-based scheme like a carbon tax or a performance based system by the end of 2018. A federal carbon pricing system now applies in those provinces that did not implement their own scheme. The federal carbon price applies to all heavy-emitting facilities and is set at CA\$20/t CO₂-e (A\$21) for 2019 (Government of Canada 2018a). In some states that have their own carbon pricing scheme, the carbon price is higher. For example, the carbon tax in British Columbia is set at CA\$40/t CO₂-e (A\$42) in 2019 (Government of British Columbia n.d.). The Government of Canada (2019a) estimates that its carbon pricing system will reduce Canada's emissions by 50 to 60 million tonnes from 2018 levels in 2022. The framework also includes an A\$2.1 billion low-carbon economy fund, which supports provinces and organisations to meet their emissions reduction commitments (Government of Canada 2019b).

4.8.2. Coal-fired power

The framework also plans the phase out of traditional coal-fired power plants by 2030 (Government of Canada 2016). In 2018, the Canadian Government passed regulations requiring all coal-fired power plants to comply with an emissions performance standard of 420 t CO₂/GWh by 2030 (Government of Canada 2018b). In 2016, 9 per cent of Canada's electricity was generated from coal (Natural Resources Canada 2018).

Canada is home to one of the world's largest commercial-scale coal-fired carbon capture, use and storage projects. The Boundary Dam coal-fired generator with carbon capture, use and storage has the capacity to capture 90 per cent of its emissions and to date has captured almost 2.5 Mt CO₂ (SaskPower 2019a, b). It received A\$256 million in Federal Government funding (Natural Resources Canada 2016)

4.8.3. Transport

Canada has carbon dioxide vehicle emissions standards for light and heavy vehicles (Government of Canada 2013, 2014). The government is also investing in infrastructure to support the uptake of low emissions vehicles (Government of Canada 2019c).

4.9. New Zealand



- **Proportion of global emissions (2014):** 0.1%
- **Annual emissions per capita (2014):** 13.2 t CO₂-e
- **Paris Agreement commitment (by 2030):** Reduce emissions by 30% compared with 2005 levels
- **Proportion of Australia's exports (2014):** 3%; major exports include tourism, aluminium
- **Proportion of Australia's imports (2014):** 3%; major imports include tourism, food products

4.9.1. Climate change policy

The New Zealand Government has recently announced that taking strong climate action is one of its top priorities (New Zealand Government 2018b). New Zealand is developing a Zero Carbon Act to legislate New Zealand's 2050 target to achieve carbon neutrality. This Act establishes a Climate Commission that will set five year carbon budgets to reach the target (Zero Carbon Act NZ 2017). In 2018, New Zealand's Productivity Commission released a report focusing on how New Zealand can reach net zero emissions most efficiently. The report found that New Zealand will need to substitute fossil fuels for clean electricity in the transport and industry sectors and shift land use, including in ways to allow more trees to be planted (New Zealand Productivity Commission 2018).

4.9.2. Emissions trading scheme, forestry and agriculture

New Zealand's main tool for reducing emissions is the New Zealand Emissions Trading Scheme, which was launched in 2008 and covers all sectors, except agriculture (Leining & Kerr 2018). The cost of units under the scheme is currently capped at NZ\$25/t CO₂-e (A\$24) (New Zealand Government 2018a). The forestry sector is allowed to generate credits as forests grow and sequester carbon (Leining & Kerr 2018).

New Zealand also plans to plant 1 billion trees between 2018 and 2027 by enhancing existing activities with grant funding (New Zealand Government MPI 2019). New Zealand's emissions profile is dominated by the agriculture sector, which accounts for nearly half of total emissions. Government efforts to reduce emissions from the sector are focused on research into mitigation technologies (New Zealand Government MFE 2018).

4.9.3. Renewable electricity

New Zealand has a target to increase renewable energy to 90 per cent of electricity by 2025 (New Zealand Government MBIE 2011). Currently, over 80 per cent of New Zealand's electricity generation comes from renewable sources, mostly hydropower. Approximately 15 per cent of its electricity comes from natural gas and three per cent from coal (New Zealand Government MBIE 2018).

4.9.4. Transport

The transport sector is covered by the New Zealand Emissions Trading Scheme (Leining & Kerr 2018). The Government also has a program to increase the uptake of electric vehicles through road user charges exemptions, support for charging infrastructure and consumer education (New Zealand Government Ministry of Transport 2018).

5. INTERNATIONAL COLLECTIVE ACTION

5.1. International cooperation

A range of international initiatives and fora sit alongside the Paris Agreement to facilitate cooperation on climate action. This includes international initiatives such as the Green Climate Fund, Mission Innovation, the Global Carbon Capture, Use, and Storage Institute, the International Solar Alliance, the International Partnership for Blue Carbon, the Asia-Pacific Rainforest Partnership, the Climate and Clean Air Coalition, the Global Forest Observation Initiative, the NDC Partnership and the Energy Transition Hub. These initiatives aim to achieve a range of climate change policy objectives, include different countries and have different funding commitments and profiles. International cooperation is also progressed through a range of international fora including the One Planet Summit, the Asia-Pacific Rainforest Summit, the Clean Energy Ministerial and the Global Climate Action Summit. Fora and summits often bring world leaders and Heads of State together and can galvanise greater ambition on climate action. The Authority's stocktake of Australian climate change policies outlines Australia's participation in some of these initiatives.

Under the 2009 Copenhagen Accord, developed country Parties to the UNFCCC committed to a goal of jointly mobilising US\$100 billion (A\$141 billion) a year by 2020 from public and private sources to support climate action in developing countries. The UNFCCC's 2018 Biennial Assessment of Climate Finance found that climate finance provided and mobilised by developed countries for developing countries reached about US\$70 billion in 2016 (A\$99 billion) (UNFCCC Standing Committee on Finance 2018). If climate finance flows continue to increase at current rates, it is anticipated that the US\$100 billion a year goal will be met (DFAT 2016). One of the major initiatives providing climate finance to developing countries is the Green Climate Fund (Box 4).

Box 4 The Green Climate Fund

The Green Climate Fund was established as part of the 2010 Cancun Agreements to help developing countries limit or reduce their emissions and adapt to climate change. It is a major source of finance for developing countries seeking to address climate change and a central component of developed countries' commitments to provide developing countries with US\$100 billion per year by 2020 in climate finance.

As of May 2018, the Green Climate Fund has received US\$10.3 billion (A\$14.5 billion) in pledges from 43 governments (Green Climate Fund 2018b). However, as well as withdrawing from the Paris Agreement, the US said it would stop contributing to the Green Climate Fund (The White House 2017). While the US pledged US\$3 billion (A\$4.2 billion), it has only paid US\$1 billion (A\$1.4 billion) (Green Climate Fund 2018b). Between 2015 and 2018, Australia provided A\$200 million to the Green Climate Fund (DFAT n.d.). Australia has announced that it does not plan to contribute to the Green Climate Fund above this commitment (Prime Minister of Australia 2018).

As of December 2018, the Green Climate Fund has committed US\$4.6 billion (A\$6.5 billion) for 93 projects around the world (Green Climate Fund 2018a). These projects include grants, loans, guarantees and equity positions in a range of climate related projects in developing countries. Projects cover a range of sectors including renewable energy, energy efficiency, transport, water management, food security, land management, forestry, and agriculture.

5.2. Climate action by non-state actors

Subnational and non-state actors such as cities, states, regions, companies, investors, foundations and civil society organisations often play an important role in meeting national emissions targets. They can also help to raise national ambition by building confidence in national governments' climate policies through advocacy and policy dialogue.

These actors often pledge climate action through networks or partnerships. Some initiatives require members to pledge specific commitments or targets, or to submit regular emissions inventories. Others focus on peer-to-peer knowledge sharing and capacity-building. Two examples of climate action by non-state actors are the C40 Cities Initiative and Mission Innovation's Breakthrough Energy Coalition. The C40 Cities Initiative connects over 90 cities that are committed to delivering on the most ambitious goals of the Paris Agreement at the local level as well as improving local air quality (C40 Cities 2019). The Breakthrough Energy Coalition is a group of private investors that aims to invest in better, more efficient and cheaper energy sources. The group has established a fund to build new companies that will link government funded research to sources of capital so that more clean energy innovation gets to market faster.

In 2017, the Taskforce on Climate-related Financial Disclosures, an industry-led initiative set up by the G20's Financial Stability Board published its recommendations for companies to disclose their climate-related financial risks (TCFD 2017). The Authority's stocktake of industry action will discuss how Australian companies are responding to these recommendations.

6. ASSESSING GLOBAL PROGRESS

This section provides an overview of recent assessments of global progress in reducing emissions and meeting the Paris Agreement's temperature goals.

6.1. UN Environment's 2018 Emissions Gap report

UN Environment's 2018 Emissions Gap Report was released on 27 November 2018 (UN Environment 2018). It finds that while most G20 countries are on track to meet their 2020 targets, the majority are not on a pathway to meet their 2030 targets or uncertainty around their progress remains. Table 3 provides an overview of various countries' progress to meeting their 2020 and 2030 targets as outlined in the UN Environment's 2018 report. A country's progress in meeting its emissions reduction targets depends on a range of factors including the extent of policy action, anticipated versus actual economic, population and emissions outcomes, and the ambition of the target itself.

While it was noted in Chapter 2 that UN Environment (2018) estimates that current emissions targets are consistent with global warming of around 3°C by 2100, that same analysis indicates that there is uncertainty as to whether those targets will be met and therefore warming may be even greater (UN Environment 2018). Details about the actions key countries are taking to meet targets are summarised in Chapter 4.

TABLE 3 UN ENVIRONMENT'S ASSESSMENT OF COUNTRIES' PROGRESS ON MEETING TARGETS

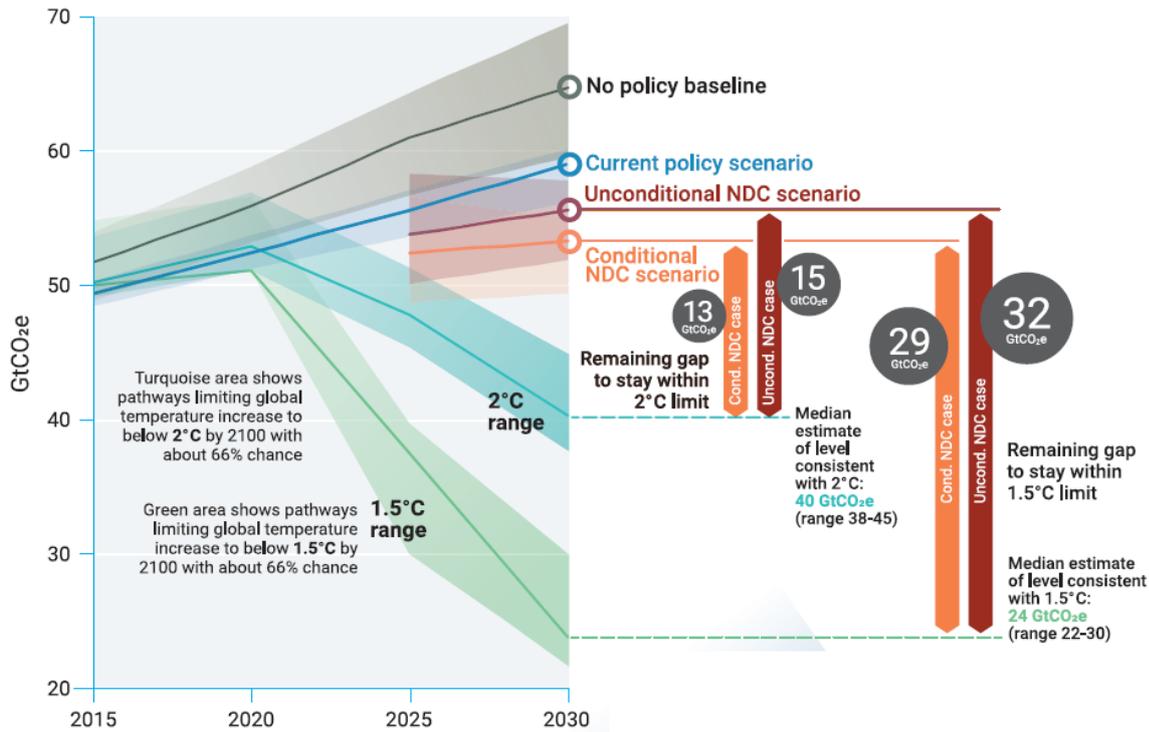
Country/ region	Progress on Cancun pledges (2020)	Progress on Paris Agreement commitments (2030)
China	On track	On track
United States	Uncertain	Not on track (2025 target)
European Union	On track	Not on track
India	On track	On track
Indonesia	Uncertain	Uncertain
Russian Federation	On track	On track
Brazil	On track	On track
Japan	On track	On track
Mexico	Uncertain	Uncertain
Republic of Korea	Not on track	Not on track
Canada	Not on track	Not on track

Source: UN Environment 2018

UN Environment (2018) global peaking of emissions by 2020 is crucial for achieving the Paris Agreement's temperature goals, yet global emissions show no sign of peaking. Global emissions from energy and industry increased in 2017, following a three-year period of stabilisation, and total emissions reached a record high of 53.5 Gt CO₂-e, an increase of 0.7 Gt CO₂-e compared with 2016. The report notes that global emissions in 2030 need to be approximately 25 and 55 per cent lower than in 2017 to put the world on a least-cost pathway to limiting global warming to 2°C and 1.5°C respectively (UN Environment 2018).

The global emissions gap between 2030 emissions consistent with conditional Nationally Determined Contributions (NDCs) and levels consistent with the Paris Agreement's temperature goal of 2°C warming is estimated to be at least 13 Gt CO₂-e or 24 per cent of current global emissions (UN Environment 2018). Figure 4 shows global greenhouse gas emissions under different scenarios and the projected emissions gap in 2030.

FIGURE 4 GLOBAL EMISSIONS PATHWAYS UNDER DIFFERENT SCENARIOS AND THE EMISSIONS GAP IN 2030



Source: UN Environment 2018

The report also notes the emissions gap could be bridged through the use of currently available technologies, such as greater deployment of wind and solar power and energy efficient appliances and cars, and increasing forest cover through afforestation and stopping deforestation. Further, actions by non-state and subnational actors play an important role and fiscal policy can create strong incentives for investment to reduce emissions (UN Environment 2018).

6.2. The International Energy Agency's 2018 World Energy Outlook

The International Energy Agency's 2018 World Energy Outlook was released on 13 November 2018. One aspect of this report models energy systems and emissions pathways under a Sustainable Development Scenario (aligned with the Paris Agreement's temperature goals) and a New Policies Scenario (that includes all current and announced government policies including NDCs) from 2017 to 2040.

The report finds the world is a long way from meeting the Paris Agreement's temperature goals. Under the New Policies Scenario, emissions continue to rise to 2040. The global energy-related emissions

gap between the Sustainable Development and New Policies scenarios is 18.3 Gt CO₂-e in 2040 (56 per cent of current energy-related emissions) (IEA 2018c).

Based on the analysis, to achieve the outcomes of the Sustainable Development Scenario, compared with the New Policies Scenario, the power sector would need to deploy more low-emissions generation and do so more quickly. The share of renewables would need to rise from one-quarter today to two-thirds in 2040 in the global power mix, from 10 per cent today to 25 per cent in the provision of heat, and from 3.5 per cent today to 19 per cent in transport (IEA 2018c).

7. CONCLUSION

The Paris Agreement is a significant milestone, where all countries have committed to reducing emissions to limit global warming to well below 2°C and to pursue efforts to limit the temperature increase to 1.5°C. Under the Agreement, countries have submitted emissions reduction targets.

This stocktake of international action on climate change shows countries have taken different approaches to their targets and the policies to meet them. The policies introduced include renewable energy targets, carbon pricing, fuel economy standards and subsidies for low emissions technologies. The range of approaches to climate change policy around the world reflects the diversity in economic structures, natural resources, political appetite and emissions profiles.

As reflected in UN Environment's 2018 Emissions Gap Report, progress on reducing emissions is being made in many countries around the world. The report found some countries are on target to reach their Paris Agreement commitments, while others have more work to do. However, the report also concludes that current emissions targets are consistent with global warming of around 3°C by 2100 and warming may be even greater if those targets are not met (UN Environment 2018). If the Paris Agreement's temperature goals are to be reached, countries will need to continue implementing policies to reduce emissions and increase the ambition of their emissions reduction targets over time.

GLOSSARY

allowances	A tradeable instrument generated under an emissions trading scheme, usually representing one tonne of greenhouse gas emissions reduced relative to baseline emissions.
business as usual (BAU) emissions	Emissions that would occur without any additional policy intervention.
Cancun Agreements	Reached on December 11 in Cancun, Mexico, at the 2010 United Nations Climate Change Conference, the Cancun Agreements established a goal for reducing human-generated greenhouse gas emissions to keep the global average temperature rise below two degrees and major economies committed to submit emissions reduction commitments.
carbon capture, use and storage (CCUS)	Technologies that capture carbon dioxide emissions from energy production or industrial processes, and use it, such as for enhanced oil recovery, or inject it below the land or the sea into underground geological formations.
carbon dioxide-equivalent (CO ₂ -e)	A measure that quantifies different greenhouse gases in terms of the amount of carbon dioxide that would deliver the same global warming.
carbon dioxide removal	A process that removes greenhouse gases from the atmosphere. For example, reforestation, soil enhancement to increase soil carbon, or biomass energy with carbon capture and storage (where biomass is burned to generate energy and the carbon dioxide emissions are captured and stored underground).
co-benefits	Benefits that arise from the introduction of a policy in addition to its main purpose. An example is health benefits from emissions standards for power plants.
Doha Amendment	The Doha Amendment refers to the changes made to the Kyoto Protocol in 2012, after the First Commitment Period of the Kyoto Protocol concluded. The Amendment adds new emissions reduction targets for the Second Commitment Period (2013–2020) for participating developed countries
emissions intensity	A measure of the amount of emissions associated with a unit of output; for example, emissions per unit of gross domestic product or electricity production.
global stocktake	The global stocktake will review the implementation of the Paris Agreement and “assess the collective progress” towards the collectively agreed goals. The first global stocktake will occur in 2023, and stocktakes will be carried out every five years thereafter.
global warming	A warming of global average temperatures caused by increased atmospheric concentrations of greenhouse gases. This warming results in changes to the climate system.
greenhouse gas	Any gas (natural or produced by human activities) that absorbs infrared radiation in the atmosphere. Key greenhouse gases include carbon dioxide, water vapour, nitrous oxide, methane and ozone.
Intergovernmental Panel on Climate Change (IPCC)	Scientific intergovernmental body that produces reports that support the United Nations Framework Convention on Climate Change, which is the main international treaty on climate change.
Kyoto Protocol	An international agreement adopted under the United Nations Framework Convention on Climate Change in 1997. It includes binding national targets for developed countries and flexible mechanisms including the Clean Development Mechanism (CDM).
land use (land use, land-use change and forestry) emissions and removals	Emissions and emissions removals associated with human-induced changes in land use, such as deforestation and afforestation, and those arising from management of forests, crop lands and rangelands and savanna burning.
net zero emissions	When greenhouse gas emissions released are balanced by an equivalent quantity removed from the atmosphere or offset.
Nationally Determined Contributions (NDCs)	Under the Paris Agreement, countries have put forward NDCs, which outline efforts by each country to reduce national emissions including emissions reduction targets, and adapt to the impacts of climate change.

offset	A verified emissions reduction in comparison to a baseline. That reduction could be used to balance ('offset') other emissions.
Paris Agreement	An international agreement adopted under the United Nations Framework Convention on Climate Change in 2015. Under the Paris Agreement, the global temperature goal is to keep warming to 'well below' 2 degrees Celsius compared with pre-industrial levels, and to 'pursue efforts to limit the temperature rise to 1.5 degrees'.
temperature goal	A goal set by the Parties to the UNFCCC to limit global warming with the aim of avoiding dangerous climate change.
renewable energy target	A type of technology pull policy that creates a market for additional renewable electricity that supports investment in new renewable capacity.
United Nations Framework Convention on Climate Change (UNFCCC)	An international treaty that commits signatory countries (known as Parties) to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human-induced interference with the climate system.

REFERENCES

Asian Development Bank (ADB) 2018, *The Korea Emissions Trading Scheme: Challenges and Emerging Opportunities*, ADB, Manila.

Asia-Pacific Economic Cooperation (APEC) 2017, *The Impact of Government Policy on Promoting New Energy Vehicles (NEVs) – the Evidence in APEC Economies*, APEC, Singapore.

Australian Energy Market Operator (AEMO) 2019, *National Electricity Market* viewed 4 February 2019, <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM>.

BloombergNEF (BNEF) 2017, *Kansai Electric Jumps as Court Paves Way for Restarts*, 28 March viewed 22 February 2019, <https://about.bnef.com/blog/japan-nuclear-reactor-halt-overtuned-by-higher-court-nhk>.

Bloomberg Philanthropies 2017, *America's Pledge Phase 1 Report: States, Cities, and Businesses in the United States Are Stepping Up on Climate Action*.

Bundesministerium für Wirtschaft und Energie (BmWi) 2019, *Abschlussbericht -Kommission „Wachstum, Strukturwandel und Beschäftigung“*, BmWi, Frankfurt am Main.

C40 Cities 2019, *About* viewed 4 February 2019, <https://www.c40.org/about>.

Center for Climate and Energy Solutions n.d.a, *California Cap and Trade* viewed 21 February 2019, <https://www.c2es.org/content/california-cap-and-trade/>.

Center for Climate and Energy Solutions n.d.b, *Regional Greenhouse Gas Initiative (RGGI)* viewed 21 February 2019, <https://www.c2es.org/content/regional-greenhouse-gas-initiative-rggi/>.

Centre for International Economics and the CM Group 2017, *Trade competitiveness and international carbon policies*, AIGN, Canberra.

Climate Action Network 2017, *Coal phaseout plans* viewed 4 February, <https://beyond-coal.eu/data/>.

Climate Action Tracker 2019, *Home* viewed 4 February 2019, <https://climateactiontracker.org/>.

Climate Change Authority (CCA) 2015, *Comparing Countries' Emissions Targets, A Practical Guide*, CCA, Melbourne.

CCA 2016, *Towards a climate policy toolkit: special review on Australia's climate goals and policies*, CCA, Melbourne.

Climate Watch 2019, *Data Explorer* viewed 4 February 2019, <https://www.climatewatchdata.org/data-explorer/historical-emissions?historical-emissions-data-sources=31&historical-emissions-gases=131&historical-emissions-qwps=1&historical-emissions-regions=All%20Selected&historical-emissions-sectors=377&page=1>.

Cohen, G, Jalles, JT, Loungani, P & Marto, R 2018, *IMF Working Paper: The Long-Run Decoupling of Emissions and Output: Evidence from the Largest Emitters*, IMF, Washington DC.

Commonwealth of Australia 2012, *Submission under the Kyoto Protocol: Quantified Emission Limitation or Reduction Objective (QELRO)*, November 2012.

Commonwealth of Australia 2018, *Hydrogen for Australia's future – A briefing paper for the COAG Energy Council*, Prepared by the Hydrogen Strategy Group, August 2018.

Denning, L 2018, *For Electric Cars, Focus on the Small Picture*, 31 August viewed 20 February 2019, Bloomberg Opinion, <https://www.bloomberg.com/opinion/articles/2018-08-30/electric-car-sales-watch-the-small-picture>.

Department of Foreign Affairs and Trade (DFAT) 2016, *Roadmap to US\$100 billion*, DFAT, Canberra.

DFAT 2018, *An India Economic Strategy to 2035 – Navigating from Potential to Delivery*, DFAT, Canberra.

European Automobile Manufacturers Association (ACEA) 2018, *Overview on tax incentives for electric vehicles in the EU* viewed 22 February 2019, https://www.acea.be/uploads/publications/EV_incentives_overview_2018.pdf.

European Commission 2018, *Expert group on the Innovation Fund 10 March* viewed 22 February 2019, https://ec.europa.eu/clima/events/expert-group-innovation-fund_en.

European Commission n.d.a, *EU Emissions Trading System (EU ETS)* viewed 21 February 2019, https://ec.europa.eu/clima/policies/ets_en.

European Commission n.d.b, *Revision for phase 4 (2021-2030)* viewed 21 February 2019, https://ec.europa.eu/clima/policies/ets/revision_en.

European Commission n.d.c, *2020 climate & energy package* viewed 22 February 2019, https://ec.europa.eu/clima/policies/strategies/2020_en.

European Commission n.d.d, *Reducing CO2 emissions from passenger cars* viewed 22 February 2019, https://ec.europa.eu/clima/policies/transport/vehicles/cars_en.

European Commission n.d.e, *Reducing CO2 emissions from heavy-duty vehicles* viewed 22 February 2019, https://ec.europa.eu/clima/policies/transport/vehicles/heavy_en.

European Commission n.d.f, *Market Stability Reserve* viewed 4 February 2019, https://ec.europa.eu/clima/policies/ets/reform_en.

European Commission n.d.g, *Renewable Energy – Moving towards a low carbon economy* viewed 19 February 2019, <https://ec.europa.eu/energy/en/topics/renewable-energy>.

European Parliament 2018, *Energy: new target of 32% from renewables by 2030 agreed by MEPs and ministers*, 14 June viewed 4 February 2019, <http://www.europarl.europa.eu/news/es/press-room/20180614IPR05810/energy-new-target-of-32-from-renewables-by-2030-agreed-by-meps-and-ministers>.

Fjellheim, H 2018, *Will high European carbon prices last?*, 12 December viewed 21 February 2019, Refinitiv, <https://www.refinitiv.com/perspectives/market-insights/will-high-european-carbon-prices-last/>.

Frankfurt School-UNEP Centre/BNEF 2018, *Global trends in Renewable Energy Investment 2018*, Iberglobal, Frankfurt am Main.

Global Carbon Project 2019, *Global Carbon Budget- Summary Highlights* viewed 13 February 2019, <https://www.globalcarbonproject.org/carbonbudget/18/highlights.htm>.

REFERENCES

Government of British Columbia n.d., *British Columbia's Carbon Tax* viewed 26 February 2019, <https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/carbon-tax>.

Government of Canada 2013, *Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations: SOR 2013-24*, *Canada Gazette*, Volume 147, Number 6.

Government of Canada 2014, *Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations: SOR/2014-207*, *Canada Gazette*, Volume 148, Number 21.

Government of Canada 2016, *The Government of Canada accelerates investments in clean electricity*, 21 November viewed 4 February 2019, <https://www.canada.ca/en/environment-climate-change/news/2016/11/government-canada-accelerates-investments-clean-electricity.html>.

Government of Canada 2018a, *Implementing Canada's plan to address climate change and grow the economy – Putting a Price on Carbon Pollution – Technical Briefing*, 23 October viewed 25 February 2019, <https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution/technical-briefing.html>.

Government of Canada 2018b, *Regulations Amending the Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations: SOR/2018-263*, *Canada Gazette, Part II*, Volume 152, Number 25.

Government of Canada 2019a, *Fall 2018 update: Estimated impacts of the federal pollution pricing system* viewed 14 February 2019, <https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/fall-2018-update-estimated-impacts-federal-pollution-pricing-system.html>.

Government of Canada 2019b, *The Low Carbon Economy Fund* viewed 25 February 2019, <https://www.canada.ca/en/environment-climate-change/services/climate-change/low-carbon-economy-fund.html>.

Government of Canada 2019c, *Transportation 2030: Green and Innovative Transportation* viewed 25 February 2019, <https://www.tc.gc.ca/eng/future-transportation-canada-green-innovative-transportation.html>.

Government of China 2011, *Outline of the Twelfth Five-Year Plan for Economic and Social Development* viewed 22 February 2019, http://www.gov.cn/2011lh/content_1825838.htm.

Government of China 2015, *The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China (2016-2020)*, Central Compilation and Translation Press, Beijing.

Government of China 2016, *The 13th Five-year Plan for Energy Development*, Beijing.

Government of India 2016, *India's Intended Nationally Determined Contribution: Working Towards Climate Justice*, UNFCCC.

Government of India Central Electricity Authority (CEA) 2018, *National Electricity Plan (Volume 1) Generation*.

Government of India Ministry of Environment, Forest and Climate Change (MoEF) 2008, *National Action Plan on Climate Change (NAPCC)*.

Government of India, Ministry of Power Bureau of Energy Efficiency (BEE) 2015, *PAT-Read more* viewed 22 February 2019, <https://beeindia.gov.in/content/pat-read-more>.

- Government of India Press Information Bureau (PIB) 2018**, *Year End Review 2018 – MNRE*, 10 December viewed 22 February 2019, <http://www.pib.nic.in/Pressreleaseshare.aspx?PRID=1555373>.
- Government of Japan 2016**, *Tokyo Aims to Realize “Hydrogen Society” by 2020 – Metro Government Undertakes Pioneering Initiative* viewed 25 February 2019, https://www.japan.go.jp/tomodachi/2016/spring2016/tokyo_realize_hydrogen_by_2020.html.
- Government of Japan Ministry of Economy, Trade and Industry 2015**, *Long-term Energy Supply and Demand Outlook*.
- Government of Japan Ministry of Economy, Trade and Industry 2018**, *Strategic Energy Plan*.
- Government of Japan Ministry of the Environment 2012**, *Details on the Carbon Tax (Tax for Climate Change Mitigation)*, Environmental Taxation Team, Tokyo.
- Government of Japan Ministry of the Environment n.d.**, *Submission of Japan's Intended Nationally Determined Contribution* viewed 22 February 2019, <https://www.env.go.jp/en/earth/cc/2030indc.html>.
- Government of Japan Ministry of Land, Infrastructure and Transport 2008**, *About automobile fuel efficiency target standard* viewed 25 February 2019, http://www.mlit.go.jp/jidosha/jidosha_fr10_000005.html.
- Green Climate Fund 2018a**, *GFC replenishment wins strong endorsement at COP24*, 13 December 2018 viewed 22 February 2019, <https://www.greenclimate.fund/news/gcf-replenishment-wins-strong-endorsement-at-cop24>.
- Green Climate Fund 2018b**, *Status of the Pledges and Contributions made to the Green Climate Fund, Status Date: 8 May 2018*, viewed 22 February 2019, https://www.greenclimate.fund/documents/20182/24868/Status_of_Pledges.pdf/eef538d3-2987-4659-8c7c-5566ed6afd19.
- Guan, D, Meng, J, Reiner, DM, Zhang, N, Shan, Y, Mi, Z, Shao, S, Liu, Z, Zhang, Q, Davis, SJ 2018**, ‘Structural decline in China’s CO2 emissions through transitions in industry and energy systems’, *Nature Geoscience*, vol 11, 551-555.
- He, H, Jin, L, Cui, H, Zhou, H 2018**, *Assessment of Electric Car Promotion Policies in Chinese Cities*, ICCT, Washington.
- Hirst, D 2018**, *Briefing Paper Number 05927, 8 January 2018: Carbon Price Floor (CPF) and the price support mechanism*, House of Commons Library, London.
- International Council on Clean Transportation (ICCT) 2015**, *Light-duty vehicle efficiency standards (Korea Factsheet)* viewed 25 February 2019, https://www.theicct.org/sites/default/files/Korea_PVstds-facts_jan2015.pdf.
- ICCT 2017a**, *2017 Global Update – Light-duty vehicle greenhouse gas and fuel economy standards*, ICCT, Washington.
- ICCT 2017b**, *Policy Update – Fuel consumption standards for heavy-duty vehicles in India* viewed 22 February 2019, https://www.theicct.org/sites/default/files/publications/ICCT_India-HDV-fuel-consumption_policy-update_20171207.pdf.

REFERENCES

- ICCT 2018**, *Briefing- Compliance with India's first fuel-consumption standards for new passenger cars (FY 2017-2018)* viewed 22 February 2019, https://www.theicct.org/sites/default/files/publications/India_fuel_consumption_standards_20180925.pdf
- International Energy Agency (IEA) 2016**, *Energy efficiency market report 2016*, IEA.
- IEA 2017a**, *IEA finds CO₂ emissions flat for third straight year even as global economy grew in 2016*, 17 March viewed 25 February 2019, <https://www.iea.org/newsroom/news/2017/march/iea-finds-co2-emissions-flat-for-third-straight-year-even-as-global-economy-grew.html>.
- IEA 2017b**, *World Energy Outlook 2017: China*, viewed 4 February 2019, <https://www.iea.org/weo/china/>
- IEA 2018a**, *The Year of Electricity at the IEA*, 16 April viewed 22 February 2019, <https://www.iea.org/newsroom/news/2018/april/the-year-of-electricity-at-the-iea.html>.
- IEA 2018b**, *World Energy Investment 2018*, IEA.
- IEA 2018c**, *World Energy Outlook 2018*, IEA.
- IEA 2019**, *Global Renewable Energy – IEA/IRENA Joint Policies and Measures database* viewed 22 February 2019, <https://www.iea.org/policiesandmeasures/renewableenergy/>.
- Intergovernmental Panel on Climate Change (IPCC) 2018**, *Global Warming of 1.5°C, an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, IPCC, Geneva.
- Japan Credit 2019**, *J-Credit Scheme – February 2019* viewed 26 February 2019, https://japancredit.go.jp/english/pdf/credit_english_001_31.pdf.
- Jiang, K, He, C, Zhuang, X, Liu, J, Gao, J, Xu, X, Chen, S 2016**, 'Scenario and Feasibility Study for Peaking CO₂ Emission from Energy Activities in China', *Progress in Climate Change Research*, vol 12 (3), 167-171.
- Jotzo, F, Karplus, V, Grubb, M, Löschel, A, Neuhoff, K, Wu, L, Teng, F 2018**, 'China's emissions trading takes steps towards big ambitions', *Nature Climate Change*, vol 8, 265-267.
- Kharina, A, Malins, C and Searle, S, 2016**, *Biofuels policy in Indonesia: Overview and status report*, ICCT.
- Kim, Y, Yoo, J & Oh, W 2015**, 'Driving forces of rapid CO₂ emissions growth: A case of Korea', *Energy Policy* vol 82, 144-155.
- Kimura, K 2017**, *Feed-in Tariffs in Japan: Five Years of Achievements and Future Challenges*, Renewable Energy Institute, Tokyo.
- Korea Energy Corporation Industrial and Power Generation Emissions Trading Scheme 2017**, *Emissions Trading System* viewed 25 February 2019, http://ets.energy.or.kr/WEBSITE/WEB_main/main.aspx.
- Leining, C & Kerr S 2018**, *A guide to the New Zealand Emissions Trading Scheme*, Ministry for the Environment, Wellington.

Martinich, J, BJ, DeAngelo, D, Diaz, B, Ekwurzel, G, Franco, C, Frisch, J, McFarland & O'Neil, B 2018, *Reducing Risks through Emissions Mitigation, In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*, U.S. Global Change Research Program, pp 1346-1386.

Ministry of Agriculture and Rural Affairs of the People's Republic of China 2018, *Minister Han Changfu: China caps fertilizer, pesticide use and increases efficiency*, 03 March viewed 22 February 2019, http://english.agri.gov.cn/news/dqnf/201803/t20180320_295943.htm.

Ministry of Foreign Affairs of Japan 2018, *Climate Change - Joint Crediting Mechanism (JCM)* viewed 25 February 2019, https://www.mofa.go.jp/ic/ch/page1we_000105.html.

National Development and Reform Commission of the People's Republic of China 2018, *Notice on matters related to photovoltaic power generation in 2018* viewed 27 February 2019, http://www.ndrc.gov.cn/gzdt/201806/t20180601_888639.html.

National Energy Administration 2017, *National Energy Administration on renewable energy development - Guiding Opinions on the Implementation of the 13th Five-Year Plan* viewed 22 February 2019, http://zfxxgk.nea.gov.cn/auto87/201707/t20170728_2835.htm.

National Ocean and Atmospheric Administration (NOAA) 2019, *Advisory Committee for the Sustained National Climate Assessment* viewed 22 February 2019, <https://sncaadvisorycommittee.noaa.gov>.

Natural Resources Canada 2016, *Boundary Dam Integrated Carbon Capture and Storage Demonstration Project* viewed 28 February 2019 <https://www.nrcan.gc.ca/energy/publications/16235>.

Natural Resources Canada 2018, *Electricity facts* viewed 28 February 2019, <https://www.nrcan.gc.ca/energy/facts/electricity/20068>.

New Zealand Government 2018a, *Government announces set of improvements to New Zealand's Emissions Trading Scheme*, 12 December viewed 25 February 2019, <https://www.beehive.govt.nz/release/government-announces-set-improvements-new-zealand%E2%80%99s-emissions-trading-scheme>.

New Zealand Government 2018b, *Priorities for a modern and fairer NZ*, 16 September 2018 viewed 25 February 2019, <https://www.beehive.govt.nz/release/priorities-modern-and-fairer-nz>.

New Zealand Government Ministry of Business, Innovation and Employment (MBIE) 2011, *New Zealand Energy Strategy 2011-2021 and the New Zealand Energy Efficiency and Conservation Strategy 2011-2016: Developing our energy potential*, MBIE, Wellington.

New Zealand Government MBIE 2018, *Energy in New Zealand 18*, MBIE, Wellington.

New Zealand Government Ministry for the Environment (MFE) 2018, *The transition to a low-emissions and climate-resilient Aotearoa New Zealand* viewed 25 February 2019, <http://www.mfe.govt.nz/climate-change/what-government-doing/climate-change-programme>.

New Zealand Government Ministry for Primary Industries (MPI) 2019, *Tracking progress of the One Billion Trees Programme* viewed 25 February 2019, <https://www.mpi.govt.nz/funding-and-programmes/forestry/planting-one-billion-trees/tracking-progress-of-the-one-billion-trees-programme/>.

REFERENCES

- New Zealand Government Ministry of Transport 2018**, *Electric vehicles* viewed 25 February 2019, <https://www.transport.govt.nz/multi-modal/climatechange/electric-vehicles/>.
- New Zealand Productivity Commission 2018**, *Low-emissions economy: Final report*.
- Nord Stream 2 2018**, *Pipelay of the Nord Stream 2 Pipeline has started in Finland*, 5 September viewed 22 February 2019, <https://www.nord-stream2.com/media-info/news-events/pipelay-of-the-nord-stream-2-pipeline-has-started-in-finland-106/>.
- Organisation for Economic Co-operation and Development (OECD) n.d.**, *OECD.Stat* viewed 4 February 2019, <https://stats.oecd.org/>.
- Partnership for Market Readiness (PMR) 2017**, *India to Pilot Carbon Pricing Instruments with \$8 Million PMR Support* 28 March viewed 21 February 2019, <https://www.thepmr.org/content/india-pilot-carbon-pricing-instruments-8-million-pmr-support>.
- Powering Past Coal Alliance (PPCA) 2018**, *Members* viewed 5 February 2019, https://poweringpastcoal.org/about/Powering_Past_Coal_Alliance_Members.
- Republic of Indonesia 2015**, *Presidential Regulation of Indonesia, Number 61 of 2011, National Action Plan for Greenhouse Gas Emissions Reductions*.
- Republic of Indonesia 2014**, *Government Regulation of the Republic of Indonesia Number 79 of 2014 on National Energy Policy*.
- Republic of Indonesia Ministry of Energy and Mineral Resources 2017**, *Country Report – Electricity Sector in Indonesia* viewed 28 February 2019, <https://eneken.ieej.or.jp/data/7390.pdf>.
- Republic of Korea Ministry of Environment 2017**, *Greenhouse Gas Reduction Road Map* viewed 25 February 2019, <http://eng.me.go.kr/eng/web/index.do?menuId=212>.
- Republic of Korea Ministry of Trade, Industry and Energy 2017**, *Notice of the 8th Basic Plan for Long-term Electricity Supply and Demand (2017-2031)*, Seoul.
- Reserve Bank of Australia (RBA) 2019**, *Exchange Rates* viewed 25 February 2019, <https://www.rba.gov.au/statistics/frequency/exchange-rates.html>.
- Reuters 2019**, *Germany's Merkel signals support for 2038 coal exit deadline*, February 5 viewed 26 February 2019, <https://www.reuters.com/article/us-germany-energy-coal/germanys-merkel-signals-support-for-2038-coal-exit-deadline-idUSKCN1PU0BV>.
- SaskPower 2019a**, *BD3 Status Update: December 2018*, January 11 viewed 25 February 2019, <https://www.saskpower.com/about-us/our-company/blog/bd3-status-update-december-2018>.
- SaskPower 2019b**, *Boundary Dam Carbon Capture Project* viewed 25 February 2019, <https://www.saskpower.com/our-power-future/infrastructure-projects/carbon-capture-and-storage/boundary-dam-carbon-capture-project>.
- State of Hawaii Office of Planning 2019**, *Greenhouse gas sequestration task force* viewed 22 February 2019, <http://planning.hawaii.gov/carbon-farming-task-force/>.
- Task Force on Climate-related Financial Disclosures (TCFD) 2017**, *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures (June 2017)*, FSB, Basel.

The White House 2017, *Statement by President Trump on the Paris Climate Accord*, 1 June 2017 viewed 21 February 2019, <https://www.whitehouse.gov/briefings-statements/statement-president-trump-paris-climate-accord/>.

The World Bank 2019a, *Carbon Pricing Dashboard* viewed 5 February 2019, <https://carbonpricingdashboard.worldbank.org/>.

The World Bank 2019b, *CO2 emissions (kg per PPP \$ of GDP)* viewed 21 February 2019, <https://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD?locations=CN>.

Tokyo Metropolitan Government 2018, *Tokyo Cap-and-Trade Program* viewed 26 February 2019, http://www.metro.tokyo.jp/english/topics/2016/161116_01.html.

United Nations (UN) 2017, *UN Comtrade Database* viewed 4 February 2019, <https://comtrade.un.org/>

UN Department of Economic and Social Affairs (DESA) 2017, *World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100*, 21 June viewed 4 February 2019, <https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html>.

UN DESA n.d., *World Population Prospects 2017* viewed 28 February 2019, <https://population.un.org/wpp/>

UN Environment 2018, *The Emissions Gap Report 2018*, United Nations Environment Programme, Nairobi.

United Nations Framework Convention on Climate Change (UNFCCC) 2019, *Paris Agreement – Status of Ratification* viewed 13 February 2019, <https://unfccc.int/process/the-paris-agreement/status-of-ratification>.

UNFCCC n.d., *NDC Registry (interim)* viewed 13 February 2019, <https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>.

UNFCCC Standing Committee on Finance 2018, *2018 Biennial Assessment and Overview of Climate Finance Flows – Technical Report*, UNFCCC, Bonn.

U.S. Energy Information Administration (EIA) 2018, *Japan has restarted five nuclear power reactors in 2018*, November 28 viewed 20 February 2019, <https://www.eia.gov/todayinenergy/detail.php?id=37633>.

U.S. EIA n.d., *International* viewed 22 February 2019, <https://www.eia.gov/beta/international>.

US Environmental Protection Agency (EPA) 2018a, *Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program*.

US EPA 2018b, *Proposed Improvements 2016 New Source Performance Standards*, viewed 22 February 2019, <https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/proposed-improvements-2016-new-source>.

US EPA 2018c, *Revised Section 608 Refrigerant Management Regulations*, viewed 22 February 2019, <https://www.epa.gov/section608/revised-section-608-refrigerant-management-regulations>.

REFERENCES

- US EPA 2018d**, *Data Shows Decrease in U.S. Greenhouse Gas Emissions During Trump's First Year in Office*, 17 October viewed 25 February 2019, <https://www.epa.gov/newsreleases/data-shows-decrease-us-greenhouse-gas-emissions-during-trumps-first-year-office>.
- US EPA 2018e**, *The Safer Affordable Fuel-Efficient (SAFE) Vehicles Proposed Rule for Model Years 2021-2026*, viewed 4 February 2019, <https://www.epa.gov/regulations-emissions-vehicles-and-engines/safer-affordable-fuel-efficient-safe-vehicles-proposed>.
- World Health Organisation (WHO) 2018**, *Global ambient air pollution* viewed 22 February 2019, <http://maps.who.int/airpollution/>.
- World Resources Institute 2016**, *The Roads to Decoupling: 21 Countries Are Reducing Carbon Emissions While Growing GDP*, 5 April viewed 4 February 2019, <https://www.wri.org/blog/2016/04/roads-decoupling-21-countries-are-reducing-carbon-emissions-while-growing-gdp>.
- Yang, Z & Bandivadekar, A 2017**, *2017 Global Update: Light-duty Vehicle Greenhouse Gas and Fuel Economy Standards*, ICCT, Washington.
- Yi, Q, Lu, J & Zhu, M 2018**, *Wind Curtailment in China and Lessons from the United States*, Brookings-Tsinghua Center for Public Policy.
- Zero Carbon Act NZ 2017**, *Zero Carbon Act Summary* viewed 25 February 2019, <https://zerocarbonact.nz/zca-summary/>.