CLIMATE COUNCIL

THE GLOBAL RENEWABLE ENERGY BOOM: HOW AUSTRALIA IS MISSING OUT

The Climate Council is an independent, crowd-funded organisation providing quality information on climate change to the Australian public.

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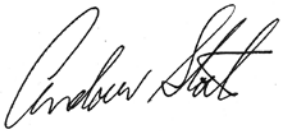

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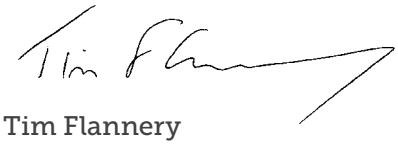

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Key Findings

1. **Renewable energy is booming globally, with strong growth in investment and jobs. In contrast, though, Australian jobs and investment in the renewable sector have fallen sharply.**

   - In 2014, clean energy investment grew in China (32%), the US (8%), Japan (12%), Germany (3%) and the UK (3%); however it fell 35% in Australia (with investment in large-scale renewable energy falling 88%), due to policy uncertainty.
   - 800,000 jobs were created in the renewable energy sector globally between 2012 and 2013. In 2014, the US solar industry added over 31,000 new solar jobs, an increase of 21.8% on the previous year. Jobs in the renewable energy sector fell by 13% in Australia in 2013 while global employment grew by the same amount.
   - The global boom is a lasting shift, with greater investment now flowing into new renewable energy capacity than other energy sources, including coal.

2. **An important driver for the global renewable energy acceleration is the steep decline in costs of wind and solar. Hundreds of thousands of Australian households have benefited with solar PV panel prices falling 75% in the last 5 years.**

   - In the period 2009 – 2014, global wind power costs fell 14% and solar module photovoltaic (PV) prices fell 75%. 1.4 million Australian homes have solar installed.
   - Solar PV costs are projected to fall another 45% over the next five years, which would make it the cheapest form of electricity generation in many parts of the world.
   - Globally, renewable energy is now cost-comparative or cheaper than fossil fuels for generating electricity.

3. **Countries with consistent long-term renewable energy policies are attracting growth.**

   - Countries with a clear, consistent, long-term energy strategy and specific policy initiatives are the most likely to attract substantial private investment. On the other hand, instability, uncertainty or changes in policy measures can negatively affect perceived sovereign risk, in turn resulting in low levels of investment.
   - In 2014, Australia and Italy experienced reduced investment in renewable energy as a result of regulatory changes and uncertainty.

4. **Australia has excellent renewable energy resources, but is missing out on the global renewable boom due to policy uncertainty and threats to wind back the Renewable Energy Target.**

   - Australia is the sunniest country in the world and one of the windiest; it has enough renewable energy resources to power the country 500 times over.
   - In Australia, Federal Government threats to wind back the Renewable Energy Target, multiple reviews of that target, and on-going debate, has substantially undermined investor confidence.

Contents

Introduction

There is now a massive body of evidence that climate change is having ever more negative impacts on human society and the environment (IPCC 2014). Climate change is increasing the frequency and severity of many extreme weather events. Heatwaves are becoming hotter, lasting longer and occurring more often, while the risk of bushfires and damage from storm surges is increasing. The impacts are wide spread and include negative effects on human health, agriculture, tourism, food security, water security and infrastructure resilience. The Climate Council has produced numerous reports on the impacts of climate change accessible on our website (www.climatecouncil.org.au).

"Climate change is happening with grave implications for humanity."

Tackling climate change requires substantial and sustained reductions of carbon dioxide (CO2) emissions and decarbonising the Australian economy. Burning fossil fuels for electricity production is the largest source of greenhouse gas emissions driving climate change. In fact, electricity and heat production represent a quarter of global greenhouse gas emissions (IPCC 2014).

"Fossil fuel emissions, from coal, oil and gas, are the largest source of greenhouse gases driving climate change."

Moving away from fossil fuels requires substantial growth in other non-carbon energy sources and renewable energy is an important solution. Solar and wind have become increasingly popular sources of energy world-wide as they have dropped dramatically in cost and governments are searching for solutions to air pollution and climate change. Most scenarios for stabilising greenhouse gas emissions rely on the world transitioning away from fossil fuels to renewable sources of energy (IPCC 2014).

"Renewable energy is an important solution to climate change."

In 2013 195 countries, including Australia, committed to limit global temperature rise to below 2°C above the pre-industrial levels (UNFCCC 2010). A 2°C rise in global temperature is considered a threshold that should not be crossed due to the likelihood of devastating consequences for humanity. Scientists have used the 2°C "guardrail" to model a carbon budget, that is, how much fossil fuels can be burnt while having a good chance of staying below a 2°C rise in temperature. Stabilising the climate at livable levels requires the vast majority of the world's fossil fuel reserves to be left in the ground, unburned. Globally, about 88% of the coal reserves must not be mined (McGlade and Ekins 2015). This fact underpins how critically important it is for the fossil fuel intensive economies to move rapidly to renewable energy. Research shows that to stabilise

global temperatures below 2°C by the end of this century requires a tripling to quadrupling of renewable and other zero or low emissions energy by the year 2050 (IPCC 2014).

"The vast majority of coal reserves cannot be burnt."

Australia is one of the ten biggest emitters of greenhouse gases from electricity and heat production, and our subcritical coal powerplant fleet is the most carbon intensive in the world (OECD/IEA 2013; Caldecott et al 2015). For Australia to take cost-effective action consistent with warming of no more than 2°C the emissions intensity of the electricity sector needs to be greatly reduced (Climate Change Authority 2014a).

Australia has huge renewable energy resources as the sunniest country in the world and one of the windiest. Australia's potential for renewable energy generation is 500 times greater than current power generation capacity. ClimateWorks Australia (2014) has modelled multiple energy scenarios for Australia staying within its carbon budget. Every scenario envisages a minimum of 50% renewable power by 2030 and an economy powered primarily by renewable energy by 2050. Each of the modelled scenarios maintains the current structure of the Australian economy, economic growth at current levels and only uses technology available today. This research, as well as other research such as the Garnaut Review (2011), demonstrate that it is necessary and possible to quickly move to source substantially more energy from renewable sources.

"Australia is the sunniest country in the world and one of the windiest."

Given that renewable energy will be such a crucial part of the Australian and global energy mix, the Climate Council has produced this report to provide an update on policy and progress on renewable energy across the globe. It explores policy measures, capacity additions, investment and costs.

"Australia is the 15th largest emitter of greenhouse gases worldwide."

The report focuses particularly on the Group of Twenty (G20) major economies, of which Australia is a member. The G20 accounts for three quarters (76%) of global carbon dioxide emissions (Yao et al 2014), and includes 18 countries among the 20 largest emitters of carbon dioxide, as well as the European Union (Global Carbon Project 2014). Australia is the 15th largest emitter of greenhouse gases worldwide, larger than 170 other countries (Climate Change Authority 2014b). The only member of the G20 not among the top twenty emitters is Argentina (Global Carbon Project 2014). The focus of this report is on energy and electricity generation, it does not discuss renewable heating, transport or fuels in detail.

1. THE GLOBAL BOOM: MORE RENEWABLE ENERGY, MORE INVESTMENT, MORE JOBS

Renewable energy growth is surging globally. In just a decade investment has increased 5 times and the world installed 760 GW of renewable power – 12 times Australia's total capacity. Following on from the boom in investment and capacity there has been substantial jobs growth. Around 800,000 new jobs were created in renewable energy between 2012 and 2013. This chapter gives an overview of this global surge.

1.1 Total renewable energy capacity

Globally, renewable energy's contribution to global capacity and generation has climbed steadily upwards (Table 1).

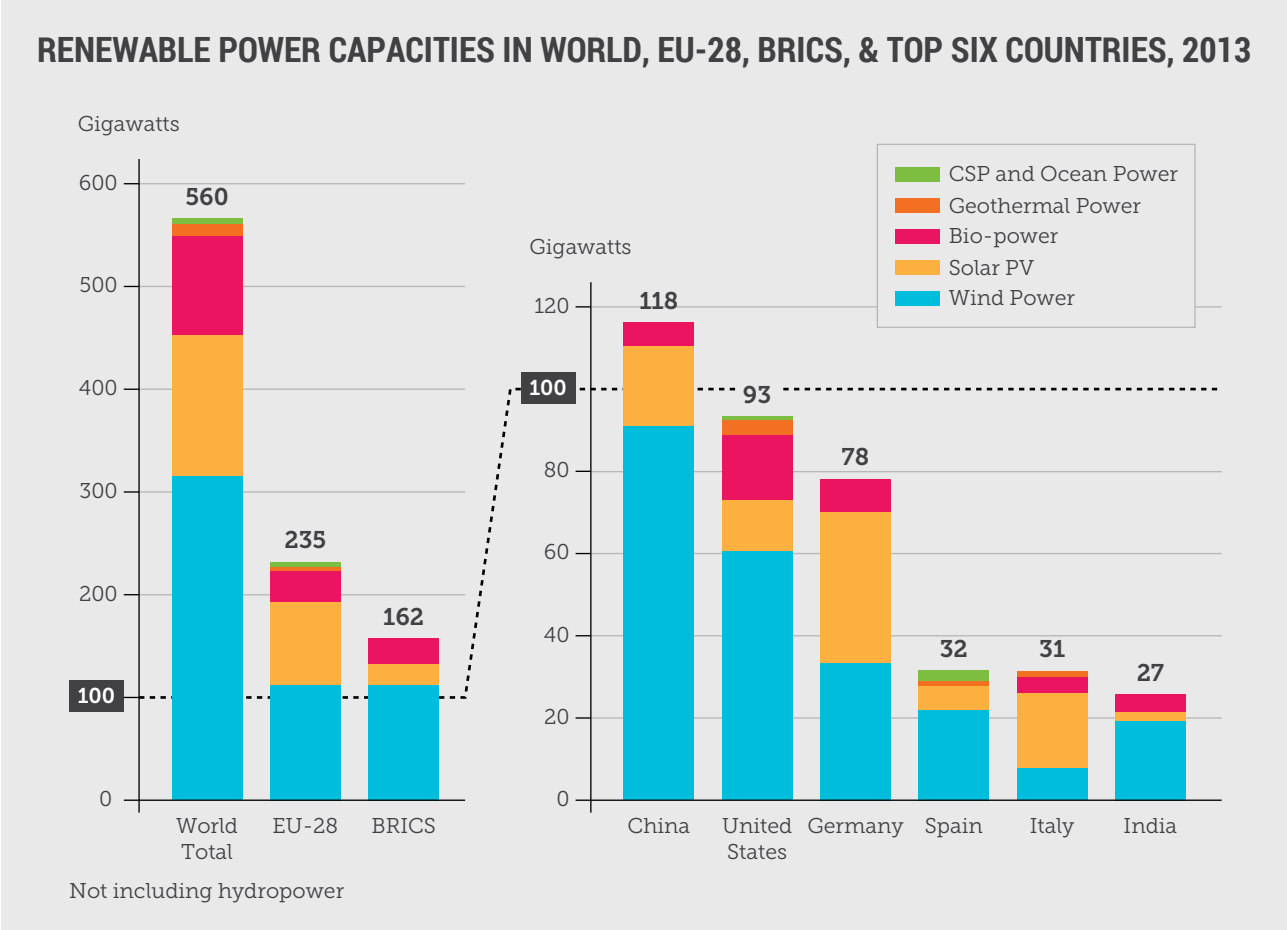
Table 1: Global renewable energy investment, capacity and generation 2004–2014

Year	2004	2012	2013	2014
Investment in clean energy	US$ 60.2 billion	US$ 286.2 billion	US$ 268.1 billion (fell 11%)	US$ 310 billion (up 16%)
Cumulative installed GW	800 GW	1,440 GW	1,560 GW (up 8%)	*
Proportion of global electricity capacity	21.1%	26%	26.4%	*
Proportion of global electricity generation	18.3%	21.7%	22.1%	*

Sources: REN21 2005; IEA 2006; BNEF 2014; REN21 2014; BNEF 2015
Note: the fall in investment in 2013 was in part due to rapid renewable energy cost reductions, particularly for solar and wind (REN21 2014). *Figures for 2014 installed capacity and proportion of generation are not yet available

At the end of 2013, China, US, Brazil, Canada, Germany led the world in total installed renewable energy capacity (REN21 2014). When hydroelectricity is taken out of the equation, the top countries become China, US, Germany, Spain, Italy and India (Figure 1).

Figure 1: Top six countries for (non-hydro) renewable power capacity

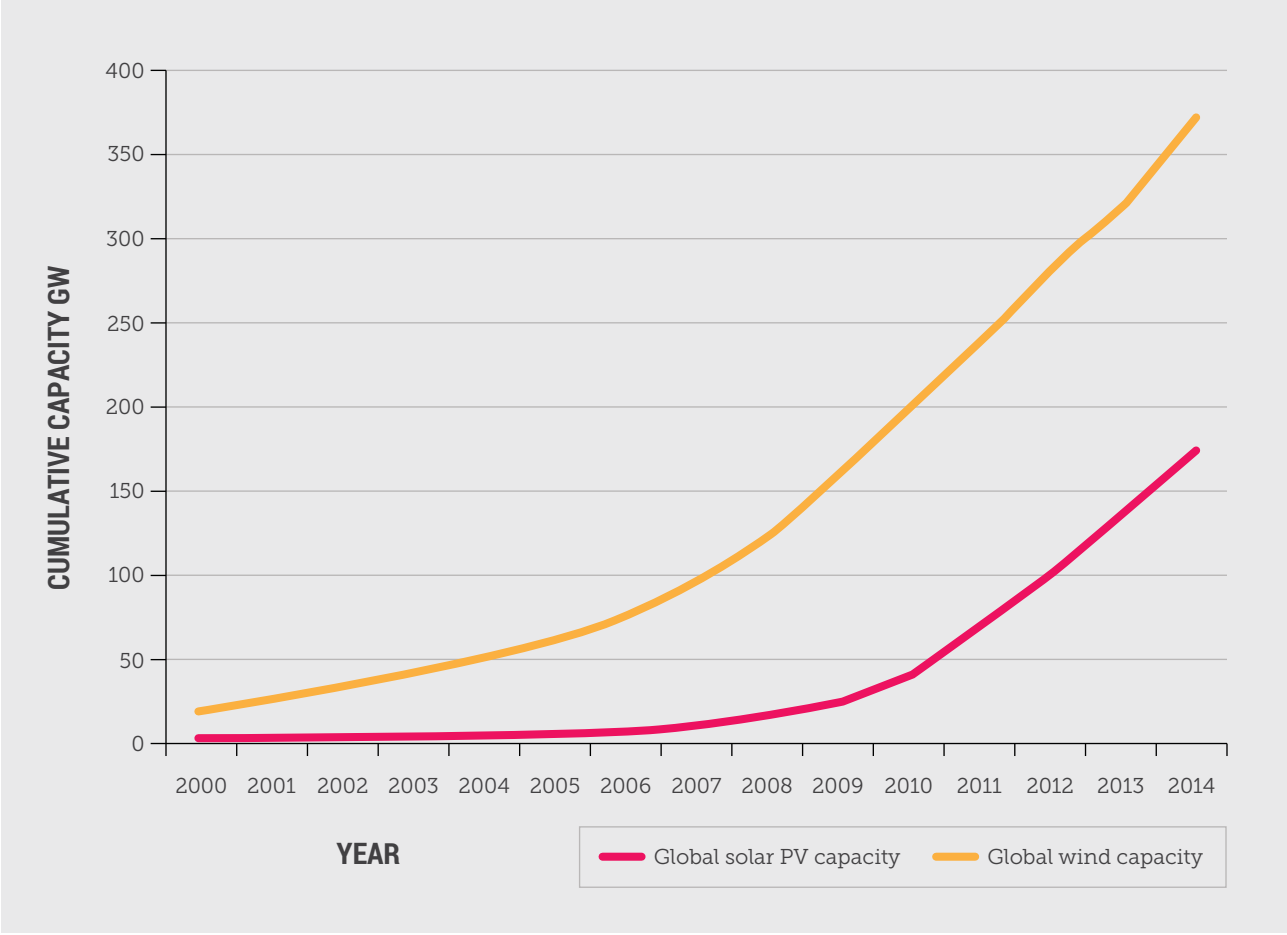


Source: REN21 2014

"Global wind and solar capacity is growing exponentially."

Global wind and solar capacity is growing exponentially (EPIA 2014; GWEC 2015; Figure 2). High levels of growth are projected to continue with more than 35 GW of solar PV (in low growth scenarios) and more than 51 GW of wind power added every year until 2018 (EPIA 2014; GWEC 2015).

Figure 2: Global wind and solar capacity 2000 – 2014



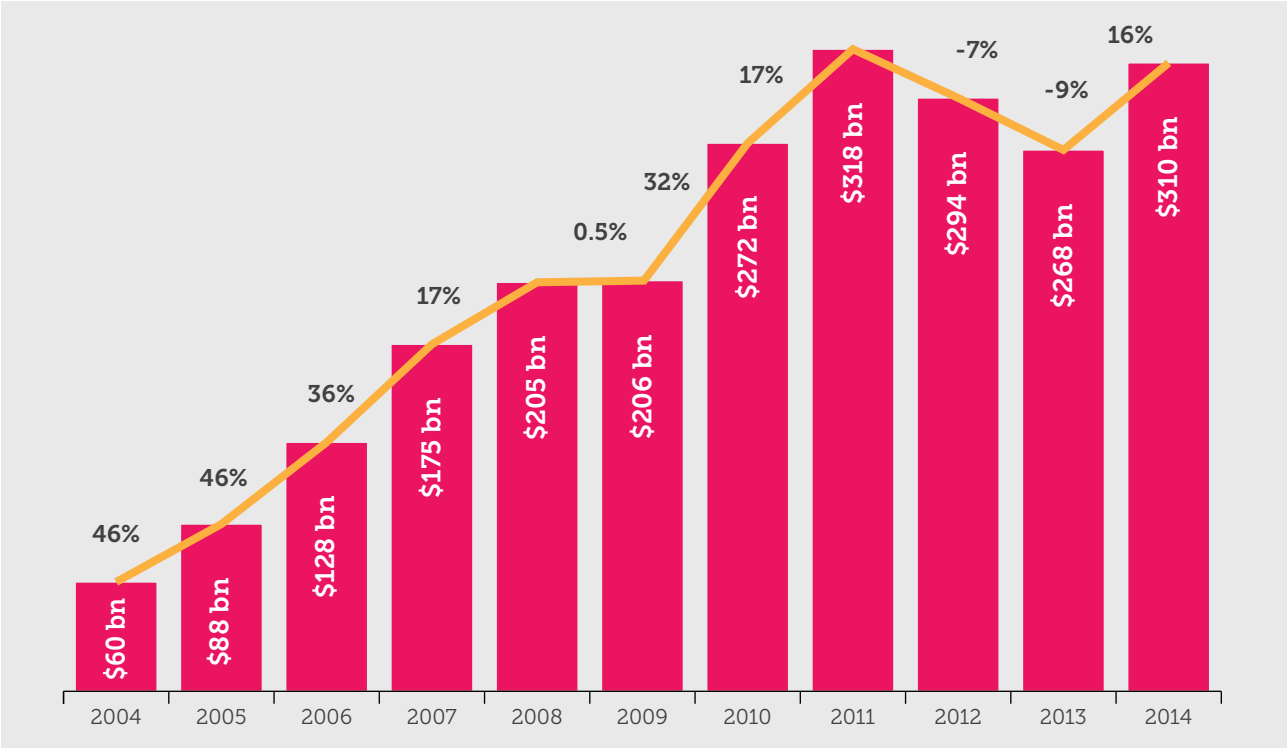
Source: Data from EPIA 2014; GWEC 2015

1.2 Investment and renewable energy capacity additions

Globally, investment in renewable energy has increased five-fold over the last decade (REN21 2014). In 2013, investment in clean energy - US$ 268.1 billion – was more than double the investment in fossil fuels - US$ 102 billion (BNEF 2014, Frankfurt School of Finance and Management 2014). Last year, global investment in clean energy grew 16% on 2013 levels to US$ 310 billion (BNEF 2015; Figure 3).

"Investment in renewable energy has increased five-fold in a decade."

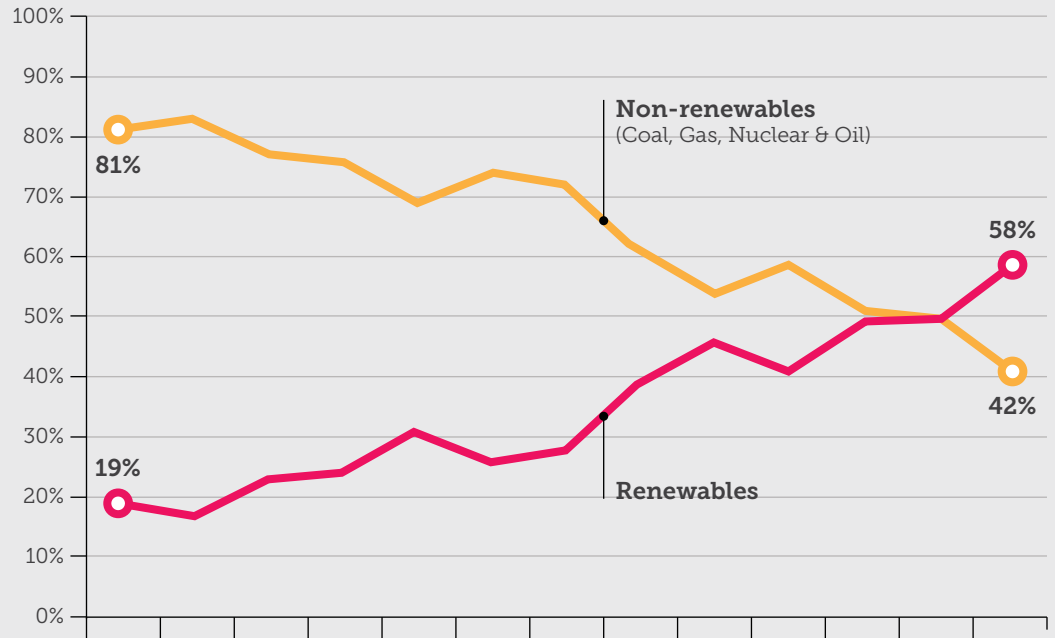
Figure 3: New investment in clean energy 2004-2014



Note: Total values include estimates for undisclosed deals. Includes corporate and government R&D, and spending for digital energy and energy storage projects (not reported in quarterly statistics). **Source:** BNEF 2015

As annual investment in renewable energy grows, so too does global renewable capacity added. Every year since 2010, renewable electricity generating capacity has represented half or more of total capacity added worldwide (IRENA 2015a). In 2013, a new record was set for renewable capacity added – over 120 GW globally – accounting for over half of global capacity additions of all energy sources (IEA 2014b; REN21 2014) (Figure 4). The 2013 record for capacity additions was made possible (in spite of investment declining 9% on 2012 levels) because of rapid renewable energy cost reductions, particularly for solar PV and wind (BNEF 2014; REN21 2014).

Figure 4: Renewables as a share of global capacity additions (2001 – 2013)



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total net capacity added per year	**104**	**134**	**150**	**153**	**134**	**180**	**200**	**174**	**185**	**232**	**234**	**233**	**207**
Renewables	20	22	34	36	41	47	56	67	85	94	115	116	120
Non-renewables	84	111	116	116	93	133	145	107	100	138	118	117	87

Source: IRENA 2014

"In many markets renewables are fast becoming the most cost-competitive option."

Increasing policy support for renewable energy worldwide has brought about a "virtuous circle" whereby more renewable capacity is installed, technologies become more efficient, equipment costs fall and overall costs continue to reduce, driving further investment (IRENA 2015a). In the past, renewable electricity generation was significantly more expensive than conventional fossil fuels, whereas now, in many cases, renewables are fast becoming the most cost-competitive option, and certainly the most cost-effective zero emissions option.

While complete figures for global renewable energy capacity additions for 2014 are yet to be released, added capacity is likely to exceed 2013's record-breaking year (IRENA 2015a). 2014 figures available for global wind and geothermal power capacity additions already show continued growth, well in excess of IRENA's estimates:

- 51.5 GW wind power was added in 2014, up from 35 GW in 2013 – exceeding the 47.3 GW forecast for 2014 (GWEC 2014; REN21 2014; GWEC 2015).
- 0.7 GW geothermal power was added in 2014, up from 0.6 GW added in 2013 (GEA 2014).

"2014 is expected to be another world-record-breaking year for new renewable power additions."

In 2013, the top five countries for clean energy investment and renewable capacity added were China, the US, Japan (Figure 5), Germany and the UK (listed in rank order for investment, rankings for capacity are slightly different) (BNEF 2014, REN21 2014). In 2014, these same five countries led investment in clean energy:

- China US$ 89.5 billion (up 32% from 2013)
- United States US$ 51.8 billion (up 8% from 2013)
- Japan US$ 41.3 billion (up 12% from 2013)
- Germany US$ 15.3 billion (up 3% from 2013)
- United Kingdom US$ 15.2 billion (up 3% from 2013).

There is increasing evidence of the positive relationship between countries' renewable energy policies and the levels of investment. Countries need to attract substantial private investment to achieve their renewable energy goals, while at the same time countries' national and sub-national policies and targets and the level of perceived regulatory risk strongly influence where investors choose to allocate capital (Lüthi and Wüstenhagen 2012; Menichetti 2012; Chassot et al 2014).

Countries with a clear, consistent, long-term energy strategy, together with specific policy initiatives designed to achieve this strategy are the most likely to attract substantial private investment (Polzin et al 2015). To invest in large energy projects investors require the policy environment to be clear and stable over the investment horizon. Renewable energy targets, Renewable Energy Performance Standards in the

Figure 5: Ukishima Solar Power Plant in Japan

US or the UK's contracts for difference attract investors because these types of measures are mostly long-term and stable.

On the other hand, instability, uncertainty or changes in policy measures can negatively affect perceived regulatory risk, in turn resulting in declining investment (Polzin et al). In Australia and Italy in 2014, investment in renewable energy fell as a result of regulatory changes and uncertainty. In Australia, even though the Renewable Energy Target policy is intended to act as a clear and longer-term policy for renewable energy, investor uncertainty has arisen from two reviews of the Renewable Energy Target (with the Warburton Review recommending significant cuts to the target) together with the repeal of the carbon price under the Clean Energy Future legislation. This uncertainty has resulted in clean energy investment falling 35% to $3.7 billion - the lowest level since 2009 (BNEF 2015). The popularity of rooftop solar PV masked an even steeper fall in investment in large-scale wind and solar. Investment in large-scale renewable energy projects in Australia dropped 88% in 2014 compared to the previous year to $240 million – levels equivalent to twelve years ago (Sydney Morning Herald 2015). According to Bloomberg New Energy Finance, 2014 investment in large-scale wind was "zero", with the majority of large-scale solar investment supported by government grants from the Australian Renewable Energy Agency (ARENA 2015; Sydney Morning Herald 2015). In Italy, investment fell 60% due to retrospective cuts to the country's feed-in tariff scheme for large-scale solar plants (REN21 2014). Even policies that should provide certainty will not if there is any doubt about the government's commitment to the policy.

In Italy, investment fell 60% due to retrospective cuts to the country's feed-in tariff scheme for large-scale solar plants (REN21 2014). Even policies that should provide certainty will not if there is any doubt about the government's commitment to the policy.

"Investment in large-scale renewable energy projects in Australia dropped 88% in 2014."

1.3 Total renewable energy capacity

In 2013, 6.5 million people were employed globally (either directly or indirectly) in the renewable energy sector (REN21 2014). Global employment in renewable energy grew 13% compared to 2012 (from 5.7 million employed in 2012) (REN21 2014). The top five countries for employment in renewable energy are: China (2.64 million); Brazil (894,000); the US (625,000); India (391,000); and Germany (371,000) (REN21 2014) (Table 2). In 2013, over half of all renewable energy jobs in China were in solar PV. In the European Union, job increases in wind and biofuels were offset by job losses in solar PV.

Non-hydro renewable energy jobs are growing in the US as employment in fossil fuels and nuclear power generation declines (EIA 2014). There are now reportedly more jobs in the US solar energy industry than in coal mining (PennEnergy 2015). In 2014, the US solar industry added over 31,000 new solar jobs, an increase of 21.8% on the previous year, with 81,000 jobs added in solar PV over the past four years (PennEnergy 2015).

Table 2: Renewable energy jobs (direct and indirect) in 2013

Country	Renewable energy jobs 2012	Renewable energy jobs 2013
China	1,747,000	2,640,000 (51% increase)
European Union	1,179,000	1,245,000 (6% increase)
Brazil	833,000	894,000 (7% increase)
United States	611,000	625,000 (2% increase)
India	391,000	391,000 (no updated numbers available for India)
UK*	275,400	/
Japan**	/	210,000 (solar PV only)
Australia	72,000	63,000 (13% decrease)
Global	5,725,000	6,492,000 (13% increase)

Source: *Department for Business, Innovation and Skills 2013; REN21 2014; **Dewit A 2014
Note: Australian direct and indirect jobs calculated using direct job numbers from Clean Energy Council 2013 and Clean Energy Council 2014 with multiplier from SKM 2012. German employment numbers are incorporated into EU figures.

2. WHAT IS DRIVING THE BOOM: FALLING COSTS, SOUND POLICIES AND IMPORTANT PARTNERSHIPS

The global renewable energy surge is being driven by a number of factors: falling costs; large scale switching of business and household energy consumption to renewable energy; and supportive domestic policy environments in many nations. Renewable energy is now competitive with fossil fuels on cost in some markets and is a key development priority for China, India and many European nations. This section explores these factors with a focus on G20 nations noting these factors will continue to drive growth into the future.

2.1 Cost of renewables

The global renewable energy surge is being driven by the rapidly dropping price of renewable energy, particularly solar. In many parts of the world, renewables now directly compete with fossil fuels in providing low cost power without the need for government assistance (IRENA 2015a). Comparing new plants on a cost per kilowatt-hour (kWh) basis, wind, biomass, geothermal and hydro-electricity generation are all competitive with fossil fuels (IRENA 2015a). In areas with good wind resources (e.g. southern Australia), onshore wind is now comparable in electricity cost to gas and coal generation without carbon capture (IRENA 2015a). Solar PV costs continue to fall rapidly, and some large-scale solar plants in Dubai and South America now provide cheaper electricity than coal and gas without carbon capture (IRENA 2015a).

We can compare the cost of energy globally by using the Levelised Cost of Energy (LCOE). LCOE is a measure of the total cost of energy per kWh produced and enables cost comparisons between electricity produced from different power plants. The LCOE is calculated by accounting for all installation and operation costs over the full life of the power station and then dividing this amount by all the electricity produced by the plant. LCOE studies typically provide an average global cost range. However individual projects vary according to installation costs, specific localized construction factors, varying fuel and labour costs, perceived government policy risk (which influences the cost of capital), the renewable resource, technology and capacity factors (IRENA 2015a).

Renewable energy is already a cheaper source of power than diesel for providing electricity to rural off-grid areas (such as rural and remote Australia) and small-scale systems, like on islands (IRENA 2015a; AECOM 2014).

While biomass, geothermal and hydro power costs have been relatively stable in recent years, wind and solar PV costs have fallen significantly and are expected to continue dropping well into the future. Wind power costs fell 14% between 2009 and 2014. Solar PV module prices fell 75% over the same period (REN21 2014).

Table 3: Cost reduction potential for onshore wind systems

Study	Cost reduction potential (% reduction)	Timeframe
IEA	18	2010 – 2030
EWEA	22/29	2010 – 2020/ 2010 – 2030
GWEC	12/18	2010 – 2020/ 2010 – 2030
Mott McDonald	12	2010 – 2020
McKinsey	30	2010 – 2025

Sources: IRENA 2012

Several studies are anticipating wind power cost reductions to continue, with unit cost reductions in the range of 10-20% by 2020 and 20-30% by 2030 (Table 3).

Energy policy experts are now predicting that solar PV will soon become the cheapest form of electricity generation in many parts of the world (Agora Energiewende 2015). Various estimates have been made of the expected cost reductions for solar PV in coming years, some of which are summarized in Table 4. Significant cost reductions for solar PV modules will result from improving efficiencies, energy storage, increasing scale and completion and reduced financing costs (Deutsche Bank 2015). Solar PV power costs are expected to drop to between 4 and 6 c/kWh by 2025 and between 2 and 4 c/kWh by 2050 (Agora Energiewende 2015).

Table 4: Cost reduction potential for PV modules and systems

Study	Cost reduction potential (% reduction)	Timeframe
IRENA 2012	51	Module 2010 – 2015
EPIA 2013	36-51	System 2010 – 2020
McKinsey and Co 2012	55	System 2010 – 2020
NREL 2012	60	System 2010 – 2020
First Solar 2014	40	System 2012 – 2017

Major global corporations are switching to renewable energy

As renewable electricity has become more cost competitive, businesses and organisations are increasingly choosing to purchase or install and operate their own renewable electricity to reduce energy costs and meet company sustainability commitments. Major companies (e.g. IKEA, Swiss Re, British Telecom, Commerzbank, Nestle, and Philips) have committed to meeting 100% of their electricity needs from renewable resources (RE100 2015). Major global utility companies are also moving away from fossil fueled generation. Recently Europe's largest utility, E.ON joined this movement, announcing plans to shift away from fossil fuels and focus exclusively on renewable energy, efficiency and distributed generation (RenewEconomy 2014a).

In the US, hundreds of organisations are now purchasing 100% (or more) green power (US EPA 2015a). Major corporations are also now generating power onsite, with the top five US companies for onsite renewable electricity generation being Walmart (204,000GWh, representing 1 % of total electricity use), Apple (112,000GWh, 17 %), BMW Manufacturing (69,000GWh, 37 %) (Figure 6), Coca Cola (34,000GWh, 4 %) and Kohl's (31,000GWh, 2 %) (US EPA 2015b). The top five US companies with the most installed solar PV capacity are Walmart (105MW), Kohl's (50MW), Costco (48MW), Apple (41MW) and Ikea (39MW) (SEIA 2014).

Figure 6: BMW World with solar power installations

Households and commercial electricity customers are switching to renewable energy

The term "grid parity" describes the point at which the cost (LCOE) of solar PV reaches the same price as retail electricity tariffs or lower (per kWh). When grid parity is reached it provides an incentive for households and commercial customers to install solar PV and generate power for their own use instead of purchasing electricity from the grid (IEA 2014c). Rooftop solar PV already costs less than the price of electricity from the power grid in many countries (between 13 to 23 c/kWh) (Deutsche Bank 2015). For example, grid parity has already been reached in Germany, Italy, Spain, Portugal, and the Netherlands (IEA 2014c; IRENA 2015a). In Germany, the cost of rooftop solar

"In 13 G20 countries there are regions with grid parity where renewable energy competes on price with fossil fuels."

PV is now 40% lower than the retail electricity price (IRENA 2015a). By 2014, Australian consumers had also voted with their feet with nearly 1.4 million households with rooftop solar systems (Clean Energy Regulator 2015).

Thirteen G20 countries now have regions of grid parity, including: Australia, Brazil, China, France, Germany, India, Italy, Japan, Mexico, South Africa, Turkey, the UK, and the US (Deutsche Bank 2015). In Australia, solar PV has already reached grid parity for all solar PV system sizes in all capital cities except for 1.5kW solar PV systems in Canberra (ESAA 2014). The approach and passing of grid parity has resulted in a growing proportion of households with solar PV on their roofs – with South Australia (almost one in four households) and Queensland both above 20 percent of households with solar PV (ESAA 2014).

Renewable energy storage technologies

Pumped storage for hydropower has been around for more than one hundred years. Battery storage technology has also been around for a long time. However only in recent years has battery storage been increasingly used in power and grid applications as a way to support greater proportions of renewable electricity, especially wind and solar power, while maintaining reliable electricity supply. Common battery storage applications now include island systems and off-grid applications, households, and to improve system reliability (IRENA 2015b).

As costs come down and renewable energy deployment continues to grow, global battery storage capacity is expected to climb from 0.36GW in 2014 to 14 GW in 2023. The global market for battery storage is expected to grow from US$22 million in 2014 to US$18 billion by 2023. Japan and the United States are currently leading on battery storage implementation (IRENA 2015b).

In 2014, Tesla announced it would build a new battery production facility in Nevada, US. The facility will produce 35GWh of battery cells and 50GWh of battery packs by 2020, able to be used on electric vehicles, for consumer electronics or sold into the power sector (IRENA 2015b).

Australian grid operators are beginning to trial battery storage to reduce peak demand, improve grid reliability and as an alternative to building or replacing electricity transmission lines (RenewEconomy 2014b; AusGrid 2015; RenewEconomy 2015).

2.2 Renewable energy targets and policies

Countries world-wide are now using policies to increase renewable energy capacity and investment. Renewable energy targets are the most common and comparable type of policy. This section details the types of renewable energy targets adopted in G20 countries as well as touching on a range of other types of policies.

Every year more and more countries are embracing targets for renewable energy. In early 2014 there were 144 countries with renewable energy targets – up from 138 in 2013 and triple the number from a decade ago (REN21 2010; REN21 2014; Table 5).

Figure 7: A wind farm in Ontario, Canada

Table 5: Number of countries with renewable energy targets

Year	2004 (start)	2009	2012	2013	2014 (start)
Number of countries with renewable energy targets	48	85	127	138	144

Sources: REN21 2010; REN21 2014

National renewable energy targets can be set in different ways. Targets for renewable energy to make up a proportion of electricity generated are common (REN21 2014). Other types of target may aim for renewable energy as a certain percentage of all energy produced in the economy (primary energy) or all energy consumed for electricity, transport, heating and cooling, and transport (final energy) and/or to build a certain amount of renewable energy capacity (BREE 2014; European Environment Agency 2014; REN21 2014).

Current renewable energy targets set by G20 nations are summarised in Table 6. Almost all G20 members have a national renewable energy target, while Canada and the US have substantial sub-national renewable energy targets and policies (REN21 2014; Box 1).

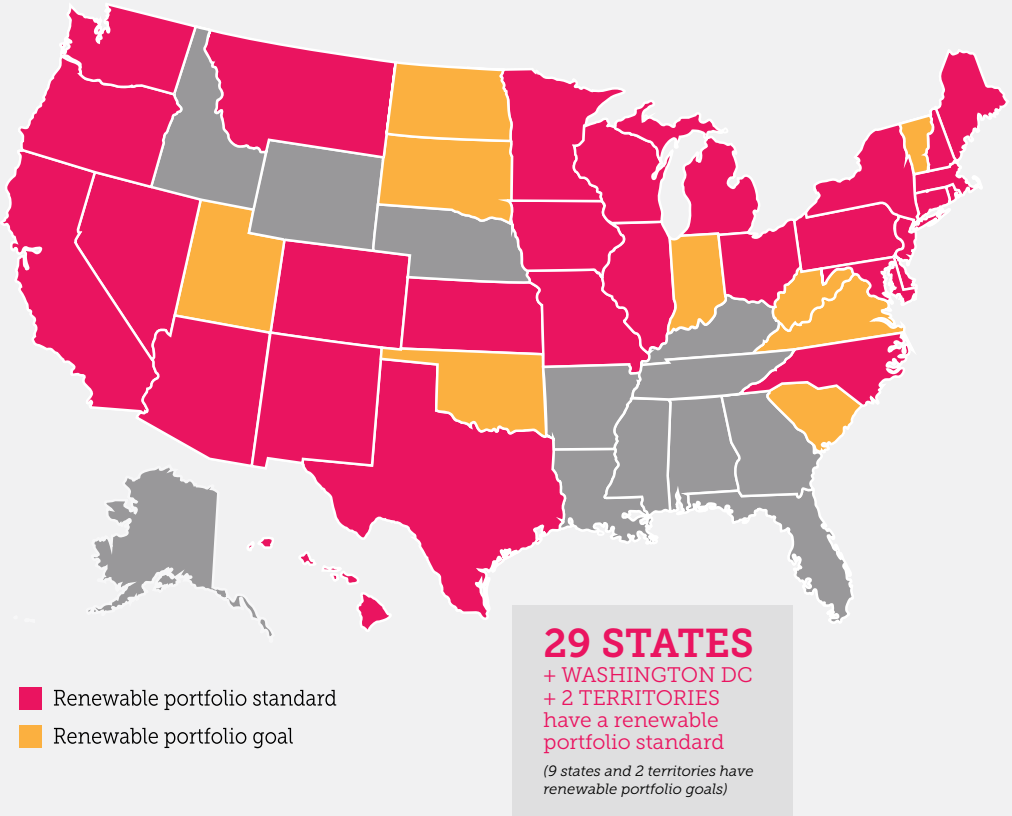
BOX 1: SUB-NATIONAL POLICIES IN THE US AND CANADA

In the US and Canada there are ambitious renewable energy policies in each country at the sub-national (state or province) level.

A large proportion (79 percent) of Canada's electricity is already produced from low or zero emissions sources, with 65 percent from renewables (Foreign Affairs, Trade and Development Canada 2014; Government of Canada 2015). Seven out of ten Canadian Provinces have capacity, percentage generation or zero emissions targets in place (IEA 2014a). For example, the provinces of Ontario (20GW renewable electricity by 2025, and eliminating coal-fired electricity by 2014)(Figure 7), New Brunswick (40% renewable electricity generation by 2020), Nova Scotia (40% renewable electricity generation by 2020) and Prince Edward Island (30MW increase capacity by 2030) all have targets for renewable energy (Ministry of Energy, Toronto, Ontario 2013; REN21 2014).

More than half of US states have State Renewable Portfolio Standards in place (DSIRE 2014; REN21 2014). Many US states have ambitious goals for renewable energy. California – the world's 8th largest economy – appears on track to achieve its 33 % target for renewable electricity by 2020 and plans to increase its target to 50 % renewable electricity by 2030 (UNFCCC 2015; Figure 8).

Figure 8: US States with renewable energy portfolio standards.

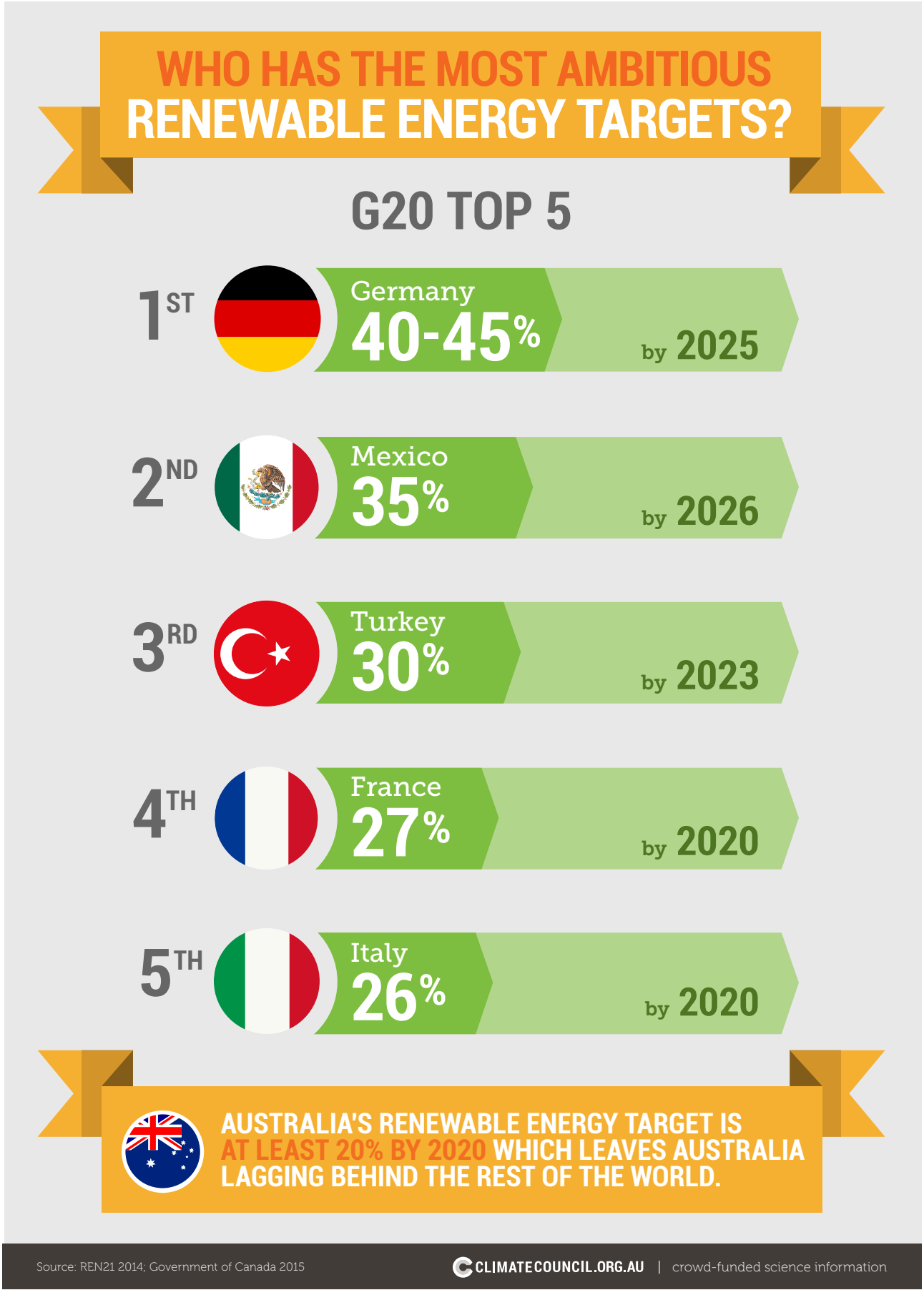


Source: DSIRE 2014

In 2014, Texas completed over 5,700 kilometres of new power lines designed to connect high quality wind resources in the Panhandle and Western parts of the state with customers in Dallas-Fort Worth, Austin and Houston. The new "Competitive Renewable Energy Zone" allows 18.5 GW of new wind developments potentially adding 50 percent more wind to Texas' current wind capacity, which is already the largest of any state in the US. The Competitive Renewable Energy Zone had attracted 7 GW of new wind capacity at the end of 2013, with grid operators already exploring further power line expansions (The New York Times 2014). Wind is now setting records for supplying almost 40 percent of Texas' power needs (Texas Tribune 2013) (Figure 9).

Figure 9: Horse Hollow Wind Farm, Texas

Figure 10: Infographic: G20 renewable energy ambitions



Renewable capacity targets

Targets for installing renewable capacity are the most common among the G20. Fifteen countries have adopted targets for adding new renewable capacity. G20 capacity targets total a substantial 1,325 GW of renewable energy capacity by 2025 – equivalent to nearly a quarter of global electricity generation capacity in 2012 (BREE 2014; US Energy Information Administration 2015; Table 2). 1,325 GW represents a 70% increase in renewable energy capacity (on 2012 levels) across these fifteen countries (EIA 2015).

The most sizeable capacity targets include:

- China: planning to install 900 GW renewable electricity capacity by 2020
- India (Figure 11): planning to install 100 GW solar photovoltaic (PV) capacity, and considering a target for 60 GW wind by 2022
- Japan: planning to install 95.33 GW renewable electricity capacity by 2020
- Italy: targeting 57.5 GW by 2020
- Brazil: targeting 54 GW by 2023.

All of these capacity targets are equivalent to (or greater than) Australia's entire electricity generating capacity. China's renewable capacity target is sixteen times Australia's entire electricity supply (BREE 2014).

BOX 2: WHAT'S A WATT? KEY TECHNICAL TERMS EXPLAINED

Gigawatts (GW) and megawatts (MW) are measures of capacity. Capacity is the maximum amount of electricity that a power station, or multiple power stations are capable of producing (Climate Council 2014).

For example, a typical wind turbine has a capacity of between 1.5 – 3 MW, and the total capacity of Australia's electricity supply was 56 GW (or 56,000 MW) in 2012–13 (BREE 2014)

"Fifteen G20 nations have committed to targets representing a 70% increase in renewable energy capacity by 2025."

Figure 11: Solar power in rural communities in India

"Four of the world's biggest economies have committed to add more renewable energy in the next ten years than Australia's entire electricity supply."

Percentage renewable electricity targets

Eleven G20 countries are targeting a percentage of renewable electricity in the future. While it is difficult to directly compare countries' renewable electricity percentage targets due to different target years and different mechanisms and implementation policies, the highest percentage targets include:

- Germany 40-45% (renewable electricity) by 2025
- Mexico 35% by 2026
- Turkey 30% by 2023
- France 27% by 2020
- Italy 26% by 2020
- Indonesia 26% by 2025.

Figure 12: Wave energy trials as part of Scotland's 100% renewable energy target

Australia's target of "at least 20 percent renewable electricity by 2020" is in the mid range of G20 percentage targets.

Scotland, which is part of the UK, aims for 100% renewable energy consumption by 2020 (REN21 2014) (Figure 12). Outside of the G20, there are now thirteen countries working towards meeting 90 to 100% of their electricity needs from renewable energy. Such countries include Denmark (aiming for 100% renewable electricity by 2050) and New Zealand (aiming for 90% by 2025) (REN21 2014).

These countries are well on their way to meeting these targets. In Scotland, renewable energy has overtaken nuclear and fossil fuels to become the main source of electricity consumed, providing 44 percent in 2013 (Department of Energy and Climate Change 2014). Renewable electricity production in Denmark is already at 43 percent and New Zealand is at 75 percent (Deutsche Welle 2014; Ministry of Business, Innovation and Employment 2014).

Primary and final energy targets

Ten G20 members have renewable energy targets for all energy produced (primary energy) or consumed (final energy). Turkey, France, Indonesia, China, and the EU have the highest percentage targets for primary and final energy. China and the EU, two of the world's largest emitters of greenhouse gases have both recently committed to extending their renewable energy targets. China is aiming for 20% zero emissions energy (nuclear and renewable sources) by 2030 (The State Council 2014; The White House 2014). The EU has set a minimum final energy target of 27% renewable energy by 2030 (European Environment Agency 2014).

Table 6: G20 nations renewable energy targets (not including targets for heating, transport or fuels)

	Argentina	Australia	Brazil	Canada	China	France	Germany	India	Indonesia	Italy
Primary	-	-	-	-	20% zero emissions energy by 2030	-	-	-	25% by 2025	-
Final	-	-	-	-	-	23% by 2020	18% by 2020 30% by 2030 45% by 2040 60% by 2050	-	-	17% by 2020
Electricity	8% (non hydro) by 2016 Bill before parliament to increase target to 20% by 2025	41,000 GWh large-scale renewable electricity annually by 2020 plus uncapped support for eligible small-scale solar and wind	-	No national target [Capacity or generation targets in 7 out of 10 Canadian provinces]	-	27% by 2020	40-45% by 2025 55-60% by 2035 65% by 2040 80% by 2050	-	26% by 2025	26% by 2020
Capacity	Renewable: 3GW by 2016 Geothermal: 30MW	-	Biopower: 19.3GW by 2021 Solar: 3.5GW by 2023 Hydro: 28GW by 2023 Wind: 23GW by 2023	-	Biomass: 30GW by 2020 Hydro: 420GW by 2020 Solar PV: 50GW by 2020 Concentrating solar: 200GW by 2020 Wind: 200GW by 2020	Ocean and offshore wind: 6GW by 2020 Wind: 25GW by 2020	Offshore wind: 6.5 GW by 2020 (15GW by 2030)	Solar: 100GW by 2022 Wind: 60GW by 2022 (under consideration)	Geothermal: 12.6 GW by 2025 Hydro: 2GW by 2025 Solar PV: 156.8 MW by 2025 Wind: 100MW by 2025	Biomass: 3.8GW by 2020 Geothermal: 920MW by 2020 Hydro: 17.8GW by 2020 Solar PV: 23GW by 2020 Onshore wind: 12GW by 2020 Offshore wind: 680MW by 2020

	Japan	Mexico	Russia	Saudi Arabia	South Africa	Republic of Korea	Turkey	United Kingdom	United States	European Union
Primary	10% by 2020	-	-	-	-	6.1% by 2020 11% by 2030	30% by 2023		-	-
Final	-	-	-	-	-	-	-	15% by 2020	-	20% by 2020 27% by 2030
Electricity	-	35% by 2026	4.5% (non hydro) by 2020	-	9% by 2030	21,977 GWh by 2020 39,517 GWh by 2030	30% by 2023	-	No national target [Renewable Portfolio Standards in over half US states]	-
Capacity	Biomass: 3.3GW by 2020 6GW by 2030 Geothermal: 0.53GW by 2020 3.88GW by 2030 Hydro: 49GW by 2020 Ocean: 1.5GW by 2030 Solar PV: 28GW by 2020 Onshore wind: 5GW by 2020 Offshore wind: 8.03GW by 2030	-	Combined small-scale hydro, solar PV and wind: 6GW by 2020	Renewable: 24GW by 2020 54GW by 2032 Solar PV: 6GW by 2020 16GW by 2032 Concentrating solar power: 25GW by 2032	Renewable: 17.8GW by 2030	Wind: 0.9GW by 2016 1.5GW by 2019	Wind: 20GW by 2023	Offshore wind: 39GW by 2030	-	-

Source: PVTech 2014; REN21 2014; The White House 2014; The White House 2015; National Resources Defense Council 2015; World Resources Institute 2015. **Note:** To gain a sense of the scale of capacity targets – the capacity of Australia's total electricity supply is 56 GW, and installed renewable electricity capacity is 15.7 GW (BREE 2014)

Policies and mechanisms designed to achieve renewable energy targets

Countries employ a wide range of policies and programs designed to achieve their renewable energy targets. Examples include feed-in tariffs, the UK's contracts for difference, competitive bidding, tax incentives and legislated targets. Japan's national feed-in tariff has driven significant expansion of solar PV. In response to the feed-in tariff policy, Japan added 6.9 GW of solar PV capacity in 2013, nearly doubling Japan's total capacity and placing the country fourth in the world for solar PV capacity (REN21 2014). Japanese solar PV manufacturers have increased their production in response to increased demand (REN 21 2014).

The UK's Contracts for Difference program involves long-term contracts between low-emissions electricity generators and the government. These contracts agree to pay electricity generators the difference between the market price and the 'strike price' (the price needed to bring forward investment in a particular technology). The UK government sets the overall budget and the strike prices for different technologies and then generators bid for the contracts (Department of Energy and Climate Change 2015).

Australia has a legislated Renewable Energy Target in place, which requires electricity retailers to meet their share of a 41,000 GWh large-scale renewable energy target by 2020, and an uncapped small-scale renewable energy scheme. To date Australia's Renewable Energy Target has:

- Encouraged more than 400 additional large-scale renewable power stations to be built (Climate Change Authority 2014a) and nearly 1.4 million rooftop solar PV systems to be installed (Clean Energy Regulator 2015).
- Reduced greenhouse gas emissions by 22.5 million tonnes of carbon dioxide (2001-2014) equivalent to 10% of Australia's annual electricity emissions (Climate Change Authority 2014a).

2.3 Increased cooperation on climate change and clean energy

The past year has seen a new global spirit of cooperation on clean energy and climate change.

UK leaders commit to phase out coal

In February 2015, the leaders of the UK's three major political parties (the Conservatives, Labour and the Liberal Democrats) – David Cameron, Ed Miliband and Nick Clegg – signed a joint statement on climate change and clean energy. The leaders' agreement to work across party lines was made despite being in the midst of an election campaign. In the statement, the leaders agreed climate change was one of the most serious threats facing the world and committed to:

- Seek a fair, strong, legally binding, global climate deal aimed at limiting temperature rises to below 2°C.
- Work together, across party lines, to agree carbon budgets in accordance with the Climate Change Act.
- Accelerate the transition to a competitive, energy efficient low carbon economy and to end the use of unabated coal for power generation (BBC 2015; Green Alliance 2015).

The US, India and China

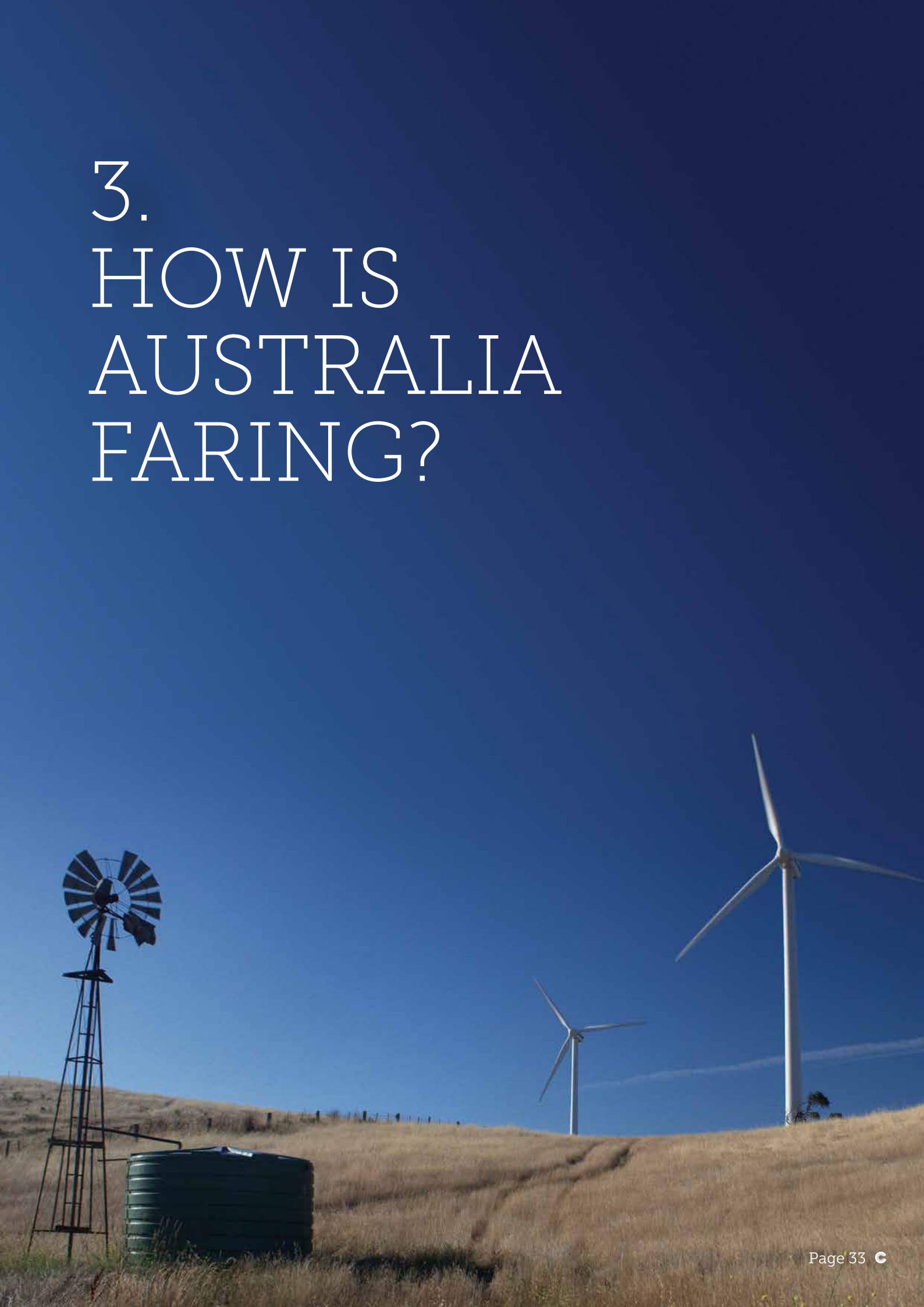
The world's largest emitters of greenhouse gases are now working together on climate change and renewable energy (The White House 2014; The White House 2015).

In January 2015, the US and India announced their intention to work together more closely to tackle climate change and expand clean energy production.

The new bilateral climate change deal between the US and India includes phasing down the production and use of hydroflurocarbons, found in refrigeration and air conditioning because their greenhouse gas emissions contribute to both global warming and the depletion of the ozone hole. The joint US and India announcement also pledged to expand existing joint research into clean energy, and launch new research into smart grid and grid storage technology. The US will also provide assistance to accelerate clean energy finance to support renewable energy growth in India. The deal saw India increase its target for solar capacity to 100 GW by 2022 (The White House 2015).

The US deal with India follows an earlier joint announcement between the US and China on climate change and clean energy. In November 2014, the two largest emitters of greenhouse gases jointly announced new emissions targets, with China also increasing the country's renewable target to 20% of primary energy sourced from zero emissions sources by 2030 (building on the previous target of 15% by 2020). The new energy target will require China to deploy an additional 800-1,000 GW of low emissions generation capacity by 2030 – an amount equivalent to more than all the coal-fired power plants that exist in China today and close to total current electricity generation capacity in the US (The White House 2014).

3. HOW IS AUSTRALIA FARING?



Australia's Renewable Energy Target sits in the middle of the range of G20 targets for percentage renewable electricity (REN21 2014). Up until 2013, Australia's Renewable Energy Target legislation has seen the proportion of renewable energy increase from 9% in 2001 to 13.1% in 2013 (BREE 2014b) with more than 400 large-scale renewable power stations (Climate Change Authority 2014a) and nearly 1.4 million rooftop solar PV systems installed (Clean Energy Regulator 2015).

However investment, new renewable energy capacity and jobs in Australia have been dramatically affected by policy uncertainty over the past eighteen months caused by the repeal of the carbon price and two reviews of the Renewable Energy Target (with the Warburton Review recommending significant cuts to the target).

While global renewable electricity costs are declining, and installations, investment and jobs grow worldwide, in Australia renewable energy investment, new capacity and jobs have declined.

The uncertain policy environment has resulted in an effective freeze on investment with an 88% drop in large-scale renewables in 2014 compared to the previous year to $240 million – levels equivalent to twelve years ago (Sydney Morning Herald 2015). Investment in large-scale wind was "zero", with the majority of large-scale solar investment supported by government grants and the Australian Renewable Energy Agency (ARENA 2015; Sydney Morning Herald 2015). All renewable energy investment in Australia fell 35 percent in 2014 to $3.7 billion - the lowest level since 2009 - even though globally, investment in renewables grew by 16 percent (BNEF 2015). Jobs in the renewable energy sector fell 13% in Australia in 2013 while global employment grew by the same amount.

Yet despite the uncertainty, Australian households and businesses have benefited from global cost reductions for solar PV. Solar PV module prices have fallen 75% over the past five years (REN21 2014). As a result, generating electricity onsite from rooftop panels has become increasingly attractive as an alternative to purchasing electricity from the grid (with assistance from the Small-scale Renewable Energy Scheme component of the Renewable Energy Target). Installations of rooftop solar PV have continued to grow in Australia with solar PV now competing with retail electricity prices in all major cities (ESAA 2014).

3.1 Renewable electricity generation

In 2013, renewable energy represented 22% of electricity generation globally (REN21 2014). G20 countries with the greatest proportion of renewable energy in electricity generation included: Brazil (85%), Canada (65%), Italy (31%), Argentina (29.2%), Turkey (27%) and Germany (25%) (REN21 2014; Government of Canada 2015).

Australia's share of renewable electricity was just over 13% in 2012-13 (BREE 2014). Despite Australia having enough renewable energy resources to power the country 500 times over (AEMO 2013), twelve G20 members have a greater proportion of renewable electricity than Australia (REN21 2014). Countries with similar proportions of renewable electricity to Australia included Indonesia, Japan, the US and the UK (REN21 2014). However, the UK has notably increased its share of renewables to around 18% renewable electricity in 2014 (UK Government 2014).

Only Saudi Arabia (~0%), South Africa (2.6%) and the Republic of Korea (3.7%) lagged behind Australia in terms of the proportion of renewable electricity (REN21 2014).

"Despite Australia having enough renewable energy resources to power the country 500 times over, twelve G20 members have a greater proportion of renewable electricity than Australia."

Conclusion

So much has changed for renewable energy in recent years. Renewable energy is now competitive with fossil fuels on cost, global capacity additions and investment.

Australia's G20 allies and trading partners are embracing renewable energy, with all but two setting targets (and many of the sub-national jurisdictions in these two countries (Canada and the US) have progressive renewable energy policies). Three of the world's largest greenhouse gas emitters, China, the EU and India, expanded their renewable energy targets over the past year. And the UK's political leaders have jointly agreed to end the use of coal for power generation.

Global renewable energy capacity additions were at a record high in 2013, and it is likely that 2014 will eclipse records set the previous year. As capacity and investment grows, costs will decline even further. And, as costs come down, more and more countries, major corporations, businesses and households are choosing to switch to renewable energy sources.

As other G20 members stride ahead on renewable energy, Australia is in danger of falling further and further behind.

Acronyms and Abbreviations

Shortened form	In full
G20	Group of Twenty
UK	United Kingdom
China	People's Republic of China
EU	European Union
US	United States of America
GW	gigawatt (= 1 billion watts, 1000 megawatts)
GWh	gigawatthour
US$	US Dollars
Solar PV	solar photovoltaic
LCOE	Levelised Cost of Energy

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