

GALILEE BASIN – UNBURNABLE COAL

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A handwritten signature in black ink that reads 'Will Steffen'.

Will Steffen
Climate Councillor

Key Findings

- 1. Tackling climate change effectively means that existing coal mines will need to be retired before they are exploited fully and new mines cannot be built.**
 - › Burning coal for electricity is one of the key drivers of climate change.
 - › 195 countries have agreed to limit temperature rise to no more than 2°C. This puts a cap on how much coal the world can burn. Even under the most optimistic assumptions, only 12 percent of the world's coal reserves can be burned.
 - › Moving away from fossil fuels means that new energy sources, like solar and wind, must come online rapidly.
 - › Any new coal mine is fundamentally at odds with protecting Australia from the impacts of climate change.
- 2. The Galilee Basin coal could emit more than Australia's entire emissions each year.**
 - › More than 90 percent of known, extractable coal in Australia's existing coal reserves must stay in the ground. Therefore, there is no justification for opening new coal mines - the most pressing challenge Australia faces is how to phase out existing coal mines well before their reserves are exhausted.
 - › If all of the Galilee Basin coal was burned, it is estimated that 705 million tonnes of carbon dioxide would be released each year – more than 1.3 times Australia's current annual emissions.

3. Potential export markets for Galilee coal are rapidly dwindling as the world moves away from coal toward renewable energy.

- › China's coal use dropped by 3 percent in 2014 and is projected to fall a further 2.5 percent in 2015. In March, China announced that it will cut coal consumption by 80 million tonnes by 2017 and by a total of 160 million tonnes between 2014 and 2020.
- › Global investment in new renewable capacity is now greater than investment in fossil fuels, and the gap is expected to widen as investment in renewables surges ahead.
- › Potential export markets for Galilee Basin are dwindling fast. Only India remains a possibility and it is wavering in its commitment to importing coal.

4. There are increasing signs from global investors that they consider Galilee coal too risky of an investment.

- › A total of 11 international banks have now publicly announced that they will not be involved with any projects in the Galilee Basin.
- › HSBC, one of the world's largest investment banks, has cited plummeting cost of renewable energy and the reduced coal demand from China as having significant consequences for Australia's coal investments and increasing the risk of stranded assets.
- › The \$890 billion Norwegian Government Pension Fund Global, the largest pension fund in the world, recently announced it would reduce its exposure to fossil fuel risk by divesting more of its coal-related holdings, sending a strong message to the financial sector.

1. Introduction

The Climate Council has produced many reports now detailing the impacts of a changing climate. Australia has become hotter: hot days have doubled in the last 50 years while heatwaves are now hotter, longer and happen more often. Heatwaves are a silent killer, killing more Australians than any other type of extreme weather event. Climate change has increased the risk of bushfires in the southeast of Australia, threatening people and property. At the same time sea level has been rising, exposing coastal infrastructure and property to coastal erosion and storm surge inundation.

Climate change has increased the risk of bushfires in the southeast of Australia.

Climate change is driven by rising greenhouse gas emissions, particularly from the burning of coal, oil and gas. The solution is clear, we must rapidly move away from fossil fuels (see, for example, Figure 1) to other sources of power.



Figure 1: The Abbot Point coal terminal in Queensland

The “carbon budget” approach allows us to quantify the amount of fossil fuels that can be burned and have a good chance of remaining under a 2°C rise in global temperature. A 2°C rise is considered so dangerous for humanity that 195 governments have agreed that it is a threshold that should not be crossed. This view is mirrored by the world’s scientific, medical and insurance organisations.

The solution to climate change is rapidly moving away from fossil fuels.

Given that humanity has taken significant time to ramp up action on climate change, there is now only a relatively small carbon budget left. That means that we must be very stringent on our use of fossil fuels into the future and, ultimately, the world must move almost entirely away from fossil fuels within the next 35 years. To tackle climate change the vast bulk of fossil fuels must be left in the ground unburned.

Tackling climate change effectively means that existing coal mines will need to be retired before they are exploited fully and new mines cannot be built. This is particularly relevant for Australia as plans are on the table to open up the Galilee Basin, and expand coal mining operations in the NSW Upper Hunter Valley and in the Liverpool Plains, a region described as the food bowl of Australia. Moving away from fossil fuels means that new energy sources, like solar and wind, must come online rapidly.

Tackling climate change effectively means that existing coal mines will need to be retired before they are exploited fully and new mines cannot be built.

The good news is that in the last few years action world-wide has been accelerating. While in the past the USA and China were perceived as laggards, today they have taken significant action. Over 100 coal fire power stations have closed in the last decade in the USA and greenhouse gas emissions have turned downwards. In March, China announced that it will cut coal consumption by 80 million tonnes by 2017 and by a total of 160 million tonnes between 2014 and 2020. A global movement to decarbonise the world is underway.

Meanwhile global investment in renewable energy has increased five-fold in the last decade and one million new jobs in the renewable energy sector were added last year. Since 2009, investment in new renewable capacity has passed investment in new capacity for all fossil fuels combined, including coal. The world’s economy grew last year for the first time in four decades without a parallel increase in emissions, primarily due to renewable energy.

One million new renewable energy jobs were added last year as the sector booms.

The financial sector is quickly reacting to the growing trend of decreasing coal usage and increased renewable energy. For example, the Norwegian Government Pension Fund Global, the largest pension fund in the world, recently announced that it would reduce its exposure to fossil-fuel risk by divesting more of its coal-related holdings. This follows a number of high profile divestments including those by Stanford University and the Rockefeller Brothers Fund.

One of the world's largest investment banks, HSBC, has also sounded the warning bell regarding stranded assets resulting from investment in fossil fuels. They cite the increasingly clear climate science, particularly the carbon budget approach, as guiding thinking about stranded assets, as well as the rapid technological advances in renewable energy coupled with falling oil and coal prices.

Coal is now considered a risky investment by the financial sector.

Most of the public discussion around Australia's contribution to climate change has centred around our domestic emissions. Australia is a heavy user of coal for electricity and also has great opportunities in renewable energy. Australia is one of the sunniest countries in the world and one of the windiest. However, Australia's coal export industry is now coming under increasing scrutiny. Australia has significant coal resources. In fact, if all of Australia's coal resources were burned it would consume two-thirds

of the global carbon budget¹. For Australia to play its role in tackling climate change over 90 percent of Australia's coal reserves must be left in the ground unburned and no new mines can be developed. Any new mine is fundamentally at odds with protecting Australia from the impacts of climate change.

Australia's coal alone would consume two-thirds of the global carbon budget.

This report considers a major new coal mine proposal for the Galilee Basin in North Queensland and its impact on the global climate. It finds that if all of the Galilee Basin coal was burned, it is estimated that 705 million tonnes of carbon dioxide (CO₂) would be released each year. That is more than 1.3 times Australia's current annual emissions. Opening up the Galilee Basin is incompatible with tackling climate change.

Any new mine is fundamentally at odds with protecting Australia from the impacts of climate change.

The climate science is clear, but we are also increasingly getting a clear financial picture of increasing risks for coal investment. With the global trend away from coal gathering momentum, the implications for Australia's thermal coal export industry are unmistakable. The industry's future looks increasingly shaky. The Galilee Basin, if developed, could well become a stranded asset in a world rapidly moving away from carbon.

¹ Based on a 75% chance of staying below 2°C rise in temperature.

2. How much coal can we burn?

To tackle climate change, 195 countries around the world, including Australia, have agreed to limit global temperature rise to no more than 2°C above the pre-industrial level. Linking this target to action on the ground is straightforward.

There is a direct relationship between our emissions of CO₂, primarily from the burning of fossil fuels, and the rise in global average temperature (IPCC 2013). The more CO₂ we emit, the more the Earth warms. So, if we want to limit warming to no more than 2°C, there is a limit to how much CO₂ we can emit. That is, there is a global carbon budget for the amount of fossil fuels we can burn.

Because the world is only now beginning to take serious action on climate change, our remaining carbon budget represents a daunting challenge.

For a 75% chance of meeting the 2°C warming limit, the budget from 2012 is 672 billion tonnes (Gt) of CO₂ (Meinshausen et al. 2009; IPCC 2013). While this looks like a very big number, current annual global emissions are around 36 Gt CO₂ (Le Quéré et al. 2014) so the budget would be exhausted in less than two decades. The bottom line is that the need to move away from fossil fuels is extremely urgent.

Emissions from fossil fuels, like coal, oil and gas, are driving global warming.

The need to move away from fossil fuels is extremely urgent.

A further analysis based on the economically optimal use of the three main fossil fuels – coal, oil and gas – highlights the need to eliminate coal usage as soon as possible (McGlade and Ekins 2015). Even for the most generous assumptions – just a 50% chance of meeting the 2°C warming limit – only 38% of the world's fossil fuels can be burned. This drops to only 23% for the more ambitious target of a 75% of meeting the 2°C warming limit (Table 1).

The news for coal is even worse. Based on the economic optimisation of McGlade and Ekins (2015), the bulk of

the allowable fossil usage comes from oil and gas, leaving very little of the carbon budget left for coal. In fact, for the most generous budget (top row in Table 1), only 12% of the world's coal reserves – deposits that are economically and technologically viable to exploit today – can be burned.

If the economic analysis is extended to geographical regions, the challenge for Australia is even more daunting. Well over 90% of our coal reserves are unburnable, even under generous assumptions and allowing for uncertainties in the analysis².

The vast majority of the world's coal must stay in the ground. No new mines can be opened.

Table 1: The carbon budget for three probabilities of meeting the 2°C warming limit, and the fraction of fossil fuel reserves and resources that can be burned within the budget.

Probability of meeting 2°C policy target	Budget from 2000 Gt CO ₂	Budget from 2012 Gt CO ₂	% of fossil fuel reserves that can be burned from 2012	% of fossil fuel resources that can be burned from 2012
50%	1440	1112	38	10
66%	1338	1010	35	9.2
75%	1000	672	23	6.1

Sources: Meinshausen et al. (2009); IPCC (2013); McGlade and Ekins (2015).

Note: "resources" are all of the fossil fuels that we know exist, and "reserves" are the subset of resources that are economically and technologically viable to exploit now.

² See 'Unburnable Carbon' report for more details: <https://www.climatecouncil.org.au/unburnable-carbon-why-we-need-to-leave-fossil-fuels-in-the-ground>.

The bottom line is simple. If we are to tackle climate change:

- › The vast majority of the world and Australia's coal must stay in the ground unburned.
- › Existing mines can only be partially exploited and will need to be retired before they are exploited fully.
- › New mines, like those in the Galilee Basin (Figure 2), cannot be built.
- › New energy sources, like solar and wind, must come online rapidly to replace coal.



Figure 2: Alpha coal mine test pit, Galilee basin

3. How is the world tracking on coal?

After a slow start over the past two decades, the world is beginning to take action on climate change, and the primary emphasis is on the switch from coal to renewables for electricity generation. The speed and magnitude of the movement away from coal as an energy source is striking, and it is gaining even more momentum.

The two biggest emitters, the USA and China, are now taking significant action.

The USA has seen a pronounced shift away from coal to renewable energy and gas in its electricity generation sector. Major drivers include the rapidly dropping cost of renewables as well as the US Environmental Protection Agency's regulations to limit pollution from electricity generation plants. Between 2003 and 2013, 111 coal-fired power stations have closed across the USA (U.S. EIA 2015), and emissions from the electricity sector have reduced by 11 percent. In 2013, greenhouse gases emissions were 9 percent below 2005 levels in the USA (U.S. EPA 2015).

The USA has seen a pronounced shift away from coal.

China, the other of the world's biggest two emitters, has also started its transition away from a coal-based electricity generation system. In fact, China may already have passed peak coal use. The country's coal use dropped by 3 percent in 2014 and is projected to fall a further 2.5 percent in 2015. In March, China announced that it will cut coal consumption by 80 million tonnes by 2017 and by a total of 160 million tonnes between 2014 and 2020. The city of Beijing, which has been plagued by severe air pollution from its coal-fired electricity stations, has already closed two of its four major coal-fired stations. The last two stations will be closed by next year (Climate Institute 2015).

China may already have passed peak coal use.

Meanwhile China is attracting 30 percent of the world's new investment in clean energy, employs nearly 3.4 million people in renewable energy, plans to install nearly 1,000 GW of renewable power by 2020 and has introduced seven emissions trading schemes covering a quarter of a billion people (REN21 2015).

China now employs nearly 3.4 million people in renewable energy.

In November 2014, the US and China made a joint announcement on climate change and clean energy cooperation. For the first time ever, China has committed to peak and then decrease its emissions around 2030, probably earlier. China has also set a new target for 20 percent of primary energy to come from zero emissions sources by 2030 (building on the previous target of 15 percent by 2020). As the US and China are major drivers of the global economy, this announcement could have a significant impact on economic decisions worldwide. For example, according to Citigroup analysts, this announcement could result in a \$US 3.9 trillion (\$A 4.5 trillion) loss in revenue for "Big Oil" and "Big Coal" over the next 15 years from the joint reduction of greenhouse gas emissions by the world's two biggest economies (RenewEconomy 2014). Other analyses show how China, by boosting markets in water, wind and solar power, is driving down costs and accelerating the uptake of renewable energy (Mathews and Tan 2014).

A million new jobs were created globally in renewable energy in 2014.

When comparing new power plants on a cost per kilowatt-hour basis, many renewable energy technologies (biomass, hydropower, geothermal, onshore wind and utility scale solar photovoltaic (PV)) are already cost-

competitive with fossil fuelled power generation (IRENA 2015). In many parts of the world, renewables are now providing similar or lower cost power than fossil fuels, even before the health, environmental and climate benefits of renewables and the USD 550 billion to USD 5.5 trillion in subsidies to fossil fuels are taken into account (IRENA 2015). In the past five years, wind power costs have fallen 14 percent, and solar PV modules have fallen 75 percent (REN21 2014; Climate Council 2015).

As renewable energy costs are projected to continue to fall into the future, new coal-fired power stations - particularly the most polluting sub-critical coal plants - are facing significant financial, regulatory and reputational risks due to current and future policies targeting climate change, air pollution and water scarcity (Caldecott et al. 2015; Climate Council 2015). As countries remove subsidies for fossil fuels - which are keeping coal power prices artificially low - renewables will become even more competitive with coal (REN21 2015). In 2014, 30 countries reduced or removed fossil fuel subsidies in response to calls from global organisations such as the G20, the International Energy Agency, the International Monetary Fund and the World Bank (Riedy 2013; REN21 2015).

Globally investment in renewable energy is booming. Since 2009, investment in new renewable capacity has passed investment in new capacity for all fossil fuels combined, including coal (REN21 2015). The world's economy grew last year for the first time in four decades without a parallel increase in

emissions, primarily due to renewable energy. New investment in renewables grew to over \$US 300 billion in 2014, a five-fold increase over the last decade. Meanwhile jobs in renewable energy grew by over one million in 2014 to 7.7 million jobs. Nearly 28 percent of the world's electricity generation capacity now comes from renewables, with solar PV capacity growing by over 60-fold over the last decade while wind power capacity grew by eight-fold over that period (REN21 2015).

Investment in renewable energy increased five-fold in the last decade.

In February 2015, the UK's three major political parties (the Conservatives, Labour and the Liberal Democrats) jointly pledged to end the use of unabated coal for power generation and accelerate the transition to a competitive, energy-efficient low carbon economy (BBC 2015a; Green Alliance 2015). Additionally, there is uncertainty concerning India's use of coal, including coal imports from Australia (The Guardian 2014; BBC 2015b).

The developing world is also joining the renewables boom, with investments last year on a par with those in the developed world (REN 21 2015). For example, renewable energy investment in China now stands at nearly US\$ 90 billion per year and has overtaken investment in fossil fuel capacity (Climate Institute 2015; REN21 2015).

The financial sector is quickly reacting to the growing trend of decreasing coal usage. The Norwegian Government Pension Fund Global, the largest pension fund in the world - worth \$US 890 billion and its total coal sector holdings are valued at US\$ 11.4 billion - recently announced that it would reduce its exposure to fossil-fuel risk by divesting more of its coal-related holdings, sending a strong message to the rest of the financial sector (IEEFA 2015). This follows a number of high profile divestments including those by Stanford University and the Rockefeller Brothers Fund.

New coal investments risk becoming stranded assets.

One of the world's largest investment banks, HSBC, has also sounded the warning bell regarding stranded assets resulting from investment in fossil fuels. They cite the increasingly clear climate science, particularly the carbon budget approach, as guiding thinking about stranded assets, as well as the rapid technological advances in renewable energy coupled with falling oil and coal prices (HSBC 2015).

With the global trend away from coal gathering momentum, the implications for Australia's thermal coal export industry are unmistakable. The industry's future looks increasingly shaky.

4. So where does this leave Galilee Basin coal?

Plans are underway for coal development in the Galilee Basin in Queensland. This basin extends over 247,000 square kilometres – roughly the same size as the UK - and contains huge quantities (7,750 million tonnes) of coal (ABC 2015).

Yet the Galilee Basin coal is unburnable. Even with the most generous carbon budget, over 90 percent of coal in Australia's existing reserves must stay in ground (McGlade and Ekins 2015). Thus, the most pressing challenge we face is to phase out existing coal mines well before their deposits are exhausted. There is no basis for developing ANY potential new coal mines, no matter where they are or what size they are. And the potential Galilee Basin deposits are indeed big in comparison to Australia's

existing coal industry. If all of the Galilee Basin mines are developed to their maximum potential, it is estimated that over 700 million tonnes of CO₂ would be released to the atmosphere each year (Greenpeace 2012). That's more than 1.3 times Australia's current annual emissions from ALL sources. Beyond the serious climate impacts, exploiting the Galilee Basin coal deposits could drive major local and regional impacts, ranging from groundwater contamination, biodiversity loss to social impacts on local communities (Duus 2012).

90 percent of coal in Australia's existing reserves is unburnable.

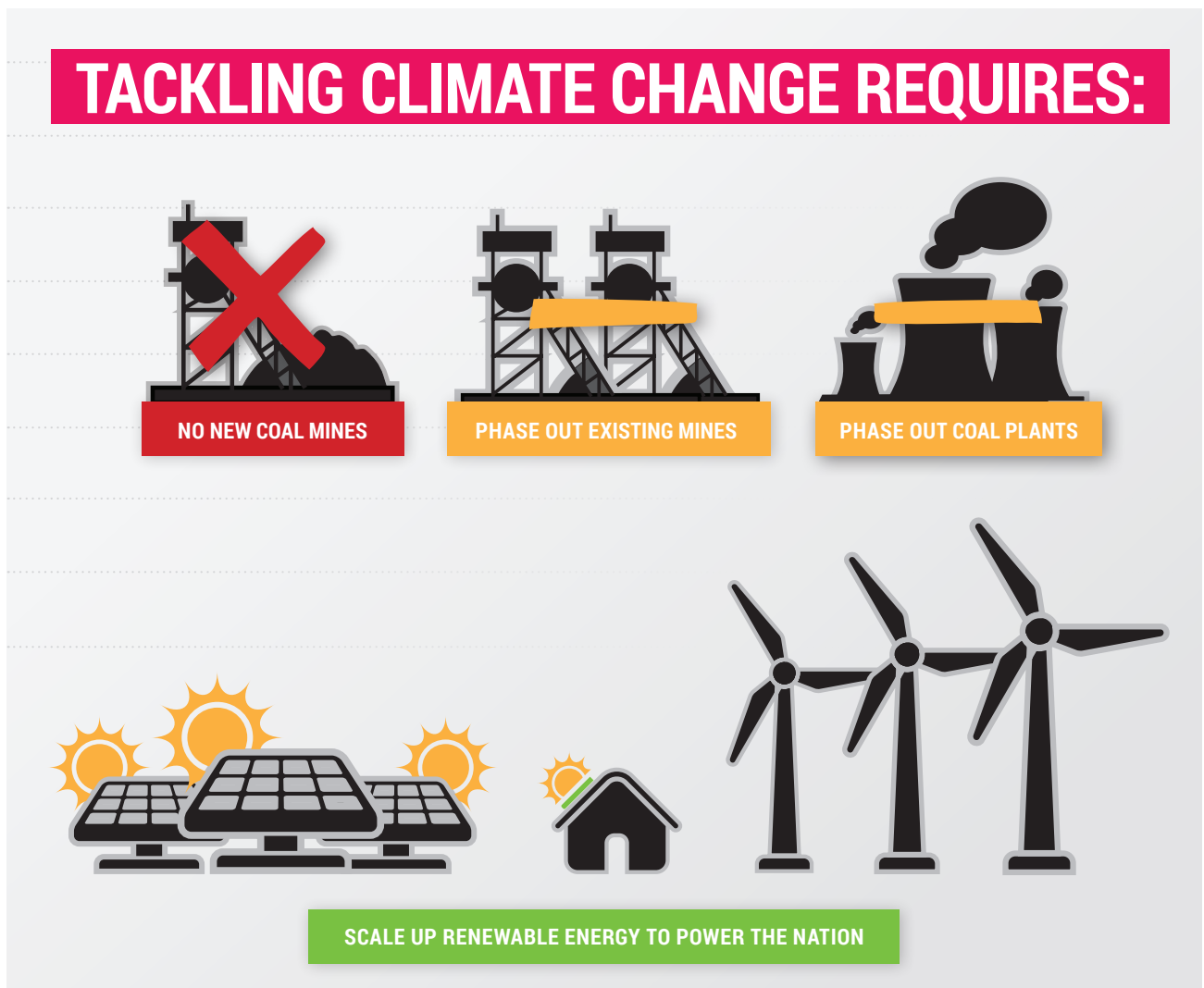


Figure 3: Moving away from fossil fuels to tackle climate change

The odds are increasingly stacked against any development of the Galilee Basin coal deposits. The climate and other environmental constraints are clear and compelling. For effective action on climate change, under any set of assumptions or uncertainties, Galilee Basin coal is unburnable.

Galilee Basin coal is unburnable.

The demand for Galilee Basin coal is dwindling with the slump in the international coal export market and the vigorous moves in China to reduce the carbon intensity of its economy and reduce its dependency on coal. The last potential market for Galilee coal is India, which is ramping up energy production as its economy develops. However, India may be reconsidering its energy options for the future, with mixed messages coming out of the country as to its reliance, or not, on imported coal. Some messages suggest that India will increase its imports of coal, but other policy announcements point to a rapid reduction in imports and a cessation within the next few years (The Guardian 2014; BBC 2015b). Such uncertainty adds to the already substantial risks of stranded assets should the Galilee Basin be developed.

Demand for Australian coal is dwindling.

With the risk of stranded assets with any development of Galilee Basin coal looking increasingly likely, the international financial sector is quickly and decisively pulling out of any potential resource development in the region. The three big French investment banks - Société Générale, Crédit Agricole and BNP Paribas – have recently announced that they've ruled out any involvement in the proposed Galilee Basin mines (The Guardian 2015).

The French banks join other large international investment banks, such as HSBC, Barclays, Morgan Stanley and Citi, which have already pulled out of Galilee. A total of 11 international banks have now publicly announced that they will not be involved with any projects in the Basin.

The heat is now turning on Australian banks. Although none of the big four banks – Westpac, NAB, ANZ and the Commonwealth Bank – has publicly stated that it will not fund coal projects in the Galilee Basin, the pressure is mounting for them not to invest in Galilee. The same risks that are convincing the international financial sector not to invest also apply to public investment in Galilee coal infrastructure, only in this case it is the taxpayers' money that is at risk.

Mounting evidence shows that investment in Galilee Basin coal is looking riskier by the week. There is an increasingly high probability of stranded assets if any investment proceeds, a likelihood underscored by the reaction of the international financial sector.

The strong move away from developing the Galilee Basin is part of a bigger, global picture. The world is now moving on climate change. There are two undeniable trends – an accelerating uptake of renewable energy and coal plant closures. For Australia to fight these trends is economically, socially and environmentally unwise and counterproductive. Rather, we need to be preparing for – and indeed joining and facilitating – this transition to a clean energy world.

References

- ABC (2015) Galilee Basin: Who wants to capitalise on last undeveloped coal resource in Queensland? Accessed at <http://www.abc.net.au/news/2015-03-15/galilee-basin-explainer/6315654>.
- BBC (2015a) Party Leaders make joint climate commitment. 14 February 2015. Accessed at <http://www.bbc.com/news/science-environment-31456161>.
- BBC (2015b) No US-India deal on climate change. 27 January 2015. Accessed at <http://www.bbc.com/news/world-south-asia-31008165>.
- Caldecott B, Dericks G and Mitchell J (2015) Stranded Assets and Subcritical Coal. The Risk to Companies and Investors. University of Oxford. Accessed at <http://www.smithschool.ox.ac.uk/research-programmes/stranded-assets/SAP%20Report%20Printed%20Subcritical%20Coal%20Final%20mid-res.pdf>.
- Climate Council (2015) The Global Renewable Energy Boom: How Australia is missing out. Accessed at <http://www.climatecouncil.org.au/uploads/4025a09a22121667977e19f6e33a1ea3.pdf>.
- Climate Institute (2015) China's path to modernising its economy. June 2015. Accessed at http://www.climateinstitute.org.au/verve/_resources/TCI__China_Brief_Final.pdf.
- DCCEE (Department of Climate Change and Energy Efficiency) (2012) National Inventory Report 2010, Volume 1. Accessed at <http://www.environment.gov.au/system/files/resources/add6a870-0846-4b62-85ac-78527144e370/files/national-inventory-report-2010-1.pdf>.
- De'ath G, Fabricius KE, Sweatman H and Puotinen M (2012) The 27-year decline of coral cover on the Great Barrier Reef and its causes. *Proceedings of the National Academy of Sciences* 109:17995-17999.
- Duus S (2012) Why the Galilee Basin is worth worrying about. *The Conversation*, 28 November 2012. Accessed at <http://theconversation.com/why-the-galilee-basin-is-worth-worrying-about-10959>.
- Green Alliance (2015) Cameron, Clegg and Miliband sign joint climate change agreement. Accessed at http://www.green-alliance.org.uk/leaders_joint_climate_change_agreement.php.
- Greenpeace (2012) Cooking the Climate, Wrecking the Reef: The global impact of coal exports from Australia's Galilee Basin*. Accessed at <http://www.greenpeace.org/australia/GLOBAL/australia/images/2012/Climate/Galilee%20Report%284.2MB%29.pdf>.
- HSBC (2015) Stranded assets: what next? 16 April 2015. Accessed at http://www.businessgreen.com/digital_assets/8779/hsbc_Stranded_assets_what_next.pdf.
- IEEFA (Institute for Energy Economics and Financial Analysis) (2015) IEEFA Lauds Norwegian Lawmakers for Moving \$900 Billion Pension Fund Toward Divesting Further From Risky Coal Assets. 27 May 2015. Accessed at <http://ieefa.org/ieefa-applauds-norwegian-lawmakers-for-instructing-worlds-largest-pension-fund-to-divest-further-from-coal-holding/>.
- IPCC (2013) Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker TF, Qin D, Plattner G-K, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V and Midgley PM (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1–30.
- IRENA (2015) Renewable Power Generation Costs in 2014. Accessed at http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Power_Costs_2014_report.pdf.
- Le Quéré C, Moriarty R, Andrew RM, Peters GP, Ciais P, Friedlingstein P, Jones SD, Sitch S, Tans P, Arneeth A, Boden TA, Bopp L, Bozec Y, Canadell JG, Chevallier F, Cosca CE, Harris I, Hoppema M, Houghton RA, House JI, Johannessen T, Kato E, Jain AK, Keeling RF, Kitidis V, Klein Goldewijk K, Koven C, Landa C, Landschützer P, Lenton A, Lima I, Marland G, Mathis JT, Metzl N, Nojiri Y, Olsen A, Peters W, Ono T, Pfeil B, Poulter B, Raupach MR, Regnier P, Rödenbeck C, Saito S, Salisbury JE, Schuster U, Schwinger J, Séférian R, Segsneider J, Steinhoff T, Stocker BD, Sutton AJ, Takahashi T, Tilbrook B, Viovy N, Wang Y-P, Wanninkhof R, Van der Werf G, Wiltshire A and Zeng N (2014) Global Carbon Budget 2014. *Earth System Science Data Discussions*, doi:10.5194/essdd-7-521-2014, <http://dx.doi.org/10.5194/essdd-7-521-2014>.
- Mathews JA and Tan H (2014) Economics: Manufacture renewables to build energy security. *Nature*. Accessed at <http://www.nature.com/news/economics-manufacture-renewables-to-build-energy-security-1.15847>.
- McGlade C and Ekins P (2015) The geographical distribution of fossil fuels unused when limiting global warming to 2°C. *Nature*, 517(7533), 187-190.

Meinshausen M, Meinshausen N, Hare W, Raper SC, Frieler K, Knutti R, Frame DJ and Allen MR (2009) Greenhouse-gas emission targets for limiting global warming to 2°C. *Nature*, 458(7242): 1158–1162.

RenewEconomy (2014) China, US climate deal delivers \$4.5 trillion blow to Big Oil, coal. Accessed at <http://reneweconomy.com.au/2014/china-us-climate-deal-delivers-4-5-trillion-blow-big-oil-coal-82211>.

REN21 (2014) Renewables 2014 Global Status Report. Accessed at <http://www.ren21.net/ren21activities/globalstatusreport.aspx>.

REN21 (2015) Renewables 2015 Global Status Report. Accessed at <http://www.ren21.net/status-of-renewables/global-status-report/>.

Riedy C (2013) Subsidies for unburnable carbon need to go up in smoke. *The Conversation*, 19 April 2013. Accessed at <https://theconversation.com/subsidies-for-unburnable-carbon-need-to-go-up-in-smoke-13458>.

The Guardian (2014) India will be renewables superpower, says energy minister. 1 October 2014. Accessed at <http://www.theguardian.com/environment/2014/oct/01/india-will-be-renewables-superpower-says-energy-minister>.

The Guardian (2015). Australian banks under pressure after French lenders rule out funding Galilee Basin coalmines. 8 April 2015. Accessed at <http://www.theguardian.com/business/2015/apr/08/galilee-basin-coalmines-australian-banks-under-pressure-after-french-lenders-rule-out-funding>.

U.S. EIA (Energy Information Administration) (2015) Count of Electric Power Industry Power Plants, by Sector, by Predominant Energy Sources within Plant, 2003 through 2013. Accessed at http://www.eia.gov/electricity/annual/html/epa_04_01.html.

U.S. EPA (Environmental Protection Agency) (2015) U.S. Greenhouse Gas Inventory Report: 1990-2013. Accessed at <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html#fullreport>.

* Estimates of emissions based on estimated energy content of coal produced from each Galilee mine and emission factors are from the Australian Government Department of Climate Change and Energy Efficiency (2012).

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