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Carmichael in Context

Quantifying Australia's threat to climate action

The Australian government has recently approved Adani's Carmichael coal project. Over an average year, Carmichael's carbon emissions will exceed those of Paris, New York, or Tokyo.

Discussion paper

Cameron Amos
Tom Swann
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Level 5, 131 City Walk
Canberra, ACT 2601
Tel: (02) 61300530
Email: mail@tai.org.au
Website: www.tai.org.au

Summary

The Australian government has recently approved Adani's Carmichael coal project. If built, it would be the biggest coal mine in Australia. This briefing note puts the vast scale of Carmichael into context.

The mine pits themselves would be 40km long and 10km wide, bigger than many capital cities. At peak capacity the mine would output 60 million tonnes of thermal coal per year. Adani expects Carmichael will output 2.3 billion tonnes of coal over its lifetime: enough to build a road one-metre thick, ten-metres wide, wrapped around the world five times.

Adani anticipates the mine – its operation and its coal -- to produce 4.7 billion tonnes of CO2-equivalent over its lifetime. This is more than 0.5% of the world carbon budget for limiting warming to 2 degrees Celsius.

Carmichael's average annual emissions of 79 million tonnes of carbon equivalent, or CO2-e, are comparable to annual emissions from many countries, including:

- Sri Lanka (57 MT CO2-e);
- Malaysia (75 MT CO2-e);
- Austria (76 MT CO2-e);
- Vietnam (104 MT CO2-e);

The carbon emissions of Carmichael's coal mine operation and production will surpass or match the annual emissions of many major cities, including:

- Three times the average annual emissions of New Delhi;
- Six times the average annual emissions of Amsterdam;
- Double the average annual emissions of Tokyo;
- 20 per cent more than the average annual emissions of New York City;
- Nearly half the average annual emissions of Beijing, a city with a population rivalling Australia.

In addition, if the Carmichael project proceeds, its output of carbon-equivalent will neutralise many of the gains made through the effort of the international community to prevent dangerous global warming. Specifically, the increase in greenhouse gas emissions from the operating of Carmichael and the burning of its coal product will:

- Entirely offset Australia's carbon reduction goals;
- Offset four-fifths of Canada's carbon reduction goals; and

- Offset half of Japan’s carbon reduction goals.

As the international community prepares for the Paris talks, the world’s climate change abatement efforts rely on leaving the bulk of coal resources in the ground. To do otherwise risks locking in long-term emissions.

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Introduction

THE PROJECT

Australia's Carmichael Coal Mine and associated rail project is a proposed open-cut and underground coal mining operation from Adani Mining Pty Ltd, a wholly owned subsidiary of India's Adani Group.

Coal from the mine would be transported hundreds of kilometres on rail, yet to be built, to the Abbot Point coal terminal, which would need to be expanded, and shipped out to consumers through the Great Barrier Reef. The mine was recently re-approved by the Australian Government.[1]

The proponent seeks to export up to 60 million tonnes of thermal product coal a year for 60 years from Queensland's Galilee Basin. The project features six open-cut pits and five underground mines.[2] Though coal production will peak at 60 million tonnes of product per annum, the average level of product coal produced per year of the mine's operation is 40 million tonnes.[3]

[1] Hasham, Nicole, "Australia's Largest Coal Mine Free to Proceed after Greg Hunt Gives Approval to Adani Carmichael Mine."

[2] GHD Pty Ltd, "Report for Updated Mine Project Description."

[3] Buckley, Tim, "Adani: Remote Prospects."

The significance of Carmichael's emissions

In a recent court case over Adani's coal project, the company's climate experts and the climate experts opposing agreed to establish emissions estimates for the Carmichael coal project, including those emissions arising from the burning of the product coal. The emissions estimates ultimately accepted by both sides of the case are detailed below:

Table 1: Carmichael Coal project emissions, by assessment scope

Measurement	Annual average emissions (Mg CO2-e)	Lifetime emissions (Mg CO2-e)
Scope 1	628,723	37,723,358
Scope 2	808,898	48,533,904
Scope 3	77,395,516	4,643,730,979
Total	**78,833,137**	**4,729,988,241**

Source: Taylor and Meinshausen[4]

The Carmichael 2013 mine supplementary environmental impact statement (SEIS) does not attempt to estimate the project's Scope 3 emissions. Indeed, under the project's terms of references, no such assessment is required. However, while such carbon accounting standards may be sufficient on a per-project basis, the climactic impact of emissions is identical regardless of whichever scope under which they are assessed.

To that extent, it is useful to include the Scope 3 emissions of a coal project, thereby considering the burning of its product as a direct function of its production.

Carmichael's average total annual emissions from Scopes 1, 2 and 3 is roughly 78.8 million metric tonnes of CO_2-equivalent (MT CO_2-e). This figure is used to compare the scale of the project's environmental impact against estimates of other significant sources of carbon emissions such as nations and notable cities.

Simply through the scale of the mine's output, Carmichael coal mine threatens the success of the world's carbon emissions abatement effort. The burning of the mine's coal will entirely negate the emissions reduction success of some major G20 nations,

[4] Taylor, Chris and Meinshausen, Malte, Joint Report to the Land Court of Queensland on "Climate Change – Emissions."

and will almost entirely offset many others. Furthermore, with the mine's 60-year project life, the coal will continue to undermine the global efforts to prevent climate change long after the 2030 emissions reduction targets have been met.

What are scope 3 emissions?

When accounting for greenhouse gas emissions, scope refers to the degree of proximity of the emission to the contributing agent (such as a nation, company, factory, etc.). One facility's Scope 2 emissions, for example, are often the Scope 1 emissions of another facility.

The GHG Protocol defines Scope 1 emissions as those arising directly from the agent (such as Adani's fuel consumption to power machinery), Scope 2 as the indirect emissions generated to produce the agent's purchased electricity, heat, steam, etc., and Scope 3 as emissions generated from activities outsourced by the agent, or generated by the consumption of the agent's product (such as the burning of Carmichael's coal).[5]

[5] Downie and Stubbs, "Evaluation of Australian Companies' Scope 3 Greenhouse Gas Emissions Assessments."

How do Carmichael's emissions compare?

LIFETIME EMISSIONS

The concept of a 'carbon budget' refers to the principle that, beyond a finite point of carbon emissions, the world will exceed 2 degrees of climate warming. This 2 degree point is considered to be the accepted upward limit to climate change, though it is not considered safe.

In a recent joint report to the Queensland Land Court, two expert authors reporting on the carbon emissions of Carmichael's output concluded:

> …the cumulative emissions proposed to be authorised are **approximately 0.53-0.56% of the carbon budget that remains after 2015** to have a likely chance of not exceeding 2 degrees warming.[6]

Put another way, the cumulative lifetime emissions of the Carmichael coal mine over the course of its life will account for a 1/180th of the world's remaining carbon budget between now and 2050.

NATIONAL ANNUAL EMISSIONS

The scale of Carmichael's annual emissions is comparable to those of many sovereign nations. The scale of the coal mine's 78 million tonnes of CO_2-e emissions relative to selected emitting nations are illustrated in the table below:

Table 2: National CO2-e emissions relative to Carmichael coal mine average annual emissions

Country	Annual emissions (MT CO_2-e)	Carmichael emissions as share of national emissions
Switzerland	50.36	157%
Bangladesh	53.76	147%
Sri Lanka	57.31	138%

[6] Emphasis added.

Malaysia	75.28	105%
Austria	76.22	103%
Algeria	100.19	79%
Vietnam	103.83	76%
Egypt	107.37	73%
Greece	108.13	73%
Colombia	152.09	52%
Pakistan	167.13	47%
Netherlands	195.21	40%

Source: United Nations Framework Convention on Climate Change [7]

On average annual emissions across its lifetime, Carmichael will emit 6 per cent more carbon equivalent emissions than Yemen, the Philippines, Mongolia and Sri Lanka combined.[8] At peak production, Carmichael will contribute more annual emissions than Bangladesh and its population of 160 million people. Otherwise, it is the equivalent to:

- 25% of Spain's annual emissions;
- 47% of Pakistan's annual emissions;
- 64% of Peru's annual emissions;
- 68% of Romania's annual emissions;
- 73% of Greece's annual emissions;
- 103% of Austria's annual emissions;
- 355% of Sweden's annual emissions;
- 362% of the Philippines' annual emissions.

Put another way, Spain would need to reduce its annual emissions by 25.4 per cent simply to offset the emissions created by the Carmichael coal mine. Pakistan would

[7] United Nations Framework Convention on Climate Change, "Sixth Compilation and Synthesis of Initial National Communications from Parties Not Included in Annex I to the Convention: Inventories of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases."

[8] Based on each nation's respective latest INFCCC GHG inventory data, LULUCF/LUCF emissions inclusive. http://unfccc.int/ghg_data/items/3800.php; http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx

need to nearly halve its own annual emissions, while Austria would need to become a net absorber of greenhouse gas emissions.

NATIONAL CUMULATIVE ABATEMENT TARGETS

In the leadup to the December 2015 Climate Conference in Paris, nations are expected to state their targets for emissions reduction. The table below summarises a selection of these base year targets:

Table 3: Base year emissions reduction targets, selected nations

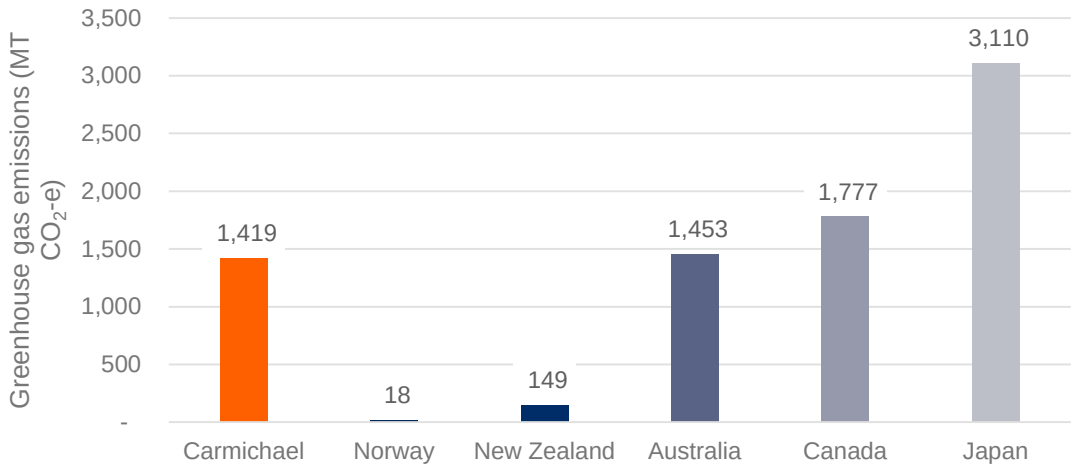
Country	Emissions reduction target	Base year	Target year
USA	26-28%[9]	2005	2030
EU(28)	40%[10]	1990	2030
Japan	25.4%[11]	2005	2030
Canada	30%[12]	2005	2030
Australia	26-28%[13]	2005	2030
New Zealand	30%[14]	2005	2030
Norway	40%[15]	1990	2030

Many nations are committing to reduce their emissions in good faith, only to have their targets effectively entirely negated by the Carmichael coal mine. Half of Japan's reductions between 2012 and 2030, for example, will be offset by Carmichael's production.

As Figure 2 below shows, nations like Canada and Australia will have their mitigation efforts nearly entirely offset by Carmichael's coal, while others such as Norway and New Zealand will be more than offset:

[9] United States of America State Department, "U.S. Cover Note, INDC and Accompanying Information."
[10] Latvian Presidency of the Council of the European Union, "Intended Nationally Determined Contribution of the EU and Its Member States."
[11] Government of Japan, "Submission of Japan's Intended Nationally Determined Contribution."
[12] Government of Canada, "INDC Submission to the INFCCC."
[13] Commonwealth of Australia, "Australia's Intended Nationally Determined Contribution to a New Climate Change Agreement."
[14] Government of New Zealand, "New Zealand's Intended Nationally Determined Contribution."
[15] Kingdom of Norway, "Norway's Intended Nationally Determined Contribution."

Figure 1: Reduction in global emissions by respective national INDC emissions targets, relative to Carmichael coal mine emissions



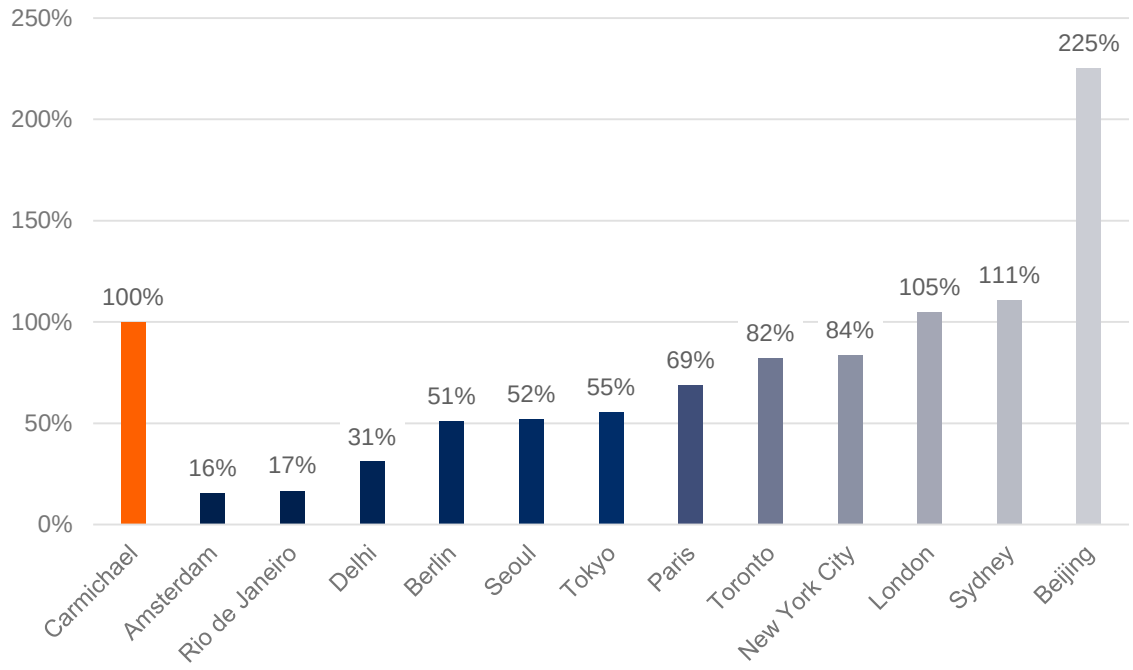
Source: The Australia Institute calculations, based on INDCs listed in Table 3 and calculated using methodology outlined in Appendix.

WORLD CITIES

Using annual per capita emissions of greenhouse gases for each nation, then comparing the emissions per person with the population of major cities within each respective nation, we can further contextualise the sheer scale of Carmichael's climate change impact.[16]

[16] For a detailed methodology, please see Appendix.

Figure 2: Annual CO_2-e emissions of major cities, as share of Carmichael mine's average annual emissions



Source: Author's calculations, based on World Bank, UN Data.[17], [18]

As shown in the figure above, Carmichael's average annual emissions exceed those of most world cities. If New York City became entirely carbon neutral tomorrow, Carmichael's average annual emissions would negate the positive action entirely.

The mine's average year of operation will produce more greenhouse gases per year than Seoul, Tokyo, Paris, Toronto, New York City, Berlin, New Delhi, Los Angeles, Vancouver, Glasgow, Chennai, Ankara, Rome and Vienna, to name but a few.

Carmichael's Scope 1, 2 and 3 emissions for an average year of operation will nearly double those of Cape Town and Tokyo, account for nearly half of Beijing's annual emissions, will exceed Kolkata five-fold, Vancouver seven-fold, and Barcelona more than 11-fold.[19]

[17] World Bank Department of Finance, Economics and Urban Development, "Representative GHG Baselines for Cities and Their Respective Countries."

[18] United Nations Statistics Division, "City Population by Sex, City and City Type."

[19] Hoornweg, Sugar, and Gomez, "Cities and Greenhouse Gas Emissions: Moving Forward."

Conclusion

Australia's Carmichael mine is vast in scale and significance. With the international community grappling with the urgent demand for coordinated reductions in greenhouse gas emissions, Adani's coal mine threatens to undermine the effectiveness of nation's climate mitigation strategies.

The ambition to limit global warming to no more than 2-degrees is inconsistent with the unfettered expansion of coal consumption. The vast bulk of Adani's climate impacts arise through the burning of its product. To maximise the international community's likelihood for success on reducing greenhouse gas emissions, Carmichael's coal product must remain unburnt.

References

Buckley, Tim. “Adani: Remote Prospects.” Briefing Note. Sydney: Institute for Energy Economics and Financial Analysis, September 2015.

Commonwealth of Australia. “Australia’s Intended Nationally Determined Contribution to a New Climate Change Agreement.” United Nations Framework Convention on Climate Change, August 11, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Australia/1/Australias%20Intended%20Nationally%20Determined%20Contribution%20to%20a%20new%20Climate%20Change%20Agreement%20-%20August%202015.pdf.

Downie, John, and Wendy Stubbs. “Evaluation of Australian Companies’ Scope 3 Greenhouse Gas Emissions Assessments.” *Journal of Cleaner Production* 56 (2013): 156–63.

GHD Pty Ltd. “Report for Updated Mine Project Description.” Supplementary Environmental Impact Statement. Carmichael Coal Mine and Rail Project SEIS, October 19, 2013.

Government of Canada. “INDC Submission to the INFCCC.” United Nations Framework Convention on Climate Change, May 15, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Canada/1/INDC%20-%20Canada%20-%20English.pdf.

Government of Japan. “Submission of Japan’s Intended Nationally Determined Contribution.” United Nations Framework Convention on Climate Change, July 17, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Japan/1/20150717_Japan’s%20INDC.pdf.

Government of New Zealand. “New Zealand’s Intended Nationally Determined Contribution.” United Nations Framework Convention on Climate Change, July 7, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/New%20Zealand/1/New%20Zealand%20INDC%202015.pdf.

Hasham, Nicole. “Australia’s Largest Coal Mine Free to Proceed after Greg Hunt Gives Approval to Adani Carmichael Mine.” *The Sydney Morning Herald*. October 16, 2015. http://www.smh.com.au/federal-politics/political-news/adani-carmichael-australias-largest-coal-mine-to-proceed-after-greg-hunt-gives-approval-20151015-gk9wof.html.

Hoornweg, Daniel, Lorraine Sugar, and Claudia Lorena Trejos Gomez. “Cities and Greenhouse Gas Emissions: Moving Forward.” *Environment and Urbanization* 23, no. 1 (2011): 207–27.

Kingdom of Norway. “Norway’s Intended Nationally Determined Contribution.” United Nations Framework Convention on Climate Change, March 26, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Norway/1/Norway%20INDC%2026MAR2015.pdf.

Latvian Presidency of the Council of the European Union. “Intended Nationally Determined Contribution of the EU and Its Member States.” United Nations Framework Convention on Climate Change, March 6, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/Latvia/1/LV-03-06-EU%20INDC.pdf.

Ponce de Leon Barido, Diego, and Julian D Marshall. “Relationship between Urbanization and CO2 Emissions Depends on Income Level and Policy.” *Environmental Science & Technology* 48, no. 7 (2014): 3632–39.

Taylor, Chris, and Meinshausen, Malte. *Joint Report to the Land Court of Queensland on “Climate Change – Emissions.”* Brisbane, 2014. http://envlaw.com.au/wp-content/uploads/carmichael14.pdf.

United Nations Framework Convention on Climate Change. “Report on National Greenhouse Gas Inventory Data from Parties Included in Annex I to the Convention for the Period 1990–2012: National Greenhouse Gas Inventory Data for the Period 1990–2012.” Subsidiary Body for Implementation. Lima: United Nations, December 1, 2014. http://unfccc.int/resource/docs/2014/sbi/eng/20.pdf.

———. “Sixth Compilation and Synthesis of Initial National Communications from Parties Not Included in Annex I to the Convention: Inventories of Anthropogenic Emissions by Sources and Removals by Sinks of Greenhouse Gases.” Addendum. Montreal: United Nations, November 28, 2005. http://unfccc.int/resource/docs/2005/sbi/eng/18a02.pdf.

United Nations Statistics Division, ed. “City Population by Sex, City and City Type.” UNSD Demographic Statistics, December 22, 2014. http://data.un.org/Data.aspx?d=POP&f=tableCode%3a240#POP.

United States of America State Department. “U.S. Cover Note, INDC and Accompanying Information.” United Nations Framework Convention on Climate Change, March 31, 2015. http://www4.unfccc.int/submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf.

Wang, Haikun, Rongrong Zhang, Miaomiao Liu, and Jun Bi. “The Carbon Emissions of Chinese Cities.” *Atmospheric Chemistry and Physics* 12, no. 14 (2012): 6197–6206.

World Bank Department of Finance, Economics and Urban Development. “Representative GHG Baselines for Cities and Their Respective Countries.” Index. Washington, D.C.: The World Bank, March 9, 2011. http://siteresources.worldbank.org/INTUWM/Resources/GHG_Index_Mar_9_2011.pdf.

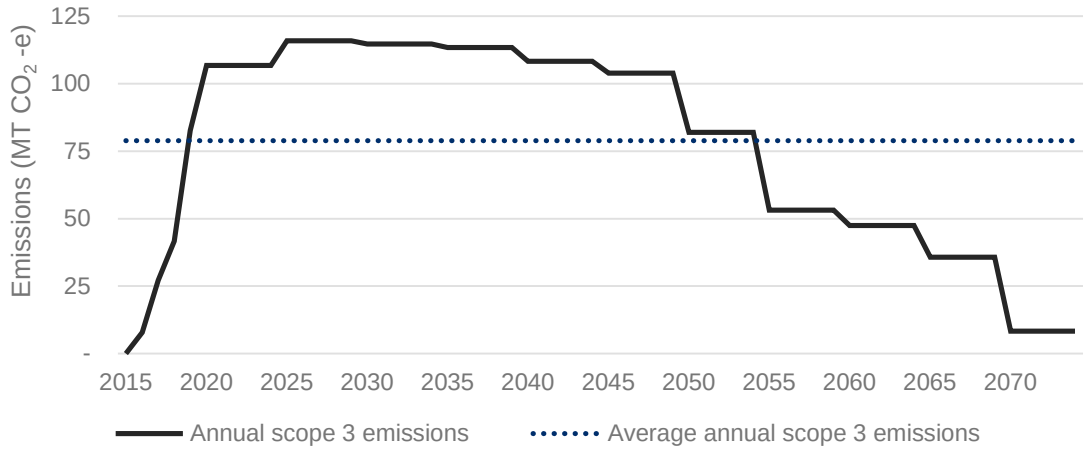
Appendix

CARMICHAEL'S ANNUAL EMISSIONS

The emissions from the coal output of Adani's proposed Carmichael mine is depicted in Figure 3. As with most greenfield projects, there is a short ramp-up to maximum supply and a gradual decline towards the end of its productive life.

At its peak, the mine will produce 60 million tonnes of product coal per annum.[20]

Figure 3: Carmichael project scope 3 emissions, annual



Source: The Australia Institute calculations, based on GHD Pty Ltd production schedule and emissions estimates from Taylor and Meinshausen.[21, 22]

NATIONAL EMISSIONS REDUCTION TARGETS

National emissions reductions targets are sourced from the respective INDC. Most developed nations have committed to a per cent reduction in total emissions from a nominated base year. Most nations have opted to use 2005 as a base year, though there are exceptions, including Russia and Norway.

The conversion of emissions reduction targets into tonnes of CO_2-e requires a consistent estimation of the baseline from which the target will be assessed. For the

[20] GHD Pty Ltd, "Report for Updated Mine Project Description."
[21] Taylor, Chris and Meinshausen, Malte, Joint Report to the Land Court of Queensland on "Climate Change – Emissions."
[22] GHD Pty Ltd, "Report for Updated Mine Project Description."

purpose of this report, we rely upon the national greenhouse gas inventories provided to the UNFCCC relating to 2012, the most recent year for reporting. Formally, for baseline estimates:

$$x_t = g(x_b)$$

Where x_t refers to the emissions output for the target year, x_b refers to the emissions output for the baseline year, and g refers to the reduction goal as a percentage (where $0 \leq g \leq 1$). The result is provided in the table below:

Table 4: National annual CO_2-e emissions (base year, target year, 2012)

Country	Emissions, MT CO_2-e (Base year)	Emissions, MT CO_2-e (Target year)	2012 emissions, MT CO_2-e
USA	6,223.1 (2005)	4,542.8 (2030)	5,546.3
EU(28)	5,367.9 (1990)	3,220.8 (2030)	4,240.7
Japan	1,261.0 (2005)	940.7 (2030)	1,268.1
Canada	789.2 (2005)	552.5 (2030)	739.5
Australia	548.4 (2005)	405.8 (2030)	558.8
New Zealand	48.2 (2005)	33.8 (2030)	49.4
Norway	40.3 (1990)	24.2 (2030)	26.1

Source: The Australia Institute calculations, based on United Nations Framework Convention on Climate Change [23]

CUMULATIVE EMISSIONS REDUCTIONS

Emissions reductions are presumed to follow a linear trend, with a constant reduction each year in absolute terms, and nations reaching their emissions reduction target in the year of their target deadline.

Letting X be the cumulative reduction in a country's emissions:

[23] United Nations Framework Convention on Climate Change, "Report on National Greenhouse Gas Inventory Data from Parties Included in Annex I to the Convention for the Period 1990–2012: National Greenhouse Gas Inventory Data for the Period 1990–2012."

$$X = \sum_{i=1}^{n} x_{n-k}$$

Where k refers to the annual emissions reduction for year i, until annual emissions equal x_t in target year n:

$$k = \frac{1}{n}(x_t - x_b)$$

Some nations express their targets as a range. In these cases the lower bound of target ranges is used. For example, Australia's target is 26-28 per cent from 2005 levels by 2030. This is taken to mean 26 per cent.

INTERNATIONAL COMPARISONS

Includes emissions arising from land use, land use change, and forestry (LULUCF/LUCF). For non-Annex I countries, the last reported GHG Inventory year has been used. As some non-Annex I nations have not reported in over ten years, these comparisons are less reliable, and should be treated carefully. Wherever possible, the emissions data from non-Annex I nations has been supplemented with third party sources.

CITY COMPARISONS

Excludes LULUCF/LUCF, and therefore not directly comparable to the international comparisons on a state basis. Calculated using most recent population statistics from the UN Data service.[24] The population size is multiplied by the per capita emissions of greenhouse gases reported by the World Bank in 2011.[25] Note data for different cities comes from different years. The resulting statistic is then divided by the total average annual emissions of Carmichael to produce a percentage comparing the two.

There is considerable variation within the reporting dates of city population emission statistics as recorded by the World Bank. As a result, the most recent per capita emissions have been taken from each, so that if $e_c = \frac{e}{p}$, where e_c refers to emissions per capita of a given population, e refers to the emissions of that total population, and p refers to the numerical size of the population from which the emissions are produced. The city's modern emissions can therefore be estimated from older data.

[24] United Nations Statistics Division, "City Population by Sex, City and City Type."

[25] World Bank Department of Finance, Economics and Urban Development, "Representative GHG Baselines for Cities and Their Respective Countries."

Specifically, modern emissions per city are estimated by finding p from the UN Data service, then multiplying it by e_c to restate the equation in another way.

The emissions for developed cities, when calculated in this manner, should be considered conservative. This is because this methodology treats emissions per capita as a constant figure, rather than a variable. Doing so favours developed cities over developing cities, as the former have a higher probability of existing within countries with strict and ambitious climate policies.[26] For example, this methodology applies a level of per capita emissions to Beijing of 10.8 Mg CO_2-e, which is higher than other estimates published in peer-reviewed journals: by doing so, it downplays Carmichael's relative size, rather than exaggerates it.[27]

[26] See, for instance, Ponce de Leon Barido and Marshall, "Relationship between Urbanization and CO2 Emissions Depends on Income Level and Policy."

[27] See, for instance, an estimate of 8.62 Mg CO2-e per capita within Wang et al., "The Carbon Emissions of Chinese Cities."