Fast, fair climate action crucial for health and equity

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Health equity underpins everyday medical practice[1,2]—and is a key motivator to set ambitious greenhouse gas (GHG) emissions targets at the impending United Nations climate conference in Paris (UN COP#21).[3-5] Fast-approaching, that conference is crucial to world health.[6-9] So, what does health equity mean for setting countries' climate targets—including ours?

Earlier this year *The Lancet* described climate change as a medical emergency threatening to undermine 50 years' progress in global health.[10] As part of the international effort to keep within 2°C—a carbon budget of 1 trillion tonnes remaining CO2 emissions (see Appendix note 1)—New Zealand has submitted GHG emissions targets as our contribution to Paris, setting a target of an 11% reduction on 1990 gross emissions by year 2030.[11-17]

Targets for, and patterns of, GHG emissions vary dramatically between countries.[18-21] For example, although China is now responsible for 30% of the world's annual fossil CO2 (fCO2) emissions, historically North America, Europe, the former Soviet bloc and Japan/Australasia have caused the bulk of the problem (eg, two-thirds of cumulative fCO2 emissions between 1950 and 2013). This compares with China's 13% cumulative emissions, while India (which has 18% world population) has 3%.[21] Per capita emissions vary a staggering 1,670 times between highest and lowest emitters (eg, Qatar 46.5 tonnes fCO2/person in 2013, vs Chad 0.028 tonnes/person).[23,24]

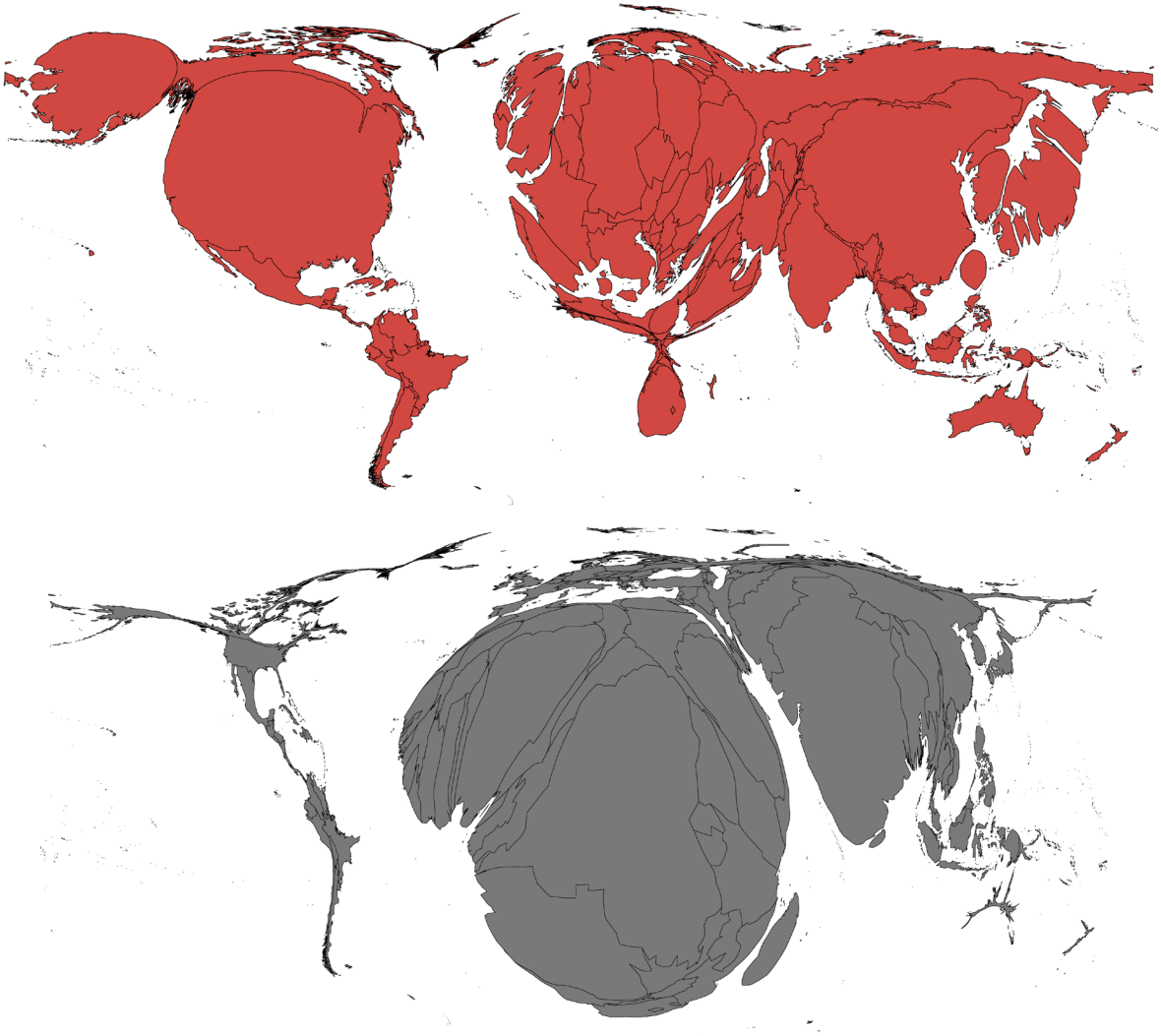
The differences in the likely health consequences of those emissions are just as large,[25,26] as is the potential for countries to reduce those emissions and/or adapt to those consequences.[27] Historic emissions correlate with both current per capita gross domestic product (GDP) and health (decreased disease burden) (see Appendix note 2),[21] with credible estimates of disease burden from climate change painting a bleak picture of inequity.[25,26] Although all countries will suffer, those hit earliest and hardest will be poorer countries, without the incomes or infrastructures to adapt—and who have contributed the least to this climate crisis (see Appendix note 3). Women and children there, especially girls, are and will be particularly affected.[28-30]

These differences are unfair.

What of New Zealand? We are both wealthy and a high emitter—both now and in the past. New Zealand accounts for 0.06% of the world's population, 0.15% of world GDP, 0.16% of world current annual gross GHG emissions, and 0.19% of cumulative gross GHG emissions.[23,24] Our per capita income, etc, is nine times that of our Pacific Island neighbours, and our per capita gross GHG emissions are eleven times as much[21,23] (see Appendix note 5)—yet they are being impacted first by sea level rises and ocean acidification, with the added risk of their lands becoming ultimately inhabitable, and their seas unfishable.

How should we share the ambitious global effort to reduce GHG emissions in time to keep well within the world's emissions budget? There are multiple ways, using multiple algorithms, to calculate countries' 'appropriate shares'. These can combine the level of global ambition (ie, how fast emissions must decline globally), current vs historic emissions, historical emissions starting from anywhere between 1850 and 1990, capitation vs population size, GDP, 'development thresholds' (base per capita emissions by rights), etc, all depending on what underlying value systems you choose.[32-44] The Contraction

Figure 1: The climate gap: those who have emitted most vs those impacted first and worst



Cumulative fossil CO2 emissions 1950–2013 [CDIAC via http://calculator.climateequityreference.org/]; additional deaths attributable to climate change from five climate-sensitive consequences, 2030 (under-nutrition, malaria, dengue, diarrhoeal disease, heat)—excluding coastal flooding (Hales, et al. WHO 2014).[25] Mapping by Mark Metcalfe. Details in Appendix note 4.

and Convergence model[42-44] is a widely-used example, the Climate Equity Reference framework (CERf, previously the GDRf)[27,45,46] is another, but there are many others still.[37]

New Zealand's small population and particular emissions profile makes it more sensitive to the choice of model and assumptions than many other countries.[12,21,22] However, under nearly all reasonable models,[12,21] our targets are very weak.[11] Where New Zealand proposes an 11% reduction on 1990 gross emissions by year 2030, the international allocation models calculate between 24% and 91% reductions on 1990 levels are required to be 'fair'.[12,21,22] Contraction and Convergence and key CERf scenarios, in light of other countries' efforts, both now estimate 63% reductions are needed (see Appendix note 6).[11,31] If most other countries were to follow New Zealand's approach, global warming would exceed 3–4°C.[12,19]

Fair is how much we rapidly reduce our greenhouse gas emissions to stay within the now tightly constrained atmospheric emissions budget. Fair is recognising that those who contributed the least emissions in the past, will ironically, now be hit first and worst. And fair is finance, both for climate loss and damage, which will be hardest for poorer countries, and to encourage their low emissions growth.[19]

Although the world can no longer afford other countries to emit GHG for growth like Western countries have, a fair approach recognises that every human has a right to good health and comparable health expectancy. This decade, the world confronts an

existential crossroads, where our best hope lies in working together fairly to rapidly reduce emissions and minimise human health costs from the climate changes already locked in.

Climate fairness also has a New Zealand face—where the most vulnerable New Zealand households will also be hit first and worst.[47] Children, Māori, Pacific peoples, older people and low-income households are all at greater risk from climate changes than other New Zealanders. Most of us will be in one or more of these groups at some stage. This year's South Dunedin, Whanganui, Kāpiti and Gisborne floodings are apt reminders of how more vulnerable households will bear more impact. Rapidly reducing climate risk is about fairness, both globally and within New Zealand. Creating a fairer country is future-proofing, in the face of climate changes already locked in.

Fair is also about future generations. We have the choice to stabilise climate changes over the next few years. Our children and the generations that follow do not have that choice; this is our responsibility, right now.

Yet as *The Lancet* Commission reminds us, tackling climate change presents the greatest global opportunity to improve people's health this century.[10] There are real practical solutions available to us that mean New Zealand can rapidly reduce emissions at a much faster rate,[11] consistent with a two-thirds chance of limiting warming to the globally agreed 2°C (or the safer limit of 1.5°C, which gives better odds and protects the lands of our Pacific neighbours and other vulnerable nations). In a world trending to zero emissions, rapid action also future-proofs our economy and our health sector, avoiding high-emitting stranded assets, and reducing health care demand. Importantly, many climate-protective measures can also generate immediate health gains in significant areas of concern,[47] which is a win-win for our health sector.

The key to success at the Paris talks, starting on 30 November, will be fairness and teamwork. No one country is too small to make a difference. This is about seizing unprecedented opportunities for better health[10]—and responding swiftly to our global medical emergency of climate change.

Competing interests:
Scott Metcalfe is on the Policy Committee of the NZ College of Public Health Medicine, the Executive Board of OraTaiao: The New Zealand Climate and Health Council, and the Board of the New Zealand Medical Association.

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www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2015/vol-128-no-1425-20-november-2015/6741

REFERENCES:

1. New Zealand Medical Association. NZMA Position Statement on Health Equity. Wellington: NZMA, 2011. https://www.nzma.org.nz/__data/assets/pdf_file/0016/1456/Health-equity-2011.pdf
2. New Zealand Medical Association. NZMA Position Statement: Consensus statement on the role of the doctors in New Zealand. Wellington: NZMA, 2011. http://www.nzma.org.nz/publications/role-of-the-doctor-consensus-statement
3. Bennett H, Macmillan A, Jones R. Health, fairness and New Zealand's contribution to global post-2020 climate change action. N Z Med J. 2015;128:6-9. https://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2015/vol-128-no-1415/6544
4. World Health Organization. Climate change and human health. http://www.who.int/globalchange/global-campaign/cop21/en/
5. World Medical Association. Health must be given higher priority in climate summit say physician leaders. WMA, 28 May 2015. http://www.wma.net/en/40news/20archives/2015/2015_22/index.html
6. Metcalfe S, Woodward A, Macmillan A, Baker M, Howden-Chapman P, et al. Why New Zealand must rapidly halve its greenhouse gas emissions [Special article]. N Z Med J. 2009;122:72-95. (hosted, with NZMJ permission, at https://d3n8a8pro7vhmx.cloudfront.net/orataiao/pages/165/attachments/original/1442214913/Metcalfe_et_al_NZMJ_2009.pdf?1442214913
7. Montgomery H. Climate change: the health consequences of inactivity. N Z Med J. 2008;122:6-8. https://www.nzma.org.nz/__data/assets/pdf_file/0010/17785/Vol-122-No-1304-09-October-2009.pdf
8. New Zealand Medical Association. NZMA Position Statement on Health and Climate Change. Wellington: NZMA, 2015. https://www.nzma.org.nz/__data/assets/pdf_file/0010/16984/NZMA-Position-Statement-on-Health-and-Climate-Change-FINAL_August-2015.pdf
9. New Zealand College of Public Health Medicine. NZCPHM Policy Statement on Climate Change. Wellington: New Zealand College of Public Health Medicine, 2013. http://www.nzcphm.org.nz/policy-publications
10. Watts N, Adger WN, Agnolucci P, Blackstock J, Byass P, et al; Montgomery H, Costello A; for The 2015 Lancet Commission on Health and Climate Change. Health and climate change: policy responses to protect public health. Lancet. 2015 Jun 24. pii: S0140-6736(15)60854-6. doi: 10.1016/S0140-6736(15)60854-6. http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(15)60854-6/
11. Graham K. Climate goals for New Zealand in 2030: an ambitious domestic emissions target within an appropriate share of the global budget. Background research paper. Feasible ambition: climate goals for New Zealand in 2030 Climate Protection conference, Wellington, 25 September 2015. http://www.nzcphm.org.nz/media/88538/150914_research_paper.pdf
12. Rocha M, Hare B, Cantzler J, Parra P, Fekete H, et al. New Zealand deploys creative accounting to allow emissions to rise. Climate Action Tracker policy brief. Climate Analytics, New Climate Institute, Potsdam Institute for Climate Impacts Research, Ecofys, 2015. http://climateactiontracker.org/publications/briefing/214/New-Zealand-deploys-creative-accounting-to-allow-emissions-to-rise-.html
13. OraTaiao: The New Zealand Climate and Health Council. Submission: Government's consultation on setting New Zealand's post-2020 climate change target, 2015. https://d3n8a8pro7vhmx.cloudfront.net/orataiao/pages/75/attachments/original/1440984195/OraTaiao_submission_to_INDC_discussion_document_FINAL.pdf?1440984195
14. New Zealand College of Public Health Medicine. Submission on New Zealand's post-2020 climate change target. Wellington: NZCPHM, 2015. http://www.nzcphm.org.nz/media/85832/nzcphm_submission_on_nzs_post-2020_climate_change_target__03062015_.pdf
15. New Zealand Medical Association. New Zealand's Climate change target. Submission to MfE. Wellington: NZMA, 2015. https://www.nzma.org.nz/__data/assets/pdf_file/0003/42843/NZMA-Submission-to-MFE-on-New-Zealands-Climate-Change-Target.pdf
16. NZ Nurses Organisation. Consultation on setting

New Zealand's post 2020 climate change target: submission to the Ministry for the Environment. Wellington: NZNO, 2015. http://www.nzno.org.nz/Portals/0/Files/Documents/Activities/Submissions/3_2015-06%20MFE%202020%20Climate%20Change_NZNO.pdf

17. Public Health Association. New Zealand's post-2020 climate change target: submission to the Ministry for the Environment from the Public health Association of New Zealand (Inc). Wellington: PHA, 2015. http://www.pha.org.nz/submissions/PHANZ-Post-2020-Climate-Change-target.pdf
18. Meinshausen ML, Jeffery J, Guetschow Y, du Pont R, Rogelj J, Schaeffer M, Hohne N, den Elzen M, Oberthur S, Meinshausen N. National post-2020 greenhouse gas targets and diversity-aware leadership. Nature Clim. Change 2015, advance online publication. http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate2826.html. Supplementary information http://www.nature.com/nclimate/journal/vaop/ncurrent/extref/nclimate2826-s1.pdf
19. Fair Shares: A Civil Society Equity Review of INDCs. 130+ international and regional civil society organisations. https://www.oxfam.org/en/research/fair-shares-civil-society-equity-review-indcs, http://civilsocietyreview.org/wp-content/uploads/2015/11/CSO_FullReport.pdf
20. New Zealand College of Public Health Medicine. Background to the NZCPHM's stance on setting national GHG emissions targets. http://www.nzcphm.org.nz/media/85324/2013_11_22_2.nzcphm_climate_change_supplement_1__final2_.pdf.Supplement One to NZCPHM Policy Statement on Climate Change. Wellington: New Zealand College of Public Health Medicine, 2013. http://www.nzcphm.org.nz/policy-publications
21. Metcalfe S. What is an appropriate emissions share for New Zealand? Sharing in the global carbon budget. Feasible ambition: climate goals for New Zealand in 2030 Climate Protection conference, Wellington, 25 September 2015. https://d3n8a8pro7vhmx.cloudfront.net/orataiao/pages/208/attachments/original/1447822888/SMetcalfe_20150925_What_is_an_appropriate_emissions_share_for_NZ.pptx?1447822888
22. Holz C. Fairness and ambition for the global response to climate change: the Climate Equity Reference framework. Feasible ambition: climate goals for New Zealand in 2030 Climate Protection conference, Wellington, 25 September 2015. https://d3n8a8pro7vhmx.cloudfront.net/orataiao/pages/208/attachments/original/1447792815/Carbon_Budget_-_Dr_Christian_Holz__'Fairness_and_Ambition_for_the_Global_Response_to_Climate_Change-The_Climate_Equity_2.pdf?1447792815
23. Climate Equity Reference project (CERP) calculator data http://calculator.climate-equityreference.org/
24. Annex C. National responsibility: global methodologies and the NZ calculation. annex to: Graham K. Climate goals for New Zealand in 2030: an ambitious domestic emissions target within an appropriate share of the global budget. Background research paper. Feasible ambition: climate goals for New Zealand in 2030 Climate Protection conference, Wellington, 25 September 2015. http://www.nzcphm.org.nz/media/88541/150914_annex_c.pdf
25. Hales S, Kovats S, Lloyd S, Campbell-Lendrum D (eds.). Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014. http://www.who.int/globalchange/publications/quantitative-risk-assessment/en/.
26. Climate Vulnerability Monitor 2nd Edition: a guide to the cold calculus of a hot planet. DARA International and the Climate Vulnerable Forum, 2012. http://daraint.org/climate-vulnerability-monitor/climate-vulnerability-monitor-2012/report/
27. Baer P, Athanasiou T, Kartha S, Kemp-Benedict E. The right to development in a climate constrained world: the Greenhouse Development Rights framework (revised 2nd edition). Heinrich Böll Foundation, Christian Aid, EcoEquity, Stockholm Environment Institute, 2008. (http://gdrights.org/wp-content/uploads/2009/01/thegdrsframework.pdf
28. World Health Organization. Gender, climate change and health. Geneva: WHO,

2014. http://www.who.int/globalchange/publications/reports/gender_climate_change/en/

29. Kangas A, Haider H, Fraser E. Gender: Topic Guide. Revised edition with E. Browne. Birmingham: GSDRC, University of Birmingham, 2014. pp130-137 Gender and climate change. http://www.gsdrc.org/wp-content/uploads/2015/07/gender.pdf, http://www.gsdrc.org/topic-guides/gender/gender-and-climate-change/

30. Bambick H. Worldwide, climate change is worse news for women. 2015. https://theconversation.com/worldwide-climate-change-is-worse-news-for-women-49668 2015

31. Climate Equity Reference Project Online Calculator http://calculator.climateequityreference.org, Calculator version 3.0.0, Data version 7.0.0dev. Last modified 22 Oct 2015 00:46:51 PDT. 2o pathway, 1990 responsibility, mid-equity settings, gross GHG (fCO2 + nonCO2 GHG emissions, excludes LULCF): New Zealand 1990 net GHG emissions 60.7 MtCO2-eq (note: this is unadjusted for new GWPs), allocation 22.3 Mt, 63% reduction.

32. den Elzen M, Höhne N, van Vliet J, Ellermann C. Exploring comparable post-2012 reduction efforts for Annex I countries. The Hague: Netherlands Environmental Assessment Agency (PBL), 2008. http://www.pbl.nl/en/publications/2009/Exploring-comparable-post-2012-reduction-efforts-for-Annex-I-countries, http://www.pbl.nl/sites/default/files/cms/publicaties/500102019.pdf

33. Baer P, Athanasiou T. Frameworks & proposals. a brief, adequacy and equity-based evaluation of some prominent climate policy frameworks and proposals. Global Issue Paper No. 30. Berlin: Heinrich Böll Foundation, 2008. https://www.boell.de/de/node/271031

34. Boston J. Framing a post-2012 climate change agreement: the quest for 'comparability of efforts'. Policy Quarterly 2008;4:40-47. http://ips.ac.nz/publications/files/b791334fbbe.pdf

35. Reisenger A. Differentiating emissions targets for individual developed countries: economics and equity. Economics Discussion Papers, No 2009-41, Kiel Institute for the World Economy, 2009. http://www.economics-ejournal.org/economics/discussionpapers/2009-41

36. Climate Action Network – International. Fair Effort Sharing Discussion Paper, 12 July 2011. http://www.climatenetwork.org/sites/default/files/CAN_effort_sharing_discussion_paper_25July2011_v2.pdf

37. Höhne N, den Elzen M, Escalante D. Regional GHG reduction targets based on effort sharing: a comparison of studies. Climate Policy 2014;14(1):122–147Höhne et al. 2013/4 http://www.tandfonline.com/doi/full/10.1080/14693062.2014.849452 . Supplemental content at http://www.tandfonline.com/doi/suppl/10.1080/14693062.2014.849452/suppl_file/tcpo_a_849452_sm2285.xlsx, reporting aggregated models for Japan/Australia/NZ combined (not New Zealand alone)

38. Fleurbaey M, Kartha S, Bolwig SA, Chee YL, Chen Y, et al. Sustainable development and equity. In: Climate Change 2014: Mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer O, Pichs-Madruga R, Sokona Y, Farahani E, Kadner SZ, et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2014. Chapter 4 http://report.mitigation2014.org/report/ipcc_wg3_ar5_chapter4.pdf 4.6.2 pp317-321

39. Clarke L, Jiang K, Akimoto K, Babiker M, Blanford G, et al. Assessing transformation pathways. In: Climate Change 2014: Mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer O, Pichs-Madruga R, Sokona Y, Farahani E, Kadner SZ, et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2014. Chapter 6 http://report.mitigation2014.org/report/ipcc_wg3_ar5_chapter6.pdf 6.2.1 Overview of integrated modelling tools, 6.3.1 Baseline scenarios, Table 6.5 Categories of effort sharing proposals (source: Hohne et al 2014) p.458, Figure 6.28 p.460 (Hohne et al 2014).

40. Pauw P, Bauer S, et al. Different perspectives on differentiated responsibilities: a state-of-the-art review of the notion of common but differentiated responsibilities in international negotiations. Bonn: German Development Institute, 2014. https://www.die-gdi.de/

en/discussion-paper/article/different-perspectives-on-differentiated-responsibilities-a-state-of-the-art-review-of-the-notion-of-common-but-differentiated-responsibilities-in-international-negotiations/

41. Kallbekken S, Sælen H, Underdal A. Equity and spectrum of mitigation commitments in the 2015 agreement. TemaNord 2014:519. Copenhagen: Norden –The Nordic Council of Ministers, 2014. http://norden.diva-portal.org/smash/get/diva2:710898/FULLTEXT01.pdf

42. Stott R. Contraction and convergence: the best possible solution to the twin problems of climate change and inequity. BMJ. 2012 Mar 19;344:e1765. doi: 10.1136/bmj.e1765. http://www.bmj.com/content/344/bmj.e1765, http://www.gci.org.uk/Documents/Stott_BMJ_2012.pdf

43. Global Commons Institute. http://www.gci.org.uk/index.html

44. Global Commons Institute. http://www.gci.org.uk/Documents/ICE.pdf

45. Climate Equity Reference project http://climate-equityreference.org/

46. Athanasiou T, Kartha S, Baer P. National Fair Shares: The mitigation gap – domestic action and international support. A Climate Equity Reference Project report. EcoEquity & Stockholm Environment Institute, 2014. http://climate-equityreference.org/national-fair-shares-the-mitigation-gap-domestic-actions-international-support/; Kartha S, Athanasiou T, Baer P. 'Fair shares' and intended nationally determined contributions: What can we learn from an equity review? SEI Discussion Brief, 2014. http://www.seiinternational.

47. Bennett H, Jones R, Keating G, Woodward A, Hales S, Metcalfe S. Health and equity impacts of climate change in Aotearoa-New Zealand, and health gains from climate action [Special article]. N Z Med J. 2014;127:16-31. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2014/vol-127-no-1406/6366

48. 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, et al (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf E8 page 27.

49. IPCC, 2013. Climate Change 2013: The Physical Science Basis. Working Group I Contribution to the IPCC Fifth Assessment Report. Final Draft Underlying Scientific-Technical Assessment. Accepted by the 12th Session of Working Group I and the 36th Session of the IPCC on the 26th September, 2013, Stockholm, Sweden. http://www.ipcc.ch/report/ar5/wg1/#.UkoOpvv29Ms. Chapter 12 http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter12_FINAL.pdf section 12.5, p1113.

50. Climate Action Tracker. Global pathways. http://climateactiontracker.org/methodology/18/Global-pathways.html

51. WHO estimates for 2000-2012 Disease burden http://www.who.int/healthinfo/global_burden_disease/estimates/en/index2.html , http://www.who.int/entity/healthinfo/global_burden_disease/GHE_DALY_2012_country.xls?ua=1

Appendix

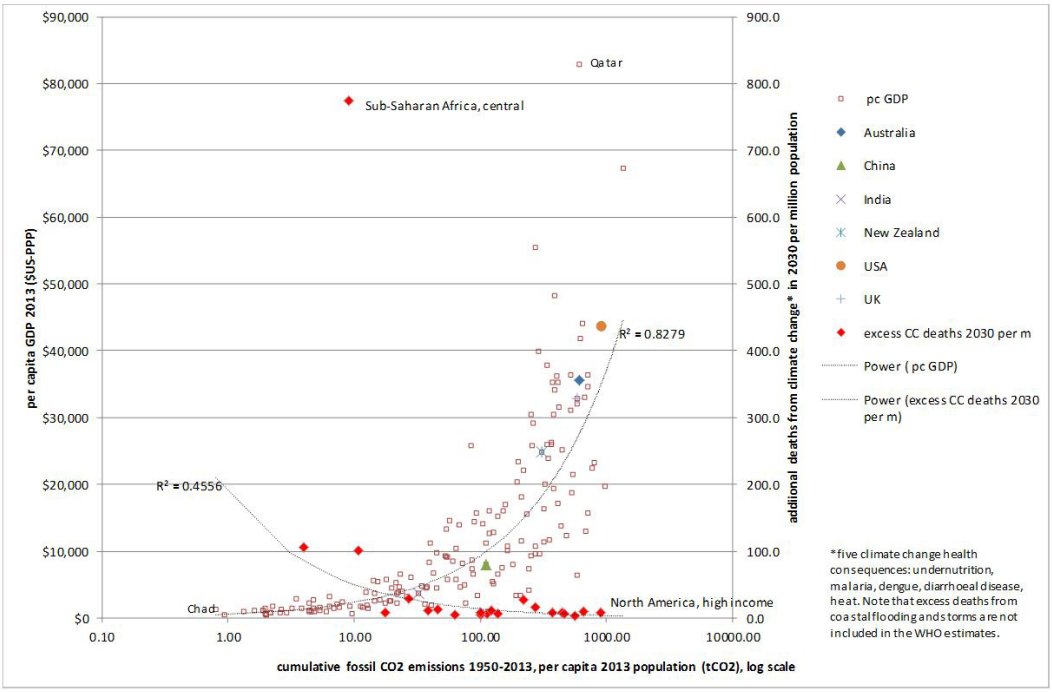
Notes:

1. The world needs to keep within the agreed 2°C guardrail (1.5°C for New Zealand's swamped Pacific neighbours), with a finite limit of the 1,010 billion tonnes (Gt) remaining net CO2 global carbon budget in the IPCC's recent 5th Assessment Report (at a very risky 66% confidence of keeping warming from CO2 alone to below 2°C).[48,49] At current rates of GHG emissions globally—let alone rates continue to rise each year—that budget will be breached by around the year 2035.[50]
2. Despite rapid growth in recent years, China and India remain relatively poor, when accounting for their large populations. Using per capita GDP (granted, a poor measure of true wealth), wealth varies 170-fold between richest and poorest (Qatar $82,000 per capita GDP in 2012, Burundi $474 ie $1.30 per day).[45] Likewise, health suffers; disease

burden varies 8-fold (United Arab Emirates 149.9 DALYs lost per 1000 in 2012, Sierra Leone 1251.3 per 1,000 DALYs lost from disability or early death).[51]

3. Sub-Saharan Africa is expected to suffer 77,760 additional deaths from just under-nutrition, malaria, dengue, diarrhoeal disease, and heat in year 2030—65% of the 241,000 of those climate deaths the World Health Organization (WHO) expects worldwide that year.[25] DARA predicts 650,000 such deaths in 2030, and estimates that already 400,000 excess deaths are caused now by climate change.[26] India and the other least developed countries (including sub-Saharan Africa) have half the world's population, but 15% of GDP and emit 13% of fCO2—and have been responsible for just 9% of 1950–2013 emissions, yet will suffer 88% of year 2030 additional climate deaths—that is 212,000 additional climate deaths just 15 years from now.[25]

Figure 2: Historic emissions, current per capita GDP and projected future excess death rates from climate change, by country[21,23,25]



4. Explanation of Figure 1:
Density-equalising cartograms. Comparison of (a) cumulative fossil CO_2 emissions by country for 1950–2013 vs (b) the regional distribution of deaths from five climate-sensitive health consequences (undernutrition, malaria, dengue, diarrhoeal disease, heat) estimated for year 2030.

Sources:

(a) analysis of CERP calculator data http://calculator.climateequityreference.org/ for cumulative fossil CO_2 emissions 1950-2013, sourced by CERP in turn from the UNFCCC dataset[1] for Annex 1 countries and the CDIAC dataset[2] for non-Annex 1 countries (see http://climateequityreference.org/calculator-information/gdp-and-emissions-baselines)

[1] Summary data from national reports to the UNFCCC are at http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php

[2] Carbon Dioxide Information and Analysis Center (CDIAC), Oak Ridge National Laboratory, US Department of Energy. Its primary national level data set is available at http://cdiac.ornl.gov/ftp/ndp030/CSV-FILES/nation.1751_2010.csv, as Boden TA, Marland G, Andres RJ. Global, Regional, and National Fossil-Fuel

CO_2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., USA, 2013. doi 10.3334/CDIAC/00001_V2013.

(b) Hales S, Kovats S, Lloyd S, Campbell-Lendrum D (eds.). Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s. Geneva: World Health Organization, 2014. www.who.int/globalchange/publications/quantitative-risk-assessment/en/ Table 1.2.

Further data disaggregation to individual countries via linear scaling (as projected $deaths_{country}$ = projected $deaths_{region}$ × projected $pop_{country}$ / projected pop_{region}), solely for mapping software purposes.

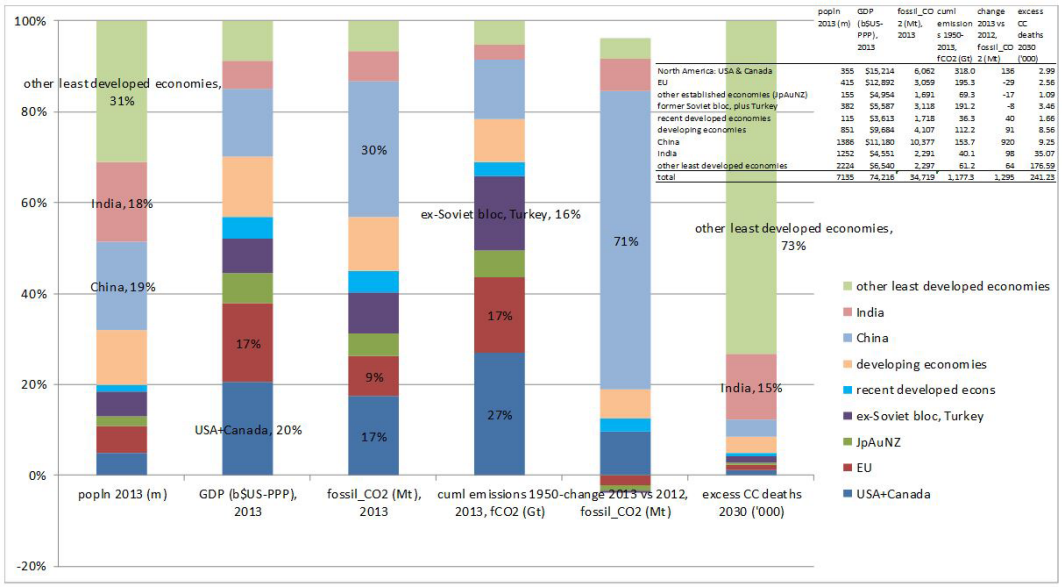
Note that excess deaths from coastal flooding are not included in these estimates.

(c) mapping by Mark Metcalfe

5. Analysis of CERP calculator data http://calculator.climateequityreference.org:[21,23]
New Zealand 2012 per capita GDP $24530 (US$-PPP) ÷ Pacific Islands (PICTs) $2826 = 8.7; New Zealand 2013 per capita gross GHG emissions = 17.1 tonnes CO2 (tCO2) ÷ PICTs 1.6 tCO2 = 10.8.
PICTs = Pacific Island Countries and Territories: Fiji, Kiribati, Marshall Islands, (Federated States of) Micronesia, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Vanuatu.
6. Climate Equity Reference Project Online Calculator (http://calculator.climateequityreference.org). Last modified 22 Oct 2015 00:46:51 PDT, Calculator version 3.0.0, Data version 7.0.0dev. 2o pathway, 1990 responsibility, mid-equity settings, gross GHG (fCO2 + nonCO2 GHG emissions, excludes LULCF):
New Zealand 1990 net GHG emissions 60.7 MtCO2-eq (note: this is unadjusted for new GWPs), allocation 22.3 Mt, 63% reduction.

Additional figures and tables:[21,24]

Figure 3: Population, GDP, current and historic emissions, and projected future excess deaths from climate change, by groups of countries



	popln 2013 (m)	GDP (b$US-PPP), 2013	fossil_CO2 (Mt), 2013	cuml emissions 1950-2013, fCO2 (Gt)	change 2013 vs 2012, fossil_CO2 (Mt)	excess CC deaths 2030 ('000)
North America: USA & Canada	355	515,214	6,062	318.0	136	2.99
EU	415	512,892	3,059	195.3	-29	2.56
other established economies (JpAuNZ)	155	54,954	1,691	69.3	-17	1.09
former Soviet bloc, plus Turkey	382	55,587	3,118	191.2	-8	3.46
recent developed economies	115	53,613	1,718	36.3	40	1.66
developing economies	851	59,684	4,107	112.2	91	8.56
China	1386	511,180	10,377	153.7	920	9.25
India	1252	54,551	2,291	40.1	98	35.07
other least developed economies	2224	56,540	2,297	61.2	64	176.59
total	7135	74,216	34,719	1,177.3	1,395	241.23

Table 1: Population, GDP, current and historic emissions, and projected future excess deaths from climate change, by groups of countries

	popln 2013 (m)	GDP (b$US-PPP), 2013	fossil_CO2 (Mt), 2013	cuml emissions 1950-2013, fCO2 (Gt)	change 2013 vs 2012, fossil_CO2 (Mt)	excess CC deaths 2030 ('000)
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