

A compromise to break the climate impasse

Marco Grasso^{1*} and J. Timmons Roberts^{2*}

To overcome the current impasse in global climate negotiations we propose a compromise for sharing the remaining carbon budget, based on four elements. First, limiting initial action to the Major Economies Forum members would streamline negotiations greatly. Second, using consumption-based carbon accounting would overcome important fairness concerns of key developing countries. Similarly, applying equity principles of responsibility and capability to apportion the burden of emissions reductions within the group can address concerns of both the global north and south. And fourth, promptly bringing this compromise back to the United Nations negotiations for wider adoption will be critical. Based on an indicative carbon budget of 420 gigatonnes carbon dioxide over the period 2012–2050, our analysis shows that ambitious but feasible emissions reductions will be needed, with sharp differences by world economic groups. The compromise offers effectiveness, feasibility and fairness.

The international community is struggling to find a strategy for breaking the enduring gridlock on climate change. In terms of international cooperation to adequately address the climate crisis, the most urgent and complicated coordination problem is the development of an inclusive, concerted framework for promptly abating greenhouse gas emissions¹. Such a framework must meet three criteria: effectiveness, feasibility and fairness.

As negotiations move towards the 2015 deadline to settle a successor treaty to the Kyoto Protocol, pressure is building to have an agreement that covers all countries, including India and China, in commitments for emissions reductions^{2,3}. These countries and others in a newly organized negotiating group, the 'Like Minded Developing Countries', have put equity at the top of the agenda and argued that wealthier countries should take on deeper cuts corresponding to their historical responsibility for greenhouse gas accumulation in the atmosphere^{4–6}.

To break this now nearly two-decade-old impasse, it is almost certainly necessary to reduce considerably the number of actors required to move simultaneously, and it is most logical to form a group consisting only of the world's largest emitters, rich and poor. A new approach is needed to share the burden and the benefits of steep emissions reductions, engaging the main developing countries without imposing a disproportionate burden on any particular country. For this to be politically feasible, China and the United States must be onboard, and agreed principles of equity must be at its root⁷. With leadership from the 'G2', other emitters are likely to follow^{5,8,9}.

As the relevant literature on regime building^{10,11} shows, including on climate change^{12,13}, the structural power exerted by China and the United States within a deal such as the one proposed by this Perspective, and their high level of social capital embedded in interstate networks, could induce laggards to join collective action for international emissions reductions. That is, when China and the United States join the 28 countries of the European Union, the 48 Least Developed Countries (LDC), the 44 members of the Association of Small Island States (AOSIS) and other groups moving towards ambitious binding commitments to reduce their emissions, emerging global norms and fear of isolation may bring along some key remaining resisting countries. Given the failure of other approaches, such an effort is certainly worth the attempt.

The compromise

We stress two points at the start. First, the climate crisis requires the most effective possible emissions abatement effort in order to stabilize the concentrations of greenhouse gases in the atmosphere at a safe level, as agreed by Article 2 of the 1992 United Nations Framework Convention on Climate Change (UNFCCC). Key observers have argued that it is in fact morally superior to look for a course of action that is likely to be politically feasible rather than a perfect one without chance of enactment^{14,15}.

Second, given the strong relationship between cumulative emissions and global warming^{16,17}, the more emissions reductions are delayed, the less any climate targets become achievable: therefore the faster collective action is agreed, the more effective it will be, and the less severe emissions reductions will need to be¹⁶.

In brief, to address climate change meaningfully, humanity must undertake a complicated and costly collective effort: steeply and quickly reducing global emissions. Hence the urgency of a compromise capable of stimulating key players to swiftly overcome their inertia in order to break the current gridlock and promote effective emissions abatements.

This article develops a compromise to international emissions reductions, based on four core elements for sharing the remaining carbon budget: (1) limiting initial action to the Major Economies Forum (MEF) members, 13 economies responsible for more than 80% of fossil fuel emissions; (2) using consumption-based carbon accounting; (3) applying equity principles of responsibility and capability to apportion the burden of emissions reductions; (4) bringing this deal back to the UN negotiations for wider adoption.

None of these elements is itself new, but this particular combination is. The originality of the proposed approach lies in the nature of its explicit compromise that, in fact, is intended to nudge parties with conflicting objectives to give up part of their narrow short-term interests for the achievement of climate stabilization. To this end, we argue that states — which are the primary unitary actors in international regimes — pursue coordinated efforts for reducing emissions mainly based on interests aimed at material objectives^{18,19}. In particular, we are sympathetic to a neorealist perspective in international climate politics^{9,20}. Such a resurgent approach, known as neoclassical realism, besides stressing the importance of structural power, material factors, and in particular of relative gains,

¹Department of Sociology and Social Research, Università Milano-Bicocca, 20126 Milan, Italy, ²Institute for the Study of Environment and Society, Brown University, 89 Waterman Street, 02912 Providence, Rhode Island, USA.

*e-mail: marco.grasso@unimib.it; timmons@brown.edu

Table 1 | MEF members' cumulative consumption-based emissions, 1990–2010.

MEF member	Cumulative emissions absolute value (Mt CO ₂)	Percentage of global emissions (%)
United States	118,034.2	22.1
European Union	101,987.9	19.1
China	79,202.7	14.8
Japan	30,171.3	5.7
Russia	26,683.7	5.0
India	23,885.9	4.5
Canada	10,952.7	2.1
Korea	10,117.0	1.9
Mexico	8,584.4	1.6
Brazil	6,788.2	1.3
Australia	6,258.9	1.2
South Africa	5,805.3	1.1
Indonesia	5,668.1	1.1
Total MEF	434,140.3	81.3
Total world	533,919.0	100

Table 1 has appeared previously in ref. 68.

takes account systematically of the multiplicity of constituents and levels of international cooperation²¹, and allows room for moral concerns, whose role is pivotal for the political feasibility of our proposed compromise.

According to the neorealist perspective adopted, relative gains matter in regard to emissions reductions especially for the most powerful countries, China and the United States^{22,23}. Together these two represent the 'great powers' that currently dominate international climate politics^{9,24}. As shown later, in terms of burden of emissions reductions, our morally grounded compromise somewhat favours China but without exceedingly penalizing the United States. It is most demanding only for the European Union, the third key actor; but the European Union would seem willing to take on relatively greater efforts towards emission reductions in exchange for recuperating a pragmatic and strategic role in global climate policy²⁵.

Thus our compromise includes considerations of the multifaceted factors that shape international cooperation on emissions reductions, and takes account of the socioeconomic facts that determine its political feasibility in MEF member countries, consistent with the provisions of the neorealist approach. For these reasons, we argue, the very nature and articulation of our compromise could help to advance collective action to limit emissions.

The four elements of our proposed compromise are outlined below.

Element one: the Major Economies Forum

Twenty years of painful negotiations among the 195 parties to the UNFCCC show that a deal for abating emissions will probably need to be struck initially in a setting with a limited number of actors^{24,26}. Consistent with this, with the objective of assisting cooperation among major economies on climate change and energy issues, the MEF was established in March 2009. Scholars with knowledge beyond climate negotiations point out that nearly every important international negotiation has required a 'great powers' leadership group such as this to succeed^{9,24}.

The MEF includes 16 countries and the European Union. Four MEF members — France, Germany, Italy and the United Kingdom — are excluded from our calculations to avoid double counting, since they belong to the European Union. The 13 MEF

members considered here are all of the largest emitters in the world, and their 1990–2010 cumulative consumption-based emissions of CO₂ from fossil fuel combustion amount to 81.3% of global cumulative emissions (Table 1).

As the United States claims and the European Union seems to concede²⁷, the MEF can therefore be the right forum for prompt coordinated action on emissions abatements, because its limited size avoids the manifest cumbersomeness of the UNFCCC universalism, while at the same time it is a group of countries sufficiently broad to have global impact and exert global leverage²⁸. Furthermore, in relation to emissions reductions the MEF seems also to comply with 'critical mass' and 'inclusive representation', the desiderata of Eckersley's institutional coordination form for moving forward climate negotiations: that is, 'inclusive multilateralism'²⁶.

So far, the MEF has not made substantial progress in tackling climate change. To motivate MEF members, we argue that one possibility might be to link their climate action to international trade, as has been suggested by some influential scholars to enforce global climate treaties^{29,30}. One potential route to accomplish that could be the use of the carrot of trade benefits, rather than the stick of trade restrictions. Well-applied, trade benefits could provide an incentive for MEF members to engage in emissions reductions activities³¹. Such benefits can take the form of promotion of trade and investment in environmental products, in climate-friendly technologies and in renewable energies, as well as the advancement of a coordinated governance of renewables³². In fact, if MEF members joined a mitigation deal such as the one proposed here, such trade benefits could be included in World Trade Organization (WTO)-compliant climate protection chapters of preferential trade agreements (PTAs). The MEF, in fact, could serve as a platform for achieving these, necessarily reciprocal, PTAs for avoiding international competitiveness concerns³¹.

Element two: consumption-based carbon accounting

The production-based emissions accounting upon which the Kyoto Protocol was built penalizes economies where carbon-intensive stages in globalized production chains take place³³. Production-based accounting systems can encourage a shift in consumption of carbon-intensive products towards cheaper imported substitutes³⁴ and incentivize the off-shoring of carbon-intensive production stages from the regulated parts of the world economy³⁵. Such carbon leakage, known as 'weak' or 'indirect', has been shown, in fact, to be largely the result of the relocation of industry to the global south for other reasons, such as cheaper labour costs^{36,37}.

In our view a more effective, feasible and fairer deal for reducing emissions should instead rely on consumption-based carbon accounting. Consumption-based accounting measures emissions deriving from the final use of goods and services. It is calculated by deducting from a country's production-based inventories emissions embodied in exports, and adding emissions embodied in imports.

Consumption-based inventories make it possible to divide MEF members into two categories: carbon exporters and carbon importers (Table 2). The relevant literature^{35,38,39} shows consistently that carbon-exporting economies, when compared with carbon-importing economies, are in a situation of systematic disadvantage in relation to the benefits deriving from the exploitation of their resources. Most importantly, framing emissions in consumption- rather than in production-based terms reduces carbon leakage^{40,41}, is generally considered fairer^{40,41}, encourages participation in and increase flexibility of agreements^{7,40,42} and eventually favours the transition to a much-needed green economy⁴⁰.

In relation to the proposed compromise, the main difficulty of consumption-based carbon accounting is that given the greater geographical concentration of fossil fuel resources than energy demand, in the current economy all countries along the international fossil fuel supply chain gain a benefit, whether they extract fossil fuels, use fuels to produce goods and services, or consume them³⁸, and

Table 2 | Carbon-exporting and -importing MEF members.

MEF member	Production-based cumulative emissions (Mt CO ₂)	Consumption-based cumulative emissions (Mt CO ₂)	P-C (Mt CO ₂)	P-C (%)
South Africa (Exp)	8,166.6	5,805.3	2,361.3	28.9
Russia (Exp)	36,150.4	26,683.7	9,466.7	26.2
China (Exp)	93,059.5	79,202.7	13,856.8	14.9
Australia (Exp)	7,090.5	6,258.9	831.6	11.7
Indonesia (Exp)	6,141.5	5,668.1	473.4	7.7
India (Exp)	25,751.1	23,885.9	1,865.2	7.2
Canada (Imp)	10,693.2	10,952.7	-259.4	-2.4
United States (Imp)	114,464.9	118,034.2	-3,569.3	-3.1
Brazil (Imp)	6,492.0	6,788.2	-296.2	-4.6
Mexico (Imp)	8,129.6	8,584.4	-454.8	-5.6
Korea (Imp)	8,755.5	10,117.0	-1,361.5	-15.6
Japan (Imp)	24,907.5	30,171.3	-5,263.8	-21.1
European Union (Imp)	83,545.0	101,987.9	-18,442.9	-22.1

Calculations based on cumulative 1990–2010 production-based (P) and consumption-based (C) emissions accounting, expressed in million tonnes. The final two columns show the difference between these two accounting systems (P – C), in absolute and percentage values. Exp: carbon exporter; Imp: carbon importer. Table 2 has appeared previously in ref. 68.

should in principle bear the related responsibility. For the current purposes, however, consumption-based accounting can be considered a ‘shadow indicator’⁴³ for its capacity of providing insights on minimization of carbon leakage for the design of more effective international emissions reductions policy. Such an accounting basis therefore represents a promising system for striking a widely agreed compromise for effective and fair collective action against excessive emissions³³. It is also worth underlining that as long as trade restrictions do not apply (as our compromise envisages), MEF carbon-exporting members and more generally the developing world could let go of their usual concerns about carbon monitoring and accounting, as doing so would be to their benefit.

Methodologies for the calculations of consumption-based emissions have existed for decades³⁹, and independent studies on their application show consistent results⁴⁴. Annual estimates of consumption-based inventories are now available for almost all the UNFCCC countries since 1990^{37,38,45}, and could be routinely measurable, reportable and verifiable. Their exclusion from the negotiations now seems a relic of the earlier time at which these negotiations began. Reporting consumption-based emissions will require some capacity-building in some nations that do not yet have well-established measurement, reporting and verification (MRV) systems. We suggest, therefore, setting a transition period where MEF members, in order to expand less-developed countries’ technical and institutional capacity for implementing a robust consumption-based MRV system, would report in both production- and consumption-based figures. After that period, expansion of consumption-based reporting could come in phases to groups of countries, by technical capacity and wealth.

Element three: responsibility and capability

Moral concerns have long been considered unavoidable for moving climate negotiations forward⁴⁶. Accordingly, in order to improve the feasibility of our compromise, the distribution of the burden of emissions reductions required by the carbon budget should be calculated on the basis of MEF members’ responsibility and capability, the core ethical principles of the UNFCCC which still play a central role in the debate on mitigation^{47–49}.

The principle of responsibility for past emissions^{50–52}, the climate variant of the much-cited ‘polluter pays’ principle, basically responds to the straightforward logic that those who created this mess must

also assume the cost of cleaning it up⁵³. Scholars upholding the principle of responsibility basically claim that ignoring responsibility would be to act in favour of people who lived in the past in heavy-emitter industrialized countries, and to discriminate against those now, and in the future, living in developing countries^{54,55}. The principle of responsibility for past emissions faces conceptual and practical difficulties in the context of emissions abatements^{50–52,56–58}. Nonetheless, such a principle can succeed if a clear framework for it is negotiated⁵⁷ in a dynamic context⁴⁷. Decision 1/CP.16 adopted in 2010 in Cancún acknowledged for the first time historical responsibility as a cornerstone of negotiations under the UNFCCC⁵⁷. Accordingly, the Durban Platform for Enhanced Action, despite the lack of direct reference to historical responsibility, opened the way for a nuanced understanding of the notion of responsibility based on past emissions that goes beyond the mere distinction between developed and developing countries^{47,56}. In fact, the compromise proposed here ultimately upholds the adoption, in the non-ideal world of negotiations on emissions reductions, of a principle of responsibility put into practice according to a short-horizon ‘polluter pays’ principle uniformly applicable to all MEF members, as explained in what follows.

The principle of capability, known in the scientific literature also as the ‘ability to pay’ principle⁵⁸, is forward-looking and demands that the currently most advantaged actors bear the largest quota of mitigation costs because of their greater wealth (in terms of welfare levels) and capacities (in terms of institutions, technology, infrastructures, and skills). In the context of our compromise, capability is normatively understood as the ability of a state to undergo an onerous obligation without suffering a disproportionate welfare sacrifice⁵⁹. In climate policy discussions a country’s current GDP per capita is often used as a proxy for its capability.

On theoretical grounds, such a flexible approach based on responsibility and capability is for both developed and developing countries in the MEF a true compromise in itself⁶⁰. First, it addresses a requirement of some wealthy developed countries by softening the rigid dichotomy of countries with and without binding duty on emissions reductions⁵⁷, by bringing developing, relatively low-responsibility countries in the MEF — who have long refused any involvement of this kind — into the leadership group in tackling climate change. To the developing countries in the MEF, some of whom have demanded accounting for historical responsibility back

Table 3 | Distribution of the 2012–2050 carbon budget of 420 Gt CO₂ among MEF members.

	Projected 2012–2050 emissions at current rates (Mt CO ₂)	Baseline shares (Mt CO ₂)	Production-based R&C-corrected shares (Mt CO ₂)	Consumption-based R&C-corrected shares (Mt CO ₂)	Differential (%)	Differential (Mt CO ₂)
Australia (Exp)	14,127	5,900	6,643	6,624	-0.3%	-19
Brazil (Imp)	16,340	6,824	8,572	8,522	-0.6%	-50
Canada (Imp)	20,448	8,540	9,497	9,442	-0.6%	-55
China (Exp)	323,515	135,110	135,975	141,037	3.6%	5,062
European Union (Imp)	145,711	60,853	56,368	52,696	-7.0%	-3,672
India (Exp)	81,969	34,233	42,172	42,154	0.0%	-18
Indonesia (Exp)	19,870	8,299	10,677	10,634	-0.4%	-43
Japan (Imp)	45,761	19,111	20,980	20,569	-2.0%	-411
Korea (Imp)	21,753	9,085	10,568	10,477	-0.9%	-91
Mexico (Imp)	17,658	7,374	9,091	9,034	-0.6%	-57
Russia (Exp)	63,739	26,620	29,962	30,579	2.0%	617
South Africa (Exp)	19,963	8,337	10,457	10,463	0.1%	7
United States (Imp)	214,819	89,715	69,040	67,769	-1.9%	-1,271

Projected 2012–2050 production-based emissions, emissions shares of the carbon budget (baseline/non-corrected, and corrected by production- and consumption-based responsibility and capability) and production-based versus consumption-based differentials in emissions shares of the carbon budget. Exp: carbon exporter; Imp: carbon importer. See Table 2 for carbon exporting and carbon importing MEF members. Table 3 has appeared previously in ref. 68.

to 1850, the developed, high-responsibility countries acknowledge, against their long-standing non-recognition, cumulative emissions since 1990, the baseline for the Kyoto Protocol and the time at which climate change became well known⁵⁷. The year 1990 is also the date back to which we have accepted estimates of consumption-based emissions, a core element of this compromise, and one that benefits most developing countries. Thus each side is giving, and receiving, concessions.

Element four: back to the UNFCCC

The proposed compromise will have immediate impact by developing a solution for 81% of the problem of excessive greenhouse gas emissions; to address the other 19% and cement its recognition in the global community it must eventually be brought back into the wider group of non-MEF members and formalized under the UNFCCC. In this context, non-MEF countries would have no initial emission limits, in order to favour the right to sustainable development of poorer countries sanctioned by the Convention. For wealthier non-MEF members, we expect rapid expansion of commitments, if they fear exclusion from trade in the MEF countries, or shaming or isolation under emerging global norms of what constitutes appropriate behaviour.

We suggest that countries with similar national circumstances such as climate zone and current export profile be placed into broad groups⁶⁰. The expectations of individual countries should be in line with those of others in their group. This idea is similar to a proposal for National Schedules put forward by the Australian government in the months before the 2009 Copenhagen negotiations. Broadly, expectations of emissions reductions for each group of countries should be based on responsibility and capability, as put into practice by this compromise.

The affluent countries, both MEF and non-MEF, should also have a moral and practical duty to extend a green ladder to poorer countries outside the MEF for realizing their equitable access to sustainable development, through green technology transfer, sufficient and predictable financial assistance, technical and institutional support, and capacity building. Given potential difficulties of putting in place effective MRV systems, particularly in more deprived non-MEF members, richer countries would have a further obligation to provide transition assistance — tools, methodologies, training and

knowledge — for collecting and calculating consumption-based figures. This practice is already established for the UN-REDD programme for reducing deforestation with support of the world's main players in remote sensing.

By building a new effective compromise and encouraging wider participation in an ambitious and inclusive regime under the UNFCCC, the MEF can also improve its political legitimacy^{61,62} and therefore its leadership in a possibly further successful global effort for abating emissions.

One way of putting the compromise into practice

Climate science posits that to avoid dangerous anthropogenic interference with the climate system, emissions should be capped at a given threshold within a timeframe^{17,63}. Accordingly, our compromise establishes as a guideline a carbon budget, and then equitably shares the consequent emissions reductions burden among the MEF members. Such a budget is absolutely required by the scientific imperative of staying below 2 °C by the end of the century. Besides being a conceptual breakthrough in addressing emissions reductions⁶⁴, the carbon budget has an intrinsic intergenerational ethical significance because it is shared among current and future generations: the atmospheric space is in fact zero-sum across all emitters and across time^{64,65}.

Given that the carbon budget is smaller than business-as-usual emissions, distributions of its shares imply proportional distributions of the burden of emissions reductions. Based on the carbon budget scenarios put forward by the IPCC *Fifth Assessment Report*⁶⁶ as interpreted according to the levels of risk associated with different global mitigation pathways⁶⁷, the carbon budget from fossil sources over the period 2012–2050 to remain under 2 °C in 2100 adds up to roughly 420 Gt CO₂ (see Supplementary Information).

The proposed compromise calculates, both in production- and consumption-based terms, the shares of the 420-Gt carbon budget distributed to MEF members according to their responsibility and their capability. Any practical use of the principles of responsibility and capability is based on inevitable value judgements, and prone to empirical uncertainty. In line with one of the most authoritative efforts to date⁵⁹, our operationalization of responsibility follows a short-horizon 'polluter pays principle', based on emissions from 1990 to 2010, and defines capability as mean per capita income.

Specifically, we measured responsibility as 1990–2010 cumulative emissions, and capability as 2010 per capita GDP, US\$ purchasing power parity (PPP; see Supplementary Information).

Importantly, our proposed compromise leaves to the sovereignty of each MEF member the decisions on how emissions reductions will be apportioned within their borders, by whatever trajectory they choose. Transparent MRV systems to ensure that countries are meeting their reductions objectives will have to be settled.

Emissions reductions required

Indicative shares of the 2012–2050 carbon budget calculated under the compromise both in production- and consumption-based terms for MEF members are reported in Table 3.

Consumption-based inventories show that the main net carbon importers would be somewhat penalized. In particular, the European Union would have over the period 2012–2050 a 7.0% larger emissions abatements burden (that is, 3.7 Gt CO₂) than if the current production-based accounting is used. More modest shifts occur for the United States, which would have 1.9% larger emissions reduction required under consumption-based accounting, equal to 1.3 Gt CO₂, and Japan, which would have a 2.0% (0.4 Gt CO₂) larger reduction. Conversely, the leading net carbon exporters (China and Russia) would have respectively 3.6% (5.0 Gt CO₂) and 2.0% (0.6 Gt CO₂) smaller emissions reductions required, when calculated in consumption rather than in production terms. For the remaining MEF members the differences in emissions reductions are not significant (<1%).

Consistent with the perspective of neorealism in international climate politics^{9,20} delineated above, the outcomes of our compromise can therefore further climate negotiations for three solid empirical reasons largely related to MEF members' relative gains. First, it should be more acceptable to China, who owing to consumption-based accounting would have substantial headroom and ultimately somewhat less stringent abatement targets between now and 2050. Second, the United States, the other top emitter, would not be excessively penalized by consumption-based accounting. Third, our calculations show that consumption-based accounting does not disproportionately penalize anyone. The main difference involves the European Union, whose relatively successful recent decarbonization seems largely due to the off-shoring of carbon intensive production^{38,39} and which, as pointed out, seems more likely to undertake structural emission reductions initiatives to maintain its leadership in global climate policy²⁵. It should be noted that these outcomes are also consistent with the fundamental requirement put forward by Steininger *et al.*⁴¹ for morally justifying a switch from production- to consumption-based carbon emissions accounting. In their view a morally justified switch should shift the onus of emissions abatements from those who bear more burden than fairness demands (in our case the less-developed MEF members and in particular China) to those who bear less burden than fairness demands (here the richer MEF members and in particular the European Union).

In Fig. 1 we juxtapose MEF members' projected 2012–2050 emissions at current rates, baseline/non-corrected 2012–2050 shares of the carbon budget, and those corrected by production- and consumption-based responsibility and capability, as calculated in Table 3.

Emissions reductions required of the MEF by our compromise are admittedly ambitious, especially for the European Union, the United States and China, even if their economies can still be greened. Given the necessity of intensive emission trading under nearly any carbon budget scenarios, the most penalized economies would nonetheless also have the possibility of achieving their stringent targets through emissions abatements conducted in other countries inside or outside the MEF, as is argued under many alternative ethical frameworks⁵⁹.

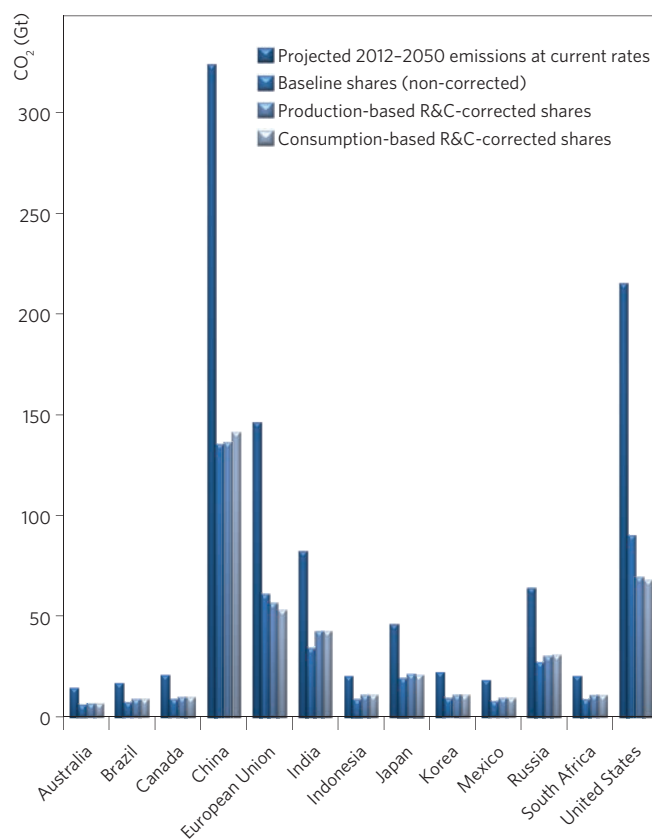


Figure 1 | MEF members' emission reductions. Projected 2012–2050 production-based emissions at current (2010) rates, baseline 2012–2050 emissions shares (non-corrected) and emissions shares corrected by production- and consumption-based responsibility and capability (R&C). All values expressed in gigatonnes CO₂.

A new way forward

The unsuccessful attempts of the past 20 years to achieve effective emissions reductions show unequivocally that realpolitik has impeded any adequate agreement, a situation which threatens the stability of the climate system that supports human civilization. Currently, the emissions reduction envisaged by the Copenhagen and Cancún systems of 'pledge and review' are expected to produce a temperature increase of 3–5 °C by 2100, well above any levels considered safe. A compromise among main emitters that complements the UN process rather than replacing it is urgently needed: our proposal is ambitious in terms of emissions reductions, but it is politically feasible, effective and fair. Each MEF member would gain and lose something in our proposed framework. They all would have to relax some of their headline positions, otherwise a meaningful outcome will not be achievable. By so doing, all countries will gain a liveable future, the core principle of national and human security.

Other details of a grand compromise will have to be defined by MEF members and then agreed and shared among UNFCCC parties. The compromise that we envisage requires key research and technical support, whose costs, however, would be genuinely minuscule compared with overall spending needed to address the climate crisis. With the 2015 deadline to forge an agreement under the Durban Platform drawing near, consideration of our proposed compromise can constructively lead the way.

Received 7 January 2014; accepted 21 May 2014; published online 8 June 2014.

References

- Keohane, R. O. & Victor D. G. The regime complex for climate change. *Perspect. Polit.* **9**, 7–23 (2011).
- Bodansky, D. The Copenhagen climate change conference: A postmortem. *Am. J. Int. Law* **104**, 230–240 (2010).
- Falkner, R., Hannes, S. & Vogler, J. International climate policy after Copenhagen: Towards a building blocks approach. *Glob. Policy* **1**, 1–11 (2010).
- Parks, B. C. & Roberts J. T. Climate change, social theory and justice. *Theor. Cult. Soc.* **27**, 134–166 (2010).
- Hurrell, A. & Sengupta, S. Emerging powers, North–South relations and global climate politics. *Int. Aff.* **88**, 463–484 (2012).
- Like-Minded Developing Countries on Climate Change. Submission to the Ad-Hoc Working Group on the Durban Platform for Enhanced Action (ADP) on the Implementation of all the elements of decision 1/CP.17, (a) Matters related to paragraphs 2 to 6. (UNFCCC, 2013).
- Harris, P. G. & Symons, J. Norm conflict in climate governance: greenhouse gas accounting and the problem of consumption. *Global Environ. Polit.* **13**, 9–29 (2013).
- Barrett, S. *Environment and Statecraft: The Strategy of Environmental Treaty-Making* (Oxford Univ. Press, 2005).
- Terhalle, M. & Depledge, G. Great-power politics, order transition, and climate governance: insights from international relations theory. *Clim. Policy* **13**, 572–588 (2013).
- Underdal, A. in *International Multilateral Negotiation: Approaches to the Management of Complexity* (ed. Zartman, I. W.) 178–197 (Jossey-Bass, 1994).
- Young, O. Political leadership and regime formation: On the development of institutions in international society. *Int. Organ.* **45**, 281–308 (1991).
- Andresen, S. & Agrawala, S. Leaders, pushers and laggards in the making of the climate regime. *Global Environ. Chang.* **12**, 41–51 (2002).
- Grundig, F. & Ward, H. Structural group leadership and regime effectiveness. *Polit. Stud.* <http://doi.org/sz4> (2013).
- Price, R. Moral limit and possibility in world politics. *Int. Organ.* **62**, 191–220 (2008).
- Sen, A. K. *The Idea of Justice* (Belknap/Harvard, 2009).
- Stocker, T. F. The closing door of climate targets. *Science* **339**, 280–282 (2013).
- Allen, M. R. *et al.* Warming caused by cumulative carbon emissions towards the trillionth tonne. *Nature* **458**, 1163–1166 (2009).
- Stern, N. (ed.) *The Economics of Climate Change [The Stern Review]* (Cambridge Univ. Press, 2007).
- Nordhaus, W. *A Question of Balance: Weighing the Options on Global Warming Policy* (Yale Univ. Press, 2008).
- Prudon, M. Neoclassical realism and international climate change politics: moral imperative and political constraint in international climate finance. *J. Int. Relat. Dev.* <http://dx.doi.org/10.1057/jird.2013.5> (2013).
- Rose, G. Neoclassical realism and theories of foreign policy. *World Polit.* **51**, 144–172 (1998).
- Grundig, F. Patterns of international cooperation and the explanatory power of relative gains: An analysis of cooperation on global climate change, ozone depletion, and international trade. *Int. Stud. Q.* **50**, 781–801 (2006).
- Vezirgiannidou, S. E. The Kyoto agreement and the pursuit of relative gains. *Environ. Polit.* **17**, 40–57 (2008).
- Brenton, A. 'Great Powers' in climate politics. *Clim. Policy* **13**, 541–546 (2013).
- Bäckstrand, K. & Elgström, O. The EU's role in climate change negotiations: from leader to 'leadier'. *J. Eur. Public Policy* **20**, 1369–1386 (2013).
- Eckersley, R. Moving forward in the climate negotiations: Multilateralism or unilateralism? *Global Environ. Polit.* **12**, 24–42 (2012).
- Nelsen, A. US considers shifting climate negotiations away from UN track. *The Guardian*, Guardian Environment Network, 16 November 2012; <http://www.theguardian.com/environment/2012/nov/16/us-considers-climate-negotiations-un>
- Victor D. G. A Madisonian approach to climate policy. *Science* **309**, 1820–1821 (2005).
- Stiglitz, J. A new agenda for global warming. *Econ. Voice* **3**, Article 3 (2006).
- Barrett, S. Rethinking climate change governance and its relationship to the world trading system. *World Econ.* **34**, 1862–1882 (2011).
- Leal-Arcas, R. Climate change mitigation from the bottom up: using preferential trade agreements to promote climate change mitigation. *Carbon Clim. Law Rev.* **7**, 34–42 (2013).
- Leal-Arcas, R. Working together: How to make trade contribute to climate action. Information Note, International Center for Trade and Sustainable Development, Geneva (2013).
- Pan, J., Phillips, J. & Chen, Y. China's balance of emissions embodied in trade: approaches to measurement and allocating international responsibility. *Oxf. Rev. Econ. Policy* **24**, 354–376 (2008).
- Van Asselt, H. & Brewer, T. Addressing competitiveness and leakage concerns in climate policy: An analysis of border adjustment measures in the US and the EU. *Energ. Policy* **38**, 42–51 (2010).
- Steinberger, J. K., Roberts, J. T., Peters, G. P. & Baiocchi, G. Pathways of human development and carbon emissions embodied in trade. *Nature Clim. Change* **2**, 81–85 (2012).
- Eckersley, R. The politics of carbon leakage and the fairness of border measures. *Ethics Int. Aff.* **20**, 367–393 (2010).
- Kanemoto, K., Moran, D., Lenzen, M. & Geschke, A. International trade undermines national emission reduction targets: New evidence from air pollution. *Global Environ. Change* **24**, 52–59 (2014).
- Davis, S., Caldeira, K. Consumption-based accounting of CO₂ emissions. *Proc. Natl Acad. Sci. USA* **107**, 5687–5682 (2010).
- Peters, G. P., Minx, J. C., Weber, C. L., Edenhofer, O. Growth in emission transfers via international trade from 1990 to 2008. *Proc. Natl Acad. Sci. USA* **108**, 8903–8908 (2011).
- Peters, G. P. & Hertwich, E. G. Post-Kyoto greenhouse gas inventories: production versus consumption. *Clim. Change* **86**, 51–66 (2008).
- Steininger, K. *et al.* Justice and cost effectiveness of consumption-based versus production-based approaches in the case of unilateral climate policies. *Global Environ. Change* **24**, 75–87 (2014).
- Bows, A. & Barret, J. Cumulative emission scenarios using a consumption-based approach: a glimmer of hope? *Carbon Manag.* **1**, 161–175 (2010).
- Peters, G. P. From production-based to consumption-based national emission inventories. *Ecol. Econ.* **65**, 13–23 (2008).
- Peters, G. P., Davis, S. J. & Andrew, R. A synthesis of carbon in international trade. *Biogeosciences* **9**, 3247–3276 (2012).
- Le Quéré, C. *et al.* The global carbon budget 1959–2011. *Earth Syst. Sci. Data Discuss.* **5**, 1107–1157 (2012).
- Shue, H. in *International Politics of the Environment* (eds Hurrell, A. & Kingsbury, B.) 373–397 (Oxford Univ. Press, 1992).
- Brunnée, J. & Streck, C. The UNFCCC as a negotiation forum: towards common but more differentiated responsibilities. *Clim. Policy* **13**, 589–607 (2013).
- Grasso, M. Sharing the emission budget. *Polit. Stud.* **60**, 668–686 (2012).
- Winkler, H. & Rajamani, L. CBDR&RC in a regime applicable to all. *Clim. Policy* **14**, 102–121 (2014).
- Caney, S. Justice and the distribution of greenhouse gas emissions. *J. Glob. Ethics* **5**, 125–146 (2009).
- Jamieson, D. in *Perspectives on Climate Change: Science, Economics, Politics, Ethics* (eds Sinnott-Armstrong, W. & Howarth, R. B.) 217–248 (Elsevier, 2005).
- Miller, D. Global justice and climate change: how should responsibilities be distributed? The Tanner Lectures on Human Values. *The International Spectator, Part I and II*, **28**, 119–156 (2008).
- Shue, H. Global environment and international inequality. *Int. Aff.* **75**, 531–545 (1999).
- Meyer, L. H. Why historical emissions should count. *Chi. J. Int. Law* **13**, 597–685 (2013).
- Neumayer, E. In defence of historical accountability for greenhouse gas emissions. *Ecol. Econ.* **33**, 185–192 (2000).
- den Elzen, M. G. J., Olivier, J. G. J., Höhne, N. & Janssens-Maenhout, G. Countries' contributions to climate change: effect of accounting for all greenhouse gases, recent trends, basic needs and technological progress. *Clim. Change* **121**, 397–412 (2013).
- Friman, M. & Strandberg, G. Historical responsibility for climate change: Science and the science-policy interface. *WIREs Clim. Change* **5**, 297–316 (2014).
- Page, E. A. Distributing the burden of climate change. *Environ. Polit.* **17**(4), 556–575 (2008).
- Baer, P. The greenhouse development rights framework for global burden sharing: reflection on principles and prospects. *WIREs Clim. Change* **4**, 61–71 (2013).
- Pauw, P., Bauer, S., Richerzhagen, C., Brandt, C., Schmolze, H. Different perspectives on differentiated responsibilities: A state-of-the-art review of the notion of common but differentiated responsibilities in international negotiations. DIE Discussion Paper 6/2014, Bonn (2014).
- Bodansky, D. in *The Oxford Handbook of International Environmental Law* (eds Bodansky, D., Brunnée, J. & Hey, E.) 704–723 (Oxford Univ. Press, 2007).
- Karlssoon-Vinkhuysen, S. I. & McGee, J. Legitimacy in an era of fragmentation: the case of global climate governance. *Global Environ. Polit.* **13**, 56–78 (2013).
- Meinshausen, M. *et al.* Greenhouse-gas emission targets for limiting global warming to 2 °C. *Nature* **458**, 1158–1162 (2009).
- Shue, H. in *The Ethics of Global Climate Change* (ed. Arnold, D. G.) 292–314 (Cambridge Univ. Press, 2011).
- Shue, H. Climate hope: Implementing the exit strategy. *Chi. J. Int. Law* **13**, 381–401 (2013).

66. IPCC. *Climate Change 2013: The Physical Science Basis. Summary for Policymakers* (eds Stocker, T. F. et al.) (Cambridge Univ. Press, 2013).
67. Baer, P., Athanasiou, T. & Kartha, S. *The Three Salient Global Mitigation Pathways Assessed in Light of the IPCC Carbon Budgets* (Stockholm Environment Institute, 2013).
68. Grasso, M. & Roberts, J. T. *A fair compromise to break the climate impasse* (Brookings Institution Global Economy and Development Program, 2013) <http://www.brookings.edu/research/papers/2013/04/04-climate-emissions-grasso-roberts>.

Acknowledgements

We thank S. Calgaro, D. Roser and G. Vittucci Marzetti. This version remains our own responsibility.

Author contributions

M.G. conceived the study. M.G. and J.T.R. carried out the study and contributed to writing the article.

Additional information

Supplementary information accompanies this paper on www.nature.com/natureclimatechange. Reprints and permissions information is available online at <http://www.nature.com/reprints>. Correspondence and requests for materials and/or information should be addressed to M.G.

Competing financial interests

The authors declare no competing financial interests.