ZERO CARBON ZERO POVERTY
THE CLIMATE JUSTICE WAY

Achieving an equitable phase-out of carbon emissions
by 2050 while protecting human rights

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EXECUTIVE SUMMARY

The impacts of climate change on human rights have by now been widely assessed, and provide strong justification for rapid emissions reductions. As evidence of current climate damages has mounted and estimates of future risks have grown, previously implausible targets such as a complete carbon phase-out by 2050 have come under serious consideration; yet the potential impacts of such rapid emissions reductions have raised new human rights concerns. This paper provides a survey of the issues raised by the prospects of a rapid carbon phase-out, specifically with regard to the implications for human rights.

In brief, our work concludes that ***a rapid carbon phase-out is possible, and that without mitigation efforts on this scale it will not be possible to prevent climate impacts from seriously undermining human rights, whereas a carbon phase-out can proceed in a way that protects human rights.***

Importantly, the challenge of climate change highlights our interdependence in the face of this true global commons problem, and the need for a vision of climate justice and global solidarity that can support a real transition toward sustainability while enabling the progressive realisation of human rights.

Though still necessarily preliminary, our research supports the following five main ***conclusions:***

- There is strong evidence that a rapid and total or nearly-total carbon phase-out will be technically feasible, both for developed and developing countries.
- Economic analyses suggest that a rapid carbon phase-out can be achieved at an aggregate global cost that is affordable, and much less than the potential costs of climate impacts.
- Nonetheless, a rapid carbon phase-out will be very demanding for all countries, especially developing countries, and presents potential risks to human rights.
- Even greater risks to human rights than the risks posed by aggressive mitigation action arise from the profound impacts of climate change, especially if temperature increase exceeds 2°C, which becomes increasingly likely if mitigation is delayed.
- There is good reason to believe that risks posed by mitigation can be dealt with, provided there is an ambitious and fairly shared global effort to achieve a rapid carbon phase-out while preserving human rights, and a commitment to integrating human rights and equity in all national climate policies.

HUMAN RIGHTS RISKS FROM AMBITIOUS MITIGATION

A carbon phase-out rapid enough to keep warming likely to stay below 2°C will require extremely ambitious mitigation action in both rich and poor countries. The risks to human rights from mitigation activities are very real, and indeed some are already being witnessed at much lower scales of mitigation than would be needed for a rapid carbon phase-out. Notably, policies to promote hydroelectric power, to use agricultural land for bioenergy feedstock production, and to designate forest reserves on indigenous land have already demonstrated the potential for human rights violations driven by mitigation efforts.

It is helpful to consider two broad types of threats to human rights that may arise from yet more stringent emissions reduction policies:

Direct rights violations, especially:

- the use of violence against persons opposed to or obstructing mitigation projects;
- displacement of persons without their consent;
- imposition of life- and health-threatening risks;
- exclusion from or diversion of essential resources;
- failure to provide information about or seek consent for actions impinging on community rights or welfare.

Indirect rights violations, especially:

- impacts on health and survival from price shifts in food, energy and other essential commodities, which will directly affect household budgets, particularly among the poor;
- loss of jobs and livelihoods due to economic shifts away from carbon-intensive sectors;
- reduced overall ability for countries to provide the conditions for progressive realisation of human rights, due to diminished developmental progress.

Threats to the right to development[i] can compromise the ability of persons, communities and nations – especially but not only the poorest – to achieve the overall level of welfare or resources needed to secure and protect other essential human rights. Most directly, the increase in energy costs due to the foreclosing of fossil-fuel driven industrialisation may adversely affect poor countries' overall development prospects. Furthermore, as has been widely noted, a low- or zero-carbon future means that a large majority of the world's fossil fuels will never be burned; potentially meaning that countries with fossil resources will have to forego revenue that otherwise could be put toward developmental objectives. Along with these "stranded assets" goes a wide range of related infrastructure and human capital.

While these risks from ambitious climate mitigation are real, the risks to human rights from climate impacts are qualitatively different in ways that make them much greater threats. The anticipated impacts of climate change are characterised by large scale, unpredictability, irreversibility, long time lags, and uncontrollable feedbacks. In contrast, the threats posed by mitigation activities are generally of limited scale, more predictable, are not generally masked by long time-lags, and are governed primarily by socio-economic process under human control rather than biophysical feedbacks that are not.

While the risks from a rapid phase-out are significant, they are qualitatively similar to those historically posed by other (non-mitigation) activities, including activities such as fossil-fuel extraction that would increase in a business-as-usual future. This provides us with experience and existing institutions and strategies that are by no means sufficient now, but

i. The right to development is defined *inter alia* in the 1986 UN Declaration on the Right to Development as the right of "… every human person and all peoples… to participate in, contribute to, and enjoy economic, social, cultural and political development, in which all human rights and fundamental freedoms can be fully realised" (Article 1). The declaration adds further that "All human beings have a responsibility for development, individually and collectively," (Article 2) and that "States have the primary responsibility for the creation of national and international conditions favourable to the realisation of the right to development" (Article 3).

can be adapted and strengthened. Society can also proceed adaptively, anticipating and preparing for the potential impacts of planned mitigation measures, and modifying plans as warranted by new information and conditions.

Policies to ensure that those who bear losses from mitigation activities are treated equitably – policies that enable a just transition away from fossil fuels – will definitely be needed to an even greater extent in support of a zero-carbon phase-out, and such programs will need to be supported by international measures. Yet the transition offers the possibility for many gains as well, including employment in growing clean technology sectors, reductions in air and water pollution, and the expanded provision of clean energy to energy-poor communities. And a more rapid carbon phase-out similarly increases the opportunity to achieve these co-benefits.

CONDITIONS FOR A CARBON PHASE-OUT THAT PROTECTS HUMAN RIGHTS: FAST, FAIR, AND PARTICIPATIVE

We present here a set of recommendations for achieving a rapid carbon phase-out in a manner that protects human rights. They are presented as three overarching conditions, each supported by a set of concrete near-term measures.

FAST: a carbon phase-out must begin quickly and extend globally in order to be effective. Delay will rapidly and dramatically increase the expected level of warming, and the concomitant risks to human rights. To even maintain a likely chance of staying below 2°C – a level that is by no means safe – the remaining budget is so small that it requires a rapid peak in global emissions and a nearly complete phase-out by 2050. There is simply no time or atmospheric space to allow emissions to grow significantly for any substantial fraction of the world's population. And while the limited remaining carbon budget must be prioritised for the development needs of the world's poorest, it only makes sense to meet their needs for energy services with the same clean technologies used to decarbonise the world's rich and emerging economies, rather than locking in dirty fossil energy because it appears to be cheaper in the short run.

As immediate steps towards a rapid carbon phase-out, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the appropriate national bodies should:

- Adopt the goal of a carbon phase-out by 2050 in the Paris agreement, with the explicit objective that the phase-out be equitable, and that all climate actions respect, protect, promote and fulfill human rights for all.
- Strengthen Workstream 2 of the Ad-hoc Durban Platform, which is focused on action in the pre-2020 timeframe, to ensure that the peak in global emissions is as soon as possible and no later than 2020.
- Accelerate the implementation and capitalisation of existing mechanisms, such as the Green Climate Fund.
- Dramatically increase investments in education, participation, access to information and capacity building, as mandated in Article 6 of the UNFCCC.
- Provide support for the development of national scenarios and plans that are explicitly consistent with a rapid and equitable carbon phase-out.

- Formalise the protection and integration of human rights into climate action by establishing a Subsidiary Body, process or work programme under the UNFCCC mandated to inform and assess COP decisions with respect to human rights considerations, in cooperation with the UN Human Rights Council.

FAIR: the effort required for a carbon phase-out must be shared equitably among countries, otherwise the phase-out will not happen. As with any commons problem, an equitable sharing of the effort is necessary to build trust, initiate cooperative action, and ultimately to achieve enough participation from all countries. If effort were to be fairly shared among countries according to the basic equity principles of responsibility and capabilities, the cost of emissions reductions would be borne primarily by the wealthy countries, even while the majority of mitigation actions will inevitably need to take place in developing countries. Thus financial and technological support from wealthier to poorer countries must be a central pillar of international cooperation on climate, and not merely lip service; in the absence of adequate financial and technological support, developing countries simply cannot be expected to decarbonise their economies with the necessary speed. Cooperation at the necessary scale calls for a level of solidarity that has few, if any, precedents. It is, however, in the interest of all countries to earnestly engage.

Steps to ensure the equitable sharing of the burdens and benefits of a rapid phase-out include:

- Civil society must mobilise public support for equitable effort-sharing in the UNFCCC and for climate justice more broadly.
- The UNFCCC should, at its COP in Lima in 2014 and subsequently, mandate that countries submit their INDCs (Intended Nationally Determined Contributions) with sufficient detail and justification to allow a meaningful equity review and comparison of effort, both with respect to domestic mitigation action and international financial and technological support
- INDCs as they are prepared by countries with broad stakeholder involvement and submitted to international assessment must be subject to both informal (civil society) and formal (within the UNFCCC or IPCC) equity review processes.
- The international negotiations in Paris and after should be structured to dynamically update the agreement on national contributions to ensure the “ratcheting up” of ambition to the necessary scale in a manner that ensures fair effort sharing.
- Finance and technology support, and not merely domestic mitigation, must be subject to equity review and iterative ratcheting.
- Developing countries must have universal access to the necessary low-carbon technologies, through appropriate rules and mechanisms relating to innovation, technology transfer, and intellectual property.
- The provision of the necessary financial support for mitigation and a wide range of “just transition” activities must not come at the expense of support for adaptation and compensation for loss and damage; even the most rapid possible phase-out will not eliminate climate impacts.
- Existing compliance institutions should be strengthened and new mechanisms developed to limit the possibility of free-riding on the global climate effort.

PARTICIPATIVE: democratic processes at all levels will be necessary to enable an effective carbon phase-out that protects human rights. Access to information and participation in decision-making are fundamental human rights, essential for the protection of other basic rights, as codified especially in Article 10 of the Rio Declaration and the Aarhus convention. The UNFCCC process has been relatively open to civil society participation, but still falls far short of the ideal of equitable access for women, indigenous people, youth, and other grass-roots communities, and remains vulnerable to considerable disparities in influence between rich and poor countries.

To enhance democratic participation in climate policy-making, Parties to the UNFCCC and national governments should:

- Address capacity gaps that make it difficult for many smaller and poorer countries, and the civil society organisations within them, to participate effectively in international negotiations.
- Implement mechanisms to limit the inordinate influence of vested interests, such as through campaign finance reform, transparency in lobbying, and appropriate multilateral processes.
- Ensure that the relevant institutions (e.g. the Green Climate Fund, Loss and Damage Mechanism) operate in a manner that respects, protects and fulfills human rights and strengthens and builds upon Article 6 of the UNFCCC.
- Continue and expand the effort to strengthen the representation of women in international and domestic climate policy, and ensure that policies to achieve a carbon phase-out are gender-sensitive and empower women as actors in climate action.
- Put in place grievance mechanisms at the national and international levels to address human rights violations arising from mitigation and adaptation activities.
- Increase formal membership in, or expand applicability of, international agreements pertaining to participation, such as the Aarhus Convention and Latin American Declaration and Plan of Action on Rio Principle 10.

CLIMATE JUSTICE, GLOBAL SOLIDARITY AND PUBLIC MOBILISATION

There are many steps we can take to ensure that a rapid carbon phase-out does not further undermine human rights. And while there is still a great distance from where we are today to the type of national and global actions and institutions we describe in this report, there are important grounds for hope.

Public awareness is rising, and public mobilisation is growing as well, as demonstrated by the worldwide climate actions in advance of the UN Climate Summit in September 2014. Furthermore, the broadening coalitions for climate action are increasingly embracing the ideals of climate justice, including a foundational commitment to human rights and global equity.

Perhaps more than any problem we have faced, climate change confronts us with the reality of our interdependence. Global cooperation is the only route we have to protect ourselves, and that cooperation can only succeed if it is broadly seen as fair. Yet beyond the power of enlightened self-interest, our mutual vulnerability offers us an opportunity to develop a new and powerful global solidarity. Climate justice, based on human rights norms and a fast, fair and participative carbon phase-out, can provide a compelling narrative for the crucial transition to sustainability within planetary boundaries.

INTRODUCTION

As highlighted by the IPCC in its Summary for Policy Makers,

> *Limiting the effects of climate change is necessary to achieve sustainable development and equity, including poverty eradication. At the same time, some mitigation efforts could undermine action on the right to promote sustainable development, and on the achievement of poverty eradication and equity.*
> [IPCC AR5, WG3, SPM]

Navigating this balance is at the core of addressing the climate crisis, and setting the course of both global and national policies. Undeniably, climate change is *already occurring* and is causing widespread human rights violations, and much more is coming based solely on the greenhouse gases we have already added into the climate system.[1] Preventing even greater damage motivates the need to consider the fastest possible reductions of greenhouse gases consistent with preventing greater human rights violations from the necessary mitigation actions.

For this reason, a 2050 carbon phase-out is emerging as a new publicly-discussed goal, arguably more explicit and compelling than the "2°C line" that has long served as a marker in the climate policy debate (and quite consistent with it, as discussed below). No doubt the unchecked growth of emissions in recent years and the lack of progress in the international negotiations make such targets seem all the more daunting, if not altogether unrealistic. But though the task is becoming more difficult, this must not to keep us from assessing what exactly it would require, if the global community were to muster the political will to take the necessary steps, acknowledging that it's even more urgent than we previously thought.[2]

HUMAN RIGHTS, CLIMATE CHANGE IMPACTS, AND MITIGATION

There are good reasons to think that reducing emissions will be cheaper and easier than we expected - notably we are experiencing a growth of the renewable power industry that is bringing down costs more rapidly than most observers predicted.[3] But cheap is not free, and the need to provide much larger amounts of renewable energy to the world's still under-served majority means that a carbon phase-out would impose tremendous demand for energy investment and emission reduction opportunities. From this competition for mitigation opportunities and its effects on food and water security, land tenure, livelihoods and other critical human rights, there are prima facie reasons to worry about the potential human impacts of such a rapid transition. Furthermore, the overall costs of the transition suggest that there are potential threats to the right to development, specifically in developing countries, endangering their ability to successfully raise their standards of living and eliminate poverty. Indeed, these considerations have been raised extensively even in the context of much more gradual mitigation pathways.

Nonetheless, we conclude that a rapid carbon phase-out is in fact justified on human rights grounds. In brief, the argument is straightforward: climate change poses fundamental risks

to life and health from extreme weather and climatic events, and these risks rise to the level of civilisational threats as warming increases or if climate sensitivity turns out to be at the higher end of the range of scientific estimates, at which point the ability of the planet to support its human population is called into question. Furthermore, these risks are tied to processes (such as changes to the carbon cycle, or accelerated loss of the ice sheets) that are difficult or impossible to predict, and may have irreversible tipping points beyond the ability of humans to manage. Hence the need to keeping increases in warming as far below 2°C as possible to limit the negative impacts on people and their rights. The risks posed by climate mitigation, are markedly different in nature. They act through human institutions and are driven by processes that we can comparatively easily predict and control. To use the canonical example, the impacts of demand for cropland for biofuels are affected by regulations and mediated by markets, both of which are amenable to modification and control if the threat of unacceptable risks to food security arises or is anticipated. Similarly, how the costs of a rapid carbon phase-out are shared among countries is a decision to be made by countries in multilateral fora, and it is thus possible to ensure that costs do not fall unfairly on developing countries and undermine the right to development.

The means to address the human rights risks of climate mitigation are thus largely within our control, within most developed and many developing countries, policies exist that address various socio-economic hardships such as unemployment, energy or food price shocks, or national disasters. Of course these programs and institutions leave a great deal to be desired, even in the wealthy countries, and implementing the kind of global rights-protection measures that seem to be called for is undeniably a formidable task. However, and critically, it is less formidable and more imaginable than the rights-protection measures that would be needed if we fail to act ambitiously and cooperatively to prevent much more global warming.

And so, under any circumstances, climate change demands of us new attention to the protection and promotion of human rights. As the share of people whose lives will be disrupted by climate change and also by a dramatic energy transition grows, affecting citizens in all countries, it becomes possible to imagine a growing appreciation for the need for solidarity in the protection of human rights to overcome the narrow pursuit of economic nationalism. And it becomes the task of human rights activists and climate activists to work together to promote such a vision in a practical way.

The fundamental principle of equal human dignity and the human rights project it underlies remains the uncompromisable core of climate justice and its rights-driven analysis. As stated in a Mary Robinson Foundation – Climate Justice position paper,

> *"A climate justice approach uses human rights standards and commitments to inform these processes, creating important connections between them and ensuring a people-centered approach which delivers outcomes which are fair, effective and transformative."*[4]

Still, we recognise fully the great distance between the state of human rights today and the ideals embodied in international law and scholarship. Thus we frame our report not simply as an effort to prevent aggressive carbon policies from worsening the human rights status quo, but moreover as envisioning how an ambitious carbon phase-out could indeed lend support to a broader flourishing of cooperative global institutions.

In the following section, we provide an overview of the risks to human rights posed by climate change. We then provide the relevant background on the scientific basis for a carbon phase-out, and the techno-economic evidence for its feasibility. (See also Appendix 1.), and discuss the types of risks to human rights that rapid carbon phase-out could potentially pose. We then assess the argument for a rapid carbon phase-out, framed in view of the risks of climate change vis-à-vis the risks of climate action. Finally, we present some overarching recommendations for ensuring that a rapid carbon phase-out proceeds in a manner that protects, respects, promotes and fulfils human rights.

THE HUMAN RIGHTS IMPACTS OF CLIMATE CHANGE

Much has been written that addresses the human rights impacts of climate change itself. From rising sea levels and increasing flooding, to more frequent and extensive heat waves and droughts, climate change poses a threat to the right to life and health, livelihood, cultural and political autonomy, and indeed threatens virtually the whole range of human rights[5]. These threats to human rights provide a compelling justification for the most rapid possible reduction of greenhouse gas emissions, and the implementation of programs to promote adaptation to unavoidable climate change and arrangements to provide compensation for loss and damage that will not be prevented. Special attention has been given in this literature to the gender dimensions of climate impacts, the impacts on indigenous people, and on other vulnerable groups including children and the elderly. Threats to the right to development from climate impacts have also been extensively addressed[6].

In a comprehensive but succinct description of the potential human rights impacts of climate change, Cameron et al. (2014) identify the primary dimensions of climate change that pose risks to human rights, the ways in which those risks will manifest in human/social systems, and the particular rights (including citations to relevant international human rights law) that are at risk. These are summarised in Table 1 overleaf; the full table including detail on the climate risks and the relevant human rights documents is included as Appendix 1. Notably the risks include fundamental risks to life and health from extreme events, risks to livelihoods and subsistence from changes in temperature and precipitation, and threats of displacement and the loss of cultural autonomy and self-determination from sea level rise and other forms of environmental disruption that render specific societies – notably small island nations – no longer viable. Furthermore the list of climate impacts includes "large scale singularities" such as methane releases which may produce further positive feedbacks to climate change; and under "impacts on human/social systems" dryly lists "Changes in agricultural productivity and food production," which includes possible cases in which the impacts reach catastrophic levels and hundreds of millions or billions of people become vulnerable to famine.

Climate Change Impacts	Impacts on Human/ Social Systems	Human rights affected
• Temperature rises	• Increased health risks/ fatalities from diseases and natural disasters	• Life
• Risk of extreme weather events	• Increased water Insecurity	• Poverty, adequate standard of living, and means of subsistence
• Threats to unique ecosystems	• Loss of livelihoods	• Food and hunger
• Changes in precipitation and distribution of water.	• Changes in agricultural productivity and food production	• Health
• Threats to biodiversity	• Threats to security/ societal cohesion	• Water
• Sea-level rises, flooding and storm surges	• Effects on human settlements,	• Culture
• Large scale “singularities”	• land and property leading to migration and displacement	• Property
	• Impacts on political/ public services	• Adequate and secure housing
	• Damage to vital Infrastructure and public utilities	• Education
	• Loss of cultural integrity	• Work
	• Decline in natural systems services	• Property
	• Distribution of impacts (vulnerable, poor, and marginalised are hit first and hardest)	• Women’s, children’s, and indigenous people’s rights
		• Self determination

TABLE 1. CLIMATE CHANGE IMPACTS, ANTICIPATED EFFECTS ON HUMAN AND SOCIAL SYSTEMS, AND THE HUMAN RIGHTS ADVERSELY AFFECTED.

Given the extensive treatment that informs the summary here, this paper does not further detail the threats and the dangers of climate change, except to note the following. First, though this list of the human rights consequences does not explicitly list the right to development, it would be severely affected by many of the types of impacts that are explicitly described; the economic impacts alone could wipe out decades of progress. And second, as we argue further below, the existing assessments of the adverse impacts of climate change suggest that they pose risks of a qualitatively different nature from those that characterise policy-driven risks. Five points stand out:

- **Scale:** Possible climate impacts are of a scale and scope that may take our planet into a state for which there is no previous analog; that is, a global climate that – with only a very small rise in global average temperature – may become qualitatively distinct from the climate of the period since the last ice age (which was itself only a few degrees cooler on average than today) within which modern agricultural and industrial societies evolved.
- **Fundamental unpredictability:** Although we have learned a great deal about the climate system through decades of research and modeling, the complexity of the system makes robust prediction impossible. As noted above we are headed for a "no analog" state; there are plenty of "imaginable surprises" that could be truly catastrophic. Moreover, the emergence of completely novel climate impacts is, frankly, one thing we can expect with some confidence.
- **Irreversibility:** Many of the anticipated impacts are essentially irreversible (or reversible only on the timescale of many centuries), including sea level rise, species extinction, coral reef dieback, and collapse of ecosystems (such as forests) due to shifting temperature and precipitation regimes.
- **Time lags and lock-in:** Due to the complexity and inertia of the climate system, the effects of our "forcing" are not felt until years to decades later, such that major and even catastrophic impacts may be "locked in" before we even notice they are happening.
- **Positive feedbacks and uncontrollable climate change:** The climate system is characterised by positive feedbacks that accelerate further climate change, for example,, natural carbon sinks become sources or previously isolated reservoirs of carbon dioxide or methane are released into the atmosphere. We cannot know when these positive feedbacks might be amplified to the point that that they accelerate the rise in GHG concentrations beyond our ability to control through *any* mitigation policies.

We do know, however, that for all of the risks associated with climate change impacts, higher emissions make such risks more likely. From the most predictable impacts like droughts and floods to the most unlikely or literally unimagined impacts, all become more likely the greater the forcing on the system. If we could reduce GHG emissions to zero tomorrow at acceptable cost, it would seem like an obvious thing to do. The quickest possible phase-out seems well justified.

THE CHALLENGES OF A RAPID CARBON PHASE-OUT

In the previous section we described the risks to human rights from the impacts of climate change. In this section we consider the justification for a 2050 carbon-phase out as a necessary response, in terms of the probability of limiting dangerous climate change, and specifically of keeping warming below 2°C under different phase-out timelines. Then, we briefly review the literature describing the costs and other characteristics of rapid reduction scenarios and their relevance to a 2050 carbon phase-out. (Given the technical nature of this section, additional detail is contained in Appendix 1).

A CARBON PHASE-OUT AND THE 2°C BUDGET

In the Working Group I volume of the IPCC's Fifth Assessment Report, released in 2013, there was a prominent new analysis of the carbon budgets associated with various likelihoods of staying below 2°C of warming. Put simply, achieving a reasonably high probability of staying below 2°C (a 2-out-of-3 chance, or "Likely" in the terminology of the IPCC) requires total net CO2 emissions going forward (2012 onwards) to be held to about 1000 GtCO2. Were emissions to be held flat from 2015 to 2020 and then decline linearly to zero in 2050 – an optimistic view of a very rapid start on the phase-out – this would lead to about 930 GtC of emissions, barely under the "likely" budget for staying below 2°C. A delay of only five years – peaking in 2020 and flat to 2025, and then dropping to zero at the same rate, would lead to emissions of 1,350 GtC, greatly exceeding the IPCC budget for an only 50% chance of staying below 2°C (1,120 GtCO2) and nearly reaching the budget for a merely 33% chance of staying below 2°C (1,410 GtCO2). If the peak is delayed to 2025, the same rate of reduction leads to emissions over 1,800 GtCO2, and a much less than one in three chance of keeping warming below 2°C. Clearly, delay causes the risk of exceeding 2°C to rise extremely rapidly.

Put simply, a "carbon phase-out" guarantees nothing. Everything depends on how high and soon global emissions peak and how rapidly carbon is phased out. With a low, early peak and a rapid phase-out, warming is likely to stay below 2°C. On the other hand, with a high peak and a late phase-out, warming is very likely to exceed 2°C, and possibly even considerably higher levels of warming.

There are two ways to defy the strict constraints of the IPCC's 2°C budgets. One way is to accept considerably greater risk (or virtual certainty) of exceeding 2°C. This, of course, implies also accepting rising risks of exceeding even higher temperatures – perhaps 3°C, 4°C, or even more – and concomitant impacts on human rights including the right to development. Without additional mitigation, global temperature rise of roughly 3°C to 8°C (IPCC AR5 WG3, SPM table 1) can be expected. While this amount of warming might not

seem terribly large when compared to our everyday experience in our own locales (after all, don't we often see the outdoor temperature rise by even 15°C on many days as the sun rises and warms the air?), it would in fact be a tremendous amount of warming when imposed at the scale of the entire planet. Indeed, the earth has warmed only 3°C to 8°C since the frigid depths of the last ice age,[7] yet this was sufficient to utterly transform the surface of the planet, in the process making it hospitable to the development of human civilisation. To risk a further warming of this magnitude is to invite a future in which the earth's surface is again profoundly transformed. Its hospitability to human civilisation can by no means be taken for granted.

A second way to defy the IPCC's budget constraints is to assume that at some point in the future, society will have the ability and willingness to deploy "negative emissions" technologies at large scale. This strategy allows us to exceed the budget in the near term and make up for it in the long term. Many of the techno-economic scenarios assessed by the IPCC are based on the assumption that this option will be available, keeping within a 2°C budget despite phase-out dates later than 2050 by requiring large-scale negative emissions over the subsequent decades. However, this strategy has its risks. We might learn, much too late, that the needed technologies are not feasible at the necessary scale. Or, if they are deployable at the necessary scales, it may be only with adverse affects of their own, such as the appropriation of land to grow biomass energy feedstock, competing with scarce land to provide natural habitat and to secure food for a growing global population. And, by exceeding the budget in the near term, we allow higher near term temperature rise, and elevate the risk of exceeding temperature thresholds that trigger tipping elements or irreversible climate impacts. This is a gamble that allows "emissions overshoot" in the near term, at the cost of mortgaging the human rights of vulnerable people and communities on the uncertain prospect that currently unavailable technologies will definitely be broadly deployed later.

THE TECHNO-ECONOMIC FEASIBILITY OF A RAPID CARBON PHASE-OUT

The question then necessarily arises, is such a rapid phase-out feasible in a techno-economic sense – do we have the technologies we need to accomplish it at an acceptable cost?

There is now a large amount of techno-economic analysis to help us explore possible future paths to decarbonisation. This literature was analysed in the report of WG3 of the IPCC, which summarise a wide range of emissions scenarios including more than 100 that were grouped as "likely" to keep warming below 2°C. While none of these reach zero carbon in 2050, many are in the range of an 85% reduction below today's levels in 2050 and reach zero or net negative emissions later in the century, with total cumulative carbon emissions roughly the same as – or less than – the 930 GtCO2 required for a rapid 2050 phase-out.

While it is not our objective in this paper to comprehensively describe a transition to a zero-carbon economy, we will draw out the salient features relevant to our discussion of human rights including the right to development. First, it is useful to explain the main sources of carbon dioxide emissions. Emissions sources can broadly be categorised by the five main sectors: energy supply, transport, buildings, industry, and land-use (now called AFOLU, for agriculture, forestry, and other land uses). Emissions in all of these sectors are increasing, leading to an 80% rise in global GHG emissions over the 1970-2010 time period.

While mitigation measures in all of these sectors are shared by emissions pathways at various levels of stringency, the following conclusions can be drawn about what is substantively different in the case of a rapid carbon phase-out. First, and most obviously, is the necessarily limited room for any residual use of fossil fuels. It would thus be necessary to address even those emissions sources that are particularly challenging to mitigate and often not addressed in less ambitious mitigation scenarios, such as air travel, and some industrial facilities.

Second is the speed and scale with which the zero-carbon alternatives must be deployed. This has many implications. It leaves a more limited window for transitional technologies (e.g., fuel switching from coal to gas) that are important in the technology portfolio of less stringent scenarios. Moreover, it is clear from techno-economic analyses that the greater the speed and scale required by the mitigation goal, the more expensive and disruptive the transition will be.

Indeed, the question of the feasibility of a complete carbon phase-out is inseparable from the question of the costs of the transition. The typical (median) costs reported in stringent mitigation scenarios are less than 2% of GDP in 2030 and less than 4% in 2050, reaching 4% and 6% respectively in the highest cases, which are perhaps better analogues for a complete carbon phase-out.[8] But here it is critical to keep the big picture in perspective: These figures, while they may seem large, are in the context of projected global GDP growth of two to three percent annually, and thus represent a delay of no more than one or two years in achieving a doubling of GDP. Indeed, the costs translate to a less than 0.1% decline in the annual rate of growth. Furthermore, if economic or social costs turn out to be unexpectedly high, the nature of mitigation policy for both individual countries and globally is such that it is possible to recalibrate and relax the mitigation target, assuming the additional anticipated climate impacts warrant it.

While this suggests – as has long been argued – that the aggregate costs of even very stringent mitigation are on aggregate quite manageable, the key question remains whether the costs will be distributed fairly, and whether poor countries in particular will find that the cost burdens present insurmountable obstacles to rapid human development and poverty alleviation. We will return to this question further below, but the key point here is that there is little doubt that the world as a whole can afford the aggregate costs of protecting the climate, and thus we have the ability to equitably share those costs if we choose to do so.

THE DUAL CHALLENGES OF DEVELOPMENT AND DECARBONISATION

The challenge inherent in a carbon phase-out can be examined in slightly greater resolution by looking at the implications for developed and developing countries independently, (acknowledging the simplifications inherent in these categories). Consider Figure 1, which highlights the predicament facing the developing world in particular.

Figure 1 also shows the developed (i.e., Annex 1) emission pathway (blue), assuming dramatic mitigation efforts were undertaken, starting immediately, such that the recent years' decline in emissions continues, driving emissions to zero in 2050. While this would be very challenging and is well beyond the mitigation pledges put forward in Cancun, developed countries do have the technological and financial wherewithal to undertake such ambitious reductions if they mustered the political will to do so.

Emissions under the fast carbon phase-out pathway, for global, Annex 1 and non-Annex 1

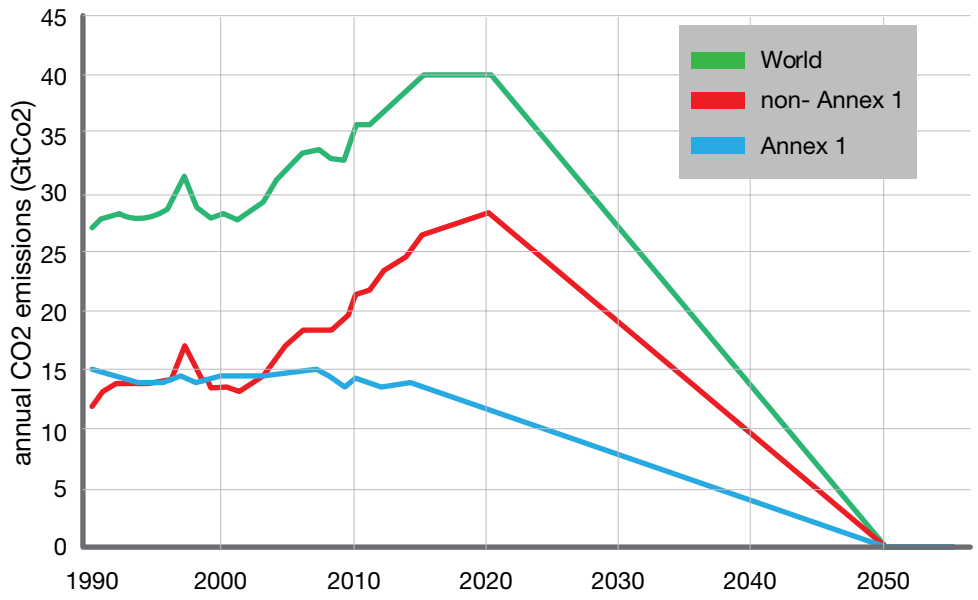

FIGURE 1. A GLOBAL CARBON PHASE-OUT BY 2050 (GREEN LINE), WITH THE PORTION OF EMISSIONS FROM THE INDUSTRIALISED (ANNEX 1, BLUE LINE) AND DEVELOPING (NON-ANNEX1, RED LINE) COUNTRIES.

Having stipulated an emissions pathway providing a global carbon phase-out by 2050, and made a heroic assumption about the developed country's emissions pathway, simple subtraction reveals the emissions pathway that would be available to support the South's development (shown in red, which is simply the green path minus the blue path). Despite the apparent aggressiveness of the developed country mitigation efforts, the developing countries are still left with a severely limited budget that forces upon them the need for equally aggressive mitigation. Developing country emissions collectively would have to peak as quickly as possible – as soon as 2020 – and then decline rapidly to 2050.

Even with aggressive mitigation within developed countries, mitigation in the developing countries would be no less aggressive. Developed countries must accelerate their decline in emissions, and with equal effort must support the most rapid possible peak in developing countries. Ultimately, the vast majority of mitigation actions would need to be undertaken in the developing world.

A sense of developmental challenge posed by the need for developing countries' emissions to peak so soon can be gained from Figure 2. The figure shows the level of income in several countries[ii] at the time at which their emissions would need to peak. For the developed countries, the figure shows incomes in the year 2010 (blue bars). The range in incomes is substantial (consider the united States and Ukraine), reflecting a wide range in material welfare. Figure 2 also shows a set of developing countries, and their projected annual per capita incomes during the 2015 to 2025 time period. (This time period is generously wide, since in order for developing countries in aggregate to peak by 2020, as Figure 1 implies, most developing countries individually would similarly need to peak by 2020.) The darker red portion of the bars in Figure 2 shows the projected income range, with the left end showing the 2015 income projection, and the right end showing the 2025 income projection.

ii. The developed countries shown here amount to about nine-tenths of total Annex 1 population. The developing countries shown here amount to about three-quarters of total non-Annex 1 population.

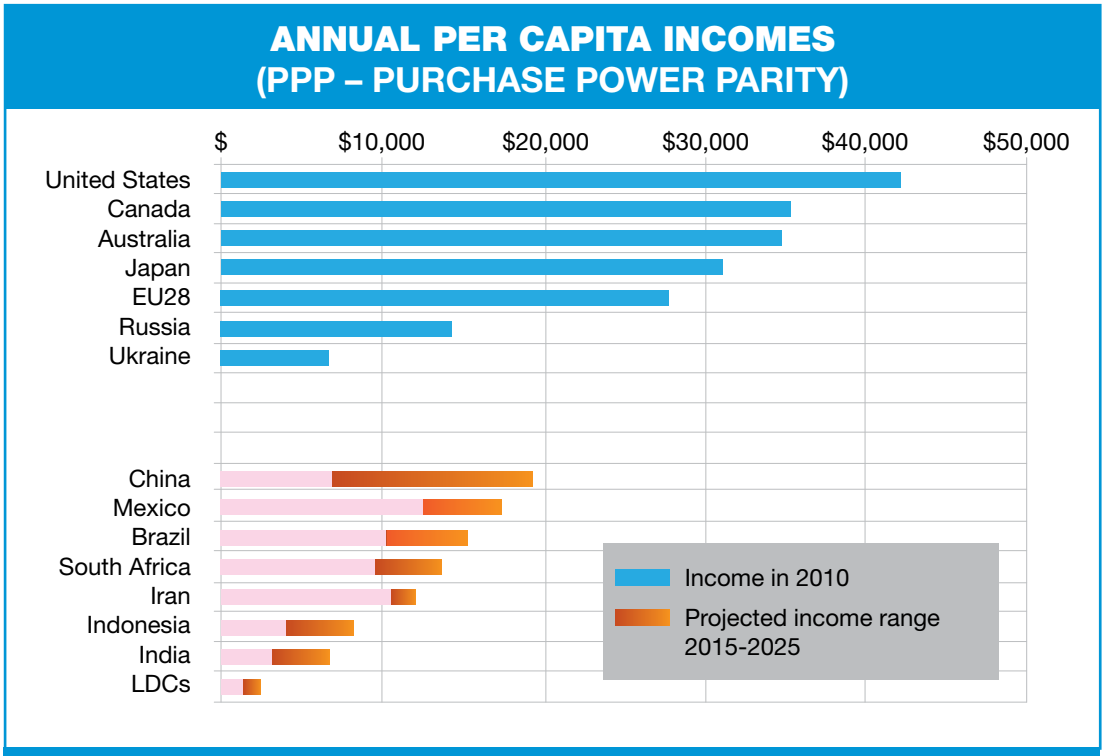

FIGURE 2. ANNUAL PER CAPITA INCOMES (PPP – PURCHASE POWER PARITY) OF SEVERAL DEVELOPED AND DEVELOPING COUNTRIES AT THE TIME OF PEAKING OF EMISSIONS.

The range in incomes across countries is substantial, but most developing countries will still be considerably less wealthy when their emissions would need to peak than most developed countries were in 2010. China, for example, is projected to have an income one-sixth to one-half the US's 2010 income level. Indonesia and India are projected to have per capita incomes in the $5,000 range, which happens to be the income level the United States was at in the 1890s[iii]. At that point in time, the US had recently found industrialisation fuelled by fossil carbon to be its route out of poverty, and its emissions were soaring. At this same level of development, countries such as Indonesia and India would need to be eliminating carbon emissions – and forgoing development driven by fossil fuels – at an annual percentage rate similar to that at which the United States had been increasing its carbon emissions.

This peaking of emissions would thus need to take place while most of the developing world's citizens were still struggling to maintain or improve their livelihoods and raise their material living standards. Yet the only proven routes to development – to water and food security, improved health and education, secure livelihoods – involve expanding access to energy services, and, consequently, a seemingly inevitable increase in fossil fuel use and thus carbon emissions. As numerous studies and reports have shown[9], access to energy services is fundamental to the fulfillment of development goals. The challenge thus posed by the dual demands development and decarbonisation is to forge an alternative route to rapid expansion of energy services for all, even while carbon emissions are declining. This is possible, but only with the necessary scale of international cooperation, including financial and technological support.

iii. See Maddison's historical database covering population by country, GDP and GDP per capita back to 1820, adjusted for purchase power parity. www.worldeconomics.com/Data/MadisonHistoricalGDP/Madison%20Historical%20GDP%20Data.efp

The challenge posed by the dual demands development and decarbonisation is to forge an alternative route to rapid expansion of energy services for all, even while carbon emissions are declining. This is possible, but only with the necessary scale of international cooperation, including financial and technological support.

TIMING OF A CARBON PHASE-OUT IN THE POOREST COUNTRIES

The remaining carbon budget is so small that it requires a rapid peak in global emissions; there is simply no time or atmospheric space to allow emissions to grow unabated for any substantial fraction of the world's population. Does this mean there is no 'leniency' for even the Least Developed Countries and other countries with majorities who are poor and have extremely low emissions?

For many reasons, including their relatively small contribution to global emissions, and relative lack of capacity to deploy advanced technologies, it is often presumed that these countries should be exempted from mitigation requirements, or given extra time to meet targets. However, it is not at all obvious that an exemption or delay from the requirements of a rapid carbon phase-out would be in their best interests.

First, it is especially important that the mitigation actions in these countries would be essentially fully supported financially and technologically. Their transition costs would be borne by wealthier countries.

Second, to the extent that there are energy and emissions needs for which low-carbon options do not exist, certainly the remaining global carbon budget should be prioritised for the development needs of the world's poorest, rather than for luxury consumption of the world's richest. This might apply, for example, in particular where emissions are unavoidable for the construction of infrastructure that is still desperately needed in developing countries: homes, schools, hospitals, roads, industrial infrastructure, and in some cases land-clearing for agriculture. However, it's important to distinguish between one-time emissions associated with the creation of this type of infrastructure, and the lifelong emissions from fossil fuel-consuming infrastructure – the latter is what creates "lock-in." Wherever substitution with low-carbon energy is technologically possible, it certainly makes sense to meet the needs for energy services in poor countries with the same clean technologies used to decarbonise the world's rich economies.

Third, not supporting the development of poor countries along low-carbon paths would imply locking in fossil energy systems, which may appear cheaper in the short run but saddle those countries with high-emitting stranded assets.

Finally, to delay the decarbonisation of the poorest countries would exclude them from the benefits of a low-carbon transition, such as energy security and reduced air pollution. Taken together, there is a strong case that the transition to low-carbon technologies should be undertaken as earnestly in poorest countries as in developed and emerging economies.

THE HUMAN RIGHTS IMPACTS OF CLIMATE CHANGE MITIGATION

There has recently appeared a distinct literature – smaller but growing – on the potential for human rights violations from mitigation activities.[10] Drawing on this work and the broader literature concerning the impacts of mitigation efforts, we broadly characterise the expected threats so they may be compared to the potential rights violations from climate change impacts. This is a necessary first step in establishing a human rights-based defense of a precautionary mitigation target, which must then address the ways in which those risks are increased by a stringent policy such as a rapid carbon phase-out.

The fact that we have already seen human rights violations associated with emissions reductions projects, and the likelihood that the increased economic value of emissions reductions will increase the incentive for such rights-violating policies, indeed underscores the need to carefully consider the potential threats from imposing rapid and comprehensive emissions reductions targets on communities worldwide. It is helpful to distinguish two types of threats to human rights that may arise from emissions reduction policies:

Direct rights violations, such as the use of violence against persons opposed to or obstructing mitigation projects; displacement of persons without their consent; imposition of life- and health-threatening risks; exclusion from or diversion of essential resources; failure to provide information about or seek consent for actions impinging on community rights or welfare.

Indirect rights violations, such as risks to health and survival from price shifts in key commodities, whether at local or global scales; risks to livelihoods from global or national policies that shift resources away from fossil-dependent sectors; and reduced developmental progress that impacts the overall ability for countries to provide the conditions for progressive realisation of human rights.

It is widely recognised that stringent global mitigation requirements may substantially raise the costs of increasing energy supplies for household, commercial and industrial use and, in the extreme case, to simply render adequate energy services unavailable. Indeed, much of the extensive discussion of fair burden sharing can be seen as addressing the question of how poor countries can raise their standards of living without the cheap fossil fuels that powered the industrial revolution and enabled the developed world to reach its present level of prosperity. The foreclosing of fossil-fuel driven industrialisation may raise energy costs in ways that adversely affect poor countries' overall development prospects, as well as directly impacting poor households. Furthermore, as has been widely noted, a low- or zero-

carbon future means that a large majority of the world's fossil fuels will never be burned[11], potentially meaning that countries with fossil resources will have to forego revenue that otherwise could be put toward developmental objectives.

POTENTIAL HUMAN RIGHTS RISKS

A starting point for examining the potential human rights violations from mitigation activities is the extensive research on potential adverse side-effects – as well as co-benefits – of various policy and technology options for reducing emissions. The WGIII report of the IPCC's AR5 provides a comprehensive table (Table 6.7, reproduced here as Appendix 2) that includes four classes of impacts (economic, social, environmental and other) for more than twenty groups of policy/technology options in six major sectors (energy supply, transport, buildings, industry, AFOLU, and human settlements and infrastructure). For each policy group, typically one or more "adverse side effect" or "potential co-benefit" is noted in each of the impacts categories, along with the level of evidence and level of agreement regarding the potential impacts. Many of the potential "adverse side effects" listed in the IPCC's comprehensive table clearly pose potential threats to human rights.

One widely cited and documented impact is displacement of people and communities due to land-intensive activities such as hydroelectric reservoir construction, forest protection, and plantation development for bioenergy or carbon sinks. Many human rights could potentially be at risk here – the right to land tenure, access to vital resources such as water, and the livelihoods of persons living in or dependent on the affected land, as well as the right to cultural autonomy. (For the specific case of bioenergy, see Box 1 below). Certain mitigation technologies involve direct health risks to various actors and bystanders, particularly those technologies that increase or redirect the location of polluting activities or waste production, whether from the immediate mitigation activity itself or upstream supply chain activities. An overarching concern that applies to all mitigation policies and technologies is the right of all persons to effectively participate in decision-making. These are among what we above referred to as potential direct rights violations.

One key point to note is that the direct impacts are in many ways qualitatively similar to the impacts that we see currently from a wide range of extractive industries. The oil industry, the mining industry, and the forestry industry all have a history of documented human rights violations, which continue to this day. Displacement for hydroelectric reservoirs similarly long predates its expansion as a mitigation measure. Thus, while the existence of these impacts today raises concerns about our ability to prevent similar impacts in a rapid mitigation scenario, the problems raised – and the necessary policies, mechanisms, and institutions – are similar to those that arise in the existing carbon-intensive economy.

There is of course a corresponding list of "direct co-benefits" that can enhance the fulfillment of human rights, such as employment opportunities created by mitigation activities, and health benefits from the reduction of pollution exposure where fossil combustion is substituted by renewable or other non-fossil energy sources, or biomass combustion is eliminated or transformed with lower polluting technology (e.g., gasification or improved cookstoves). Similarly, rapid emissions reduction will reduce the human rights violations associated with fossil-fuel extraction.

The second class of impacts – indirect impacts – are reflected in the IPCC table in two key domains affecting food security (through increased food prices, driven by competition with non-food uses for arable land), and energy access (through higher energy costs).

As with all policy shifts that affect supply and demand and produce technological and social innovation, there will be winners and losers from the resulting effects on prices and quantities in numerous markets. More expensive energy drives up many prices economy-wide, but many kinds of efficiency investments can produce net savings with various payback times.

The indirect impacts of mitigation policies, such as potentially life- and health-threatening price increases for food, energy and other commodities, as well as threats to work and livelihoods from economic shifts away from carbon-intensive sectors, are indeed also not qualitatively different from the observed impacts of existing trade, regulatory, agricultural and other policies. While it is common to see global commodity price swings portrayed as the inevitable impact of the "natural" market forces of supply and demand, it is plainly the case that intentional policy interventions – in the form of trade regimes, domestic subsidies, coordinated monetary policies, and other policy drivers – define the markets in which those forces act, and that policy decisions can and often are taken to avoid or blunt the impact of those price swings. Similarly, in the case of climate policy, measures to avoid or temper price-driven impacts on poor and vulnerable communities can in principle be built into policy designs.

BOX 1: Biofuels demand and food security

Because the direct and indirect impacts of biofuels production are a major source of concerns about rapid reductions in fossil fuel use, it is worth considering the potential scale of biofuels production. Even at current production rates, biofuels can affect food security, and indeed it is generally held that the diversion of corn production to ethanol was a significant contributor to global food price increases during 2007-2008. If a carbon phase-out relies heavily on biofuels, the risks to human rights could be substantial, with impacts on food security and the right to food.

One prominent scenario which falls well short of a complete carbon phase-out is the International Energy Agency's Biofuels Technology Roadmap (OECD/IEA 2011). In this scenario, in which biofuels rise from 2% to 27% of global transportation fuels, the net demand for feedstocks is estimated to reach 65 Exajoules and require 100 million hectares in 2050. While much of this would be expected to come from agricultural wastes, nonetheless this would be an area equal to roughly 8% of global arable land. Furthermore, in this scenario another 80 EJ of biomass is anticipated to be used for heat and power.

In a full 2050 phase-out, pressure to exceed these amounts of biofuels could be substantial. And as noted, even with the relatively modest amount of bioenergy that is currently being produced there is evidence of food price impacts from energy crop demand, thus these are threats that need to be taken seriously; given the precarious state of food security in the world today, price shifts can readily cause severe impacts on health and human welfare that are appropriately considered human rights concerns.

However, while stringent mitigation like a carbon phase-out may impact food security and the right to food, these will not be the only drivers of this type of human rights impact. Climate change itself is widely recognised to pose substantial risks to food develop new institutions and strengthen existing ones to preserve and hopefully expand food security.

Work on this subject has been going on for many years, and recently especially under the guidance of the UN Special Rapporteur on the Right to Food.

In a series of reports (UNHRC 2008, 2009; De Shutter 2010) the Special Rapporteur has outlined a variety of ways in which both climate change and climate mitigation may impact food security, and offered suggestions for improving the protection of the right to food. Many of these address the nature of obligations of countries to provide aid, and ensuring that it is provided in a timely, participatory and non-discriminatory manner. However, it is also widely acknowledged that food security is a matter not merely of providing aid, but of ensuring that people have the purchasing power to buy the food that is available. Thus, and unsurprisingly, protecting the right to food in the context of rapid emissions reductions requires the enhancement of social protection mechanisms very broadly, which will plainly not be done primarily within the climate regime.

Importantly, increasing demand for biofuels does provide opportunities for increased agricultural incomes, an important component of food security for producers. However, for this opportunity to lead to equitable benefits for smallholders rather than simply promoting corporate agriculture, policy interventions are required. As the special rapporteur put it, there is "…a need for a "positive discrimination" for family agriculture, in order to encourage the increased inclusion of smallholder farmers in the market. In this regard, capacity building, technical assistance and access to land and credit should be promoted" (De Shutter 2010). And while these issues are not restricted to the impacts of biofuels production and mitigation policy, there is room for implementation of these types of programs under current and future climate-related institutions.

The price-driven "indirect" impacts discussed above can potentially also undermine the right to development. Beyond the rapid or even gradual price shifts that push households below human rights thresholds, indirect impacts can impose aggregate constraints on the long-term ability of nations to provide increasing well-being (i.e., "development") for their citizens. Of particular concern of course are the implications for poor people and poor countries. In poor countries where the level of nutrition, health care and education all fall below standards considered acceptable in "developed" nations, substantial increases in energy or food prices may significantly slow the rate at which development progresses.

Much has been said of the need to preserve the rights of poor people and poor countries to continue to develop to meet their basic needs and rise from the still massive extent of poverty and destitution. The historic linking of development with industrialisation and the spread of increasingly energy-intensive (and especially fossil-fuel-intensive) lifestyles has always highlighted the climate risks of development-as-usual. Conversely, the absence of a demonstrated ultra-low carbon pathway and the apparent dependence of even modest decarbonisation on expensive technological substitutions has roused concerns about the risks to development of stringent climate policy.

Indeed, concern about the preservation of their right to development has been a fundamental motivation of developing countries in resisting binding climate targets or "commitments" under the UNFCCC. As we discussed above, in any plausible future consistent with even a moderate likelihood of staying below 2°C emissions will need to peak and begin to fall rapidly in most developing countries while they remain very poor in relationship to rich countries making the same transition; put differently, they will need to be decreasing their emissions rapidly at the same stage of development at which the

now industrialised countries were rapidly increasing theirs. It is not hard to see how global policies which demand such reductions in developing countries and increase the price of energy and energy services appear to pose a serious threat to the interests protected by the right to development.

Developing countries could find themselves bidding for both carbon emission rights and low carbon technologies in order to provide the energy necessary for development. The protections for the right to sustainable development that are embodied in the UNFCCC are plainly and justifiably intended to ensure that such impacts are avoided or minimised. And, as we will argue further below, the equitable provision of international support for mitigation can be a crucial tool for ensuring that mitigation does not in fact result in harmful impacts on poor countries' development prospects.

The economic issues raised however go far beyond the question of simple mitigation costs, expressed as the incremental cost of carbon-free energy. A low- or zero-carbon future means that a large majority of the world's fossil fuels will never be burned, which can translate to significant foregone income, foreign exchange revenue, and wealth for those countries with fossil resources. Along with these "stranded assets" goes a wide range of related infrastructure and human capital. Correspondingly, jobs will be lost both to direct providers of current fossil energy, and (also a large concern) to those whose employment is dependent on the fossil-fuel derived income that is a huge fraction of many nations' GDP. There is also increasing work on the design of a so-called "just transition," addressing the impacts on work and livelihoods of economic disruption due to climate and energy policy impacts, and these issues are already being discussed in the UNFCCC[12]. While there will certainly be a great deal of job creation from the necessary transition, policies to ensure that "losers" are treated equitably will be needed to an even greater extent in support of a complete carbon phase-out, and such programs will need to be supported by international measures.

Clearly, the potential for serious human rights risks from a rapid carbon phase-out is very real. These cannot be ignored, and strongly indicate that human rights protections would need to be central to a global carbon phase-out program. In the final two sections of this report, we return to this question in detail, and elaborate several recommendations for integrating human rights protections into a rapid carbon phase-out.

Climate mitigation, especially at the scale and speed needed for a rapid carbon phase-out, poses potential risks to human rights. There are risks of both direct rights violations from mitigation activities such as dam building or forest enclosure, and indirect violations from price increases in essential commodities, as well as losses of wealth and income for fossil-fuel producers. These cannot be ignored, and require us to make human rights protections central to mitigation strategies generally, and a carbon phase-out in particular.

THREATS TO HUMAN RIGHTS: COMPARING CLIMATE CHANGE IMPACTS AND CLIMATE MITIGATION

Clearly the threat of human rights violations as a result of ambitious mitigation – and a rapid carbon phase-out in particular – can by no means be ignored, and indeed such violations have already been documented at much lower scales of mitigation. Yet, this does not serve as justification for deferring mitigation. Several critical points make this clear.

First, the threats posed by mitigation activities are plainly not of the same character and magnitude as those posed by climate change. As discussed above, the anticipated impacts of climate change are characterised by large scale, unpredictability, irreversibility, long time lags, and uncontrollable feedbacks. In contrast, the threats posed by mitigation activities are generally of limited scale, more predictable, are not generally masked by long time-lags, and are governed primarily by socio-economic process under human control rather than biophysical feedbacks that are not.

Second, the human rights threats posed by mitigation activities tend to be qualitatively similar to those historically posed by other (non-mitigation) policies and economic activities. This does not make them acceptable, of course, but it does provide us with experience and existing institutions and strategies that can be adapted and strengthened, if society chose to take concerted action to allay the anticipated threats.

Third, avoiding potential human rights threats from a carbon phase-out does not require us to precisely identify the ultimate end point of a carbon phase-out several decades in the future and take measures to prevent those threats from ever being realised. Indeed, it is impossible to predict that end-point, as we cannot know the outcome of innovation in technologies or institutions, nor the evolution of society's demands. Rather, what is needed is to anticipate and prepare for the potential impacts arising from measures we need to implement in the relatively near term. As experience is gained, efforts to phase-out carbon can be adaptively managed, continuing to aim to minimise the adverse human rights impacts.

Fourth, if society decides, as time progresses, that a carbon phase-out indeed is threatening unacceptable human rights violations and undermining the right to development, it can choose to relax the mitigation target –providing, that is, that the additional anticipated climate impacts warrant it. A crucial asymmetry must be stressed: if we choose a less stringent mitigation target and discover the climate impacts impose unacceptable harm, we can't go back in time and make the target more stringent.

But not only do climate mitigation activities present risks that are more manageable than climate change, they also present clear benefits and opportunities. Climate policies can contribute to broader efforts to enhanced energy access, improve air quality and public health, generate jobs and sustain livelihoods, and preserve environmental resources on which natural and human systems – including food production and water resource management – critically rely.

However, climate mitigation will by no means yield these benefits by default. They will arise only if mitigation strategies are integrated with development goals from the start, and if mitigation activities are designed and implemented with the deliberate objective of enhancing welfare and promoting human rights. The following two sections are focused on concrete recommendations for ensuring that climate mitigation – and a rapid carbon phase-out in particular – yield such benefits, and more generally **respect, protect, promote and fulfill human rights - including the right to development.**

The risks to human rights posed by climate change are fundamentally and qualitatively different in nature from those posed by mitigation, and much more likely to be insurmountable. The risks posed by climate change are mediated by human institutions, and therefore are more predictable and manageable through means such as those used to address other societally caused risks to human rights. Moreover, climate mitigation can yield important developmental benefits and enhance the fulfillment of human rights, providing these are built in as deliberate objectives.

THE RIGHT TO DEVELOPMENT AND FAIR EFFORT-SHARING

In this section and the following one, we discuss in more detail a variety of specific recommendations to address such risks and create the conditions for a rapid carbon phase-out that promotes human rights. Since so many of the human rights risks from mitigation policy arise from the imposition of costs on poor people and poor countries, a fundamental challenge is agreeing how the costs of a rapid carbon phase-out will be shared. Who will bear the costs of the globally essential low-carbon transition? For this reason, we focus in this section specifically on this key dimension of the problem: fair effort-sharing between countries.

As we stressed earlier, the urgency of a carbon phase-out and the small remaining carbon budget means that there is very little leeway for developing countries to continue to increase their carbon emissions. Yet there is a tremendous need for growth in energy services if “energy access for all” and the right to development are to be honored. And while the aggregate costs of a carbon phase-out may be manageable globally, poor countries cannot – and should not – be expected to bear the costs of full decarbonising their economies. The right to development is a human right as recognised1986 UN Declaration on the Right to Development.

Nonetheless, in a climate-constrained world, the right to development can only be a right to sustainable development – that is, a level and form of material consumption that is truly sustainable and universalisable. It is not viable to say that the right to development implies the right to emit all the carbon you want until you reach the level of wealth of the currently developed countries, consequences for the planet be damned. However, neither is it viable to say that those countries that do not have the technological and financial wherewithal to develop within the remaining limited carbon emissions space are themselves damned to continuing poverty.

Resolving this tension requires posing the right to sustainable development as a positive right, that is, one with both rights-holders and duty-bearers. This implies an obligation not only on the still-poor countries to develop sustainably, but on the currently wealthy countries to financially and technologically support the expansion of decarbonised energy supply and end-use efficiency. It is not surprising that precisely this obligation is reflected in the UNFCCC, and animates much of the contentious debate surrounding the negotiations in the run-up to Paris COP.

For these reasons – the essential role of fair effort sharing in making a rapid carbon phase-out feasible, and the centrality of this vexing issue to the current international debate – we present in this section a substantial discussion of equitable effort sharing. We move on in the subsequent section to specific recommendations.

EQUITABLE EFFORT-SHARING IN A COMMONS PROBLEM

Even though discussions of equity on the international stage have been extremely divisive and shown little progress so far, an approach based on equity may be the only viable way forward. Such an approach is morally preferable, of course, and is also a legal commitment for all Parties to the UNFCCC, who have agreed to "protect the climate system … *on the basis of equity* and in accordance with their common but differentiated responsibilities and respective capabilities." But most importantly, an equitable approach may be essential to solving the climate crisis.

This is so because climate change is a classic case of a *commons* problem. As with any commons problem, the solution lies in collective action. No single country is able to protect its own climate by reducing its own emissions, and thus no country can solve its climate problem by itself. But rather must persuade other countries to help it. Thus, countries reduce their own emissions – and cooperate in other ways – not in order to directly protect their climate, but to get other countries to do likewise. And, crucially, a country is only likely to succeed in inducing reciprocal effort among its negotiating partners *if it is perceived to be doing its fair share of the effort.* Thus, a cooperative agreement among countries is more likely to be agreed and successfully implemented if based on equitable effort-sharing. In other words, there is a strong argument for equity based not in ethics, but in enlightened self-interest.

Young (2013) has identified a few general conditions—all of which apply to the climate context—under which the successful formation and eventual effectiveness of a collective action regime may hinge on equitable burden sharing: the absence of actors who are powerful enough to coercively impose their preferred burden sharing arrangements; the inapplicability of standard utilitarian methods of calculating costs and benefits; and the fact that regime effectiveness depends on a long-term commitment of members to implement its terms. Thus, in the terse words of the WG3 Summary for Policy Makers, "The evidence suggests that outcomes seen as equitable can lead to more effective cooperation."

This leaves open the question of what sorts of arrangements would be seen as equitable. Here, we distinguish a three tier set of criteria by which a country may assess whether a global climate agreement is sufficiently equitable to warrant its participation.

CRITERIA FOR JUDGING AN EQUITABLE AGREEMENT

The first tier criterion, indeed a minimal requirement, is that the agreement does not jeopardise human rights. As has been discussed, human rights could be undermined by either by mitigation activities that are not governed by adequate safeguards, or inability to secure vital energy services because of the inability to implement zero-carbon options, due to the lack of access to the necessary financial or technological resources.

The second tier criterion, which is somewhat more encompassing, is that the agreement does not undermine a right to development. Understanding this requirement raises questions for which the complete answers are far from clear. In particular, it focuses attention on the right to sustainable development, and on the meaning of that concept in countries that are already wealthy. Clearly, for a given emissions target, the faster the growth in aggregate consumption, the greater the need to improve energy intensity and carbon intensity. Furthermore the diversion of our remaining emissions budget to luxury consumption among high-income populations will directly affect the costs for low and middle-income people to meet their needs. It is thus no longer a fringe position to argue that economic growth and luxury consumption must be constrained to provide "environmental space" for the necessary growth in consumption of energy and other goods in poor countries - the "development" that the "right to development" is intended to protect and enhance.[13]

It is thus understandable that a poor person (or a well-off policy maker, for that matter) in a developing country might have little sympathy for the demand that climate policy must not impact economic growth in rich countries with four or ten or twenty times the per capita income and energy use. At the same time, one cannot ignore the fact that in our current economic system, employment stability in the rich world has been contingent on growth, and that a mitigation requirement that reduces GDP growth will meet well-founded opposition among workers in wealthy countries. Livelihood is a human right in wealthy as well as poor societies, and the social protection mechanisms in the developed world are far from adequate to the present economic status quo, no less a disruptive transition.

Yet, inevitably, the level of energy use and consumption that the rich countries consider their due will calibrate the willingness of developing countries to constrain their own economic growth. There is little reason to expect that the majority of the world's population that still commands a small per capita share of the world's resources will accept a permanent second-class status in energy consumption and level of development generally. A standard of living can only be considered sustainable if it can be sustainably shared by all of the perhaps nine billion people who will likely live on the planet in the second half of this century, as none of the nine billion will accept a permanent relegation to a lower standard of living. Since many will view the right to development through the lens of ensuring the potential for convergence and parity between the now-poor and the now-rich, any global agreement would arguably need to be seen as preserving this possibility.

A third tier of criteria pertains to what is perceived as being a "fair" distribution of effort that is consistent with basic equity principles. Given the demanding mitigation efforts required by a rapid carbon phase-out, this raises the question of who bears the costs of the global transition. This problem – call it "the equity question" – has long bedeviled the negotiations, and spite of an apparent consensus on broad principles, in practice it has been the source of seemingly insurmountable controversy.

THE CONVENTION EQUITY PRINCIPLES: COMMON BUT DIFFERENTIATED RESPONSIBILITIES AND RESPECTIVE CAPABILITIES

The UNFCCC famously calls on Parties to address the climate problem "on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities." This echoes the more explicit text of the Rio Declaration, agreed among Parties at the same 1992 Earth Summit in Rio de Janeiro as the UNFCCC, in which Principle 7 reads:

> *"In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command." [Principle 7, Rio Declaration, 1992]*

The Rio Declaration is helpfully explicit about the relationship between the phrase "common but differentiated responsibilities" and ethical principles suggesting that countries' contribution to addressing global problems should be in accordance with their contribution to the problem (Responsibility) and their capabilities to solve it (Capacity).

Contribution in proportion to Responsibility and Capacity are virtually universal principles, quite consistent with the ethical standards that societies tend to apply within their own sovereign countries. Both common sense ethics and legal practice hold persons responsible for harms or risks they knowingly impose or could have reasonably foreseen, (and, in certain cases, regardless of whether they could have been foreseen). The principle of Responsibility is thus closely connected to the Polluter Pays principle, and effort-sharing principles which derive from it hold that countries should be accountable for their greenhouse gas emissions. Generally, the principle of Capacity is taken to imply that the more one can afford to contribute to the costs of preserving or generating societal public goods, the more one should. A minimal interpretation of this is that one's efforts should be in proportion to one's resources; however most ethical perspectives take a stronger stance, calling for a progressive approach. This is why most societies have progressive income taxation, whereby marginal tax rates rise with income.

Table 2 overleaf provides a sense of how such principles can be interpreted as quantitative indicators, and how these can in turn provide an indication of the share of the global effort that individual countries might undertake. The data is provided by the Climate Equity Reference Calculator[14], an online tool and database that allows the user to select specific equity-related settings and other key parameters, and then to calculate the implied national fair shares of the global mitigation effort based on each country's Capacity and Responsibility. In the example shown below, Responsibility is based on CO2 (excluding land use emissions) and non-CO2 emissions going back to 1950, roughly the beginning of the post-war industrial expansion and the establishment of modern national borders; Capacity is based on national income distributions and "development threshold" of $20/day (PPP adjusted) per capita, below which income is excluded from consideration as Capacity; a similar proportion of emissions are also excluded from Responsibility.

	Population (% of global, 2010)	GDP per capita (2010) ($US PPP2005)	Responsibility (% of global, 2010)	Capacity (% of global, 2010)
EU 28	7%	$27,644	24%	30%
EU 15	6%	$30,688	21%	28%
EU 13	1.6%	$16,411	2.9%	1.8%
United States	5%	$41,773	37%	29%
China	20%	$6,713	2.5%	6.4%
Japan	1.8%	$30,729	5.5%	10.%
Russia	2.1%	$13,998	7.4%	2.0%
India	17%	$3,171	0.1%	0.2%
LDCs	11%	$1,498	0.3%	0.1%
Annex 1	19%	$28,596	82%	79%
Non-Annex 1	81%	$5,445	18%	21%
World	100%	$9,777	100%	100%

TABLE 2. POPULATION SHARE, PER CAPITA INCOME, AND NATIONAL/REGIONAL SHARES OF CAPACITY AND RESPONSIBILITY IN 2010. SEE TEXT.

What this table shows is that, using middle-of-the-road definitions, the large majority of both Responsibility and Capacity in 2010 is located in the Annex 1 countries, primarily in the wealthy (Annex 2) countries (though that disaggregation is not provided in this table). There is no single "correct" way to combine Capacity and Responsibility into a unique index, but plainly under any framework that allocates the burden according to these two principles, the cost of the overwhelming majority of emissions reductions would appropriately be borne by the wealthy countries. Yet, as discussed earlier, the majority of mitigation activities will need to take place in developing countries. Taken together, these two observations justify the need for financial and technological support to form a central pillar of international cooperation on climate, and for the institutions needed to ensure that such support is designed, governed and implemented equitably.

Undeniably, given the state of politics in most developed countries today, it is manifestly "unrealistic" to expect the required scale of finance and other means of implementation (e.g., technology transfer and capacity building) to appear quickly. However, we reiterate that what is needed is not the sudden emergence of a global altruism, but rather an enlightened self-interest. For what is even more politically unrealistic is to expect that, in the absence of adequate support from the wealthy countries, poor countries will willingly divert their own resources from proven paths of development toward investments in decarbonisation, which – so far at least – appears to conflict with the energy service demands of industrialisation, urbanisation, poverty alleviation, and thus development itself.

If effort is shared among countries according to the basic equity principles of responsibility and capabilities, the cost of emissions reductions would be primarily borne by the wealthy countries. At the same time, the majority of mitigation activities will inevitably need to take place in developing countries. Taken together, these two observations explain why financial and technological support from wealthier to poorer countries is a central pillar of international cooperation on climate.

RECOMMENDATIONS FOR ACTION

We have argued that a carbon phase-out is warranted by the risks that climate change poses to human rights, and that while mitigation on the necessary scale will also pose risks to human rights, they are fundamentally less threatening and more manageable. We have also argued that 2050 is a seemingly appropriate time-frame for a carbon phase-out. It is consistent with the severely limited carbon budget available if warming is to be likely to remain below 2°C, especially given that further delay makes meeting any mitigation goal more expensive and difficult, and puts some targets quickly out of reach.[15] However, is 2050 really the right time frame? Would, say, ten years later be preferable, so as to better ensure that human rights can truly be protected from the risks posed by a zero-carbon world?

While the "optimal" target year for the total carbon phase-out is not an answerable question, delaying the phase-out beyond 2050 by more than a few years can no longer even be considered consistent with the 2° C goal. The mitigation options that will be available in 2050, and the social and political context in which they will be chosen and implemented, are impossible for us to know. We cannot anticipate the outcome of innovation in technologies or institutions, nor the evolution of society's demands. Attempting to predict precisely the human rights impacts in that time frame is unlikely to prove especially fruitful, especially in determining today whether 2050 is the right goal for a carbon phase-out.

Thankfully, committing to a rapid carbon phase-out does not require us to precisely identify the entire pathway up to the final end point several decades in the future. Rather, what is needed is merely to set out along the pathway – to dramatically accelerate mitigation activities in the *immediate* future, as rapidly as possible, consistent with putting in place a set of strong measures to protect human rights, includingthe right to development. In other words, it is not the choice of a distant year such as 2050 that determines our course now, but rather the near-term mitigation options and human rights protections. As conditions evolve and experience is gained, efforts to phase-out carbon can be adaptively managed, as different threats emerge or recede, and as different opportunities become available.

A CARBON PHASE-OUT MUST BE FAST, FAIR AND PARTICIPATORY

In light of these arguments, in this section we present the following ***recommendations*** regarding the necessary features of a common global effort to achieve a carbon phase-out in a manner that preserves human rights and a right to sustainable development.

FAST: a carbon phase-out must begin quickly and extend globally in order to be effective.

Our comparison of phase-out pathways with the available carbon budgets showed that further delay will rapidly and dramatically increase the expected level of warming, and the concomitant risks to human rights including the right to development. **A carbon phase-out delayed by more than a few years can no longer even be considered consistent with the 2°C goal.** Ultimately, taking action now that keeps an early phase-out – and a likely chance to keep warming below 2°C – within reach while preserving human rights is what is important; the technological details and human rights implications of the distant end-point of the transition will emerge only over time.

FAIR: the effort required for a carbon phase-out must be shared equitably among countries, otherwise it will not happen.

Climate change is a classic case of a *commons* problem, and thus must be addressed through cooperative action. Given the scale of the required effort, especially against the backdrop of deep global inequality, a cooperative agreement among countries is likely to be agreed and successfully implemented only if it is widely seen as fair. If effort is fairly shared among countries according to the basic equity principles of responsibility and capabilities, the cost of the emissions reductions would be borne primarily by the wealthy countries. At the same time, the overwhelming majority of mitigation activities will inevitably need to take place in developing countries. Taken together, these two observations explain why financial and technological support from wealthier to poorer countries is a central pillar of international cooperation on climate. This in turn motivates the need for effective institutions and mechanisms for mediating financial and technological transfers at the scale necessary to enable ambitious mitigation, while protecting human rights including the right to development.

PARTICIPATIVE: democratic processes at all levels will be necessary to enable an effective carbon phase-out that preserves human rights including the right to development.

At the level of international climate negotiations, procedural equity is necessary to ensure the effective involvement of all countries, including developing countries. In the design, selection, and implementation of mitigation efforts, stakeholders must be empowered to effectively participate, while limiting the inordinate influence of powerful vested interests to obstruct action or to appropriate excessive benefits.

In all of this, there is a critical role for strengthening the protection of human rights in existing institutions and developing new institutions to address the many interlocking requirements of a transition to an equitable zero-carbon future. Institutions will be needed that can mediate equitable burden-sharing, recognising the unprecedented scale of international cooperation and support that will be needed. Existing institutions, such as those associated with development assistance, foreign direct investment, and trading systems may provide helpful lessons, but are themselves far from adequate to the task. At the same time, and at a range of scales, more effective institutions will be needed to ensure democratic governance and participation based on the effective involvement of stakeholders. International and national institutions that support human rights will need to be expanded and strengthened, as will those charged with multilateral environmental governance. These institutions must be designed to enable adaptive management that can

cope with the inherent uncertainties and dynamic conditions of a long-term carbon phase-out spanning decades and a diversity of national contexts.

It is important to point out that the promotion of human rights including the right to development has been underway for decades, since at least the drafting of the Universal Declaration of Human Rights in 1948. Many recommendations have been advanced to promote human rights including the right to development. Indeed, there are experts and organisations dedicated to devising such recommendations and seeing them realised. So, here, we do not attempt to rehash – nor presume to improve upon – these recommendations. Rather, we focus on those recommendations that are specifically relevant to a carbon phase-out.

SPECIFIC RECOMMENDATIONS FOR A RAPID CARBON PHASE-OUT THAT PROMOTES HUMAN RIGHTS

Again, it is not possible - nor is it our objective here – to propose a complete blueprint for a rapid carbon phase-out, or the policies needed to ensure its compatibility with human rights protections. But we do seek here to recommend a number of practical ***near-term steps*** – especially in the context of the international UNFCCC negotiations – that arguably must be taken in order to lay the necessary foundation. In what follows we group our recommendations under the broad categories outlined above – "Fast, Fair, and Participative" – recognising that any such categories have overlaps and interactions.

FAST: A rapid global phase-out of carbon emissions

- Adopt the goal of a carbon phase-out by 2050 in the Paris agreement, with the explicit objective that the phase-out be equitable, and that all climate actions respect, protect, promote and fulfill human rights for all.

Adopting such a goal serves several purposes. It builds on the 2°C objective agreed in Cancun, making it more concrete, actionable, and consistent with current science. It serves as a guiding objective for the scale and distribution of commitments under the Paris agreement.

Such a goal will also serve to further entrench human rights including the right to development in the UNFCCC regime. It can strengthen the recognition of human rights already found in the Cancun Agreements (UNFCCC Decision 1/CP16), which "Emphasises that Parties should, in all climate change related actions, fully respect human rights;" Likewise, it can strengthen the recognition of a right to development, building upon the agreement the that the climate protection objective of the UNFCCC "should be achieved within a time-frame sufficient … to enable economic development to proceed in a sustainable manner" (UNFCCC, Art. 2, Objective) and that "Parties have a right to, and should, promote sustainable development" (UNFCCC, Art. 3, Principles). It also brings the rights framework to bear on the notion of "equitable access to sustainable development" (UNFCCC 1/CP16).

Ideally, beyond the UNFCCC, this goal can also motivate other individuals, organisations, and political bodies, helping to seed a growing consensus around an aggressive and equitable global climate response. With some civil society groups (e.g., Climate Action Network) already having adopted a carbon phase-out by 2050 as their stated position, the formal UNFCCC adoption of this goal can be expected to accelerate its support.

All countries must be involved, if an early global peak is to be achieved. To the extent that there are energy and emissions needs for which low-carbon options do not exist, the remaining global carbon budget should be prioritised for the development needs of the world's poorest, rather than for luxury consumption of the world's richest. This might apply, for example, where emissions are unavoidable for the construction of infrastructure that is still desperately needed in developing countries: homes, schools, hospitals, roads, industrial infrastructure, and in some cases land-clearing for agriculture.

In addition to adopting an overall goal of a 2050 carbon phase-out, Parties to the UNFCCC should focus on practical steps that accelerate current mitigation activities, again ensuring that all such steps are done with attention towards the protection of human rights. Such steps include:

- Strengthen Workstream 2 of the Ad-hoc Durban Platform, which is focused on action in the pre-2020 timeframe, to ensure that the peak in global emissions is as soon as possible and no later than 2020.
- Accelerate the implementation and capitalisation of existing mechanisms, such as the Green Climate Fund.
- Provide support for the development of national scenarios and plans that are explicitly consistent with a rapid and equitable carbon phase-out that promotes human rights. For example, energy sector scenarios should explicitly examine potential regressive impacts of mitigation policies on energy access, rather than merely aggregate energy supply. Forest sector scenarios should explicitly address the livelihood needs of forest-dependent communities. Agriculture sector scenarios should explicitly examine the needs of small-holders and landless labourers.

Finally, an overarching task is to better integrate human rights concerns into all of the processes associated with UNFCCC negotiations and the development of international and domestic policies supporting a rapid carbon phase-out. Accordingly we suggest that the UNFCCC:

- Formalise the protection and integration of human rights into climate action by establishing a Subsidiary Body, process or work programme under the UNFCCC mandated to inform and assess COP decisions with respect to human rights considerations, in cooperation with the UN Human Rights Council, and appoint a focal point in the Secretariat to facilitate and coordinate engagement.

Such a body could go a long way towards ensuring that human rights concerns are not merely an afterthought to global climate policymaking. There are a variety of different options for how such a body could be created and charged, and of course it would necessarily be required to address not only the impacts of mitigation that are the focus of this paper, but also the human rights violations and potential violations from climate impacts.[16]

FAIR: EQUITABLE EFFORT SHARING

Fair effort sharing between countries is key to a carbon phase-out that respects human rights, and especially the right to development. This major step is made all the more challenging by the heavy reliance of the present climate regime on bottom-up contributions that are determined by domestic political considerations that may have little relation to the requirements of science or principles of equity. Advancing equitable effort-sharing in the UNFCCC hence entails actions at various levels.

- Civil society must mobilise public support for equitable effort-sharing in the UNFCCC and for climate justice and global solidarity more broadly.

Firstly, it will require promoting an explicit discussion among civil society and policy makers within countries about equitable contribution to the global climate challenge, and building a constituency that is able to articulate coherent demands for equitable action, mobilise popular support for them, and press for their implementation. Initial steps taken by civil society, but also climate scientists and policy researchers (and in a few countries by policy makers), that have proven helpful in this regard and should be undertaken more broadly include the following:

- Developing and disseminating tools and information sources that can effectively inform discussions of national fair shares, to bring quantitative specificity and consistency with science to the domestic debates of fair shares.
- Convening public symposia, discussions, and hearings by civil society groups or government agencies with convening power
- Undertaking outreach to journalists to increase coverage of climate equity,
- Initiating legal actions to pressure responsible government agencies to take action.
- Creating partnerships between organisations traditionally focused on environment and organisations traditionally focused on development.
- Mobilising eminent personalities as emissaries of climate equity.
- Coordinating forums and processes by which diverse actors can work toward a domestic consensus.
- The UNFCCC should mandate that Parties propose their INDCs with the necessary information to enable a thorough assessment on the basis of ambition and equity, and subsequent “ratcheting” process.

Within the UNFCCC process, the first quarter of 2015 will see Parties communicating their “Intended Nationally Determined Contributions” (INDCs). While this is understood to be only a first step, it poses the serious risk that weak INDCs will be enshrined in a static international agreement, locking in inadequate and inequitable levels of action for the long-term. What is needed yet still lacking is an explicit agreed process to “ratchet” these initial offers up to higher levels of ambition and equity. This is a critical necessity if a bridge is to be built between the initial offers that are heavily constrained by domestic political realism, and the global cooperative solution that is guided by science and principles of equity.

A key aspect of the process is ensuring that the INDCs are submitted in a form and including information that is amenable to a subsequent ratcheting process to increase ambition and equity. Parties have already agreed to decide at COP 20 in Lima what information is required to be submitted along with the INDCs. In particular, this should include the following requirements:

- Countries must submit their INDCs along with sufficient information to evaluate them with regard to their overall effect on emission reductions and overall contribution to financial and technological support for mitigation, adaptation, capacity building, and loss and damage.
- Countries must also provide sufficient information to understand and assess the basis on which a country's INDC is being presented as its equitable share of the global effort, consistent with protecting, respecting and promoting human rights and a right to development. This information should be presented in a form that is explicit and concrete; the underlying equity principles must be transparent, the relevant indicators, data, and methodological approach must be clear, and the quantitative implications must be straightforwardly reproducible and applicable generally to all countries. Ultimately, sufficient information should be provided so Parties are clearly explaining the equity basis on which they are offering to contribute a fair share of the global effort.
- Countries also provide explicit information regarding the conditions under which their INDCs would be increased in ambition, both for domestic climate action and for international support. This formalisation of the procedure established in Cancun to submit "conditional" and "unconditional" pledges will provide a starting point for a ratcheting dynamic and help avoid locking in weak INDCs early in the process.
- The UNFCCC must establish a process for the review of INDCs, for parties to respond to the reviews, and to iteratively increase ("ratchet") the ambition of mitigation actions.

The nature of the review process is a key item of the ongoing negotiations. Inevitably there will be both formal and informal reviews. We suggest the following for the formal review process:

- Undertaking (by the Secretariat or a mandated body of experts) an assessment and compilation of INDCs on the basis of the above information. This process should provide an evaluation with respect to completeness, consistency, individual and aggregate impact on emissions and contribution to support, and a determination of the extent to which national "conditions" are fulfilled. It should raise questions or concerns, to the extent that the mandated information requirements for submission of INDCs have not been fully met.
- Establishing a formal process whereby Parties are required to respond to the above compilation and assessment, addressing any specific questions or concerns raised, as necessary, clarifying their INDCs.
- Creating a formal "request and offer" process by which Parties offering support (for mitigation, adaptation, capacity building and loss and damage) and Parties requesting support can to assess each other's offers or requests, request clarifications, increase concreteness, and iteratively reach convergence and a mutual provisional commitment. Such a process provides a basis for establishing trust and circumventing the longstanding dynamic by which vague demands for support are met by equally vague promises of support.
- Developing countries must have universal access to the necessary low-carbon technologies, through appropriate rules and mechanisms relating to innovation, technology transfer, and intellectual property.

Another important domain for institutional change remains the treatment of intellectual property rights for low-carbon technologies. IPR and technology transfer more generally have been highly contested issues within the climate negotiations themselves as well as in other international fora. Preventing the exclusion of poor countries from technological advances is essential to preserving and enhancing the right to sustainable development. The intellectual property provisions regarding so-called essential medicines provides some valuable precedents and models; they can be translated to the context of ensuring access to developing countries of necessary low-carbon technologies.

- The provision of the necessary financial support for "just transition" activities.

In addition to providing direct support for mitigation and adaptation to climate impacts, financial resources will be necessary to support a wide range of "just transition" activities. The right to work and livelihoods will be at risk in many sectors, and it should not fall solely to national governments to address the disruptive effects of a rapid carbon phase-out. Particularly in poor countries with weak institutions of social protection, both direct international support as well as capacity building will be essential to protecting livelihoods and the basic rights to food, health, and shelter that market incomes provide. However, these resources must not come at the expense of resources for adaptation and compensation for loss and damage; even the most rapid possible phase-out will not eliminate climate impacts.

- Existing compliance institutions should be strengthened and new mechanisms developed to limit the possibility of free-riding on the global climate effort.

A key institutional question, of course, remains the availability of means to sanction free riders on the global climate regime, both with regard to mitigation of national emissions, and the provision of appropriate financial and technological support. The move from top-down, binding commitments (as in the Kyoto protocol) to bottom-up, nationally determined contributions may have been a necessary step at the time, but it is hard to see how a stringent mitigation path and a regime capable of addressing adaptation needs can be sustained in the long run if there are not compliance mechanisms available.

PARTICIPATIVE: EXPANDING DEMOCRATIC PROCESSES

Access to information and participation in decision making are fundamental human rights, essential for the protection of other basic rights. While the UNFCCC has in fact been relatively open to civil society participation, especially compared to international trade and financial decision-making, facilitating democratic participation in global decisions remains challenging, and there are many proposals for ways to improve the UNFCCC process. These include not only facilitating access to decision-making venues such as the COPs, the Green Climate Fund and the Clean Development Mechanisms Board, but also providing for grievance mechanisms and appeals processes for stakeholders adversely affected by mitigation and adaptation projects.[17] Specifically, we propose the following steps:

- Address capacity gaps that make it difficult for many smaller and poorer countries, and the civil society organisations within them, to participate effectively in international negotiations.

Within the UNFCCC, Parties should cooperate to address capacity gaps and process asymmetries that make it difficult for many smaller and poorer countries, and the civil society organisations within them, as well as representatives of indigenous groups, to participate effectively. The UNFCCC processes should facilitate the involvement of civil society as major proponents of ambitious and equitable climate action.

- Adopt measures to limit the inordinate influence of vested interests, such as through campaign finance reform and transparency in lobbying.

Several recent assessments have noted the shrinking political space for civil society engagement[18]. Recommendations that have been put forward to address this issue generally apply equally to the specific context of promoting a carbon phase-out that promotes human rights. Lobbying, campaign finance and other issues regarding electoral fairness are primarily national affairs, and need to be addressed in that context. Nonetheless, privileged access of special interests to international negotiations is also a major concern, as exemplified especially in global trade negotiations to which industry lobbyists often have more access than elected officials, to say nothing of civil society. Of particular interest in this regard are those measures adopted in the Framework Convention on Tobacco Control.

While it is important to acknowledge that businesses, along with governments and civil society organisations, will be critical actors in a zero-carbon transition, they must also be included in mechanisms that promote transparency, accountability and respect for human rights. The Ruggie Principles – the UN's Guiding Principles on Business and Human Rights – provide an important benchmark for further development within the climate regime.

- Ensure that the UNFCCC and its relevant institutions (e.g. the Green Climate Fund, Loss and Damage Mechanism) operate in a manner that respects, protects and fulfils human rights and strengthens and builds upon Article 6 of the UNFCCC.

There are a variety of institutions under the UNFCCC (e.g., the Green Climate Fund and Loss and Damage mechanism) that directly provide (or will provide) resources for mitigation and adaptation projects or that authorise crediting for mitigation projects (e.g., the CDM Executive Board). It is essential that the rules and procedures of these institutions take human rights considerations into primary consideration at every level. Among the necessary measures are:

- Dramatically increased investments in education, participation, access to information and capacity building, as mandated in Article 6 of the UNFCCC.
- The expanded availability of information about procedures for accessing funds and about proposed projects (not simply posting on an English language web site).
- Legitimate consultation with affected communities, and meaningful grievance procedures.
- Rigorous standards and safeguards such as those that have been generated for bioenergy activities and large dam projects in other contexts through multi-stakeholder initiatives, along with accountability procedures to ensure compliance.
- To facilitate participation more broadly, increase formal membership in, or expand applicability of, international agreements pertaining to participation, such as Arhus and Latin American Declaration and Plan of Action on Rio Principle 10.

- Continue and expand the effort to strengthen the representation of women in international and domestic climate policy, and ensure that policies to achieve a carbon phase-out are gender-sensitive and empower women as actors in climate action.

Building on the recent decision (Decision 23/CP.18) to promote gender balance and improve the participation of women in the UNFCCC, there is a continuing need to address the special concerns of women in the development and implementation of climate policy. The greater vulnerability of women to climate change impacts, due to their provisioning roles and their subordinate social status, has been widely acknowledged; similar concerns arise with regard to the impacts of mitigation, particularly where it results in rising prices or reduced access to food, water, fuel, or land. Conversely, it is critical to recognise and support the role of women as primary agents designing, innovating, and implementing adaptation and mitigation measures. Participation in decision-making and implementation that is sensitive to gender and other dimensions of exclusion is essential to the equitable distribution of mitigation benefits as well as mitigation costs.

With respect specifically to expanding representation of women in the UNFCCC, the following steps would help in the immediate term[19].

- Gender balance in UNFCCC bodies should be improved, through appointments of women to positions of responsibility, the implementation of affirmative action targets with appropriate compliance mechanisms.
- To improve gender balance on national delegations and engagement in negotiations, the COP should consider creation of a fund to support women's participation, capacity building as necessary, training and awareness-raising to make conveners of negotiating processes more gender-sensitive, and monitoring to track progress.
- Ensure women's representation and gender equality are included in the 2015 agreement and inform gender sensitive climate policies and actions.
- Put in place grievance mechanisms at the national and international levels to address human rights violations arising from mitigation and adaption activities.

One of the recognised weaknesses of the Clean Development Mechanism in particular has been the lack of any procedures for communities to file grievances after a project is approved. As funding for climate-related projects expands under new institutions, these problems can be expected to recur. Grievance mechanisms must exist within all project funding and approving organisations, but independent grievance mechanisms must also exist outside the direct control of the funding organisations.

CONCLUSIONS

This paper has provided a survey of the issues raised by the prospects of a rapid carbon phase-out, specifically with regard to the implications for human rights including the right to development. Though brief and preliminary, it has allowed us to draw the following five main ***conclusions*** that justify a rapid carbon-phase out as an appropriate response to the threats posed by climate impacts; more specific recommendations for ensuring that such a phase-out does not further endanger human rights are detailed following this section.

First, there is strong evidence that a rapid carbon phase-out will be feasible, both for developed and developing countries. Modeling studies have identified a range of techno-economic paths that reduce global carbon emissions to very low levels by mid-century, and that keep cumulative emissions below the budget associated with a rapid carbon phase-out. They achieve this while satisfying all energy service demands. These decarbonisation pathways rely for the next decade or more on technological options that are currently available and market-ready, followed by subsequent technological innovations that can be expected to emerge with continued investment in R&D. An encouraging sign, the world is currently experiencing a growth of the renewable power industry that is bringing down costs more rapidly than most observers expected, and recent experience provides some real-world examples of countries embarking on rapid scale-up of these zero-carbon energy sources that could emerge as the initial steps toward substantial decarbonisation at the national scale.

Second, economic analyses suggest that a rapid carbon phase-out can be achieved at an aggregate global cost that is affordable, and much less than the potential costs of climate impacts. As we noted above, according to economic models, the costs for ambitious mitigation scenarios are large in absolute terms – on the order of 3-4% of global GDP annually in 2050, which is estimated to reach $150 trillion or so at 2% annual growth, and the costs of a complete phase-out would be expected to be larger. Nonetheless this still implies a doubling of GDP only two or three years later. This is a relatively modest cost for “insurance” against potentially much larger costs; the alternative after all is not unrestricted GDP growth, but growing and potentially catastrophic climate damages.

Third, a rapid carbon phase-out will be tremendously demanding for all countries, especially developing countries, and presents potential risks to human rights including the right to development. A carbon phase-out rapid enough to keep warming likely to stay below 2°C will require extremely ambitious action virtually across the world. It will require a mobilisation of unprecedented scale encompassing all sectors of the economy within both rich and poor countries, and requiring the wide-scale implementation of policies and strengthening of institutions necessary to enable the broad deployment of zero-carbon technologies. It has already been observed that mitigation activities can pose risks to human rights including the right to development, and the greater scale, speed, and costs of a rapid carbon phase-out will elevate these risks if they are not proactively managed.

Fourth, even *greater* risks confront human rights including the right to development from the profound impacts of climate change. The risks posed by climate change are fundamentally and qualitatively different in nature from those posed by mitigation, and much more likely to be insurmountable. These risks arise from anticipated climate change impacts that are characterised by large scale, unpredictability, and irreversibility. They can be masked by long time lags, and amplified by uncontrollable feedbacks within the climate system. In contrast, the threats posed by mitigation activities are generally of limited scale, more predictable, are not masked by long time-lags, and are governed primarily by socio-economic process under human control rather than biophysical feedbacks that are not.

Fifth, there is good reason to believe that risks posed by mitigation can be managed, *provided* there is a deliberate and shared global effort to achieve carbon phase-out while preserving human rights, including the right to development. The risks from mitigation activities are very real, and indeed some are already being witnessed at much lower scales of mitigation than would be needed for a rapid carbon phase-out. Nonetheless, there is good reason to believe that they could be avoided, providing global society was committed to doing so. These risks are qualitatively similar to those historically posed by other (non-mitigation) activities, which provides us with experience and existing institutions and strategies that can be adapted and strengthened. Society can also proceed adaptively, anticipating and preparing for the potential impacts of planned mitigation measures, and modifying its plan as warranted by new information and conditions. Ultimately, if society decides as time progresses that a carbon phase-out indeed is threatening unacceptable human rights violations, it can choose to relax the mitigation target (if justified despite the additional climate impacts). A crucial asymmetry must be stressed: if we choose a less stringent mitigation target and discover the climate impacts impose unacceptable harm, we can't go back in time and make the target more stringent.

In summary, the primary justification for a rapid carbon phase-out is that the threats to human rights from climate change are qualitatively different from the threats from rapid emissions reductions. They are more dire and harder to protect against. They are also already being suffered, and no possible rate of emissions reductions would be fast enough to avoid further human rights violations, nor even to prevent with certainty the chance of catastrophic and irreversible impacts. All we can be sure of is that more rapidly emissions are cut, the lower the climate impacts on human rights, and the less the chance of truly dire consequences. In this light, and given that the human rights impacts of stringent mitigation policies are easier to predict and protect against, the case for initiating a carbon phase-out with the aim of phasing out carbon as soon as possible can be firmly justified on human rights grounds.

The recommendations provided in the preceding two sections are but a brief overview of some key measures that are concrete and that can be taken in the near term to promote a rapid carbon phase-out that promotes human rights, including the right to development.

FINAL REMARKS

As we have argued, a rapid carbon phase-out is necessary to protect human rights from climate impacts, and we can indeed take many steps to ensure that the necessary mitigation does not further endanger human rights. And while there is still a great distance from where we are today to the type of national and global actions and institutions we describe in this report, there are many practical actions available, and important grounds for hope.

With climate change now emerging as an unprecedented threat to human rights and even human civilisation, public awareness is rising, and public mobilisation is growing as well, as demonstrated by the worldwide climate actions in advance of the UN Climate Summit in September 2014. Furthermore, the broadening coalitions for climate action are increasingly embracing the ideals of climate justice, including a foundational commitment to human rights and global equity. By bringing together the many communities fighting their own battles for justice, without diminishing their importance as unique struggles, a global climate justice movement can be a critical voice for change.

Perhaps more than any problem we have faced, climate change confronts us with the reality of our interdependence. There are no walls high enough or lifeboats big enough, should we fail to halt the steady increase in greenhouse gas concentrations. Global cooperation is the only route we have to protect ourselves, and that cooperation can only succeed if it is broadly seen as fair.

Yet beyond the power of enlightened self-interest, our mutual vulnerability offers us an opportunity to develop a new and powerful global solidarity. Climate justice, based on human rights norms and a fast, fair and participative carbon phase-out, can provide a compelling narrative for the crucial transition to sustainability within planetary boundaries

APPENDIX 1: KEY TECHNICAL BACKGROUND ON A RAPID CARBON PHASE-OUT

To make the implications of a carbon phase-out clearer, we present three deliberately simple, stylised carbon phase-out pathways (Figure 3) with varying levels of stringency. The most stringent pathway has global emissions rising until 2015, flat for five years, and starting to decline as of 2020 such that carbon emissions reach zero in 2050. The pathway of intermediate stringency delays the emissions peak and start of decline by five years. With emissions declining at the same rate as the more stringent pathway, but from a higher level, carbon emissions reach zero in 2060. The least stringent pathway allows another five years of delay, resulting in carbon emissions reaching zero in 2070. (See Table 3 for details of the pathways.)

The five years delay in each successive pathway has striking implications as far as the rapidly rising degree of risk. This can be seen by comparing the total carbon dioxide emissions of each path to the "carbon budgets" presented in the IPCC AR5 corresponding to various levels of risk of exceeding 2°C global warming[iv]. (See Table 4.) For a 2-in-3 chance (i.e., a 66% chance) that warming will stay below 2°C, the available budget is about 1,010 GtCO2. For a more risky 1-in-2 chance that warming will stay below 2°C, (i.e., a 50% chance), the budget is about 1,120 GtCO2. And for still more risky 1-in-3 chance (i.e., 33% chance), the budget is around 1,410 GtCO2. (See Table 2.) (Note, that the analysis presented by IPCC WG3[20] suggests that even the least risky of these budgets – from the standpoint of keeping warming below 2°C – is "more unlikely than likely" to hold warming below 1.5°C.)

Three carbon phase-out pathways of varying stringency

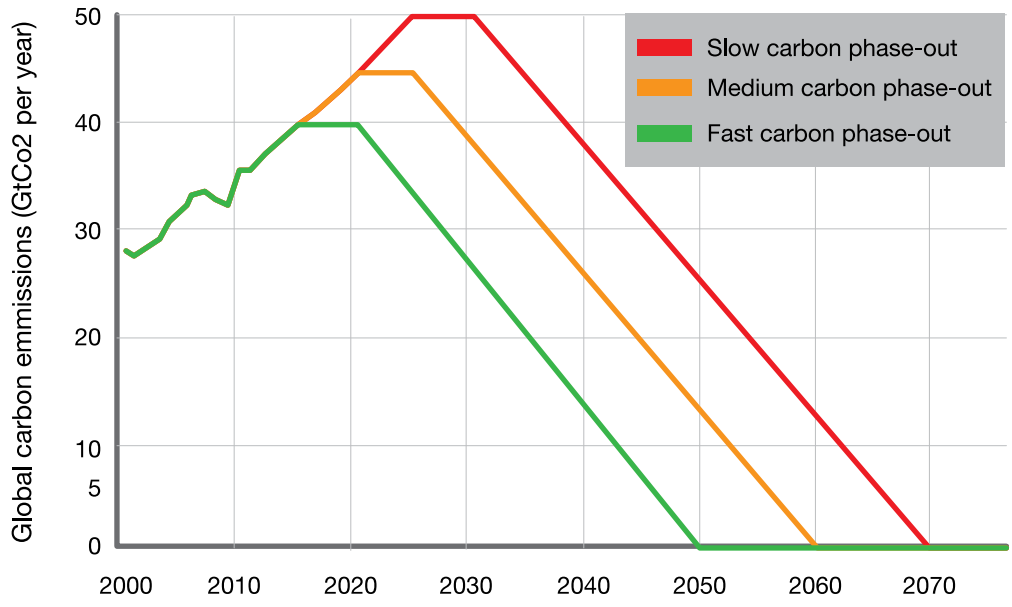

FIGURE 3. THREE CARBON PHASE-OUT PATHWAYS WITH VARYING LEVELS OF STRINGENCY AND RISKS OF EXCEEDING 1.5°C AND 2°C. THE "FAST CARBON PHASE-OUT" PATHWAY HAS EMISSIONS PEAKING IN 2015, FLAT UNTIL 2020, AND THEN DECLINING SO AS TO PHASE-OUT CARBON BY 2050. THE MEDIUM CARBON PHASE-OPUT PATHWAY ALLOWS FOR FIVE YEARS DELAY IN EMISSIONS PEAKING AND DECLINING, AND PHASES OUT CARBON IN 2060. THE SLOW CARBON PHASE-OUT ALLOWS FOR A FURTHER FIVE YEARS DELAY, AND PHASES OUT CARBON IN 2070.

Three carbon phase-out pathways of varying stringency			
	Fast carbon phase-out	Medium carbon phase-out	Slow carbon phase-out
Emissions continue to rise until…	2015	2020	2025
Emissions are flat until…	2020	2025	2030
Emissions reach zero in…	2050	2060	2070
Annual decline (GtCO2/yr)	1.3	1.3	1.3
Required CO2 budget (2012 forward)	**930**	**1,350**	**1,830**

TABLE 3. DEATAILED FEATURES OF THREE CARBON PHASE-OUT PATHWAYS WITH VARYING LEVELS OF STRINGENCY AND RISKS OF EXCEEDING 2°C.

This comparison of the carbon phase-out pathway emissions with the IPCC budgets shows the following:

- The "fast carbon phase-out" pathway has cumulative carbon dioxide emissions (from 2012 forward) of 930 GtCO2, which is modestly within the IPCC's budget of 1,010 GtCO2 for maintaining a 66% likelihood of keeping warming below 2°C. **It thus has a greater than 66% chance of keeping warming below 2°C.**
- The "medium carbon phase-out" pathway has cumulative emissions of 1,350 GtCO2 – nearly 50% greater than the fast phase-out pathway and significantly greater than the IPCC's budget of 1,120 GtCO2 for maintaining a 50% chance of keeping warming below 2°C. Even though it eliminates carbon emissions by 2060, **the medium phase-out pathway still imposes a substantially higher than 50% chance of exceeding 2°C.**
- The "slow carbon phase-out" pathway nearly doubles the cumulative emissions of the fast phase-out pathway, greatly exceeding the IPCC's budget of 1,410 for a 33% chance of keeping warming below 2°C. **It is very unlikely to keep warming below 2°C.**

The IPCC's Three Carbon Budgets as Presented in the Wg1 Ar5 Summary for Policy Makers			
Chance of keeping warming below 2°C	**>66% chance**	**>50% chance**	**>33% chance**
Total CO2 budget (assuming no non-CO2 forcing) (1880 forward) (GtCO2)	3,670	4,440	5,760
Adjusted CO2 budget (accounting for non-CO2 forcing as per RCP2.6) (1880 forward) (Gt CO2)	2,900	3,010	3,300
Already used CO2 budget (up to 2011) (Gt CO2)	1,890	1,890	1,890
Remaining CO2 budget (2012 forward) (Gt CO2)	**1,010**	**1,120**	**1,410**

TABLE 4. DETAILED FEATURES OF THREE IPCC CARBON BUDGETS ASSOCIATED WITH VARYING LEVELS OF RISKS OF EXCEEDING 2°C.

iv. These IPCC carbon dioxide budgets are calculated assuming that non-CO2 greenhouse gases are mitigated very stringently consistent with the "RCP2.6" IPCC concentration pathway.

CO2 budgets of carbon phase-out pathways, compared to IPCC 2˚C budgets

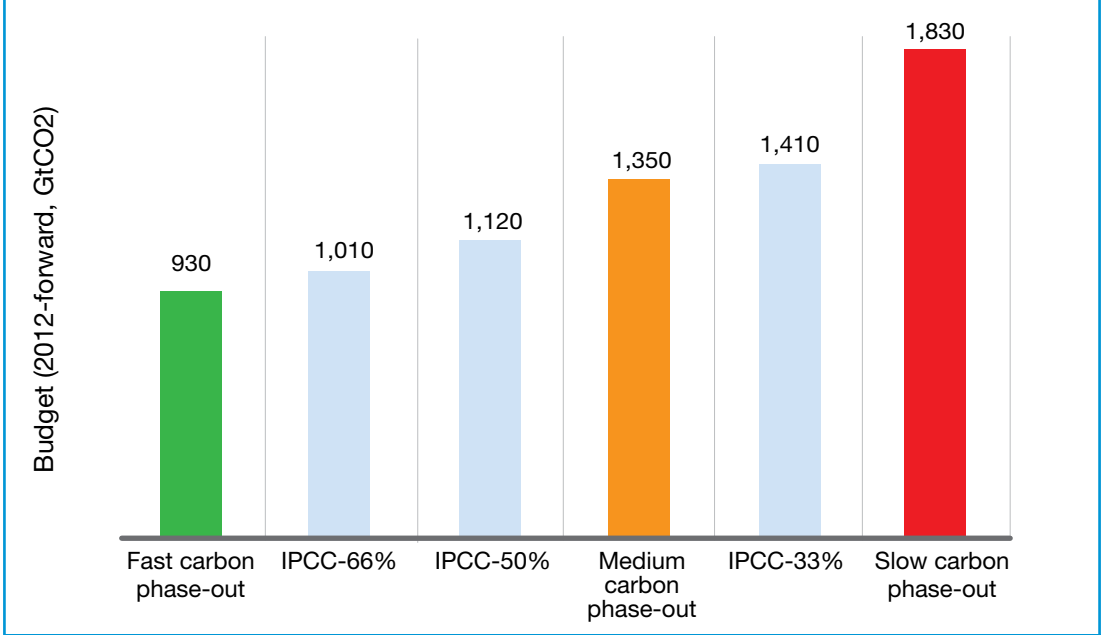

FIGURE 4. COMPARISON OF THE EMISSIONS OF THE CARBON PHASE-OUT PATHWAYS WITH THE IPCC 2°C BUDGETS. THE "FAST CARBON PHASE-OUT" PATHWAY HAS A MODESTLY BETTER THAN 66% CHANCE OF KEEPING WARMING BELOW 2°C; THE MEDIUM CARBON PHASE-OUT HAS A CONSIDERABLY WORSE THAN 50% CHANCE OF KEEPING WARMING BELOW 2°C; THE SLOW CARBON PHASE-OUT HAS A CONSIDERABLY WORSE THAN 33% CHANCE OF KEEPING WARMING BELOW 2°C.

A "carbon phase-out" guarantees nothing. Everything depends on how high global emissions peak and how rapidly carbon is phased out. With a low peak and an early phase-out, warming is likely to stay below 2°C. On the other hand, with a high peak and a late phase-out, warming is very likely to exceed 2°C, and possibly even considerably higher levels of warming.

Not only do the slow and medium pathways fail to keep warming below 2°C with a "likely" probability (i.e., 2-in-3 chance), but they actually render this objective out of reach very soon. The medium phase-out pathway expends the entire available "likely 2°C" budget of 1,010 GtCO2 by the year 2037, and the slow phase-out pathway expends it by the year 2034.

What this tells us is that upholding the 2°C global climate objective requires aggressive mitigation in the immediate term, and that failing to achieve this will rapidly render that goal unachievable. This implies that, beyond the imperative of an ambitious agreement in Paris for post-2020 emissions reductions targets, it is essential that Workstream 2, which focuses on cooperative mitigation efforts between now and 2020, be given much greater emphasis.

There are two ways to defy the strict constraints of the IPCC's 2°C budgets. One way is to accept considerably greater risk (or virtual certainty) of exceeding 2°C. This, of course, implies also accepting rising risks of exceeding even higher temperatures – perhaps 3°C, 4°C, or even more – and concomitant impacts on human rights including the right to development. Without additional mitigation, global temperature rise of roughly 3°C to 8°C (IPCC AR5 WG3, SPM table 1) can be expected. While this amount of warming might not seem terribly large when compared to our everyday experience in our own locales (after all, don't we often see the outdoor temperature rise by even 15°C on many days as the sun rises and warms the air?), it would in fact be a tremendous amount of warming when imposed at the scale of the entire planet. Indeed, the earth has warmed only 3°C to 8°C since the frigid depths of the last ice age[21], yet this was sufficient to utterly transform the surface of the planet, in the process making it hospitable to the development of human civilisation. To risk a further warming of this magnitude is to invite a future in which the earth's surface is again profoundly transformed. Its hospitability to human civilisation can by no means be taken for granted.

A second way to defy the IPCC's budget constraints is to assume that at some point in the future, society will have the ability and willingness to deploy "negative emissions" technologies at large scale. This strategy allows us to exceed the budget in the near term and make up for it in the long term. Many of the techno-economic scenarios assessed by the IPCC are based on the assumption that this option will be available, keeping within a 2°C budget despite phase-out dates later than 2050 by requiring large-scale negative emissions over the subsequent decades. However, this strategy has its risks. We might learn, much too late, that the needed technologies are not feasible at the necessary scale. Or, if they are deployable at the necessary scales, it may be only with adverse affects of their own, such as the appropriation of land to grow biomass energy feedstocks, competing with scarce land to provide natural habitat and to secure food for a growing global population. And, by exceeding the budget in the near term, we allow higher near term temperature rise, and elevate the risk of exceeding temperature thresholds that trigger tipping elements or irreversible climate impacts. This is a gamble that allows "emissions overshoot" in the near term, at the cost of mortgaging the human rights of vulnerable people and communities on the uncertain prospect that currently unavailable technologies will definitely be broadly deployed later.

The challenge inherent in a carbon phase-out can be examined in slightly greater resolution by looking at the implications for developed and developing countries independently, (acknowledging the simplifications inherent in these categories). Consider Figure 5, which highlights the predicament facing the developing world in particular. The figure illustrates this in the case of the fast carbon phase-out as shown in Figure 3.

Emissions under the fast carbon phase-out pathway, for global, Annex 1 and non-Annex 1

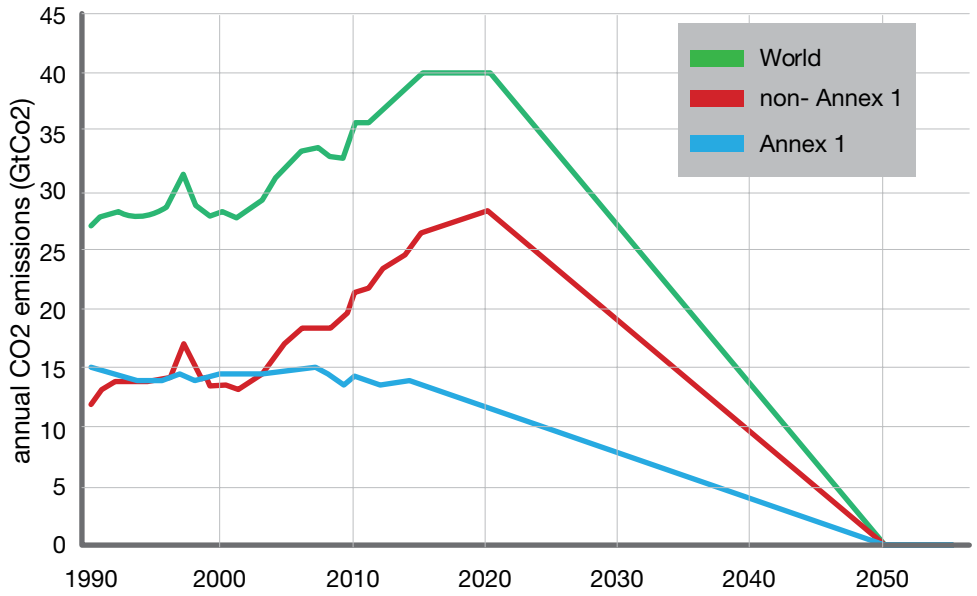

FIGURE 5. A GLOBAL CARBON PHASE-OUT BY 2050, SHOWN WITH THE PORTION OF THE TOTAL EMISSIONS FROM THE INDUSTRIALISED (ANNEX 1) AND DEVELOPING (NON-ANNEX1) COUNTRIES.

Figure 5 also shows the developed (i.e., Annex 1) emission pathway (blue), assuming dramatic mitigation efforts were undertaken, starting immediately, such that the recent years' decline in emissions continues, driving emissions to zero in 2050. While this would be very challenging and is well beyond the mitigation pledges put forward in Cancun, developed countries do have the technological and financial wherewithal to undertake such ambitious reductions if they mustered the political will to do so. Further discussion about the techno-economic details of such a pathway follow below.

Having stipulated a global carbon phase-out pathway, and made a heroic assumption about the future developed country pathway, simple subtraction reveals the pathway that would be available to support the South's development (shown in red, which is simply the green path minus the blue path). Despite the apparent aggressiveness of the developed country mitigation efforts, the developing countries are still left with a severely limited budget that forces upon them the need for no less aggressive mitigation. Developing country emissions would have to peak only a few years later than those in the North – roughly 2020 – and then decline rapidly to 2050.

ANNUAL PER CAPITA INCOMES (PPP – PURCHASE POWER PARITY)

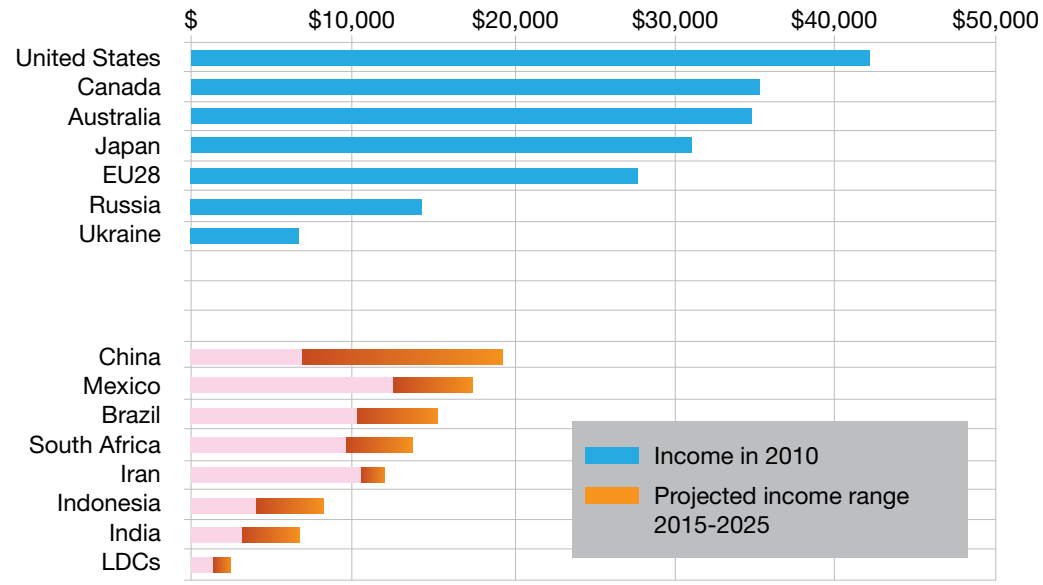

FIGURE 6. ANNUAL PER CAPITA INCOMES (PPP – PURCHASE POWER PARITY) OF SEVERAL DEVELOPED AND DEVELOPING COUNTRIES AT THE TIME OF PEAKING OF EMISSIONS.

Figure 6 gives a sense of the level of development in several countries at the time at which their emissions need to peak. For the developed countries, the figure shows incomes in the year 2010 (blue bars), roughly when aggregate developed countries emissions started a decline, partly as a result of mitigation efforts, and partly due to financial crisis and other autonomous energy sector dynamics (such as the growth in natural gas production). The range in incomes is substantial (consider the united States and Ukraine), reflecting a substantial range in material welfare.

Figure 6 also shows a set of developing countries[v], and their projected annual per capita incomes during the 2015 to 2025 time period. (This time period is generously wide, since in order for developing countries in aggregate to peak by 2020, as Figure 5 implies, most developing countries individually would similarly need to peak by 2020.) The darker red portion of the bars in Figure 6 shows the projected income range, with the left end showing the 2015 income projection, and the right end showing the 2025 income projection. The range in incomes across countries is substantial, but most developing countries will still be considerably less wealthy when their emissions would need to peak than most developed countries were in 2010. China, for example, is projected to have an income one-sixth to one-half the US's 2010 income level. Indonesia and India are projected to have per capita incomes in the $5,000 range, which happens to be the income level the United States was at in the 1890s[vi]. At that point in time, the US had recently found industrialisation fuelled by fossil carbon to be its route out of poverty, and its emissions were soaring. At this same level of development, countries such as Indonesia and India would need to be eliminating carbon emissions – and forgoing development driven by fossil fuels – at an annual percentage rate similar to that at which the United States had been increasing its carbon emissions.

v. The developed countries shown here amount to about nine-tenths of total Annex 1 population. The developing countries shown here amount to about three-quarters of total non-Annex 1 population.

vi. See Maddison's historical database covering population by country, GDP and GDP per capita back to 1820. www.worldeconomics.com/Data/MadisonHistoricalGDP/Madison%20Historical%20GDP%20Data.efp

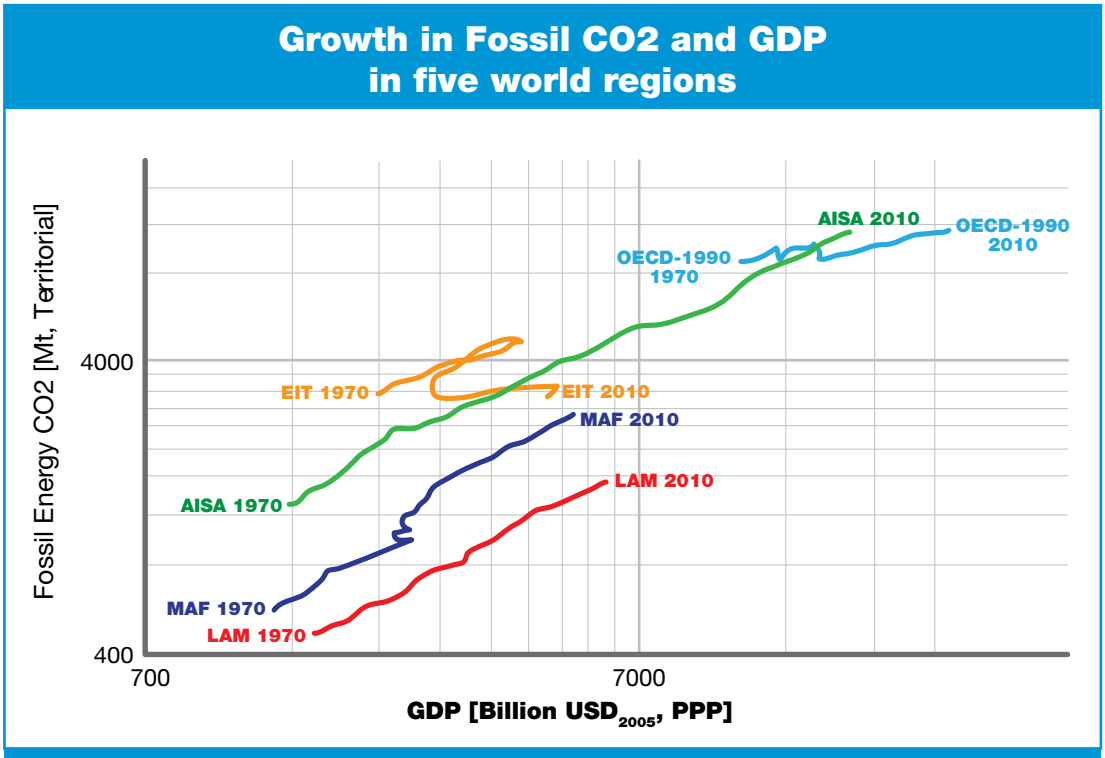

FIGURE 7. GROWTH IN FOSSIL CO2 AND GDP IN FIVE WORLD REGIONS. (REFERENCE: IPCC, WG3, CH. 5.)

This peaking of emissions would thus need to take place while most of the developing world's citizens were still struggling to maintain or improve their livelihoods and raise their material living standards. Yet the only proven routes to development – to water and food security, improved health and education, secure livelihoods – involve expanding access to energy services, and, consequently, a seemingly inevitable increase in fossil fuel use and thus carbon emissions. As numerous studies and reports have shown[22], access to energy services is fundamental to the fulfillment of development goals.

Indeed, in the absence of climate constraints, developing countries would continue to increase the use of conventional energy resources to fuel the expansion of their infrastructure and the improvement of the material well-being of their citizens, as was done in the developed world. This is clearly evident in the range of business-as-usual emissions scenarios available in the literature, which typically show a large rise in emissions in developing countries by mid-century. Such business-as-usual scenarios are based on the assumption that technological development will continue along trends that are largely continuous with the trends of recent decades. And, as is clearly seen by looking at the historic development across all regions of the world (Figure 7), growing economies have been accompanied inexorably by growing fossil carbon emissions.

We must stress, however, that such projections of rising emissions are designed with the *assumption* that there are no policy efforts and investments to deploy technologies to curb emissions growth. But as we have seen in recent years, concerted policy efforts and investments can in fact effectively deploy technologies that curb emissions growth. Indeed, in some countries we have seen efforts that may be seen as the initial steps toward substantial decarbonisation.

In addition to these encouraging developments, there is now a large amount of techno-economic analysis to help us explore possible future paths to decarbonisation. The following section lays out findings from such studies, and lessons for a carbon phase-out.

TECHNO-ECONOMIC ANALYSIS, AND LESSONS FOR A CARBON PHASE-OUT

The main finding to highlight from the techno-economic analysis is that rapid and large-scale decarbonisation is technically feasible and economically affordable, for both the developed and developing world. This conclusion is supported by the findings of IPCC's AR5, Working Group 3, along with other recent studies.[23] The WG3 report provided a comprehensive overview of the broad literature of mitigation scenarios, comprising more than 1000 scenarios from the published literature, including 114 which are grouped together – in the category labeled "450 (430 – 480)" – as "likely" to keep global temperature increase below 2°C. (See Figure 8.)

EMISSIONS SCENARIOS ASSESSED BY THE IPCC

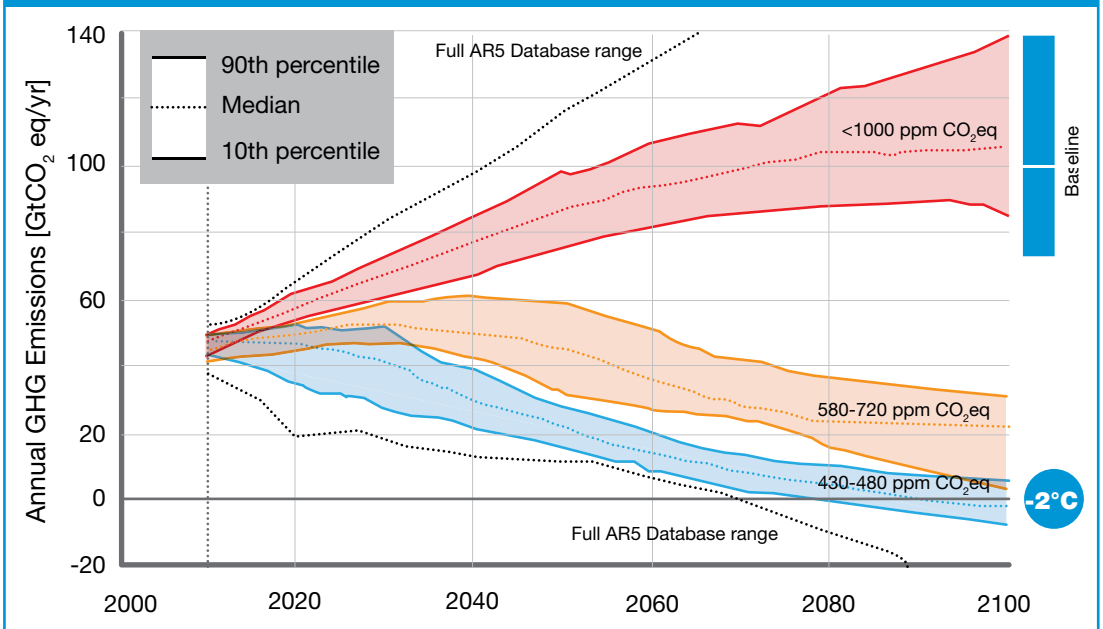

FIGURE 8. EMISSIONS SCENARIOS ASSESSED BY THE IPCC. THE COLORED BANDS INCLUDE THE 10TH TO 90TH PERCENTILE OF THE 1000 SCENARIOS ASSESSED. THE LOWEST CATEGORY (THE LIGHT BLUE BAND LABELLED "450 PPM (430 – 480 PPMCO2EQ") INCLUDES SCENARIOS WITH CO2 EMISSIONS IN 2050 AS LOW AS 6 GTCO2. THE DOTTED LINES BOUND THE "FULL AR5 DATABASE RANGE" IPCC AR5 WG3 SPM, SUGGESTING 10% OF THE SCENARIOS HAVE EMISSIONS LOWER THAN 6 GTCO2.

The IPCC's assessment did not include pathways specifically designed with a total carbon phase-out as an explicit objective, as modelers generally design pathways based on a range of interlinked economic and technical objectives. Nonetheless, considering the most ambitious of these techno-economic paths, one observes scenarios that are characterised by global emissions peaking by 2020 or shortly thereafter, followed by a rapid and sustained decline, and reaching a level of 13 GtCO2eq/yr or lower by 2050. Assuming non-CO2 emissions of roughly 7 GtCO2eq in 2050 (as per the RCP 2.6 pathway), carbon dioxide emissions would thus be no more than roughly 6 GtCO2, implying a greater than 85% phase-out of carbon relative to today's carbon emission level. While this is obviously not

a total carbon phase-out by 2050, it is nearly so. Perhaps more importantly, scenarios in the "450 ppm" category are categorised as those having cumulative CO2 emission that are less than 950 GtCO2 (and as low as 550 GtCO2)[24], which is essentially equivalent[25] to the "fast phase-out" pathway (930 GtCO2) discussed above. It is important to note also that the IPCC acknowledged a limited number of scenarios that are even more stringent than the "450 ppm" group of scenarios, but did not assess them[26]. The colored bands include the 10th to 90th percentile emission scenarios, whereas the dotted lines bound the full range of scenarios. This suggests that 10% of the 1000 scenarios have emissions in 2050 less than roughly 6 GtCO2.

Modeling studies have identified a range of techno-economic paths that reduce global carbon emissions to very low levels by mid-century, and that keep cumulative emissions below the budget associated with a rapid carbon phase-out. They achieve this while satisfying all energy service demands, in both developed and developing countries.

While it is not our objective in this paper to comprehensively describe a transition to a zero-carbon economy, we will draw out the salient features relevant to our discussion of human rights and the right to development. First, it is useful to explain the main sources of carbon dioxide emissions, and the activities that would be need to phase-out those emissions. Figure 9 shows the main sources of emissions, and their trajectory over the last forty years. As shown, emission sources can broadly be categorised by the five main sectors: energy supply, transport, buildings, industry, and land-use (now called AFOLU, for agriculture, forestry, and other land uses). Emissions in all of these sectors are increasing, leading to an 80% rise in global GHG emissions over the 1970-2010 time period.

Main sources of emissions and their evolution over the 1970-2010 period

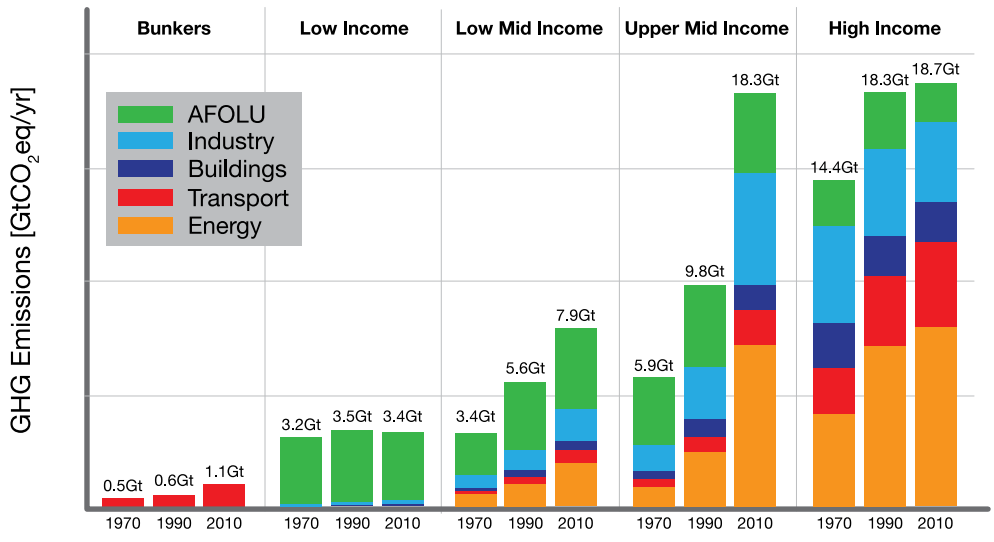

FIGURE 9. MAIN SOURCES OF EMISSIONS, AND THEIR EVOLUTION OVER THE 1970-2010 PERIOD, DISAGGREGATED BY COUNTRY INCOME GROUPING. (IPCC WG3, CH. 1, FIGURE 5.18)

As is evident from Figure 10, emissions over the course of the century are expected to continue to grow in each sector (except AFOLU) in business-as-usual scenarios (i.e., scenarios in which there is no deliberate effort to curb GHG emissions). That said, because of the unpredictability of future technological evolution, economic growth rates, and possible changes in consumption patterns over the century, there is a wide range in these emissions projections (note the widening span of the white bars as time progresses).

Main sources of emissions and their evolution over the 1970-2010 period

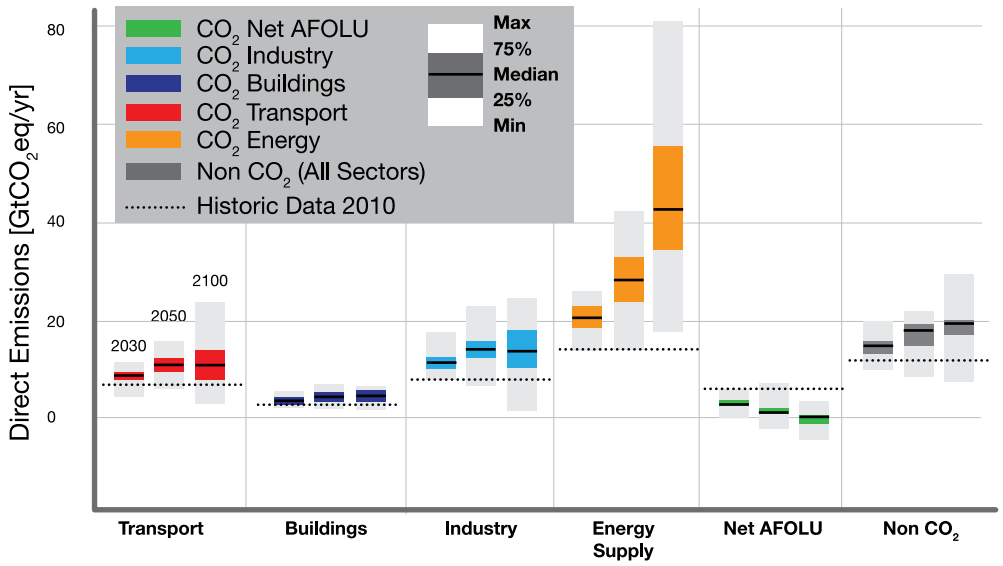

FIGURE 10. MAIN SOURCES OF EMISSIONS, AND THEIR EVOLUTION OVER THE PERIOD TO 2100, ACCORDING TO BUSINESS-AS-USUAL PROJECTIONS. (IPCC WG3, CH. 6, FIGURE 6.34)

The goal of a carbon phase-out implies several specific objectives. These will be very briefly outlined in Box 2 by sector.

While these general mitigation measures are shared by emissions pathways at various levels of stringency, the following conclusions can be drawn about what is substantively different in the case of a rapid carbon phase-out. First, and most obviously, is the necessarily limited room for any residual use of fossil fuels. One need not assume a meaningful carbon phase-out must reduce CO2 emissions to precisely zero; but there is a substantive difference between scenarios that have one or two gigatonnes of CO2 emissions remaining from those that have ten gigatonnes. It would thus be necessary to address even those emissions sources that are particularly challenging to mitigate and often not addressed in less ambitious mitigation scenarios, such as air travel, and some industrial facilities requiring high-temperature process heat or generating process emissions (such as cement and iron production)[27].

Second is the speed and scale with which the zero-carbon alternatives must be deployed. This has many implications. It leaves a more limited window for transitional technologies (e.g., fuel switching from coal to gas or the deployment of fossil-fuel based cogeneration) that are important in the technology portfolio of less stringent scenarios. It also has direct cost consequences. Moreover, it is clear from techno-economic analyses that the greater

BOX 2: Main sources of emissions, and key measures for reducing emission

Energy Supply: Energy supply is the largest contributor to emissions, giving rise to roughly one-third of global emissions, caused overwhelmingly by the burning of fossil fuels (coal, oil, and natural gas). As much of this is burned in power plants to generate electricity, phasing out carbon in the energy supply sector requires shifting to zero-carbon energy sources. This leaves the following three classes of options: renewable electricity (such as wind, solar, hydro, biomass, and the less widely exploited geothermal and tidal), nuclear energy, and fossil fuels with carbon capture and sequestration.

Buildings: the buildings sector generates CO2 emissions through the burning of fossil fuel for space heat, cooking and hot water. It is also the source of a large demand for electricity for lighting, air conditioning, and powering appliances, which gives rise indirectly to about half of the emissions from the energy supply sector. The primary means for reducing emissions are improved insulation to reduce energy needed for space conditioning and improved appliance efficiency. Also, the installation of decentralised power "behind the meter," while plainly a form of decarbonised energy supply, is also frequently considered as a source of demand reduction when the generation demand for grid-supplied electricity generation is considered.

Transport: transport emissions arise almost entirely from the burning of crude oil-derived transportation fuels, such as petrol, diesel fuel, and jet fuel. The primary means of reducing emissions from transport sector are: improved vehicle efficiency (including smaller passenger vehicles), increased use of mass transportation and non-motorised transportation (such as walking and biking), more transport-efficient design of human settlements, and alternative fuels including electricity and biofuels.

Industry: The industry sector is also the source of a large demand for electricity for ventilation, lighting, heating, air conditioning, and powering motors and other machinery, which gives rise indirectly to about 40% of the emissions from the energy supply sector. The primary means of reducing emissions are process efficiency improvements, as well as electrification where possible. As noted by Höhne et al, there are some industrial processes for which substitute technologies are not readily available; they conclude that innovation will need to be focused in those areas, for a complete phase-out to be feasible, or will require offsetting negative emissions.

Agriculture, forestry, and other land use (AFOLU): Combined, these activities are responsible for roughly one-quarter of GHG emissions. The key measures for reducing emissions include forest management and reforestation, management of cropland and grasing land, and restoration of agricultural soil carbon. Note that AFOLU has the largest share of non-CO2 emissions, due especially to methane emissions from livestock and N20 emissions from fertiliser use.

the speed and scale required by the mitigation goal, the more expensive and disruptive the transition will be. Economists have long had the basic insight that there are emissions reductions available at a range of costs, and that the more mitigation required, the more expensive will be the additional ("marginal") reductions.

Indeed, the question of the feasibility of a complete carbon phase-out is inseparable from the question of the costs of the transition. The typical (median) costs reported in stringent mitigation scenarios are less than 2% of GDP in 2030 and less than 4% in 2050, reaching 4% and 6% respectively in the highest cases, which are perhaps better analogues for a complete carbon phase-out.[28] But here it is critical to keep the big picture in perspective: These figures, while they may seem large, are in the context of projected global GDP growth of two to three percent annually, and thus represent a delay of no more than one or two years in achieving a doubling of GDP. Indeed, the costs translate to a less than 0.1% decline in the annual rate of growth. Furthermore, as we have noted, the nature of mitigation policy for both individual countries and globally is that it is possible to recalibrate and relax the mitigation target if the economic costs are rising too steeply.

While this suggests – as has long been argued – that the aggregate costs of even very stringent mitigation are on aggregate quite manageable, the key question remains whether the costs will be distributed fairly, and whether poor countries in particular will find that the cost burdens present insurmountable obstacles to rapid human development and poverty alleviation. We will return to this question further below, but there is little doubt that the world as a whole can afford the aggregate costs of protecting the climate, and thus we have the ability to equitably share those costs if we choose to do so. As we suggested above, the threats to human rights including the right to development that arise from rapid emissions reductions are, compared to the impacts of climate change itself, relatively familiar, predictable, and manageable. In the next section we discuss the nature of these risks in greater detail, before proceeding to a further discussion of the institutions necessary to address them.

APPENDIX 2: HUMAN RIGHTS IMPACTS OF CLIMATE CHANGE

CLIMATE CHANGE IMPACTS PROJECTED BY THE IPCC AND OTHER SCIENTIFIC ASSESSMENTS	IMPACTS ON HUMAN / SOCIAL SYSTEMS	RIGHTS IMPLICATED	PROVISIONS IN CORE INTERNATIONAL CONVENTIONS
Temperature rises The IPCC projects a range of temperature increase scenarios, each of which is dependent on the level of CO_2(e) in the atmosphere. A recent report for the World Bank written by the Potsdam Institute for Climate Impact Research and Climate Analytics estimates warming in the range of 4°C at the end of the century if the global community fails to act on climate change.	Increased health risks/fatalities from diseases and natural disasters Increased water Insecurity Loss of livelihoods Changes in agricultural productivity and food production Threats to security/societal cohesion Effects on human settlements, land and property leading to migration and displacement Impacts on political/public services Damage to vital Infrastructure and public utilities Loss of cultural integrity Decline in natural systems services Distribution of impacts (vulnerable, poor, and marginalized are hit first and hardest)	Life Poverty, adequate standard of living, and means of subsistence Food and hunger Health Water Culture Property Adequate and secure housing Education Property Women's, children's, and indigenous people's rights Self determination	e.g. Art 3 UDHR (1948) "Everyone has the right to life, liberty, and security of person." / Art 6 International Covenant on Civil and Political Rights (1966) — "Every human being has the inherent right to life. This right shall be protected by law…" e.g. Art 25 Universal Declaration of Human Rights — "Everyone has the right to a standard of living adequate for the health of himself and of his family, including food, clothing, housing and medical care and necessary social services." / Art 11 International Covenant on Economic Social and Cultural Rights (1966) — Everyone has a right "to an adequate standard of living for himself and his family, including adequate food, clothing and housing, and to the continuous improvement of living conditions." e.g. Art 11 International Covenant on Economic Social and Cultural Rights (1966) — "The States Parties to the present Covenant, recognizing the fundamental right of everyone to be free from hunger." e.g. Art 1.2 International Covenant on Civil and Political Rights (1966) — "In no case may a people be deprived of its own means of subsistence." e.g. Art 12 International Covenant on Economic, Social, and Cultural Rights (1966) — "The State Parties… recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health." e.g. Art 14 Convention on the Elimination of All Forms of Discrimination Against Women (1979) — "State Parties will take into account the particular problems faced by rural women…" e.g. Art 6 Convention on the Rights of the Child (1989) — "State Parties shall ensure to the maximum possible extent the survival and development of the child."
Risks of extreme weather events According to the March 2012 IPCC Special Report on Managing the Risks of Extreme Events, climate change is reinforcing the intensity and frequency of extreme weather events including floods, droughts, tornadoes, tropical storms, and heatwaves.			
Threats to unique ecosystems The IUCN estimates that up to 35% of the world's bird species, 52% of the amphibian species, and 71% of the coral reef systems display traits that make them potentially susceptible to climate change including bleaching events, ocean acidification, and sea-level rise.			
Changes in precipitation and distribution of water. By 2020, between 75 million and 250 million people are projected to be exposed to increased water stress due to climate change. Drought affected areas will likely increase. Heavy precipitation events, which are very likely to increase in frequency, will augment flood risk.			
Threats to biodiversity Approximately 20% to 30% of plant and animal species are likely to be at increased risk of extinction if global average temperature exceeds 1.5°C to 2.5°C. There are projected to be major changes in ecosystem structure and function, species ecological interactions, and species geographical ranges, with predominantly negative consequences for biodiversity, and ecosystems.			
Sea-level rises, flooding and storm surges The World Bank 4°C report warns that warming of this magnitude will likely lead to a sea-level rise of 0.5 to 1 meter, and possibly more, by 2100; while limiting warming to 2°C would likely reduce sea-level rise by about 20 cm by 2100 compared to a 4°C world.			
Large scale singularities Climate impacts could lead to the melting of the Greenland/Antarctic ice-shelves, release of methane in Siberia, and the halting of the Atlantic conveyor belt.			

Table 1: From Cameron, Edward, Tara Shine, and Wendi Bevins. 2013. "Climate Justice: Equity and Justice Informing a New Climate Agreement." Working Paper. World Resources Institute, Washington DC and Mary Robinson Foundation — Climate Justice, Dublin. Available online at http://www.climatejusticedialogue.org.

Table 6.7 | Potential co-benefits (green arrows ↑) and adverse side-effects (orange arrows ↑) of the main sectoral mitigation measures; arrows pointing up/down denote a positive/negative effect on the respective objective or concern; a question mark (**?**) denotes an uncertain net effect. Co-benefits and adverse side-effects depend on local circumstances as well as on the implementation practice, pace, and scale (see Tables 7.3, 8.4, 9.7, 10.5, 11.9, 11.12). Column two provides the contribution of different sectoral mitigation strategies to stringent mitigation scenarios reaching atmospheric CO_2eq concentrations of 430–530 ppm in 2100. The interquartile ranges of the scenario results for the year 2050 show that there is flexibility in the choice of mitigation strategies within and across sectors consistent with low-concentration goals (see Sections 6.4 and 6.8). Scenario results for energy supply and end-use sectors are based on the AR5 Scenario Database (see Annex II.10). For an assessment of macroeconomic, cross-sectoral effects associated with mitigation policies (e.g., on energy prices, consumption, growth, and trade), see Sections 3.9, 6.3.6, 13.2.2.3, and 14.4.2. The uncertainty qualifiers in brackets denote the level of evidence and agreement on the respective effects. Abbreviations for evidence: l = limited, m = medium, r = robust; for agreement: l = low, m = medium, h = high.

Sectoral mitigation measures	Integrated model results for stringent mitigation scenarios			Effect on additional objectives/concerns			
				Economic	Social	Environmental	Other
Energy Supply	Deployment[1] 2010	Deployment[1] 2050	Rate of change [%/yr]	*For possible upstream effects of biomass supply for bioenergy, see AFOLU.*			
Nuclear replacing coal power	10 EJ/yr	(4–22) *17–47* EJ/yr	(–2–2) *1–4*	↑ Energy security (reduced exposure to fuel price volatility) (**m**/**m**) ↑ Local employment impact (but uncertain net effect) (**l**/**m**) ↑ Legacy cost of waste and abandoned reactors (**m**/**h**)	Health impact via ↓ Air pollution and coal mining accidents (**m**/**h**) ↑ Nuclear accidents and waste treatment, uranium mining and milling (**m**/**l**) ↑ Safety and waste concerns (**r**/**h**)	Ecosystem impact via ↓ Air pollution (**m**/**h**) and coal mining (**l**/**h**) ↑ Nuclear accidents (**m**/**m**)	Proliferation risk (**m**/**m**)
Renewable energy (wind, photovoltaic (PV), concentrated solar power (CSP), hydro, geothermal, bioenergy) replacing coal	62 EJ/yr	(66–125) *194–282* EJ/y	(0.2–2) *3–4*	↑ Energy security (resource sufficiency, diversity in the near/medium term) (**r**/**m**) ↑ Local employment impact (but uncertain net effect) (**m**/**m**) ↑ Irrigation, flood control, navigation, water availability (for multipurpose use of reservoirs and regulated rivers) (**m**/**h**) ↑ Extra measures to match demand (for PV, wind and some CSP) (**r**/**h**)	Health impact via ↓ Air pollution (except bioenergy) (**r**/**h**) ↓ Coal mining accidents (**m**/**h**) ↑ Contribution to (off-grid) energy access (**m**/**l**) **?** Project-specific public acceptance concerns (e.g., visibility of wind) (**l**/**m**) ↑ Threat of displacement (for large hydro) (**m**/**h**)	Ecosystem impact via ↓ Air pollution (except bioenergy) (**m**/**h**) ↓ Coal mining (**l**/**h**) ↑ Habitat impact (for some hydro) (**m**/**m**) ↑ Landscape and wildlife impact (for wind) **m**/**m**) ↓ Water use (for wind and PV) (**m**/**m**) ↑ Water use (for bioenergy, CSP, geothermal, and reservoir hydro) (**m**/**h**)	Higher use of critical metals for PV and direct drive wind turbines (**r**/**m**)
Fossil CCS replacing coal	0 Gt CO_2/yr stored	(0) *4–12* CO_2/yr stored	(0) *NA*	↑ Preservation vs. lock-in of human and ↑ physical capital in the fossil industry (**m**/**m**)	Health impact via ↑ Risk of CO_2 leakage (**m**/**m**) ↑ Upstream supply-chain activities (**m**/**h**) ↑ Safety concerns (CO_2 storage and transport) (**m**/**h**)	↑ Ecosystem impact via upstream supply-chain activities (**m**/**m**) ↑ Water use (**m**/**h**)	Long-term monitoring of CO_2 storage (**m**/**h**)
BECCS replacing coal	0 Gt CO_2/yr	(0) *0–6* CO_2/yr	*NA*	*See fossil CCS where applicable. For possible upstream effect of biomass supply, see agriculture, forestry, and other land use (AFOLU).*			
Methane leakage prevention, capture or treatment	NA	NA	NA	↑ Energy security (potential to use gas in some cases) (**l**/**h**)	↓ Health impact via reduced air pollution (**m**/**m**) ↑ Occupational safety at coal mines (**m**/**m**)	↓ Ecosystem impact via reduced air pollution (**l**/**m**)	

Sectoral mitigation measures	Integrated model results for stringent mitigation scenarios	Effect on additional objectives/concerns			
		Economic	**Social**	**Environmental**	**Other**
Transport	Scenario results	*For possible upstream effects of low-carbon electricity, see Energy Supply. For possible upstream effects of biomass supply, see AFOLU.*			
Reduction of fuel carbon intensity: electricity, hydrogen (H_2), compressed natural gas (CNG), biofuels	*Interquartile ranges for the whole sector in 2050 with 430–530 ppm CO_2eq concentrations in 2100 (see Figures 6.37 & 6.38):* 1) Final energy low-carbon fuel shares 27–41 % 2) Final energy reduction relative to baseline 20–45 %	↑ Energy security (diversification, reduced oil dependence and exposure to oil price volatility) (**m/m**) ↑ Technological spillovers (e.g., battery technologies for consumer electronics) (**l/l**)	Health impact via urban air pollution by ? CNG, biofuels: net effect unclear (**m/l**) ↓ Electricity, H_2: reducing most pollutants (**r/h**) ↑ Diesel: potentially increasing pollution (**l/m**) ↓ Health impact via reduced noise (electrification and fuel cell LDVs) (**l/m**) ↓ Road safety (silent electric LDVs at low speed) (**l/l**)	Ecosystem impact of electricity and hydrogen via ↓ Urban air pollution (**m/m**) ↑ Material use (unsustainable resource mining) (**l/l**) ? Ecosystem impact of biofuels: *see AFOLU*	
Reduction of energy intensity		↑ Energy security (reduced oil dependence and exposure to oil price volatility) (**m/m**)	↓ Health impact via reduced urban air pollution (**r/h**) ↑ Road safety (via increased crash-worthiness) (**m/m**)	↓ Ecosystem and biodiversity impact via reduced urban air pollution (**m/h**)	
Compact urban form and improved transport infrastructure **Modal shift**		↑ Energy security (reduced oil dependence and exposure to oil price volatility) (**m/m**) ↑ Productivity (reduced urban congestion and travel times, affordable and accessible transport) (**m/h**) ? Employment opportunities in the public transport sector vs car manufacturing jobs (**l/m**)	Health impact for non-motorized modes via ↓ Increased physical activity (**r/h**) ↑ Potentially higher exposure to air pollution (**r/h**) ↓ Noise (modal shift and travel reduction) (**r/h**) ↑ Equitable mobility access to employment opportunities, particularly in developing countries (DCs) (**r/h**) ↑ Road safety (via modal shift and/or infrastructure for pedestrians and cyclists) (**r/h**)	Ecosystem impact via reduced ↓ Urban air pollution (**r/h**) ↓ Land-use competition (**m/m**)	
Journey distance reduction and avoidance		↑ Energy security (reduced oil dependence and exposure to oil price volatility) (**r/h**) ↑ Productivity (reduced urban congestion, travel times, walking) (**r/h**)	↓ Health impact (for non-motorized transport modes) (**r/h**)	Ecosystem impact via ↓ Urban air pollution (**r/h**) ↑ New/shorter shipping routes (**r/h**) ↓ Land-use competition from transport infrastructure (**r/h**)	
Buildings	Scenario results	*For possible upstream effects of fuel switching and RES, see Energy Supply.*			
Fuel switching, incorporation of renewable energy, green roofs, and other measures reducing GHG emissions intensity	*Interquartile ranges for the whole sector in 2050 with 430–530 ppm CO_2eq concentrations in 2100 (see Figures 6.37 & 6.38):* 1) Final energy low-carbon fuel shares 51–60 % 2) Final energy reduction relative to baseline 14–35 %	↑ Energy security (**m/h**) ↑ Employment impact (**m/m**) ↑ Lower need for energy subsidies (**l/l**) ↑ Asset values of buildings (**l/m**)	Fuel poverty (residential) via ↓ Energy demand (**m/h**) ↑ Energy cost (**l/m**) ↓ Energy access (for higher energy cost) (**l/m**) ↑ Productive time for women/children (for replaced traditional cookstoves) (**m/h**)	Health impact in residential buildings via ↓ Outdoor air pollution (**r/h**) ↓ Indoor air pollution (in DCs) (**r/h**) ↓ Fuel poverty (**r/h**) ↓ Ecosystem impact (less outdoor air pollution) (**r/h**) ↑ Urban biodiversity (for green roofs) (**m/m**)	Reduced Urban Heat Island (UHI) effect (**l/m**)
Retrofits of existing buildings (e.g., cool roof, passive solar, etc.) **Exemplary new buildings** **Efficient equipment**		↑ Energy security (**m/h**) ↑ Employment impact (**m/m**) ↑ Productivity (for commercial buildings) (**m/h**) ↑ Lower need for energy subsidies (**l/l**) ↑ Asset values of buildings (**l/m**) ↑ Disaster resilience (**l/m**)	↓ Fuel poverty (for retrofits and efficient equipment) (**m/h**) ↓ Energy access (higher cost for housing due to the investments needed) (**l/m**) ↑ Thermal comfort (for retrofits and exemplary new buildings) (**m/h**) ↑ Productive time for women and children (for replaced traditional cookstoves) (**m/h**)	Health impact via ↓ Outdoor air pollution (**r/h**) ↓ Indoor air pollution (for efficient cookstoves) (**r/h**) ↓ Improved indoor environmental conditions (**m/h**) ↓ Fuel poverty (**r/h**) ↓ Insufficient ventilation (**m/m**) ↓ Ecosystem impact (less outdoor air pollution) (**r/h**) ↓ Water consumption and sewage production (**l/l**)	Reduced UHI effect (retrofits and new exemplary buildings) (**l/m**)
Behavioural changes reducing energy demand		↑ Energy security (**m/h**) ↑ Lower need for energy subsidies (**l/l**)		↓ Health impact via less outdoor air pollution (**r/h**) and improved indoor environmental conditions (**m/h**) ↓ Ecosystem impact (less outdoor air pollution) (**r/h**)	

Sectoral mitigation measures	Integrated model results for stringent mitigation scenarios	Effect on additional objectives/concerns			
		Economic	**Social**	**Environmental**	**Other**
Industry	Scenario results	*For possible upstream effects of low-carbon energy supply (incl CCS), see energy supply and of biomass supply, see AFOLU.*			
CO_2 and non-CO_2 GHG emissions intensity reduction	*Interquartile ranges for the whole sector in 2050 with 430–530 ppm CO_2eq concentrations in 2100 (see Figures 6.37 & 6.38):* 1) Final energy low-carbon fuel shares: 44–57 % 2) Final energy reduction relative to baseline: 22–38 %	↑ Competitiveness and productivity (**m/h**)	↓ Health impact via reduced local air pollution and better work conditions (for perfluorinated compounds (PFCs) from aluminium) (**m/m**)	↓ Ecosystem impact via reduced local air pollution and reduced water pollution (**m/m**) ↑ Water conservation (**l/m**)	
Technical energy efficiency improvements via new processes and technologies		↑ Energy security (via lower energy intensity) (**m/m**) ↑ Employment impact (**l/l**) ↑ Competitiveness and productivity (**m/h**) ↑ Technological spillovers in DCs (due to supply chain linkages) (**l/l**)	↓ Health impact via reduced local pollution (**l/m**) ↑ New business opportunities (**m/m**) ↑ Water availability and quality (**l/l**) ↑ Safety, working conditions and job satisfaction (**m/m**)	Ecosystem impact via ↓ Fossil fuel extraction (**l/l**) ↓ Local pollution and waste (**m/m**)	
Material efficiency of goods, recycling		↓ National sales tax revenue in medium term (**l/l**) ↑ Employment impact in waste recycling market (**l/l**) ↑ Competitiveness in manufacturing (**l/l**) ↑ New infrastructure for industrial clusters (**l/l**)	↓ Health impacts and safety concerns (**l/m**) ↑ New business opportunities (**m/m**) ↓ Local conflicts (reduced resource extraction) (**l/m**)	↓ Ecosystem impact via reduced local air and water pollution and waste material disposal (**m/m**) ↓ Use of raw/virgin materials and natural resources implying reduced unsustainable resource mining (**l/l**)	
Product demand reductions		↓ National sales tax revenue (medium term) (**l/l**)	↑ Wellbeing via diverse lifestyle choices (**l/l**)	↓ Post-consumption waste (**l/l**)	
AFOLU	Scenario results	*Note: co-benefits and adverse side-effects depend on the development context and the scale of the intervention (size).*			
Supply side: Forestry, land-based agriculture, livestock, integrated systems and bioenergy (**marked by** †) **Demand side:** Reduced losses in the food supply chain, changes in human diets, changes in demand for wood and forestry products	Ranges for cumulative land-related emissions reductions relative to baseline for CH_4, CO_2, and N_2O in idealized implementation scenarios with 450 CO_2eq ppm concentrations in 2100 (see Table 11.10): CH_4: 2–18 % CO_2: −104–423 % N_2O: 8–17 %	† ↑ Employment impact via Entrepreneurship development (**m/h**) ↓ Use of less labor-intensive (**m/m**) Technologies in agriculture ↑† Diversification of income sources and access to markets (**r/h**) ↑† Additional income to (sustainable) landscape management (**m/h**) ↑† Income concentration (**m/m**) ↑† Energy security (resource sufficiency) (**m/h**) ↑ Innovative financing mechanisms for sustainable resource management (**m/h**) ↑ Technology innovation and transfer (**m/m**)	↑† Food-crops production through integrated systems and sustainable agriculture intensification (**r/m**) ↓† Food production (locally) due to large-scale monocultures of non-food crops (**r/l**) ↑ Cultural habitats and recreational areas via (sustainable) forest management and conservation (**m/m**) ↑† Human health and animal welfare e.g., through less pesticides, reduced burning practices and practices like agroforestry and silvo-pastoral systems (**m/h**) ↓† Human health when using burning practices (in agriculture or bioenergy) (**m/m**) † Gender, intra- and inter-generational equity via ↑ Participation and fair benefit sharing (**r/h**) ↑ Concentration of benefits (**m/m**)	↑ Provision of ecosystem services via Ecosystem conservation and sustainable management as well as sustainable agriculture (**r/h**) ↑† Large-scale monocultures (**r/h**) ↑† Land use competition (**r/m**) ↑ Soil quality (**r/h**) ↓ Erosion (**r/h**) ↑ Ecosystem resilience (**m/h**) ↑ Albedo and evaporation (**r/h**)	*Institutional aspects:* ↑↓† Tenure and use rights at the local level (for indigenous people and local communities) especially when implementing activities in natural forests (**r/h**) ↑↓ Access to participative mechanisms for land management decisions (**r/h**) ↑ Enforcement of existing policies for sustainable resource management (**r/h**)
Human Settlements and Infrastructure		*For co-benefits and adverse side-effects of compact urban form and improved transport infrastructure, see also Transport.*			
Compact development and infrastructure		↑ Innovation, productivity and efficient resource use and delivery (**r/h**) ↑ Higher rents and property values (**m/m**)	↑ Health from increased physical activity: *see Transport*	↑ Preservation of open space (**m/m**)	
Increased accessibility		↑ Commute savings (**r/h**)	↑ Health from increased physical activity: *see Transport* ↑ Social interaction and mental health (**m/m**)	↑ Air quality and reduced ecosystem and health impacts (**m/h**)	
Mixed land use		↑ Commute savings (**r/h**) ↑↑ Higher rents and property values (**m/m**)	↑ Health from increased physical activity (**r/h**) ↑ Social interaction and mental health (**l/m**)	↑ Air quality and reduced ecosystem and health impacts (**m/h**)	

From IPCC, AR5, Working Group 3, Chapter 6.

APPENDIX 3: PRINCIPLES OF CLIMATE JUSTICE

In seeking to realise its vision of a world engaged in the advancing of climate justice, the Mary Robinson Foundation - Climate Justice dedicates itself to action which will be informed by core principles.

The Foundation elaborated a draft set of principles which it had an opportunity to introduce to a small group of people from all parts of the world who have been working on climate justice issues. The meeting was supported by the Rockefeller Brothers Fund in Pocantico, New York in July 2011.

The draft principles were developed and amended based on the common understanding of key principles, concepts and opportunities identified and discussed at the meeting. The Principles of Climate Justice, now adopted by the Board and operative in the Foundation's activities, follow.

Respect and Protect Human Rights

The international rights framework provides a reservoir for the supply of legal imperatives with which to frame morally appropriate responses to climate change, rooted in equality and justice.

The idea of human rights point societies towards internationally agreed values around which common action can be negotiated and then acted upon. Human rights yardsticks deliver valuable minimal thresholds, legally defined, about which there is widespread consensus. The guarantee of basic rights rooted in respect for the dignity of the person which is at the core of this approach makes it an indispensable foundation for action on climate justice.

Support the Right to Development

The vast gulf in resources between rich and poor, evident in the gap between countries in the North and South and also within many countries (both North and South) is the deepest injustice of our age. This failure of resource-fairness makes it impossible for billions of humans to lead decent lives, the sort of life-opportunities that a commitment to true equality should make an absolute essential.

Climate change both highlights and exacerbates this gulf in equality. It also provides the world with an opportunity. Climate change highlights our true interdependence and must lead to a new and respectful paradigm of sustainable development, based on the urgent need to scale up and transfer green technologies and to support low-carbon climate resilient strategies for the poorest so that they become part of the combined effort in mitigation and adaptation.

Share Benefits and Burdens Equitably

The benefits and burdens associated with climate change and its resolution must be fairly allocated. This involves acceptance of common but differentiated responsibilities and respective capabilities in relation to the reduction of greenhouse gas emissions. Those who have most responsibility for greenhouse gas emissions and most capacity to act must cut emissions first.

In addition, those who have benefited and still benefit from emissions in the form of on-going economic development and increased wealth, mainly in industrialised countries, have an ethical obligation to share benefits with those who are today suffering from the effects of these emissions, mainly vulnerable people in developing countries. People in low-income countries must have access to opportunities to adapt to the impacts of climate change and embrace low carbon development to avoid future environmental damage.

Ensure that Decisions on Climate Change are Participatory, Transparent and Accountable

The opportunity to participate in decision-making processes which are fair, accountable, open and corruption-free is essential to the growth of a culture of climate justice. The voices of the most vulnerable to climate change must be heard and acted upon. A basic of good international practice is the requirement for transparency in decision-making, and accountability for decisions that are made. It must be possible to ensure that policy developments and policy implementation in this field are seen to be informed by an understanding of the needs of low income countries in relation to climate justice, and that these needs are adequately understood and addressed.

Decisions on policies with regard to climate change taken in a range of fora from the UNFCCC to trade, human rights, business, investment and development must be implemented in a way that is transparent and accountable: poverty can never be an alibi for government failure in this sphere.

Highlight Gender Equality and Equity

The gender dimension of climate change, and in turn climate justice, must be highlighted. The impacts of climate changes are different for women and men, with women likely to bear the greater burden in situations of poverty.

Women's voices must be heard and their priorities supported as part of climate justice. In many countries and cultures, women are at the forefront of living with the reality of the injustices caused by climate change. They are critically aware of the importance of climate justice in contributing to the right to development being recognised and can play a vital role as agents of change within their communities.

Harness the Transformative Power of Education for Climate Stewardship

The transformative power of education under-pins other principles, making their successful adoption more likely and inculcating into cultures a deeper awareness of human rights and climate justice than is presently to be found. To achieve climate stabilisation will necessitate radical changes in lifestyle and behaviour and education has the power to equip future generations with the skills and knowledge they will need to thrive and survive.

As well as being a fundamental human right which is already well developed in the international framework of rights referred to above, education is indispensable to the just society. It draws those in receipt of it towards a fuller understanding of the world about them, deepening their awareness both of themselves and of those around them. Done well, it invites reflection on ethics and justice that make the well-educated also good citizens, both of their home state and (in these global times) of the world as well.

Delivered in an effective multi-disciplinary school, college or university environmental education can increase consciousness of climate change, producing new insights not only at the scientific but also at the sociological and political level. Education is also achievable outside the formal system, through public and, increasingly, virtual (i.e. web-based) activity. The learning required to see climate change in justice terms cannot be done at the schools and universities alone: it is a life-long responsibility and therefore a commitment.

Use Effective Partnerships to Secure Climate Justice

The principle of partnership points in the direction of solutions to climate change that are integrated both within states and across state boundaries.

Climate justice requires effective action on a global scale which in turn requires a pooling of resources and a sharing of skills across the world. The nation state may remain the basic building block of the international system but without openness to coalitions of states and corporate interests and elements within civil society as well, the risk is that the whole house produced by these blocks will be rendered uninhabitable. Openness to partnership is a vital aspect of any coherent approach to climate change, and in the name of climate justice, this must also involve partnership with those most affected by climate change and least able adequately to deal with it – the poor and under-resourced.

These principles are rooted in the frameworks of international and regional human rights law and do not require the breaking of any new ground on the part of those who ought, in the name of climate justice, to be willing to take them on.

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END NOTES

1 IPCC, 2013

2 IPCC, 2013; World Bank, 2012.

3 IRENA, 2012.

4 Mary Robinson Foundation – Climate Justice, 2014.

5 See for example International Council on Human Rights Policy, 2008; Humphreys, 2010.

6 See for example Baer et al., 2008.

7 IPCC 2013 (WGI), Ch. 5.

8 IPCC, 2014, AR5, WG3, SPM Table SPM.2

9 See for example the various reports of Sustainability Energy for All, www.se4all.org.

10 See for example sections devoted to this topic in International Council on Human Rights Policy (2008) and Humphreys (2010).

11 Carbon Tracker Initiative, 2012.

12 UNFCCC, 2013.

13 See for example Anderson and Bows, 2011.

14 To access the Climate Equity Reference Calculator, see www.gdrights.org/calculator.

15 See for example Executive Office of the President of the United States, 2014, and references therein.

16 This issue is explored in detail in Loftus-Farren and McKieran (2011).

17 Johl and Duyck, 2012.

18 CIVICUS, 2013; ACT Alliance, 2011.

19 UN Women and MRFCJ, 2013

20 IPCC, 2014 (WG3)

21 IPCC 2013 (WGI), Ch. 5.

22 Sustainable Energy for All, Note 8 supra.

23 Höhne et al., 2013.

24 The 950 GtCO2 threshold for the “450 ppm” category is found in IPCC WG3 Chapter 6, Table 6.2. The minimum level of 550 GtCO2 is found in IPCC WG3 SPM, Table SPM.1.

25 The 950 GtCO2 is “essentially equivalent” to the “fast carbon phase-out” budget of 930 GtCO2 since the former refers to cumulative emissions from 2011, whereas the latter applies to emissions from 2012.

26 An example of these is the Energy [R]evolution scenario (Greenpeace International et al, 2012) which achieves a phase-out of fossil carbon to 3 GtCO2/yr in 2050.

27 Hohne et al. 2013, op. cit.

28 IPCC, 2014, AR5, WG3, SPM Table SPM.2

Mary Robinson Foundation
Climate Justice

Trinity College, 6 South Leinster Street, Dublin 2, Ireland
t +353 (0)1 661 8427 | **e** info@mrfcj.org | www.mrfcj.org