Convergence: How can it be a part of the pathway to sustainability?

CONVERGE Discussion Paper 1

CONVERGE

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Introduction

Today's global sustainability challenges are urgent and growing. Global inequalities are "monstrously large" (Sutcliffe 2005), making inequity a growing problem in an ever more populated world. Patterns of production and consumption of goods are resulting in widespread environmental degradation, rising risks of resource scarcity and irreversible damage to the ecosystems that sustain human society (Steffen et al. 2004). We argue that the journey to sustainability must follow a more equitable, convergent path, recognising a moral responsibility for the disadvantaged in the world and for the generations that will follow ours, and also recognising that environmental limits exist. Human society faces serious risks when it ventures into "operating spaces" that exceed Earth's fundamental capacity to accommodate and adapt.

One example of human perturbation of the environment at a global scale is anthropogenic climate change (IPCC 2007). Growing recognition of the role of human activity in the climate system has prompted international debate and research on how to avoid the most dangerous consequences of a warming climate. Working from the Global Commons Institute in the early 1990s, Meyer (2000) proposed the principle of Contraction and Convergence™ (C&C) as an equitable, science-based framework for managing the transition to an acceptable level of greenhouse gas (GHG) emissions from human activity. C&C is founded on the recognition of the need to limit fossil fuel consumption, if global climate destabilisation is to be averted, and on the principle that all global citizens have an equal entitlement to future emissions, to correct the skewed and inequitable distribution of the present. It proposes that an acceptable atmospheric concentration of global greenhouse gases should be determined, that maintains Earth's climate system operating within safe limits (Rockström 2009, Hansen et al. 2008, Schneider and Lane 2006), based on the climate assessments of the Intergovernmental Panel on Climate Change. This agreed global level should then be used to determine a full-term budget setting out how much each nation needs to cut back on emissions in order to stabilise greenhouse gas concentrations – the "Contraction" part of the concept. An equal per capita apportionment of carbon dioxide emissions can then be calculated to set national entitlements, and guide reduction and trading of emissions ("Convergence").

Economists and energy policy experts have broadly endorsed C&C, especially in comparison with other carbon reduction regimes (e.g. Bohringer and Welsch 2004; den Elzen et al. 2005; Persson et al. 2006). Since its initial debut, the C&C framework has also gained increasing recognition and sponsorship from decision makers. The C&C concept informed the UN Framework Convention for Climate Change, including the Kyoto Protocol where it influenced the design of the Clean Development Mechanism, and the EU Emissions Trading Scheme (GCI 2004). More recently, the C&C concept was implicitly used in negotiations of a follow-up or replacement to the Kyoto Protocol (Meyer and O'Connell 2010).

While climate change is an important and multi-faceted sustainability challenge, the impact of humanity on the Earth system extends well beyond the emission of greenhouse gases. Pressure on the aquatic and terrestrial ecosystems that sustain human society is rising because of the growing human population, the expansion of economies, and the overconsumption of renewable and non-renewable resources (Steffen et al., 2004, MA 2005, GEO 2007, EEA 2007). Patterns of economic growth have resulted in deep divergence between those who have and those who do not – both among and within nations (UNDP 2007). The demand for and pressure placed on natural resources is also unevenly distributed across the globe. Neoliberal economics focuses on the efficient allocation

of resources, not on their equitable distribution amongst people (White 2007), and this economic model has become globally dominant, in many cases impacting negatively on communities that once pursued (relatively) sustainable livelihoods (Easterly 2006).

The global resource base cannot support a scenario where the developing world follows the trajectory of consumption levels of the developed world (Daly 2009, UNDP 2007). Therefore, equity cannot be realised by raising the levels of material consumption of the poor to those currently enjoyed by the rich of the global North. For example, it is inconceivable that everyone in the world could own as many cars, eat the same quantity of fish and meat, and burn the same amount of oil as the wealthy citizens of developed countries – biophysical limits prevent this. To live within Earth's limits, either wealth is reserved for a global elite and the majority remain without, or nations move towards more sustainable paths where wellbeing is shared by all (Sachs 2007). Fortunately, studies have shown that quality of life does not continue to rise indefinitely in response to increased consumption and income levels (Figure 1). Daly (1996) refers to the phenomenon of fairly static wellbeing despite rising national expenditure (Gross National Product, GNP) as *uneconomic* growth. These analyses suggest that a high quality of life for all the people of the world is achievable without developing countries adopting the consumption patterns of developed countries (NEF 2009). Figure 2 shows how a convergent world could operate.

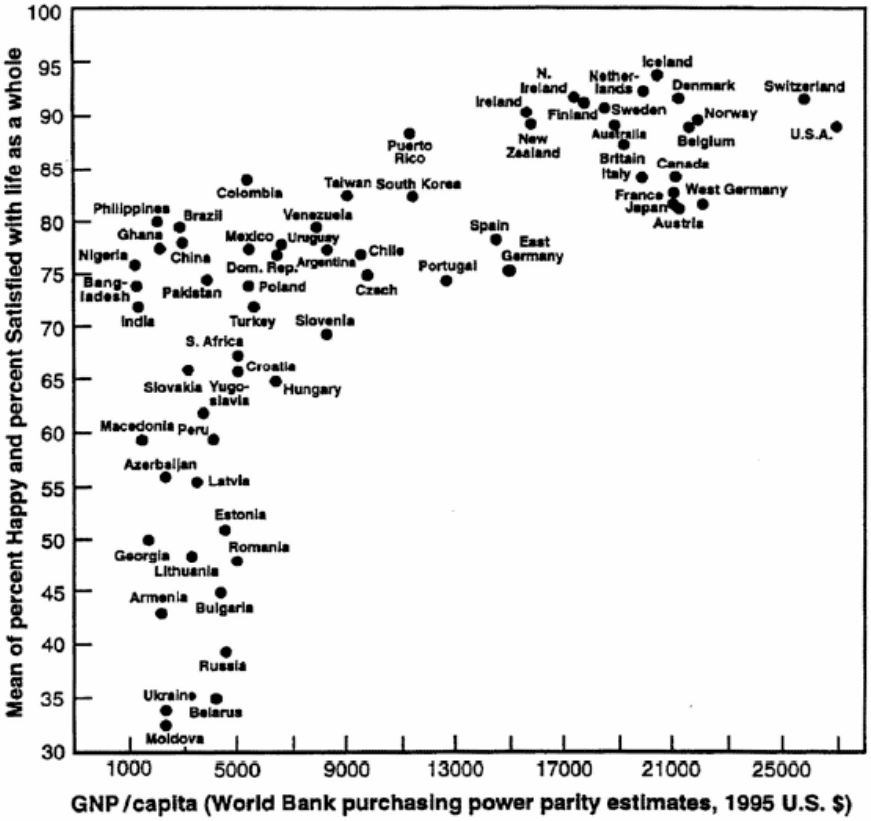

Figure 1: Subjective wellbeing by level of economic development. Source: Inglehart and Klingemann (2000). Data from World Values Survey, www.worldvaluessurvey.org; GNP per capita estimates from World Bank's 1997 World Development Report.

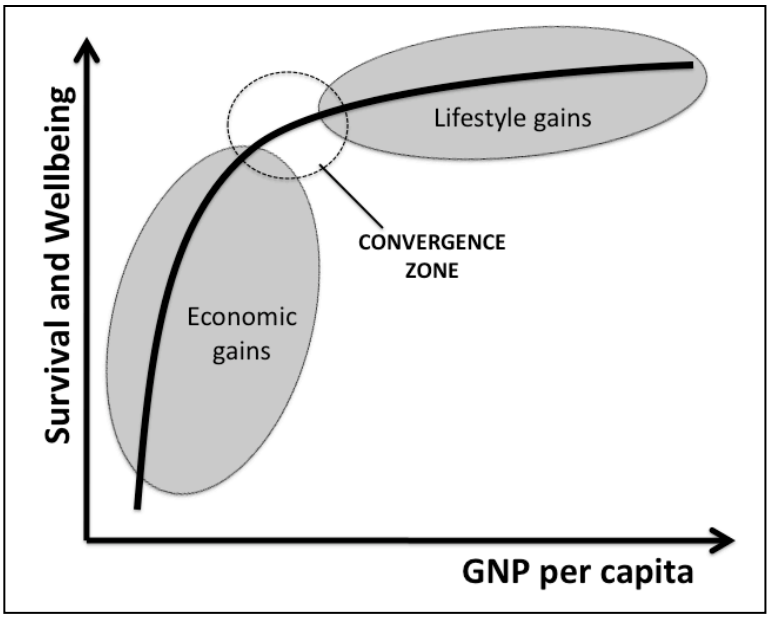

Figure 2: Convergence, wellbeing and economic development. Adapted from Inglehart 1997.

Within the frame of greenhouse gas emissions, C&C unites the simple ethical principle of basic human equality with the recognition of the limits of the planetary commons, and suggests the broad outlines of a programme to guide positive future change. To date, there has been little exploration of whether C&C could be applied as a framework for the wider sustainability agenda. The importance of global equity, a key principle of the C&C framework, in providing a different perspective on sustainability remains open to question.

This study explores the barriers and opportunities for the C&C concept to be applied to other aspects of socio-ecological sustainability. This analysis does not attempt to examine in detail the political challenges of its implementation, but rather asks whether and where it is relevant. The paper unpacks the C&C framework used for climate change, and asks which of its core principles could be applicable to a pathway towards the end goal of a sustainable human society. This pathway explicitly advocates equity, and thus recognises the need for redistribution in order to operate enduringly within Earth's biophysical limits. We will call this pathway *Convergence.*

Critiques of Contraction & Convergence™ – lessons for sustainability

The C&C concept has been praised for its simplicity, transparency, inclusiveness (in that it encompasses every nation), and its effectiveness – if applied, it leads to levels of greenhouse gases that are not expected to cause catastrophic climate change. However, its simplicity is also a weakness. It has been criticised for not incorporating the full range of economic and social factors behind climate change, such as historic responsibility and the differing patterns of socio-economic development of each nation (Walker & King 2007). Although it is undeniably egalitarian, it falls short of being equitable (fundamentally fair) as a result. A number of iterations of the original C&C framework have been suggested to address these inadequacies (e.g. Höhne et al. 2005, Höhne & Kornelis 2005, Blok et al. 1997, Feasta 2008, Schellnhuber & Cornell 2006).

While the concept of C&C may be theoretically pleasing and elegant, actually realising it may be seen to be utopian and unrealistic, not only by policymakers who are criticised for making decisions on the basis of realpolitik, but also by the lay public who could perceive that reducing their personal carbon footprints is inextricably linked to a reduction in their standards of living – regardless of

evidence that may indicate otherwise. To put the concept of C&C into action, a prerequisite is the existence of a laity informed about the potential threats of failing to cap greenhouse gas emissions, and a willingness (of those in the developed world) to share the burden of any reduction in the size of the global carbon footprint.

Additionally, the operationalization of C&C in the form of carbon trading has received much criticism. The quantitative basis of C&C is fraught with complications, with significant uncertainty in calculating safe limits within which dangerous climate change can be avoided (Hansen et al. 2008 and Rockström et al. 2009 argue that the safe limit is 350 ppm CO_2, which was exceeded some 20 years ago[1]). There are problems in accounting for changing populations, and accurately allocating and pricing carbon quotas. At the global level, these are currently particularly intractable challenges. Even at its more regional level, the European Emissions Trading Scheme (ETS) is frequently criticised for oversupplying carbon credits (e.g., the New York Times 2009), even though Europe's capability for providing and interpreting observational data and carbon cycle and climate models at this level is unequalled in the world.

Moreover, critics argue that although C&C presents a global framework where emissions entitlements are given to nations on an equal per capita basis, its puts an unwarranted focus on individual lifestyles and carbon footprints, rather than on the transformational societal and political action required to address climate change (e.g., Gilbertson & Reyes 2009). Despite this, it does not address the role of individuals and local communities in moving towards sustainability. Perhaps another weakness of the C&C proposition is that by singling out CO_2 emissions, the concept takes a reductionist perspective, whereas in reality climate is related systematically to a range of other factors.

For these reasons the adoption and application of C&C has been politically challenging. It involves many stakeholders with differing priorities and interests. The conflict between the interests of developed and developing nations was apparent at the UNFCCC's COP15 in Copenhagen (December 2009), where developing nations advocating the C&C argument came up against strong opposition from developed and rapidly developing nations[2].

All of these challenges will be manifest if the principles of C&C were to be applied to the broader goal of a sustainable global socio-ecological system. This is the task being addressed in the EU FP7 research project CONVERGE (*Rethinking Globalisation in the Light of Contraction and Convergence,* www.converge.org). CONVERGE starts from the Brundtland definition of sustainability (WCED 1987): "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". We consider that a more equitable world is an essential component of sustainability, and that convergence must therefore be part of the pathway to this goal, recognising that there are ecological limits to growth (i.e. unlimited growth is not possible), and that human society is bound up within a complex socio-ecological system in which changes in one part will affect other system parts[3].

[1] See co2now.org for current concentrations. Currently Earth's atmosphere contains ~390 ppm.
[2] This was given a great deal of press coverage, for example www.guardian.co.uk/environment/2009/dec/19/copenhagen-blame-game. For a full summary report of COP15, see www.iisd.ca/vol12/enb12459e.html
[3] CONVERGE working definitions, www.convergeproject.org/node/3

Principles and requirements for sustainable global convergence

In order to explore how convergence may be applied to other natural resources and social benefits towards the goal of sustainability, we interrogate the key principles of the C&C framework.

Table 1: The principles of C&C and their requirements for implementation

Principle	Description of C&C context	Requirements
Acceptable limits/boundaries	C&C requires that acceptable levels of GHG emissions for the Earth be estimated. 'Acceptable levels' should fall within safe limits that do not risk thresholds or tipping points being passed that would move systems to a undesirable state. This adheres to the precautionary principle.	• Understanding of the coupled carbon cycle/climate system • Emissions assessment (the source of CO_2) • Atmospheric monitoring (the sink of CO_2) • Consensus on the acceptable level
Contraction	Current levels of anthropogenic emissions are not sustainable, and need to be reduced, ultimately to zero (IPCC 2001), for stabilisation of atmospheric concentrations. Because this cannot be done instantaneously and the world has to progress from its very unequal current situation, developed countries need to reduce (contract) their GHG emissions sharply, while underdeveloped countries may still increase emissions to the convergence point.	• Quotas: An equal per capita share is calculated based on the agreed safe level of GHG concentrations (e.g. 350ppm). Nations are allocated a carbon quota according to their population size. • Targets: all governments collectively agree to be bound by targets. This makes it possible to measure the movement of societies towards an equitable share of GHG emissions
Equity	*"Equity for survival* is unavoidable and urgent once the imperative of observing global limits to GHG emissions is recognized" (Meyer 2000). C&C is predicated on every individual's right to emit an equal share of GHGs.	• Efficient and effective systems • Multi-scale perspective (local and global): C&C frames both global and national responsibilities, but does not address local scale well.
Convergence	On the basis of equity, each nation should converge to an agreed per capita share of GHG emissions that averts dangerous climate change.	• Allocations trading: C&C uses property rights, or a market-based approach. If nations (or businesses) exceed their carbon quota, they can buy unused shares from other nations. Sales of unused allocations fund clean energy and climate change adaptation projects in less developed countries.

Convergence as a pathway to (strong) sustainability

Convergence for sustainability is the proposition that those in the developed world reduce their consumption of natural resources and energy (and reduce emissions of greenhouse gases) allowing for an increasing level of consumption in the developing world. These changes in consumption behaviours should allow for wealth and wellbeing to converge across nations and cultures, within the levels of resource use that the planet can support. Sachs (2007) argues that global environmental justice may be achieved if the rich reduce their use of environmental space by contracting their resource consumption. The poor should be entitled to have more environmental space, given that they have used less in the past, but the rise of their consumption should flatten out

much sooner than the past trajectories of developed countries. In other words, convergence is not about giving everyone the right to *over*-consume as developed countries have done.

The feasibility of applying ideals of convergence to social "resources" also deserves investigation: is it possible or desirable for there to be global convergence in access to education, security, and freedoms? Indeed, the world has gone a long way to stating that everyone should have political and religious freedom and access to the law, healthcare and education. The preamble to the Universal Declaration of Human Rights states that "… *the recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world"*. The Declaration distinguishes political rights from economic, social and cultural rights. So far, implementation in legislation has concentrated on the political and freedom rights, while comparatively little has happened on incorporating rights on employment, education, health and security (Pontin & Roderick 2007).

Politicians and citizens are beginning to realise that the current situation is unsustainable. They recognise the need for global cooperation to solve global problems. The Brundtland Report (WCED 1987) alluded to convergence by calling for transfers of resources from the North to the South in order to meet the basic needs of the global population. It also states that inequality is the planet's main environmental problem, and that the quest for sustainability would fail without efforts to address the problems of global inequalities.

A number of global environmental agreements since the 1970s have laid the foundations for global cooperation in moving towards an equitable global society, and have produced concepts such as C&C, the principle of "common but differentiated responsibility" (de Lucia 2007), and the "polluter pays" principle (UNCED 1992). These agreements represent the first steps by policy makers in adopting principles of justice and equity in order to achieve global sustainability (Okereke 2006). The UN Millennium Development Goals (MDGs, www.un.org/millenniumgoals) aim to tackle poverty. They comprise eight internationally agreed targets for including, for example, halving extreme poverty, halting the spread of HIV/AIDS, and providing universal primary education by 2015. Not all efforts are being made by governments. For example, the Fairtrade Foundation (www.fairtrade.org.uk) seeks greater equity in international trade by offering better working conditions and secured rights for marginalized workers and producers. This is convergence in action since they are addressing injustices of conventional trade systems.

Many initiatives already exist that advocate equity whilst living within the limits of the biosphere. The Earth Charter (2009) developed by the Earth Charter Commission, has gone the furthest yet in defining fundamental ethical principles for building a just, sustainable and peaceful global society. The Commission claim the Charter was created based on "the most open and participatory consultation process ever conducted in connection with an international document." One of its core principles is "Ecological Integrity". The WWF's One Planet Living initiative (2009) also aims to create a world in which everyone can lead happy, healthy lives within their fair share of the planet's resources, by setting out key principles and promoting activities that move society towards them.

Although these targets and initiatives are admirable, it is not known whether they actually lead to improvements in wellbeing in the long-term. Well-intentioned but piecemeal targets are unlikely to achieve sustainability unless they are placed within a global perspective that recognizes the interconnectedness of the social and environmental sub-systems. At present, whilst some indicators of development are improving, many aspects of environmental quality are deteriorating relentlessly, reducing the quality of the benefits and services humans derive from well-functioning ecosystems (MA 2005). This environmental degradation presents a significant barrier to achieving the

Millennium Development Goals (MA 2005, McMichael & Butler 2007, Hilderink 2005), which in some ways can be regarded as the agreed lower limit of global sustainability.

Successfully implemented, the Declaration on Human Rights, MDGs and the Earth Charter would result in global convergence towards a sustainable future. However, without a coherent framework to guide countries towards these aspirations, many argue that their visions are unobtainable. Again taking the MDGs as an example, after a decade of international efforts, progress on many measures has slowed and even reversed (UN 2009). While the gap between those that have and those that do not continues to grow (Sutcliffe 2005), the world is diverging as opposed to converging, and moving away from a pathway towards sustainability. Since there are powerful sets of reinforcing drivers of globalisation predominantly working against these high-level goals of greater equity, their achievement is very likely to require the rethinking of the fundamental ingredients of globalisation. Inappropriately, GDP is still used as the predominant measure of "progress" around the world. When it was devised, GDP was intended to measure economic growth, not progress in human development (Costanza et al. 2009). As long as GDP is held up as a proxy for progress, the current link between economic growth and ever increasing levels of material consumption is likely to remain, a situation fundamentally incompatible with sustainable development (Marks et al. 2007), and with the contraction element of C&C.

The C&C ideology is closely tied to efforts to promote global consciousness of inequality and address issues of injustice, and much can be learnt from that initiative (Pontin & Roderick 2007). Many local communities, projects, and businesses are already pursuing goals that could fall within the Convergence perspective. CONVERGE is collating examples of such initiatives in order to learn from them. C&C may provide a starting framework to understand these issues in a more systemic way.

Convergence in natural resource use

While C&C is conceptually applicable for carbon emissions, seeking for convergence in natural resource use is often more problematic. The atmosphere distributes carbon emissions globally regardless of where they are released, making climate change a global problem. Atmospheric CO_2 can be measured and monitored, and a notional "optimum" concentration can at least be conceptualised, taking the range of past atmospheric concentrations and climatic conditions into account. One of the key principles in C&C, then, is defining acceptable limits for GHG emissions that would prevent catastrophic climate change. Scientists and politicians have generally agreed that global warming in excess of 2°C above pre-industrialisation temperatures would be undesirable for ecosystems and societies (e.g. EU Climate Change Expert Group 2008). An equal per capita right to emit carbon can be deduced from this, and targets created.

In contrast, the impacts of other resource use are usually not shared globally. Impacts are often location specific (e.g. pollution), and they may be displaced in place or time from their sources. This does mean that – like climate change – the people vulnerable to exposure to the worst impacts of resource over-consumption are not those who are currently benefiting from the resource use. Furthermore, the identification of environmental limits for most other natural resources is tremendously difficult, even at a conceptual level. Inequity cannot easily be redressed by redistribution, especially where the historic exploitation of resources is a major factor.

Despite the difficulty of defining environmental limits, Rockström at al. (2009) have proposed nine planetary boundaries (including for CO_2 concentration) that define the safe limits for human activity. Beyond these limits, critical thresholds are passed that could transform socio-ecological systems into new, potentially undesirable, states. Although they did not propose planetary boundaries for the purpose of allocating entitlements, the values of some of the control variables for these boundaries

could in principle be used to calculate per capita entitlements. Table 2 lists these planetary boundaries and comments on the viability of control variables that could be used to measure contraction and convergence to a point that lies within which humanity can operate safely. This preliminary analysis of these priority parameters shows many the difficulties in doing so.[4]

Table 2: Preliminary consideration of the application of a contract-and converge concept to different Earth system processes where planetary safe-operating boundaries have been defined. *See Rockström et al. 2009 for calculations of limits and the state of scientific knowledge underpinning each boundary.

	Earth system process* and control variable	**Planetary boundary* = convergence target**	**Contraction of**	**Per capita quotas?**
Systemic processes at the planetary scale	**Climate change** Atmospheric CO_2 concentration, ppm	350 ppm atmospheric CO_2 concentration	CO_2 emissions	Requires absolute emissions cessation and carbon sequestration, not just emissions reduction. CO_2 emissions can be calculated per capita.
	Ocean acidification Carbonate ion (aragonite) concentration	>80% of pre-industrial aragonite saturation state of mean surface ocean	CO_2 emissions	As above, since change in ocean pH is driven by CO_2
	Stratospheric ozone depletion Stratospheric O_3 concentration, DU	<5% reduction from pre-industrial level of 290 DU	Emissions of ozone depleting substances	Yes, could calculate per capita quota for release of ozone depleting substances. Montreal Protocol allows differential developing world entitlements.
Aggregated processes from	**Atmospheric aerosol loading** Particulate concentration (PM2.5, 10, etc)	Difficult: sources are both natural and anthropogenic; sensitivity of humans and ecosystems is variable; primarily local/regional impacts.	Anthropogenic aerosol emissions	Global per capita quotas not appropriate. Other sustainability measures required (polluter pays, precautionary principle)
	Biogeochemical flows: **interference with P and N cycles** Net inflow of P to ocean in excess of background weathering Anthropogenic N fixation, N deposition	P <10x natural background weathering Anthropogenic N fixation at 25% of natural fixation rate	Phosphorus use Industrial and agricultural N fixation	P: Feasibility of calculating P footprint – unknown. Also should consider remaining available reserves of P. N: Present human population Is sustained by anthropogenic N fixation. Quota implies population decline.
	Global freshwater use Consumptive blue water use ($km^3\ yr^{-1}$)	4000 $km^3\ yr^{-1}$ globally (does not determine regional thresholds)	Water use Water consumption	Direct water use could be given a notional allocation, but moving water to meet needs presents efficiency constraints. Impact of water extraction at source (water scarcity,

[4] We recognize that other important processes and indicators could be employed, but this table is intended merely to illustrate some of the challenges with applying a contract-and converge approach to natural resources other than anthropogenic greenhouse gases. CONVERGE Work Package 3 will develop indicators and identify parameters that will be analysed further in terms of their appropriateness for *Convergence*.

				ecosystem needs, etc.) is not accounted for in consumptive blue water use. Development of water footprint impact indicator would address direct and indirect use.
	Land-system change Percentage of global land cover converted to cropland	<15% of global ice-free land surface converted to cropland	Conversion of natural land to agriculture	Extremely difficult given the historical conversion of land, and food demand to sustain growing population. Quota could be calculated based on methodologies of ecological footprint analysis.
	Rate of biodiversity loss Extinction rate, extinctions per million species per year (E/MSY)	<10 E/MSY	Biodiversity loss	Difficult to link per capita responsibility for biodiversity loss given that products and services are sourced from around the world with various indirect impacts on biodiversity associated with production.
	Chemical pollution Various: emissions, concentrations, or critical loads; effects on ecosystem functioning from persistent organic pollutants; plastics, heavy metals and nuclear wastes etc.	Undetermined	Emissions of chemical pollutants	Local impact not considered which could differ according to the assimilative capacities of environments that pollutants are released into (local carrying capacity). Calculating the chemical pollution footprint of products and services (and hence compliance with per capita rights) would be difficult, but probably not impossible.

Ecological footprint analysis is an effort to capture and represent the hidden environmental impacts of resource use. In its most widely used form, it estimates the amount of bioproductive land necessary to support a given level of consumption (Wackernagel and Rees 1996). It is well suited as a method for focusing on the human demands placed on the environment, but it is of limited use in understanding the sustainability of a specific nation or region (White 2007). Many researchers have commented on the inappropriateness of ecological footprinting for the design of sustainability policy (Ayers 2000; Van den Bergh & Verbruggen 1999; Wiedmann et al. 2006; Moffat, 2000). Nevertheless, Kitzes et al. (2007) and Ohl et al. (2008) grappled with the challenge, extending ecological footprint analysis to include a broader range of ecological demands (grazing land, fishing grounds, forest land, carbon-absorption land, and built-up area) within an equity framework, which they named Shrink-and-Share and Cap-and-Trade of ecological footprints, respectively. In both cases, the "shrinking" element meant reducing ecological footprints to a size where consumption of renewable resources does not exceed the ability of ecosystems to regenerate their productivity capacity. "Sharing" refers to the allocation of Earth's biologically productive capacity amongst

individuals, nations and/or regions. Although the ecological footprint approach would address distributive justice and reduce ecological damage, Ohl et al. (2008) identified several shortcomings. The approach cannot easily include non-renewable resources, nor does it address social aspects of sustainability such as access to education and healthcare. It may also create perverse incentives. For example, increasing biocapacity by converting forest land to cultivation would fail to account for the value of the forest ecosystem. Moreover, convergence of the ecological footprints of nations would not necessarily guarantee that individuals have access to resources. History suggests that elites may push the burden of compliance onto marginalised groups.

Rockstrom et al.'s (2009) proposed planetary boundary for total global freshwater consumption is 4,000 km^3 per year. This equates to an annual water footprint allowance of roughly 590 m^3 per person, which could be used as a target within a convergence framework. Water footprint analysis can be used to define the total volume of freshwater that is used to produce the goods and services consumed by an individual, company or nation. Using the water footprint volume alone, however, to calculate allowances or quotas would mask the differential impacts of the water embedded in products and services (virtual water; Allan 1996); water extracted from different locations has different impacts due to local water availability, competition between water users, environmental flow requirements, and the assimilative capacity (Hoekstra 2008, Warner & Johnson 2007). For example, irrigation water used to grow flowers for export in a water scarce region has a far higher water-related impact compared with growing the same flowers in a region with abundant water resources. The impact of a water footprint may however be overcome by overlaying a water footprint map with a water stress map (Van Oel et al. 2008)

For non-renewable resources, estimates could be made of remaining reserves and a per capita entitlement to access that resource calculated. An agreement would need to define acceptable time scales for exploiting all the reserves of a particular resource. Quotas may incentivise the re-use of non-renewable resources and may lead to closed waste loops. This is fraught with many issues such as: uncertainty in quantifying the remaining reserves of mineral; cultural and socio-economic factors; and perhaps, most challengingly, property rights.

The atmosphere is one of the only remaining global commons – the others being the high seas and the deep seabed, Antarctica and outer space. In such instances, cooperative governance has tended to be adopted rather than centralised government. Examples include the international regimes for stratospheric ozone (the Vienna Convention and Montreal Protocol) and for climate change (the United Nations Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol (Vogler 2001)**.** For almost every other kind of global resource, however, established property rights intervene. It is only because there are no property rights (yet) for the atmosphere that we can even imagine the kind of equity advocated by C&C. This raises the question of what realistically could be considered a global commons, where per capita rights could be granted. This is a challenge given that the trend is for greater privatisation and property rights. There is also the risk that global commons could be miscalculated, resulting in trajectories that could be unsustainable. The interactions of processes initiated by C&C could in theory make convergence in the exploitation of other global common difficult to achieve.

Convergence and socio-economic wellbeing

The two core principles advocated in the C&C proposition are equity and living within environmental limits: that as a global society, we should find mechanisms to reduce inequalities while living within the means of the biosphere. Convergence also implies a harmonisation and movement towards a common target or goal. Partly because of this, the mechanisms of C&C (as outlined in Table 1)

cannot be translated directly to a social and economic context. Most socio-economic norms and goals are determined from commonly held values, rather than the absolute biophysical limits and thresholds that can pertain in natural systems. As previously noted, internationally agreed socio-economic goals have been set out in various places, such as in the Declaration of Human Rights for political and religious freedom and access to the law, healthcare and education, and in the Millennium Development Goals. For a sustainable society, it is desirable to have less global divergence in matters like security, egalitarian justice, prosperity and peace, but going beyond the articulation of such shared goals towards the allocation of individual quotas of these entities is not in line with sustainability – at least, not as currently understood.

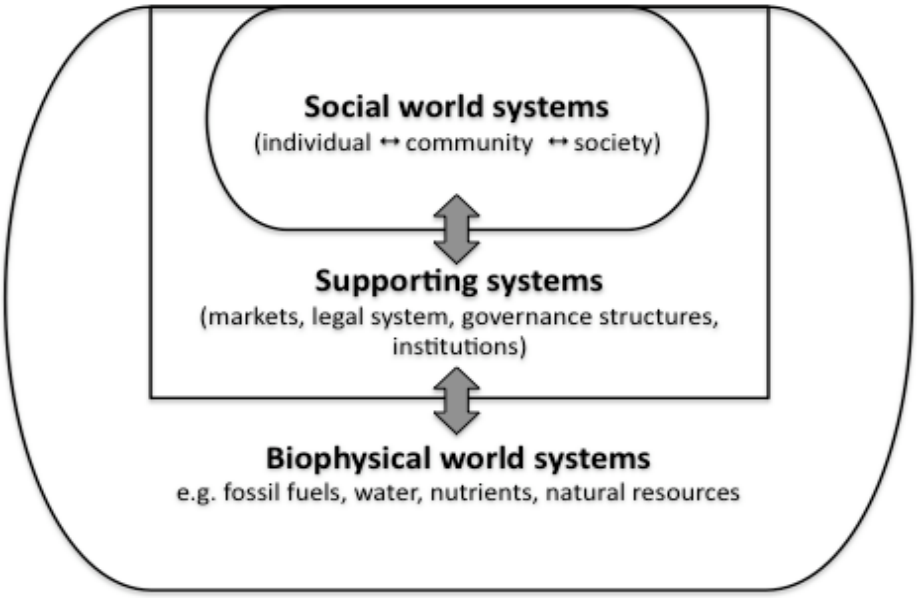

Figure 3: The interconnected socio-ecological system, contained within the biophysical world.

Figure 3 above shows how CONVERGE conceptualises the interacting socio-ecological system, with human systems operating within environmental limits presented by the biophysical world. Concerns about equity present real challenges to sustainability at all three of these system levels, yet implementing convergence is necessarily very different at each level. Returning to the requirements for implementation of C&C identified in Table 1, we can consider how much a convergent approach can be applied to human wellbeing, in terms of both immediate and indirect needs of individuals (e.g., Maslow 1948, Max-Neef et al. 1991), which of course are mediated by the socio-political systems (governance institutions, markets etc.) within which people live.

Table 3: Possible requirements of a contract-and-converge approach to equity in human systems

Understanding of the coupled socio-ecological system	Still limited – policy and academic study have tended to be developed for human and biophysical systems in isolation
Assessment of baseline needs	Possible for some components of human wellbeing (food, shelter); inappropriate for

	others
Assessment of consumption	Possible
Consensus on an acceptable level or threshold	Difficult: may be culturally determined; may be politically intractable
National targets allowing for the measurement of the movement of societies towards equity	Possible, and certain measures already exist (Human Development Index, Genuine Progress Indicator)
Equal per capita quotas	Often deeply problematic – the doctrine of egalitarianism has a shameful history. Many human needs are met with non-rival, non-excludable goods, where quotas are inappropriate.
Multi-scale perspective (local and global)	Essential for sustainability
Efficient and effective systems	Essential for sustainability
Allocations trading	Global commoditisation of wellbeing sounds inappropriate

The matrix below shows the results of a preliminary scoping exercise that explored the feasibility of applying Convergence principles to various elements of social and economic wellbeing. The core C&C principles of *equity* and *convergence within acceptable environmental limits* are common to (most) sustainability frameworks. Where sustainability frameworks may fail, Convergence could potentially provide a procedure to work by these principles rather than just holding them up as goals (Ohl et al. 2008). However, the mechanisms of C&C, namely setting quotas and global contraction are less feasible or desirable in many cases, and may conflict with sustainability goals. For example, education (in common with most social and cultural activities) involves a cost (e.g. time spent) and requires materials that are not negligible in their environmental impacts (e.g. computers, books and infrastructure), yet it is hard to envisage a situation where the sustainable pathway would involve limiting a nation's future access to education with a quota. Even if an end goal of educational equality was agreed, the means are not appropriate.

Table 4: Matrix exploring the feasibility of applying the principles and mechanisms of C&C to examples of components of socio-economic wellbeing.

Key: Green = Yes; Orange = Conditional; Red = No

	Acceptable limits: understanding of socio-ecological system, assessment of needs and of consumption	Contraction – consensus on acceptable level or threshold, equal per capita quotas, national targets	Equity – effective and efficient systems, multi-scale perspective	Convergence – allocations trading (or other redistribute mechanism?)
Subsistence/physiological needs				
Health				
Education/self actualisation				
Community, identity				
Income equality				
Opportunities for work, personal creativity and recreation				
Governance (accountability; social participation)				
Built capital				

The challenges of Convergence

So far, we have explored how the guiding principles and mechanisms of the C&C concept, as developed by Meyer (2000) to tackle climate change, could be applied to other sustainability contexts. Here, we discuss forms of convergence or harmonisation that are already occurring, and then the types of convergence that could lead towards sustainability.

In social and economic systems, there are examples of both 'good' and 'bad' 'convergence', witnessed in governance and political systems, institutions, economic systems, and corporate practices. Countries have become increasing interconnected through trade, communication, and the exchange of ideas and knowledge. This has created dependencies on each other for vital services. Interconnectivity can lead to integration when vital functions and institutions are given to a larger unit of multiple nations. The European Union now sets laws and governs many economic and social aspects of its member states. Such integration leads to similarities in political norms, social organisation and cultural patterns. This kind of convergence we call homogenisation, examples of which include (Pontin & Roderick 2007):

- Standardised technology
- Similar legal procedures, accountancy, insurance and taxation for private sector
- Class and social clusters

- Similar lives governed by similar technologies, institutions, and patterns of social organisation can lead to the adoption of similar attitudes and behaviour
- Political and economic systems can become similar due to external pressures from powerful multinational companies and the desire for a country to be competitive to attract business and ensure economic growth
- Economic convergence occurs when an industry becomes dominated by oligopoly. The individuality of organisations yields to more collective forms through networking and relationships (Braman 1998).

What does this homogenisation mean in the context of sustainability? Processes of globalisation drive many of the above forms of homogenisation. Some support 'convergence towards sustainability', while for others the opposite is true, creating negative divergent processes such as rising income disparities. Determining what aspects of social, economic and cultural systems may be desirable to converge is important. Diversities of cultures, ecosystems and livelihoods are important for maintaining and building social-ecological resilience (Gunderson & Holling 2002) to natural and social stresses and shocks such as climate extremes and political change. Diversity also nurtures innovation and creativity, needed for finding solutions and facilitating adaptive learning and management. Therefore, to converge towards sustainability, not everything should be equalised and homogenised. The egalitarian ideals implicit in convergence also require further exploration of its compatibility with the diverse ideologies and cultures of the world.

Convergence towards sustainability adds the further dimensions of global consciousness, responsibility and equity. These dimensions can deliberately influence other ingredients of globalisation such as scientific and technological processes, social organisations, relationships and behaviours, and political and economic processes. These moral dimensions of convergence towards sustainability, we call *Convergence* (capital 'C'). We refer to other forms of convergence noted above as homogenisation.

Equity can be unpacked into inter-generational equity and intra-generational equity. The former (in a sustainability context) means meeting the needs of the present generations without compromising the ability of future generations to meet their needs – as employed in the Bruntland report's (WCED 1987) widely used definition of sustainable development. According to Rogers (2000), stronger forms of sustainability must consider intra-generational equity such as North-South equity concerns, and equity of members within society. Intra-generational equity is a necessary condition for moving towards intergenerational equity (de Paula & Cavalcanti 2000).

Equity in the C&C proposition is defined at the individual level with individual rights being assigned. However, individuals then have little influence over the actual national entitlements, so although equity principles are embedded in C&C, more equitable practices do not necessarily follow. As noted earlier, individually determined allocations may result in a number of perverse incentives. A nation's population size may therefore not be appropriate for defining quotas or establishing targets.

Convergence embodies social justice, which has become important to most definitions of sustainability (Benton 1997, cited in Okereke 2006). Since 1972, the majority of important environmental agreements at least mention international justice (Franck 1995, Kokott 1999, in Okereke 2006), but no attempt is made to clarify what the parties mean by justice. Environmental justice, a term that focuses on the different exposure of minorities to environmental stresses and risk (Ikeme 2003), may also contribute to our understanding and construction of a *Convergence* concept. The exporting of hazardous waste for disposal in developing countries is an example of global environmental injustice. Advocating environmental justice is advocating equality (Been

1993), a key principle of the *Convergence* proposition. Environmental justice aims to address inequalities and injustice in the distribution of environmental costs and benefits (Lazarus 1994) based on the principle that all people are equal and have equal rights.

Can any of this work in practice? Benton (1999) argues that given the extreme inequalities across the globe, 'the scale of redistribution required to meet the basic needs of the poor might be relatively slight compared with a more ambitious aim of "fair" or "equitable" distribution of the world's wealth.' Many alternative thinkers have identified the global economic collapse that began in August 2007 as an opportunity for the reorganisation of the financial system. Periods following global crises often present opportunities for radical change. The Green New Deal (2007) is one proposal to respond to the recent economic crisis, and the associated threats of climate change and peak oil. Policy makers and the public may be more receptive to the radical changes that would be required by an extended concept of C&C. The implicit global citizenship element of the C&C proposition is challenging since without a global state there can't be true global citizens. Some argue that for sustainability to take root, a new form of global governance is required with greater powers than the UN (Sachs & Santarius 2007), others call for greater decentralisation of power. In any case, for Convergence to contribute to a sustainable relationship between humans and their biophysical environment, we will need good governance at all levels in society, coupled with the application of the best scientific understanding of our uncertain and changing world (the Precautionary Principle), and a transformed economy where social and environmental costs are met by those who impose them (the Polluter Pays Principle).

Our working definition of Convergence (for sustainability)

Convergence is a rights-based framework based on the principle that every global citizen has the right to a fair share of the Earth's biocapacity and access to fundamental human rights. It advocates *socio-ecological justice*, calling for wealth, wellbeing and consumption to converge across and within nations to a level that the biosphere can support. *Convergence* aims to enshrine intra-generational equity in the sustainability discourse. Pontin & Roderick (2007) state that *Convergence* is not about creating one homogeneous culture; it is about allowing diversity while advocating universal concepts of human rights.

Convergence is not restricted to the global scale, it can occur at regional, national and local levels as well. Any framework for *Convergence* requires participation and equitable sharing of benefits and costs.

The key themes identified by this study that could be employed in the development of a Convergence framework are, but not limited to, the following. Rather than providing an overarching set of principles for sustainable development, they are intended to identify the themes that *Convergence* emphasises:

- ***Biophysical limits:*** Explicitly identify and respect the Earth's biocapacity, carrying capacities and the laws of thermodynamics.
- ***Acceptable limits:*** Account for the limits within which humans can operate safely without passing dangerous thresholds in the natural world.
- ***Convergence:*** Provide a smooth pathway (e.g. using interim targets) for economic activity and wellbeing to converge across nations and cultures to a level that the planet can support and is equitable.
- ***Contraction:*** To achieve convergence, a contraction in resource use, consumption levels and waste will be necessary for some (the developed world) to enable themselves, others and future generations to obtain a better quality of life.

- ***Intra- and inter-generational equity:*** Satisfy the basic needs and enable a better quality of life, for all people of the world without compromising the quality of life of future generations.
- ***Systems approach:*** Recognise feedbacks, non-linear changes, discontinuities, tipping points, and causal loops when seeking solutions.

Conclusions

Contraction & Convergence (C&C) is a concept developed to guide the reduction of greenhouse gas concentrations in the atmosphere to a safe level in order to avoid catastrophic climate change. At its core are a number of moral principles – equity, equality, and a movement to commonly held goals at local and global scales – that may be transferred or widened to account for a fuller spectrum of sustainability issues. Thus we regard *Convergence* as an important pathway to the goal of sustainability.

Applying the practical mechanisms proposed by C&C in this wider context was found to be more problematic. The extended concept of *Convergence* will be further developed during the EC FP7 project, CONVERGE, to test its usefulness in reaching sustainability. *Convergence* may articulate common mechanisms to evaluate whether policies, plans and actions contribute towards a common goal. The concept should and will be developed through real-world participation, learning and understanding.

The exploratory nature of this paper has perhaps provided more questions than answers. Given the complexity and challenges already faced in applying C&C to the reduction of CO_2 emissions, it may not be feasible to apply the theoretical ideals of convergence to other dimensions of sustainable development. This study has highlighted several egalitarian principles for sustainability, but further exploration is required to identify what convergence can add to the sustainable development discourse.

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Topics for further discussion (from review)

1. Use of I=PAT equation: What is CONVERGE's understanding and position on population growth?
2. Is population size the appropriate measure of calculating equal shares to global commons?
3. What is good convergence, what is bad convergence?
4. How does "Convergism" relate to Marxism – what are the similarities, how do they differ? What are our own ideological presumptions?
5. What are the connections between environmental equity and equal rights/allocations?
6. What are the key indicators we should be considering (task for WP3)? What indicators can Convergence realistically be applied to? Do "safe limits" exist for other key indicators of sustainability? What are the risks of reductionism?
7. Is *Convergence* possible without global governance, and if so is convergence possible?
8. Given the difficulties in extending C&C beyond carbon emissions, what are the characteristics of key natural resources that the concept could be applied to? Should we focus on the current situation where happiness, wellbeing, and indeed, success are so much connected to materials use (see the Beyond GDP literature)?
9. Related to this, we should devote some space to discussing human behaviour (studies in psychology and sociology) to see how we humans can deal with equity.
10. Exploration of historic capital flows (trade and aid) between north and south. See Belgrade report: www.eea.europa.eu/publications/state_of_environment_report_2007_1