

CONNECTING THE DOTS

How Climate Change Transforms Market Risks and Opportunities



United Nations Global Compact

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Foreword

The earth's climate is already changing in ways that are damaging to human well being. A failure to seal the deal in Copenhagen will lead inexorably to faster and more dangerous climate change and greater harm to human beings. This will undermine the global drive to reduce poverty by threatening the food, water and energy security which are the foundations of prosperity.

The increasingly mature public debate on climate change has focussed predominantly on the scientific and economic challenges of a rapidly changing climate. Less attention has been paid to what this might mean for the daily lives of billions of people. Nor has there yet been a wide ranging debate on what the success or failure would mean for the global system on which our prosperity and security depend.

This report charts the intimate interaction of climate change with other key issues on the global agenda. It identifies the requirement this places on governments and international agencies to develop a new level of policy coherence. It warns business that both the success or failure of climate policy will transform the landscape of risk and opportunity for investment. It urges the faster and more imaginative development of partnerships between governments, international agencies, businesses and civil society organisations.

Above all, it stresses the urgency of the climate problem facing humanity and the magnitude of the changes we must make cooperatively if climate events are not to force changes that will please no-one. It argues that a failure to deal successfully with this challenge not only puts at risk the global effort to reduce poverty but also political support for the institutions of international cooperation on which that effort has been based.

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Introduction

It is now clear that climate change poses a systemic risk to human well being. A systemic risk¹ is one where failure causes a cascade of contingent failures which in turn leads to the collapse of a whole system. In this case, that system is the global economy. By analogy with a very large bank in the global financial system, a stable climate is an environmental component of the global economy that is simply too big to be allowed to fail.

This paper explores briefly the policy linkages between climate change and a nexus of key resource issues that underpin the robustness of the global economy and its ability to deliver poverty alleviation and the other human needs codified in the Millennium Development Goals. It outlines some of the consequences of policy failure for governments and for business and suggests some of the steps needed to bring about the necessary policy coherence for success.

We now have a precise indicator of what constitutes such policy success. Earlier this year, at a meeting of the Major Economies Forum in L'Aquila, Italy, the leaders of the world's largest economies accepted the scientific advice that 'the increase in global average temperature above pre-industrial levels ought not to exceed 2°C'.³ In practice, they defined this point as the threshold of dangerous climate change.

This sets a clear mission for the meeting in Copenhagen in December of COP 15 of the United Nations Framework Convention on Climate Change. The deal sealed at this meeting must be sufficiently ambitious and inclusive as to set the world clearly on a path to developing the low carbon economy necessary to keep the eventual rise in global average temperatures below 2°C.⁴ Above all it must give business the necessary policy certainty to be able to make the high capital, long-life investments central to delivering a low carbon economy.

Climate change is more than simply another environmental problem, one among a long list of unintended consequences of the rapid pace of human development since 1950. At stake is the current and future prosperity and security the whole global community and any prospect of a successful and equitable transition to sustainable development.

Climate change transforms the landscape of risk and opportunity for everyone – gov-

ernments, businesses and civil society alike. Finding and delivering solutions is a task that requires the business community to play a central role. It cannot do this without robust policy frameworks from governments and widespread support from civil society. Above all, the urgency and scale of the task will require relationships within and between these social partners dominated by cooperation and collaboration.

A Unique Problem

Among the array of problems facing mankind, climate change has three unique characteristics that pose distinctive challenges to policy makers of all kinds.

First, **it is a problem that is more truly global than any other.** The livelihood of literally every single person in every single nation will be affected by a changing climate. Far too many people lead lives constrained by poverty, violence, ignorance and ill-health. But they share the planet with others who lead lives that are affluent, peaceful, educated and healthy. Everyone, for better or for worse, will live with the consequences of climate change.

This characteristic creates an entanglement of interests unprecedented in history. Perhaps more importantly, while there might be hard power consequences to a failure of climate policy, there are no hard power solutions to the problem. It cannot be solved by one nation imposing its will on another.

The only climate solutions available require an intensity and persistence of cooperation between nations not so far seen. Since cooperation between governments is never one dimensional this means climate policy success is ultimately predicated on the development of a global system that is fundamentally more cooperative than at present.

Second, **policy failure is not an option.** The development of public policy is typically empirical. Human beings learn by doing. Policy measures are adopted, monitored for effectiveness, reviewed to take account of changing circumstances and revised as necessary. Other social or political goals not achieved today can be pursued again tomorrow. This is not true for climate change.

The long lifetime of carbon dioxide in the

atmosphere — many centuries — means that we are committed irrevocably and, in policy terms, indefinitely, to whatever climate is generated by the carbon burden in the atmosphere at the point of stabilization. If we fail to stabilise greenhouse gas concentrations at a level compatible with staying below 2°C⁵ we cannot try again later to achieve this goal.

Third, **there is a specific time frame within which action must be taken.** The build up of carbon in the atmosphere is cumulative and effectively irreversible. Climate scientists are now confident that for there to be a reasonable probability of keeping the eventual rise in global average temperatures to below 2°C the concentration of greenhouse gases should not rise beyond 450ppmCO_{2e}.^{6,7} To remain within this boundary condition, global carbon emissions must peak within the period 2015-2020 and decline rapidly thereafter.⁸

Thus not only must climate policy meet a precisely specified goal if it is to be successful, it must do so within a clearly defined window of opportunity or it will have failed anyway. In other words, achieving the emissions reductions required to remain within the 2°C threshold too late is, for all practical purposes, the same as not achieving them at all.

Success and Failure

Recent evidence suggests that adverse changes to the climate are likely to be more rapid and more severe even than those reported by the Intergovernmental Panel on Climate Change (IPCC) just two years ago.⁹ Climate change will transform the landscape of risk and opportunity for countries, for companies and for citizens everywhere. This is equally true whether climate policy succeeds or fails.

The business world has yet to grasp how profoundly climate change transforms the landscape of risk and opportunity. Its has focussed its attention predominantly on the first order impacts of climate change on costs and near term market issues. There is not yet a mature debate within much of the business world on how the interactions between climate change and other issues on the global agenda will impact the fundamental international structures on which all business success is predicated.

Climate policy success requires the accomplishment of a carbon neutral global energy system by about the middle of the century, as well as a significant reduction in the rate of loss of tropical forest and a transformation of

agriculture and water management practises and the scale and nature of much civic infrastructure. This will entail a massive change in both public and private investment patterns from those expected on a business as usual trajectory.¹⁰

Policy failure will compound other resource stresses in the global economy since a changing climate acts as a stress multiplier. Fundamental to the achievement of a prosperous, secure and equitable world is the provision of reliable and affordable access to food, water and energy for all 6.5 billion people now on the planet and for the additional 2.5 billion that will be added before the middle of this century.¹¹ Unmanaged climate change, by altering the variability of precipitation, extreme weather events and other impacts, will greatly increase the cost and difficulty of meeting this daunting challenge.¹²

Climate policy failure thus puts at risk the global framework of policies and institutions central to the considerable advances in human welfare that have occurred over half a century. This framework is already under stress from the collapse of confidence in the global financial system and the subsequent severe economic downturn.

Threat to Globalisation¹³

There is an increased risk that, as publics lose confidence in their government's ability to deliver prosperity and security, support for a multilateral, rules based global system rooted in progressive trade liberalization will diminish. Unmanaged climate change, by undermining food, water and energy security, threatens the internal social and political stability on which cooperative international efforts depends thus compounding existing threats to the open markets on which prosperity depends.

Climate policy thus stands at the apex of a geopolitical fulcrum. On one side lies the continuing development of a multilateral global system that has consistently improved human welfare for more than fifty years. On the other lies a return to a mercantilist and nationalist past that cannot, in any case, support the aspirations of a world of 9 billion people. Climate policy success maintains the globalisation that underpins prosperity and security. Policy failure will eventually bring globalisation to a halt. This makes climate policy success an imperative not an option if other global goals are to be achieved.

Background

The sixty years since the end of the Second World War have seen an improvement in human welfare unprecedented in history. More people live longer, healthier lives, with more prosperity and greater security than ever before in history.

Between 1960 and 2007 world population more than doubled to over 6.5 billion people.¹⁴ The global economy expanded to six times its previous size.¹⁵ GDP per capita grew more than four times in the same period to over \$6,300.¹⁶ Food production globally increased by more than 160%.¹⁷

Life expectancy at birth has increased dramatically. In 1950, the global average was 46.6 years. Today it is 67.6 years.¹⁸ Global averages must always be interpreted with care. In some of the richer countries the figure is over 80 years while in some other countries it is still well below the average, and in a small number, actually falling.

Similarly, infant mortality at birth has declined 65% from 152 per thousand births to today's 52 per thousand births.¹⁹ The mortality rate for infants under 5 has also fallen by half.²⁰ These declines, together with the spread of birth control programmes and the rapid increase in education of women and girls have helped cut fertility rates in half, from 5 to 2.5 per woman, since 1950 thus contributing to a progressive reduction in the rate of global population growth.²¹

There has been a massive increase in access to primary and secondary education. Today some 86% of all children complete primary education and in 56 richer countries over 90% go on to secondary education.²² In the developing world more than half of those entering primary education now make this transition in all but 18 countries.²³ Interestingly, in many developing countries more girls than boys go through to secondary education.²⁴ This has led to an increase in adult literacy from 56% in 1950 to over 82% today.²⁵

But these benefits are a long way from being available to all. 1.4 billion people still live in extreme poverty struggling to survive on a marginal income of about a dollar a day.²⁶ Global aggregates conceal large disparities between and within countries. Over 800 million people are still under-

nourished, mostly, but not exclusively, in developing countries.²⁷ More than a billion people lack access to safe drinking water and more than twice as many are without adequate sanitation.²⁸ One and a half billion have no access to electricity and are thus even more disadvantaged in an increasingly connected world.²⁹

Institutional Foundations

The progress in building a more prosperous and equitable world that has taken place over the past half century is not a given. It is the product of an increasingly focussed effort on the part of governments, companies and citizens. That effort must be further intensified as the century unfolds, not only for the well-being of those already alive, but also to ensure the well-being of the 2.5 billion additional people that will arrive by 2050, the majority of whom will be born in the poorer parts of the world.

Underpinning this extraordinary achievement has been the growth of an extensive network of multilateral institutions starting with the foundation of the United Nations itself. Without peace, prosperity is not possible. Born out of a rejection of the nationalism that led to the catastrophic first half of the 20th Century, the United Nations family of organisations has worked for 60 years to preserve peace, support development and promote human rights. In doing so it has given concrete expression of the benefit to all of the values and habits of multilateralism which provide the essential stability on which investment depends.

Peace alone does not guarantee prosperity. Simultaneously with the creation of the United Nations came the effort to forestall the economic nationalism that had intensified the political stresses in the same half century. The outcome was the establishment of the Bretton Woods institutions: the IMF, charged with promoting international monetary cooperation and exchange rate stability, and the World Bank, charged with reducing global poverty and promoting growth.³⁰

The third of these central institutional pillars on which post-war prosperity has been built was the creation of the World

Trade Organisation (WTO). Its task was the promotion of open markets though the lowering of barriers to trade and the movement of capital.³¹ Its birth was difficult, the initial effort to create the International Trade Organisation failed. This was succeeded by the less binding General Agreement on Tariffs and Trade (GATT) which over a period of 40 years, and seven rounds of increasingly complex negotiations led to the creation of the WTO as the guardian of the rules based global trading system that we know today.³²

As memories of the catastrophe that impelled their creation have faded, so doubt about the value and efficacy of all three institutional pillars has become pervasive. Deepening these doubts have been the stresses arising from the unintended consequences of the astonishing rapidity with which population, technological innovation and economic development have grown.

The Uncounted Cost

The spectacular economic progress of the second half of the 20th Century was accompanied by a considerable and largely unaccounted for cost in damage to the ecological foundations of the economy. The seriousness of this problem was first recognised towards the end of the 1960s and led to the convening of the United Nations Conference on the Human Environment in Stockholm in 1972. This was the first in a series of global conferences that ran through the Earth Summit in Brazil in 1992 to the World Summit on Sustainable Development in Johannesburg in 2002.

The indicators of environmental stress appeared in many forms, most immediately as gross air and water pollution with significant impacts on human health as well as on biodiversity and buildings. Persistent bio-accumulative toxins were found building

up in both humans and animals. There was growing public anxiety about the management of hazardous and radioactive wastes.

There was also a growing loss of natural habitats. More land was converted to cropland between 1950 and 1980 than in the 150 years of agricultural expansion between 1700 and 1850.³³ Cultivated systems now cover about a quarter of the Earth's terrestrial surface. Over 40% of the world's coral reefs have been lost or degraded in recent decades at the same time as at least a third of all mangroves were destroyed.³⁴ The rate of species extinction is now about 1,000 times more than the background rate.³⁵

Of even greater concern is the growing impact of human activities on the very large scale natural processes. Rather than damaging the health of individual human beings these issues threaten the health of the economy as a whole.³⁶ Water withdrawals from lakes and rivers for irrigation, urban or industrial use doubled between 1960 and 2000.³⁷ Projections of future water demand, without considering any climate impacts, suggest that by 2025 it will exceed the total 14,000 cubic kilometres a year easily accessible for human use.

Since 1960 flows of reactive nitrogen in terrestrial ecosystems have doubled and flows of phosphorus have tripled.³⁸ The nitrogen flows are now almost equal to those observed in natural processes. The atmospheric concentration of carbon dioxide has increased to 385 parts per million, 32% above pre-industrial levels.³⁹ Apart from climate change this has led to an increase in ocean acidity by 30% — an increase in acidity for marine organisms more rapid than any experienced in the last 20 million years.⁴⁰

These signals of intensifying environmental stress led to two overlapping waves of policy response. The first wave, initiated by the Stockholm Conference, led to successful

action in many parts of the world to reduce the impact on human health of the environmental stresses resulting from gross air and water pollution, the accumulation of toxic chemicals and mismanagement of wastes.

Not all of these gains, however, were a result of environmental policy. As basic industrial production moved over time to the emerging economies, so too did the accompanying pollution. Acute impacts on human health from gross air and water pollution are now to be found in many urban areas in those economies. Nevertheless, the technologies and policy measures to address these problems are now well understood and increasingly applied everywhere.

The second wave of policy response tackled the resource issues. These issues — climate change, deforestation, water availability, biodiversity loss, fisheries collapse, soil loss — are now the dominant issues on the environmental agenda. They came more sharply into focus at the Earth Summit in 1992. A successful policy response to them has been more elusive, in part because they are significantly more difficult with impacts that pervade the whole economy. Effective policy responses are not yet well understood and the institutional arrangements to implement them remain immature.

Sustainable Development

The need to bring about a more coherent alignment of economic development imperatives with the necessity to maintain the productivity of its resource foundations was recognised by 1987. In that year the Brundtland Report was published. Its core message was that the world needed to make a transition to sustainable development which it defined as development which meets ‘the needs of the present without compromising

the ability of future generations to meet their own needs’.⁴¹

This definition remains robust today. During the great economic expansion launched by the industrial revolution it quickly became apparent that very rapid economic growth precipitated very large social change. That social change, unmanaged, threatened to undermine social and political stability on which that growth depended during the 19th Century. The lesson learnt was that it was vital to maintain social cohesion if the economy was to continue to grow.

It is now universally accepted that part of the proceeds of economic growth must be invested in maintaining the social conditions for growth or the economy will be undermined. This investment principally takes the form of providing a social security safety net, healthcare and education. Debate continues on the best way in each country to maintain those conditions and will doubtless do so into the future. But there is no longer an argument that if economic development is to continue then the social conditions for growth must be maintained.

The combination of very rapid population growth, vastly increased technological ability and accelerating economic development that has characterised the last 60 years has precipitated a magnitude of environmental change that now threatens to undermine the environmental conditions for economic development to continue. The challenge of sustainable development is to invest enough of the proceeds of today’s economic development to maintain those environmental conditions into the future.

The Pillars of Prosperity

The most important of those conditions is a stable climate. Without a stable climate food and water security, which are the foundations of economic development, become increasingly difficult, and eventually impossible, to guarantee. Climate change is a consequence of providing our economy with the secure and affordable energy services on which economic growth depends largely by the extensive combustion of fossil fuels.

Thus climate security, food security, water security and energy security form an interlocking set of resource pillars which underpin prosperity. If the productivity of those pillars degrades then so does the productivity of the economy as a whole. If that decline is deep and prolonged then political support for the institutional pillars underpinning the economic success of the past fifty years will be undermined.

No government will put at risk energy, water or food security in order to achieve climate security. These are more familiar risks for government's to manage and are issues where policy failure has very immediate political consequences. Not surprisingly, for a majority of governments they currently take priority over climate security. Allowing the more immediate to obscure the more urgent is not an uncommon cause of policy failure.

We know from experience that it is possible for nations to recover from a loss of energy, water or food security, albeit it at great human and economic cost. The same is not true for climate security. Once lost it cannot be regained. The time bound nature of the climate problem thus makes it more urgent, though less immediate, than the resource issues with which it is closely interlocked. This leads to a significant risk that without a far deeper understanding of the dynamics of this complex nexus of issues governments will adopt policies with perverse or contradictory consequences which will greatly inhibit the ability of business to play its part in meeting the challenge effectively.

Climate Security

The IPCC concluded in 2007 both that it was beyond doubt that climate change was occurring and that human activities were responsible.⁴² These activities have led to an increase in the concentration of greenhouse gases in the atmosphere, principally carbon dioxide which alone accounts for about two thirds of the resultant warming.⁴³ Some 85% of that carbon dioxide results from the combustion of fossil fuels.⁴⁴ The rest comes from land use changes, including the burning of forests. The remaining third of the greenhouse gases comes from a variety of industrial process and from agriculture. The concentration of carbon dioxide in the atmosphere is now 385 parts per million (ppm), up from the pre-industrial level of 280 ppm. It is rising at a slowly accelerating rate of about 2.0ppm a year.^{45 46}

The IPCC concluded that to be very confident of keeping the eventual temperature rise to the 2°C threshold the carbon dioxide concentration would need to stabilise at 400ppm. If the other greenhouse gases are included and an allowance is made for the cooling effect of aerosols, it is estimated that a CO_{2e} concentration of 450ppm would create a 50-50 chance of staying within that limit.⁴⁷

Since 1800 total carbon emissions from human activities have been increasing at about 2% a year.⁴⁸ However the emissions from fossil fuels have accelerated since 2000 and are now growing at 3.4% a year. This is at the upper end of the range used by the IPCC. To be confident of avoiding dangerous climate change we should reduce carbon emissions by 60-80% immediately.

Such a drastic immediate reduction is not possible. This worsens the odds against constraining the eventual temperature rise to 2°C. The advice from climate scientists is that, if global emissions peak by 2015 and reduce quickly thereafter, there remains a reasonable chance of staying below the 2°C threshold. If global carbon emissions do not peak until after 2020 then they would need to decline by more than 5% a year to retain this chance.⁴⁹

Energy security

However, these emissions reductions must occur without compromising the affordable and reliable access of a growing number of people to the energy services on which prosperity, indeed modern civilisation itself, depends. Even without having to deal with climate change delivering energy security presents an enormous challenge. Nearly a quarter of the world – some 1.5 billion people – still lacks access to electricity.⁵⁰ The International Energy Agency (IEA) estimates that to meet the world's growing demand for energy will require an investment of some \$26 trillion between now and 2030.⁵¹

The IEA's current World Energy Outlook projects global primary energy demand to grow by 1.6% a year to 2030. By then fossil fuels will account for 80% of the world's primary energy mix with demand for coal rising faster than any other fuel. This will drive energy related carbon dioxide emissions up 45% to 41GtCO₂ a year.⁵²

Adding in the carbon dioxide emissions from non-energy sources and those from all the other greenhouse gases leads to total emissions of 60GtCO_{2e} by 2030. The energy sector would be contributing nearly 70% of the annual addition to the total carbon burden which could then be increasing at a rate of over 4.0ppm per year.

These two data sets define a shared dilemma for the governments of the world. Without an increase in energy services on the scale projected by the IEA sustaining the economic growth necessary to maintain social and political stability and to alleviate poverty will be impossible. But if that energy growth is delivered primarily by current fossil fuel intensive technologies, as projected, then avoiding dangerous climate change which will also undermine social and political stability becomes impossible.

This is a true dilemma. Choosing one of the horns means being driven to the same unacceptable outcome by the other. Nor is searching for an illusory trade-off between

the horns a solution. This simply increases the risk of achieving neither a sufficient increase in energy services nor avoiding dangerous climate change. True dilemmas must be resolved by meeting both goals simultaneously – in effect, by using investment, innovation and ingenuity to step out from between the horns.

Food Security

Difficult as this task already is, it is made more difficult by the intimacy of the relationship between energy and climate security on the one hand and food and water security on the other. The sudden and sharp spike in global food prices in 2008 was a timely reminder of the political importance of food security. It led to food riots in over 60 countries and, indirectly, to regime change in one.⁵³

Nearly a billion people remain undernourished⁵⁴ despite the massive increase in food production over the past fifty years. Agriculture is the dominant human impact on land and water resources. About a quarter of the world's ice-free land surface is used for crop cultivation or pasture. This produces, among other crops, 2 billion tonnes of grains a year providing about two-thirds of human protein intake.⁵⁵

The current level of food production is highly dependent on cheap energy, particularly oil and gas, along the whole supply chain from farm to consumer. Cultivation, processing, refrigeration, shipping and distribution are all energy intensive steps in this supply chain, becoming more so as the shift of rural populations into the cities continues. This helps make agriculture a major emitter of greenhouse gases, responsible for about a third of the total from human activities – some 13-15 GtCO_{2e} a year.⁵⁶

Global agriculture is under increasing stress from high energy prices, competition from biofuels and the progressive loss of productive land to urbanisation, erosion, salinisation and desertification. As incomes

rise, diets change to include more meat and dairy products whose production is itself increasingly grain intensive thus adding to these stresses.

The combined effect of projected population and income growth has led the Food and Agricultural Organisation (FAO) to project a doubling of world food demand by 2050.⁵⁷ Expanding food production to meeting this demand growth in the face of tightening constraints on land and water availability will be very energy intensive.

Climate change will increase these stresses both directly and indirectly. It is now clear that the temperature increase of 1-2°C to which we are already committed will reduce crop yields in seasonally dry and tropical regions. Researchers expect some benefits to crops and pasture in higher latitudes. Beyond the 2°C threshold, however, the likelihood is that there will be negative effects in all regions. They will fall particularly heavily on semi-tropical and tropical regions.⁵⁸

Food production will also be negatively affected by climate change induced increases in crop, livestock and human pests, by extreme weather events, including both extended floods and droughts and by fire. The diminished predictability of the weather in a changing climate will compound the difficulty for farmers of making efficient planting choices.

Even when adequate food is produced in many parts of the world climate damage to critical infrastructure will deny access to it for vulnerable populations, sometimes for prolonged periods.⁵⁹ Furthermore, the climate induced spread of infectious diseases to new areas can cause or compound hunger though negative effects on human food utilisation.

150 million tonnes of fish and other aquatic products are consumed each year. About a quarter of global commercial fish stocks are already over-exploited, depleted or recovering.⁶⁰ Half are being fished to full capacity. Both the rising ocean temperatures and increased acidification resulting from greenhouse gas emissions are already compounding these stresses by changing the distribution of migratory species and the productivity of the oceanic food chain.

Water Security

In the past fifty years population growth and increased demand have combined to cut the freshwater per person available globally in half.⁶¹ Historically, water use has increased almost twice as fast as population. Already some 2.8 billion people live in areas of high water stress.⁶² On current trends that is expected to increase to 3.9 billion by 2030. Since the nineties, water prices globally have risen at a marginally faster rate than oil prices.⁶³

Access to an adequate supply of clean water is essential for life. 1.1 billion people live without clean drinking water and more than twice as many lack adequate sanitation. As a consequence, 1.8 million people die every year from diarrhoeal diseases.⁶⁴ Although some 80% of agriculture is rainfed, the 18% that relies on irrigation has yields 2-3 times higher delivering over 1 billion tonnes of grain each year.⁶⁵

The 2005 Millennium Ecosystem Assessment warned that it would not be possible to sustain food production or poverty reduction if the water environment were compromised too severely. 70 major rivers around the world are near maximum extraction levels to supply water for irrigation systems and for reservoirs, including the Colorado, Ganges, Jordan, Nile and Tigris-Euphrates rivers.⁶⁶ Several, including the Yangtze, Colorado and Murray, struggle, and sometimes fail, to reach the sea.

Agriculture is by far the largest consumer of water at 70%, industry, including energy, uses 23% and households about 8%.⁶⁷ As urban populations grow – to some 60% of the total by 2030⁶⁸ – and economies industrialise an increasing proportion of their water goes to domestic and industrial uses and less to agriculture. Under investment in pollution controls and wastewater treatment further reduces the amount of useable water in many parts of the world.

Water systems are themselves intensive users of energy. Some 4% of US electricity is used for the collection, transfer, purification, distribution and waste treatment of water.⁶⁹ As water tables drop, by as much as 1 metre

a year in many parts of the world, more energy is needed for pumping.⁷⁰ The increased use of desalination plants and large scale water transfer projects to maintain water security will further increase the energy intensity of water provision. Rising energy prices will thus have a significant impact on water security, especially in the poorer parts of the world.

Climate change adds further stress to the water system. In arid and semi-arid areas at low latitudes there will simply be less water available. Most dramatically, it will diminish the availability of water from glaciers.⁷¹

Across much of Central Asia, Latin America and South Asia rural livelihoods depend on glaciers. The glaciers of the Himalayas and Tibet alone feed seven of the world's greatest rivers — the Brahmaputra, Ganges, Indus, Irrawaddy, Mekong, Salween and Yangtze — that provide water to more than 2 billion people. These glacial water banks are already melting at an accelerating rate. In the 1990s, glacial mass fell at more than twice the rate of the previous decade.⁷²

Particularly difficult will be the increase in the variability of timing, intensity and distribution of precipitation. A future to which the past is no guide complicates the task of water infrastructure planners and inevitably increases the cost of its provision. In coastal areas, rising sea level is already leading to the salinisation of coastal aquifers. Flooding from extreme weather events damages both water quality and the integrity of water infrastructure.

Managing the Pillars

These stresses on the pillars of prosperity are not unmanageable. There is no doubt that humanity possesses the technical competence to do so effectively. There is a deep and growing understanding of the stresses. Essential technologies and appropriate engineering skills are already in existence. Furthermore, it is also clear that there is no fundamental economic barrier to their management, although there are large barriers to the equitable al-

location of the necessary capital.

The complexity and dynamic nature of the relationship between these pillars, however does present difficulties which are not yet well understood either by governments or by business. Tackling climate change successfully will require a well articulated conversation between business and government at every level from the local to the global. This cannot occur if both continue to address these deeply entwined issues in separate silos. Managing these interactions effectively will require the achievement of a step change in the level of policy coherence by governments. Businesses will need to understand and play a part in this change to ensure good alignment between public policy and investment decisions. But even the achievement of more coherent policy designs will do little to change outcomes if those policies are not adopted and vigorously implemented.

The institutional structures governments currently have in place to tackle these issues treat each one separately. Typically, energy, water, food and climate are each dealt with by different government departments and agencies. Each has a separate constellation of supporting professionals and cluster of related businesses. This significantly increases the risk of policy cannibalism as the solutions to one problem add to the difficulties of another. There are few greater disincentives to business investments than the uncertainty created by policy conflict.

Threatened water security can be addressed by energy intensive desalination and water transfer projects but at the risk of undermining energy security by increasing dependence on expensive imports. If the extra energy is provided by the combustion of fossil fuels that will undermine climate security and eventually the water security being sought.

If lower water security threatens food security by climate altered precipitation this can be compensated by the use of energy intensive agro-chemicals and water transfer projects. But, if the additional energy is

provided from fossil fuels this increases the risk of further altering precipitation patterns and raising temperatures, thus undermining both water and food security.

Little is gained if the policy effort to strengthen one of the pillars of prosperity simply weakens another. In particular, poor policy coherence undermines the ability of the business world to make confident and timely investment decisions. It also complicates the task of aligning collaborative efforts along the business supply chain to manage this nexus of risks efficiently.

The scale and urgency of the social and economic change needed to step out successfully from between the horns of this set of policy dilemmas presents a profound challenge to politicians as well as to policy makers. Without political will the transformational change needed will not occur. By the same token, it presents an equally profound challenge to the business community to develop business processes which connect up the internal conversation about these risks with the core business conversation.

Political will is more than just the expression of best intentions. It is the willingness and ability to communicate effectively to established economic interests and the wider public the need for and scale of change; to develop a strategy for bringing it about and to allocate the necessary financial and institutional resources to implement that strategy.

To manage the pillars of prosperity well in the face of these interacting stresses politicians will need to build a wide base of business and public support for more coherent public policy making. For business to play its full part it must understand these external pressures as comprehensively as it currently understands its market, financial and operational pressures. This need to create a better alignment between policy and politics makes good governance central to the maintenance of the pillars of prosperity and thus to human well being.

Consequences for People

The public discourse on climate change has focussed extensively on the confidence to be placed in climate science and the magnitude and pace of the projected changes. A great deal is now widely understood about the impact of rising global average temperatures on sea level rise, ice-sheets, the occurrence and severity of extreme weather events and other bio-geo-physical effects.

There is a deepening understanding of how this might affect the global economy and of the scale and nature of the change that must occur in the global energy system to mitigate climate change. It is also widely accepted that considerable resources must be devoted to adapting to the amount of climate change to which we are already committed.

But far less of the public discourse to date has addressed the impact of a changing climate on the daily lives and livelihood of individuals. The full scope, scale and timing of these impacts are poorly understood by policy makers and have yet to add significant impetus to the urgency of policy response. There has been a persistent perception that the direct impacts of climate change on human well being are some way off in the future. The recent publication of 'The Anatomy of a Silent Crisis' by the Global Humanitarian Forum⁷³ has brought this issue into much clearer focus.

The report's principal finding was that climate change is **already** responsible for some 300,000 deaths a year, economic losses of some \$125 billion and serious damaging impacts on 325 million people. It concluded that 4 billion people were vulnerable to climate change and half a billion at extreme risk.

The economic losses already due to climate change are more than the individual GDP of three quarters of the world's nations and more than the total amount of all Overseas Development Assistance. Effectively, the world is taking away from the poor with one hand what it is giving with the other. The report acknowledged that these conclusions, based on projected trends, carried a significant margin

of error but pointed out that the real numbers could be higher as well as lower.

The negative impacts of climate change on individual human beings are both direct and indirect. The increased frequency of extreme weather events or exposure to storm surges in low-lying areas will have direct and immediate impacts on human well being. But elsewhere the impacts will often be less direct. As climate change stresses other stressors, often simultaneously, otherwise manageable circumstances become unmanageable. For three issues this is particularly important: displacement, conflict and health.

There are multiple drivers for the internal and international displacement of people and for intra- and inter- state conflicts. Climate change will thus rarely, if ever, be a single cause of an increase in conflict or displacement. As climate stress progressively increases it will further interact with these other drivers to accelerate and worsen the impact of conflict and displacement on human wellbeing. Similarly, human health is subject to multiple stresses which climate change will worsen as well as to direct impacts from physical injury or changing pathogen distribution.

Displacement

The people most vulnerable to displacement by climate change are those whose livelihoods are dependent on ecosystem services – subsistence farmers, pastoralists and fishermen. Migration, whether permanent or temporary, internal or international, is a traditional response of such populations to adverse changes in their circumstances.

Estimates of how much additional displacement will occur as a consequence of climate change vary greatly and are much disputed. To some extent this is because separating the particular climate change driver from the other displacement drivers is not easy. But it is also because of there

remain large uncertainties in forecasting climate impacts at a high enough resolution to identify the pressure to which a specific population will be subject.

The Global Humanitarian Project⁷⁴ estimated that about 7% of the 350 million people currently displaced could be attributed to climate change. The number of people permanently displaced by rising sea-levels, floods and droughts could reach 150-200 million by 2050.⁷⁵

It may be more useful in our present state of knowledge to consider that some 2.8 billion people are already vulnerable to weather related disasters. The arid and semi-arid areas that cover 40% of the world's land surface are home to some 2.0 billion people.⁷⁶ In both cases, it is already clear that the higher global average temperatures are permitted to rise the larger the fraction of these populations that will suffer temporary or permanent displacement.

Current analyses of, and policy responses to, displacement for the most part focus on movement out of rural areas into the cities. By 2050 some 60% of the global population will be urbanised. A large number of megacities are located in low lying coastal areas vulnerable to sea level rise. Little thought has yet been given to managing large scale displacement out of such cities.

Conflict

In recent months the United Kingdom has appointed a senior naval officer to the post of climate envoy in its Ministry of Defence. This is another marker of the growing awareness that climate change is a potentially significant driver of future conflict and thus a threat to national security. This appointment took place in the wake of the first ever debate at the United Nations Security Council in 2007. It was addressed by more countries than had ever previously spoken at a Council thematic debate. It also follows a spate of official assessments in the US, UK, the EU and other countries of the impact of climate change on national security.

As with displacement, and indeed often because of it, climate change is already intensifying the stresses that lead to conflict in many parts of the world. Land degradation and water scarcity frequently forces pastoralists onto lands occupied by farmers themselves already under stress. Extreme weather events in countries with weaker governance often result in extended breakdowns in security for communities. Where these intra-state pressures occur near international borders the resulting conflict can spread to neighbouring countries.

There is growing concern that water scarcity will lead to serious conflict between nations that share river basins. Over 260 of the world's major rivers are shared, with 37 flowing through four or more countries. These river basins occupy over 45% of the earth's land surface, account for some 60% of accessible freshwater and supply 40% of the world's population with water. During the past 50 years there have been at least 450 water related disputes between nations, leading to violent action by one nation against another on 37 occasions.⁷⁷

To date increasing pressure on shared river basins has predominantly produced a cooperative response between nations. The stress being generated by increased water scarcity due to climate induced changes in precipitation patterns or loss of dry season glacial melt water is intensified by an accelerating programme of dam building both for electricity generation and water storage. There is a growing risk that this will now lead to conflict rather than cooperation.

The prospect of an ice free Arctic in the summer time is opening new areas of potential conflict as states scramble to assert jurisdiction over newly available resources. Changes in the movement of migratory species of fish as ocean temperature and salinity change in response to climate change could also generate conflict. The only occasions in the past sixty years on which NATO members have fired on each other have been during disputes over access to fisheries.⁷⁸

Health

The most dramatic and immediate affects of climate change on health are those that result directly from extreme weather events. Floods and droughts kill directly as do storms, fires and prolonged period of very high temperatures. All are expected to increase as the climate changes. The Global Humanitarian Report estimated that by 2030 the health of some 660 million people might be seriously affected by natural disasters.⁷⁹ This is almost twice the number of people expected to suffer from diabetes by then.

Other health impacts are mediated through ecological disturbances such as changes in the distribution or frequency of occurrence of disease vectors. A 2°C temperature rise could as much as double the geographic range of schistosomiasis in China endangering millions of people. In Alaska a 1°C rise in water temperature increased the exposure of people to gastro-enteritis by permitting summer-long proliferation of bacteria in shellfish.⁸⁰

There is an approximately linear relationship between incidences of food poisoning and each degree of increase in temperature. Higher temperatures also increase the abundance and activity of flies and other disease transmitting pests. Malaria, dengue, and meningitis are all diseases where a changing climate will alter the distribution and occurrence of the exposure of human beings.⁸¹

A third set of climate impacts on human health arises as a result of both first and second order consequence of the disruptions to the ecosystem services described above. Both too little and too much water increases exposure to the diarrhoeal diseases resulting from an inadequate access to clean water and sanitation services. Poor nutrition weakens response to ill health however caused, especially for the very young and old. Extreme weather events not only do direct harm to people they also interrupt access to health services, sometimes for long periods. The displacement and conflict resulting from loss of food or water security not only cause physical harm but also much mental distress – as yet a much overlooked aspect of the health affects of climate change.

The Millennium Development Goals

The Millennium Development Goals (MDGs) were developed out of the United Nations Millennium Declaration signed in September 2000. 192 members states of the United Nations and some 232 international organisations have adopted these goals. The intention is to reach them by 2015. Since their adoption they have guided public policy at all levels throughout the world. They have played a central part in the accelerated effort to bring more prosperous and secure lives to individuals in every part of the planet.

One way to assess the seriousness of the threat to people posed by dangerous climate change is to look at its likely impact on the achievement of these goals. These impacts, both direct and indirect, will interact with each other to magnify their full impact. By 2015 the contribution to the total carbon burden of emissions from the 1980s will by then be beginning to have an effect. Global average temperatures will be approaching 1°C above those at the end of the 19th Century.

Goal 1: Eradicate extreme poverty and reduce hunger

Even at 1°C agricultural productivity in many parts of the world be lower, especially in Africa and Asia making the reduction of hunger more difficult to achieve.⁸² Both the impact of increased extreme weather occurrences and of the need to invest in measures to adapt to changing climate will divert public expenditure from meeting immediate poverty reduction needs. Climate related impacts on health will lower the productivity of workforces and thus prolong poverty.

Goal 2: Achieve universal primary education

Considerable progress has been made towards achieving this goal. Climate change will impede further progress both by damaging or destroying essential infrastructure and by intensifying displacement of people away from their homes. In some parts of the world lost agricultural productivity will mean an increase in child labour.

Goal 3: Promote gender equality and empower women

The loss of livelihoods in those populations most exposed to the early impacts of a changing climate falls disproportionately on women. In particular, greater water stress increases women's workload, renders infants and women themselves more vulnerable to disease and limits the amount of time available to women to participate in income generation and decision making.

Goal 4: Reducing child mortality

Both the increase in water stress itself and the greater competition for limited public investment from other climate change related priorities will make the attainment of this goal more difficult. Furthermore children are more vulnerable to changes in the distribution of pathogens and to heatwaves. Climate change induced displacement and conflict has a particularly adverse effect on child mortality.

Goal 5: Improve maternal health

In addition to all the other ways in which a rapidly changing climate affects the health of everyone, both its negative effects on gender equality and the family disruption caused by displacement and conflict are additional risks to improved maternal health.

Goal 6: Combat HIV/AIDS, malaria and other diseases

Climate change will increase the prevalence of malaria and other vector borne diseases and in doing so place additional economic and administrative stress on already overburdened public health services. This matters particularly to care-intensive conditions such as HIV/AIDS. Loss of food security and the resulting increase in food prices and reduction in nutrition increases vulnerability to all diseases.

Goal 7: Ensure environmental sustainability

Over the course of this century climate change will become the dominant direct driver of biodiversity loss already at 1,000 times greater than the background rate. Even at temperature rises below 2°C many unique and threatened ecological systems are at risk. Above this level, climate change and environmental sustainability rapidly become incompatible.

Goal 8: Develop a global partnership for development

A rapidly changing climate makes partnerships of any kind, at any level, less likely as conflict over resources and displacement of people destroy the partnership impulse. Conversely, the level of cooperation necessary to prevent dangerous climate change requires the building of such partnerships on a scale not yet seen in human history.

There would be value in a more systematic analysis of the impact of climate change at different levels, and at different points in the timeline, on the achievement of the MDGs both by each member state and by the international agencies which are committed to them.

Implications for Policy and Business

There is no previous experience in history of governments attempting to deal with a problem that combines the scale, scope and urgency generated by the threat of dangerous climate change. Only the Second World War and the Cold War in the 20th Century have come anywhere close to presenting systemic risks of similar proportions.

The Second World War demonstrated the immense capacity of modern industrialised economies to transform their patterns of production extremely rapidly. Climate change requires a far greater change in those patterns. But more importantly, it requires that we bring it about without the compelling presence of a visible and dangerous enemy. This makes achieving the necessary mobilisation of effort by companies and citizens and the acceptance of a very strong role for government in aligning those efforts considerably more difficult. Since what is at stake for the business community is the social and political stability essential for investment it will need to play a higher profile and more pro-active role in mobilising the societal response to climate change than it might otherwise consider. Business cannot rely on government alone to build the broad base of support that will be needed.

The successful ending of the Cold War demonstrated that it was possible for the international community to sustain a concerted policy effort over many decades. To do so, many nations invested proportions of their national income in deploying weapons they hoped never to use. When those weapons became obsolete they were replaced with new and more expensive weapons in several cycles over half a century.

That this was a justified diversion of resources from more productive use in the face of a perceived systemic risk was not significantly doubted. But this effort was sustain-

able by governments in large part because there was a very broad understanding by the public of the consequences of policy failure. No such broad public understanding exists in the case of climate change which makes the task of mobilising and aligning efforts more difficult.

This mismatch between the intensity and urgency of the effort required and the perceived remoteness of the threat to every day life is a major obstacle to policy success. Governments and businesses are unlikely to find themselves soon being urged to more vigorous action by an aware and alarmed public. This will increasingly necessitate developing a framing for the issue that emphasises opportunity more than risk.

Policy Coherence

The complexity and intimacy of the links between energy, food, water and climate policy requires an unprecedented level of policy coherence at all levels of government and business. Without it there is a considerable risk that policy gains in one area will simply annihilate those in another. Furthermore, the resultant confusion will make it impossible for businesses, especially those making the long-life, high capital investments central to resolving these problems, to plan with confidence.

This means creating a far greater level of integration between different sets of institutions, knowledge centres, policy frameworks, analytic methodologies and funding methods than is currently the case. Since the structure of international organisations reflects to a considerable extent that of national governments, this integration must take place rapidly within nations if a complementary level of policy coherence is to be achieved among international agencies.

Achieving policy coherence is not simply a matter of policy design or institutional form. There are many different policy suites and institutional forms that can promote policy synergy and avoid policy conflict. They only work effectively, however, if there is the political will at the centre of government, actively and publicly supported by business leaders, focused on outcomes that require policy coherence. This is what occurs in wartime when the existence of an existential threat focuses political will on the over-riding goal of national survival.

Securing the integrity of the four resource pillars of prosperity – climate security, energy security, food security and water security – will require an even greater focusing of political will. In part, this is because the effort will have to be sustained over a far greater period of time than is typically the case with modern warfare. But it is also because no nation can preserve all of the pillars by its own efforts alone.

This characteristic of the problem nexus effectively dissolves the distinction between foreign and domestic policy. Since policy success depends as much on the actions of other nations as on each nation's own actions misalignments between domestic and foreign policy will undermine the trust on which successful collective action depends. It also requires a far stronger alignment between business and government strategy, particularly with international businesses, to work together to build the same mutual confidence.

The imperative to cooperate and to align domestic and foreign policy priorities much more closely emphasises the role of national leaders. It is only at this level that the authority to align national efforts to a cooperative purpose on the necessary scale exists.

This will mean building the appropriate awareness and staffing not only internally but also between nations. The response to the current global financial crisis has taken cooperative action to a new level of intensity. Policy success with climate change will

require a further step change. Similarly, business leaders will have to build the necessary capacity within their companies to play a fully informed part in this endeavour.

Building the shared awareness and high level of trust necessary for even more intense cooperation will require something more structured than the current meetings of part-time sherpas. To succeed their work will need to be underpinned by a shared analysis of the resource outlook. This already exists in partial form in the work of the IEA, the FAO, the IPCC and others but needs to be brought together into a more systematic World Resource Outlook covering climate, energy, water and food.

There has been a tentative trend in recent years for the kind of inter-operability between nations long practised in the national security sphere to extend beyond this realm. Typically, this takes the form of personnel secondments, shared training and joint exercises. This approach needs to be greatly extended to cover all four pillars and to include extensive participation by international agencies as well as national governments. Furthermore, since their role is central to policy success, such efforts should include business and non-governmental organisation personnel.

Partnerships

Policy success on this nexus of complex and interacting issues cannot be driven from the top down alone. Without alignment between top-down and bottom-up responses the necessary speed and scale of response will be very difficult to achieve. Partnerships of all kinds extending vertically, so that they reach across local, national, regional and global levels; geographically, so that they cross national and cultural boundaries and functionally, so that they involve public authorities, businesses and civil society are essential.

The world's capacity to build such partnerships in many forms has grown greatly over the past decade. Facilitated by the

extension of the Internet, the falling cost of information and the increasing integration of communications technologies a previously unobtainable level of cooperation has become possible.

The development of public-private partnerships as a model for investment in public infrastructure has permitted a big increase in the ability of governments to leverage capital into supporting the provision of public goods. There are now extensive global issues and public policy networks that allow a crucial sharing of information and analysis to tunnel through institutional and geographic barriers. Multi-stakeholder processes bring together wide ranges of social actors and enable perspectives from the base of society to engage more effectively in decision making at all levels.

The prospects for policy success with climate change will be much improved by accelerating the development of these network centric approaches to public policy. Governments bring the authority and legitimacy to provide the frameworks of policy and regulation that are essential to mobilise the capital needed for business to play its full part. Policy uncertainty kills the innovation and ingenuity that only business can bring to the challenge. But that policy certainty is difficult to achieve if governments do not have the trust of society which the non-governmental organisations are uniquely placed to win.

The world has had a brutal lesson in the risks of allowing the globalisation of capital flows to develop faster than the capacity of society to manage those risks. There is a similar asymmetry in the globalisation of resource use which is continuing to grow much faster than society's capacity to manage those risks.

The global economy is now too large, too integrated and too complex for a return to the kind of central planning used to tackle policy failure in the 20th Century. The alter-

native to a false choice between central planning or market driven approaches to climate policy is to accelerate the use of network centric approaches based on the versatility of an ever wider range of partnerships.

Transformation is Inevitable

Climate change will lead to a complete transformation of the human prospect. This is true whether climate policy succeeds or fails. If it succeeds the transformation will take place over the next thirty years. If it fails, the transformation that is already underway will accelerate gradually and become dramatic in the thirty years after that.

The choice is whether events or people drive that transformation. If people make the choice, then over the next thirty years the way energy is used will be transformed. This will bring with it a wide range of co-benefits in terms both of economic efficiency and human well being. In resolving the climate-energy security dilemma successfully the conditions will be created that make possible the preservation of food and water security and thus resource pillars of prosperity will be maintained.

If events drive the transformation then the global average temperature will rise inexorably and for all practical purposes, irreversibly. Food and water security will be undermined and ever larger numbers of people will be displaced, exposed to conflict and disease and subject to deeper climate induced poverty. In those circumstances preserving political support for the international institutions that have sustained the prosperity and security of billions of people over half a century will become progressively more difficult.

Endnotes

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The Ten Principles of the United Nations Global Compact

HUMAN RIGHTS

- Principle 1 Businesses should support and respect the protection of internationally proclaimed human rights; and
Principle 2 make sure that they are not complicit in human rights abuses.

LABOUR

- Principle 3 Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;
Principle 4 the elimination of all forms of forced and compulsory labour;
Principle 5 the effective abolition of child labour; and
Principle 6 the elimination of discrimination in respect of employment and occupation.

ENVIRONMENT

- Principle 7 Businesses are asked to support a precautionary approach to environmental challenges;
Principle 8 undertake initiatives to promote greater environmental responsibility; and
Principle 9 encourage the development and diffusion of environmentally friendly technologies.

ANTI-CORRUPTION

- Principle 10 Businesses should work against corruption in all its forms, including extortion and bribery.

Caring for Climate

Caring for Climate is a unique initiative – a commitment to action by business and a call to governments, incorporating transparency. Endorsed by more than 360 companies from 65 countries, Caring for Climate assists companies in the development of effective climate change policies while also providing a channel for the business community to contribute inputs and perspectives to key governmental deliberations.

CEO Water Mandate

Launched by the UN Secretary-General in July 2007, the Global Compact's CEO Water Mandate is focused on developing corporate strategies and solutions to contribute positively to global water issues. The Mandate is a call-to-action to business everywhere, and provides a strategic management framework covering six areas: direct operations, supply chain and watershed management, collective action, public policy, community engagement and transparency.

