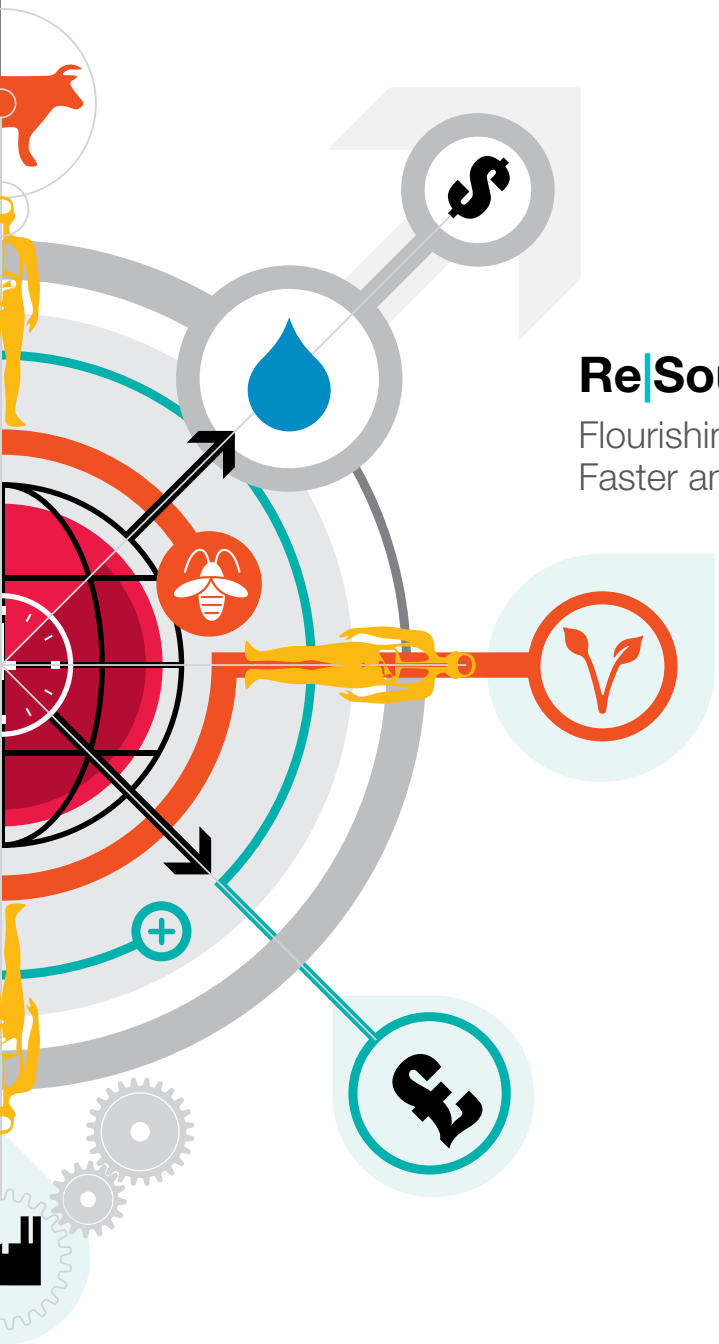
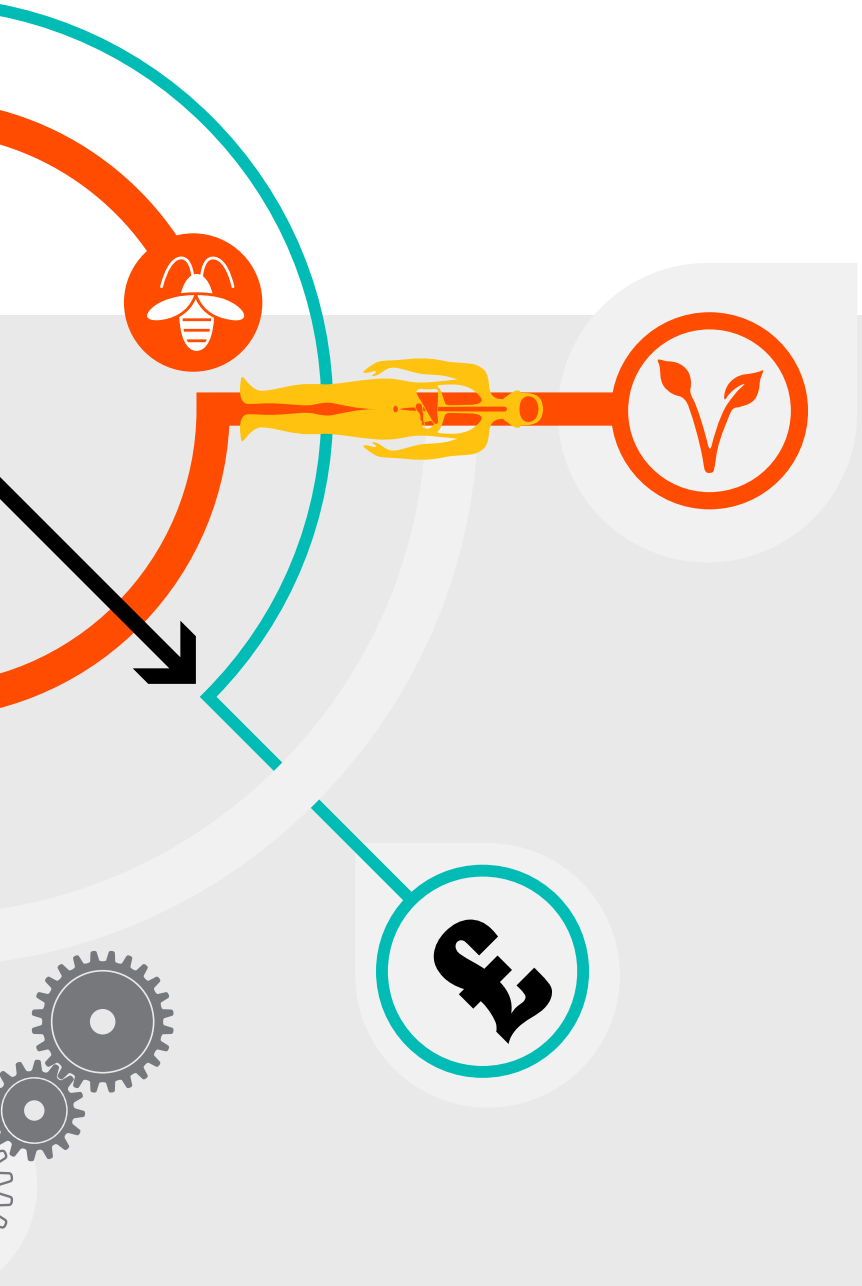


Re|Source 2050

Flourishing from Prosperity: Faster and Further



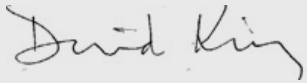
Foreword

The consumption habits of the West have driven demand for food, energy and water and intensified environmental pressure, a situation that has been compounded by astonishing growth in the BRIC (Brazil, Russia, India and China) Economies. Indeed the recent shift in global power structure has given rise to a new wave of middle class consumers, who are anticipated to reach 4.5 billion by 2030.

Faced with dwindling supplies, rising prices and unabated consumption, and with the regional crises and conflicts triggered by these stress points, we urgently need to find new patterns of production, new resource-efficient systems, and new partnerships to achieve lasting and meaningful change.

The Smith School of Enterprise and the Environment works closely with business, governments and academia to address these issues. In July 2012 we held Re|Source 2012 with our partners the Rothschild Foundation and the University of Oxford, to address the global resource challenge and look at potential future solutions. The discussions held between business, governments and academia are captured in our Re|Source 2012 report.

As well as this report, a parallel process was undertaken by a team of futures experts who, with the aid of the delegates, distilled the content of the forum into two clear frames to assist in maturing the debate. These two frames, and the evidence that produced them, is detailed in the following document. We hope that these frames are useful as a tool to enable the collaboration and engagement of actors from a variety of backgrounds and sectors, to work together to produce tangible actions that help us achieve a more sustainable future.



Professor Sir David King

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University of Oxford

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Disclaimer:

The views, opinions, and information presented in the contributions to the Re|Form section of this document are those of the individual authors and should in no way be inferred to be those of the organizations they work for.

Contents

Introduction

In July 2012, the third World Forum of the Smith School for Enterprise and the Environment, University of Oxford, focused on increasing concerns about the link between growing prosperity and unsustainable resources in the face of world population increase and climate change. The event was attended by over 200 of the global 'great and the good', including several Heads of State, business leaders, and Nobel Prize-winning academics, with the majority of the delegates coming from the financial and investor communities. One estimate suggested that the management of $5 trillion of investor and philanthropic assets was convened at this Forum.

The Forum highlighted that growing demand for resources creates systemic interlinked challenges that are difficult to appreciate and address due to the diversity of actors and factors that are shaping the increasingly complex interplay of markets, policies, and food, water, and energy systems. It noted the significant role of investors, distinguishing their interests in the future of resources from those of ordinary citizens, governments, and other forms of business.

There was no agreement on whether a resource crisis is inevitable or on the forms of such a crisis should it occur – and yet, there was a palpable sense that something needs to be done and that whatever can be done will require collaborative leadership.

Some were bullish that a supply-side crisis due to resource availability is not inevitable. Others pointed out that another source of crisis is to be found in the tightening of global supply-demand balance and the limited investment in new capacity for the supply and distribution of resources in greater volumes over longer distances in shorter times. The opportunities and risks of new resource abundances (for example, in aquaculture and shale gas) were also noted. Some highlighted that correcting for market failure via the creation of environmental markets and effective price signals (especially in relation to carbon and water) coupled with the removal of subsidies for fossil fuels will bring huge productivity on a silo-by-silo basis. Others questioned whether the gains would be sufficient to delay absolute physical limits for energy, water, and food and provide the means for another three billion people to join the ranks of the global consumer class.

Some claimed that business leadership is changing in anticipation of the inevitable crisis facing a 'business-as-usual' world, but that inertia caused by a combination of short-termism, commercially vested interests, and lags in political leadership will continue to increase.

Some mentioned the prospect of resource wars and environmentally driven migration and social crises, connecting the uneven distribution of natural resources to man-made boundaries (political borders) and structural inequalities, and adding climate change, institutional innovation, and people into the nexus of food, energy, and water. Others noted that leadership would need to come from enlightened business if governments continued to ignore their role in enabling more integrated risk management. In effect, the Forum reflected a diversity of different perspectives on specific dimensions of the resource security-climate change stress nexus.[1]

Is the world facing a temporary tightening of supply-demand, which will adjust in time with enhancement in resource productivity enabled by restoring the flow of global capital and accelerating technology replacement? Or do we urgently need to embark on a more fundamental transition in order to avoid the irreversible breaking of ecological and social limits – for example, going beyond the 2°C safe limit of global average temperature?

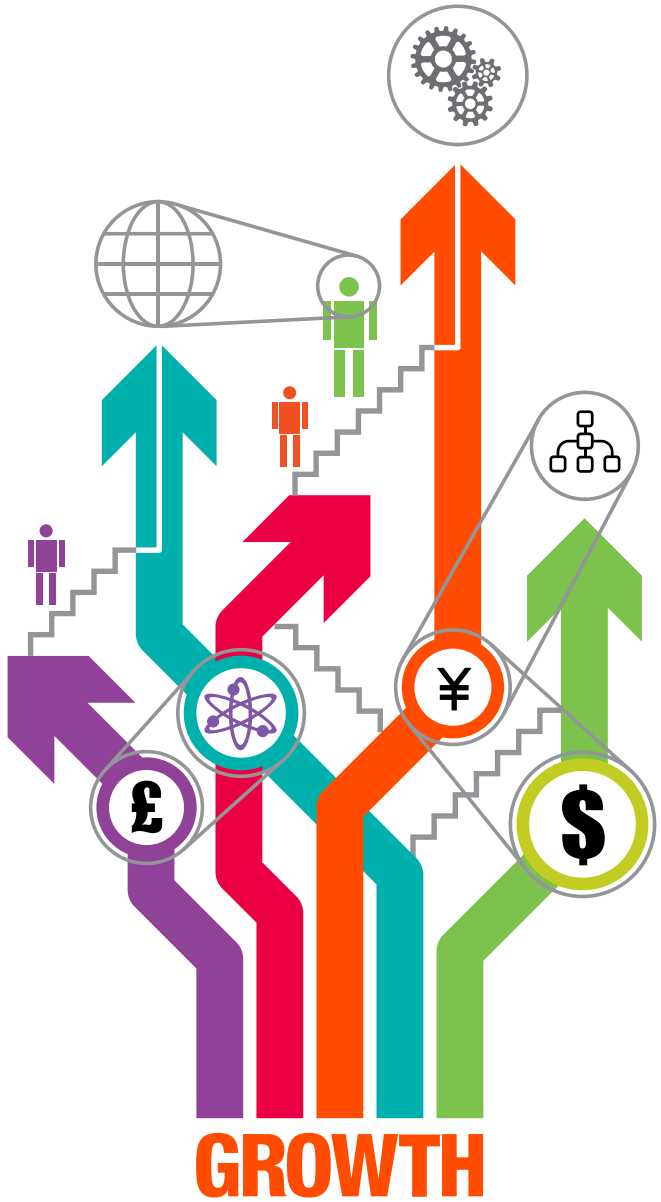
To help clarify the debate and explore these questions we offer a set of two alternative frames for the future – ***Growth*** and ***Health***.[2] Using these frames, we provide an interpretation of the discussions at the Forum to reveal the dominance of the ***Growth*** frame. We then detail different scenarios that can be developed and deployed in each frame to deepen the leadership debate on resource security in the 21st century. Rather than focusing on the questions of forecasting the next 'perfect storm', the ***Growth*** and ***Health*** frames enable a new set of questions to be discussed that are relevant to a collaborative leadership agenda. They have been developed by a team of experienced futures scholars and resource experts who took part in the Re|Source 2012 World Forum.

These future frames and scenarios are not intended as predictions or forecasts of what will happen, but rather offer a way to reveal and test deeply held expectations and assumptions about the past and future that shape our understanding of the situation and of the decisions and actions taken today. They are also intended to provide a set of tools for navigating action in the context of the inherent uncertainties in a more highly interconnected world. In this way, ***Growth*** and ***Health*** serve as a means to reveal, refresh, and reform individual and collective understanding of the resource challenges we are facing. They are a work in process and offered as a platform for further dialogue to all those who participated and to others actively engaged in questions about how and why the long term matters for ensuring the quality of leadership judgments in the immediate term.

1 Hereafter referred to as the resource-climate stress nexus.
2 These frames were derived from The Oxford Scenarios: Beyond the Financial Crisis, http://www.insis.ox.ac.uk/fileadmin/InSIS/Publications/financial-scenarios.pdf.

Re|Think

Business-as-usual projections of current patterns of resource demand and consumption imply that we must rethink the link between economic development and a viable environment.



‘Peak Child’ and Population Challenges

Today, Arctic sea ice levels are at an all-time low, and we can say with certainty that human actions, based on a growing population, are behind this. However the solution to the challenge of climate change is not to control the population. The total population of the world is expected to plateau at 10 billion by 2050. This is due to ‘peak child’. The total number of children (0-15 years) will peak at about 2 billion, as child mortality reduces, female empowerment increases, and economies grow. These 2 billion children will largely survive into adulthood, and when increasing life expectancy is taken into account, will result in a total of 10 billion people over five generations.

The solution to climate change lies not in the total number of people but what those people do – their per capita metrics – and this is based on their level of economic development. Of the current global population of 7 billion people, 2 billion live below the ‘poverty line’ on less than $2 a day. At the other end of the scale, there are 1 billion people living above the ‘air line’ who spend more than $80 a day and who can afford luxury goods, technology, and air travel. In between the poverty line and the air line there are 4 billion people, 3 billion of which have electricity, and 1 billion who live above the ‘washing line’ on $40 a day and with access to that revolutionary piece of technology, the washing machine. So, in total, 2 billion people have access to washing machines, which means that 5 billion people in the world today still wash their clothes by hand – a hard and tedious job with relatively low productivity.

Imagine if the current world of 7 billion used a total of 12 units of resources. At present consumption levels, the richest 1 billion, those above the air line, would use six of these units; the 1 billion above the washing line but below the air line would use two units; the 3 billion above the poverty line, with electricity but without washing machines, would use three; and the 2 billion below the poverty line would use one. By 2050, due to economic development and population growth, there will be 2 billion over the air line, 3 billion over the washing line, 2 billion over the poverty line and 3 billion people below the poverty line. Without action on resource consumption rates the total global resource use by 2050 would rise to 22 units, an 80% increase in demand.

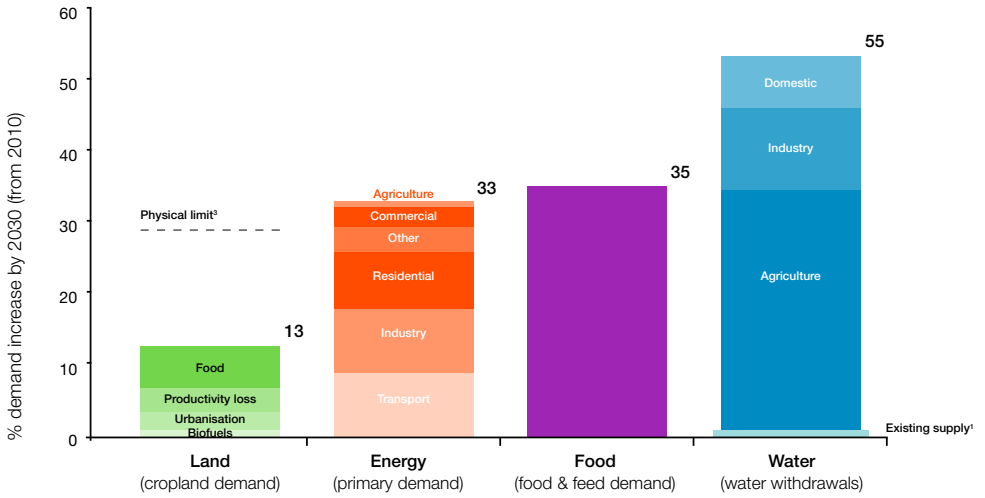
With the population increase to approximately 10 billion already a certainty, and baring a global catastrophe, the only area in which a solution may be found is resource use, whether through demand reduction or more efficient use.

Source: Adapted from Hans Rosling, RelSource 2012
Note: The UN median population projection is an increase to 9 billion people by 2050.

A number of deeper themes emerged from the Forum panels:

- A *new abundance* of resources is driving enterprise to new locations, often to more fragile and less familiar environments, such as the Polar Regions and the oceans. In particular, shale gas in the US is changing the energy landscape and presenting a new host of social and enterprise challenges.
- *Peak supply:* Absolute availability of resources is not the same as access and distribution. Our current crisis arises not just from shortages, but also from challenges in terms of access and distribution. In addition, it is increasingly recognized that tensions arise between new technologies and the environmental hazards they introduce – for example, unsustainable water withdrawals needed to access new sources of energy.
- Subsidies lead to many *structural inequalities* and an erosion of the triangle of trust between governments, businesses, and society.
- *Misalignment of incentives:* There are few positive incentives to finance new and greener infrastructure, while there are perverse incentives to maintain existing returns of capital-intensive infrastructure.
- Resource concerns should not be viewed in isolation, but in terms of *connected and systemic risks* that will become rapidly amplified by climate change impacts.

Business-as-usual demand increase for primary sources to 2030
Projected global figures relative to 2010



Sources: Land (McKinsey analysis); Energy (IEA); Food (McKinsey analysis, FAO); Water (Water Resources Group, WEA)
1 Existing supply which can be provided at 90% reliability, based on historical hydrology and infrastructure investments scheduled through 2010, net of environmental requirements. 2 Cropland demand is defined as “arable land and permanent crops” by the FAO. 3 FAO states that an additional 445 million hectares of arable land is available globally for cultivation.

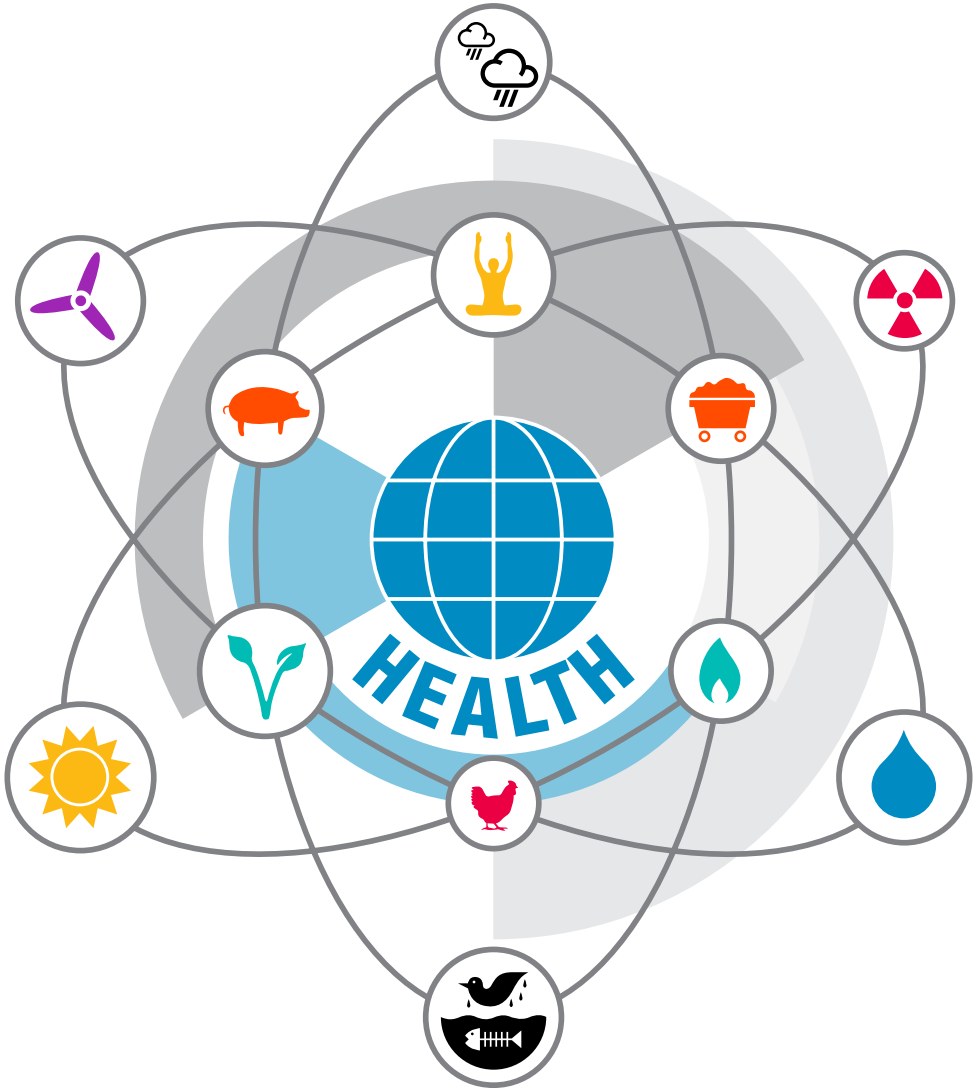
- Getting another *3 billion people across the bread line to the washing line*: the shift from per capita to per lifestyle consumption has a huge impact on the resource issue. Increased consumption will impact resource demand over the coming years, as 3 billion more people enter the 'consuming class'.

- There will be *increasing inertia* due to a combination of vested interests and political short-termism, including shorter CEO tenures, political election cycles, automatic trading in shares, and increased trading by small shareholders.

These themes imply a new challenge: the resource-climate stress nexus.

Underpinning these concerns is a profound question about whether the system of capitalism that has catalysed and sustained an unprecedented period of prosperity (in the West) is adequate to meet the challenge of global human development in a more interconnected world. Perhaps our true need is not *growth*, but the *health* of the whole global system, both economic and ecological. As at least one panellist noted, we have no adequate economic theory that usefully treats the finiteness of resources.

Two different approaches to the financial crisis were depicted in the ***Growth*** and ***Health*** scenarios presented in *Beyond the Financial Crisis*, sponsored by the Institute for Science, Innovation, and Society at the Said Business School and the James Martin 21st Century School at the University of Oxford.[3] Given our own resource constraints, we have chosen to present what we learnt at the Re|Source 2012 Forum within the ***Growth*** and ***Health*** scenario frames so that we can re|think the problem as a whole.



[3] http://www.insis.ox.ac.uk/fileadmin/InSIS/Publications/financial-scenarios.pdf

Sustainability, Robustness, Resilience, and Transformation

It is difficult to get a man to understand something, when his salary depends upon his not understanding it.

Upton Sinclair, American author

Sustainability can be clearly distinguished as a goal or, more precisely, as a measure of system performance from the processes associated with achieving that goal, where the concepts of resilience and robustness become important. The term can be used to refer to a particular decision- making framework for issues related to the interaction between human societies and the environment in which the performance measures used emphasize inter-generational, intra-generational, and inter-species equity (which can be formalized using the concept of inclusive wealth).

Resilience generally refers to broader system-level attributes, such as the ability to build and increase the capacity for learning and adaptation. The resilience lens is useful for making suggestions about broad categories of investment, such as the capacity to learn, adapt, and transform. Linking these investments to existing risk and value frameworks can be difficult. Thus, although resilience thinking provides heuristics for living in a complex world, its utility may be limited if only applied to the organisational level. It is important to point out that resilience arises in multi-scalar interactions, that is, between firms and their wider contexts, and is distinct from sustainability in that it is not normative – sometimes reducing resilience to allow change to happen can be desirable.

Robustness means that the output from a system or algorithm doesn't vary much when some of the inputs do. Since 'shocks' are specific examples of variation in inputs, robustness can be interpreted as reduced sensitivity of outputs to shocks, and if outputs are related to the continued functioning of the system, then robustness and resilience are related.

Transformation and resilience are not 'opposites'; they work together across scales. Transformability involves getting beyond the state of denial and identifying and creating new options and trajectories for the system. Transformation emphasizes experiments and novelty, trying new things while knowing that many will fail, and it emphasizes the need for developing the capacity to change, which depends on the health of all the five capitals – (natural, social, human, manufactured and financial capital), and, especially, governance. Transformation failure is mostly due to inappropriate or poor governance, or strong 'lock-in'.

Source: Anderies et al., "Aligning Key Concepts for Global Change Policy: Robustness, Resilience, and Sustainability," CSID Working Paper Series, September 2012.

In the ***Growth*** frame, resources come increasingly to the foreground. We are either making more – enhancing productivity and efficiency – or doing more with less. In the ***Health*** frame, the focus is not just on productivity but on creating systems – of governance, production, and resource management – that take the resiliency of the whole system into account.

Comparison of *Growth* and *Health* frames

	Growth	Health
Myth	Efficiency	Resiliency
Worldview	A vibrant economy will develop the people, institutions, and technologies to keep the economy growing	Multi-scale, sub-optimal solutions can be more effective in the long run
System assumptions	Equilibrium—independent, closed systems	Dynamic complexity—interconnected, open systems
System objectives	Increasing efficiency and productivity to sustain competitive growth	New model of economic development in a resource-constrained world
Governance	Top-down and inclusive	Polycentric
Tools and metrics	GDP, stock price, CO_2 emissions, real-time intervention, profitability, return on capital, share prices	Feedback loops, adaptive capacity, redundancy, development indicators (e.g., ecosystem health, access to education, human health, diversity)
Approach to resource challenge	Based on optimizing on a resource-by-resource basis; risk management	Based on recognizing a complex, interconnected, environmental-economic-social system

Both of these frames assume the world is complex and that change is continuous and nonlinear. In a linear world, we would think of the economy, the society, and the environment as separate domains and of the future as heading towards dystopia or utopia. But in a complex world, we recognize that these domains are inextricably linked, with aspects of positive and negative factors threaded throughout.

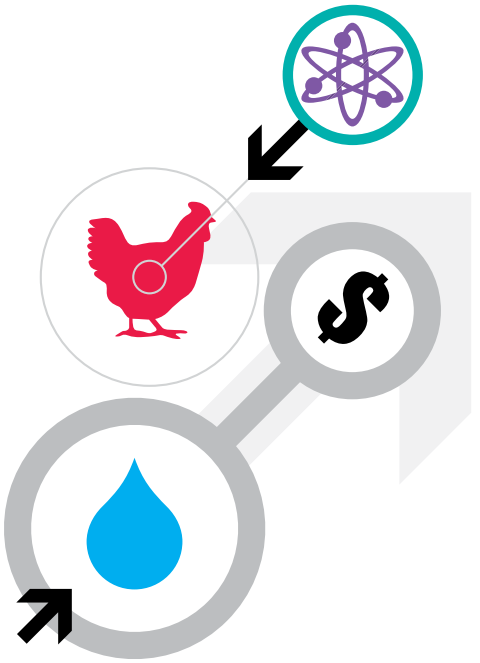
A complicated world is one that is comprised of many parts that do not change what they do: taking apart the system and understanding it at the level of the parts will tell you how the system operates. You can analyse and predict cause-effect. A car engine is a complicated system, for example. Neoclassical economics assumes the world is a complicated system of independent systems – economy, society, and ecology, or nature. It suggests we can sustain linear or exponential economic growth and manage the impact of enterprise on the environment by addressing market failure and pricing in externalities, such as carbon and water.

Complex systems are comprised of heterogeneous agents interacting and adapting to each other – that is, they co-evolve. Co-evolution between many different parts of a system results in a pattern of nonlinear change. The behaviour of systems is not predictable in terms of linear cause-effect. Change is bottom-up, and the overarching rules of the game are shaped by the interplay of actors across many different scales (local, national, international), rather than being controlled by the top-down imposition of global regulations. With complex systems, understanding past behaviour doesn't necessarily lead to an understanding of the behaviour of the whole system. New theories of economics – evolutionary, ecological, complexity – provide new insights on complex systems dynamics and change. These theories highlight the significance of initial conditions and introduce new concepts such as path dependency and lock-in.

Path Dependency and Lock-in

Complex systems exhibit path dependency. Previous or existing policy regimes developed around particular economic or social norms or on certain technologies can result in a 'path dependency' – "the continued use of a product or practice based on historical preference or use." The use continues even though more efficient methods or products may be available to replace them.

Path dependency, in turn, can result in an increasingly narrower set of technologies and actions, resulting in 'lock-in'. In turn, 'locked-in' systems can become too rigid to effectively adapt to changing conditions, becoming crisis-prone as they are overwhelmed by different external circumstances. Overcoming lock-in requires an intervention, such as a time-bound subsidy or regulation, until the system is free to find a new state.



Globalization moves human activity from the realm of the complicated to the realm of the complex. Connectivity becomes a first-order driver rather than a second-order driver. With complex systems, we have to understand not only the pathways to resource sustainability but also the linkages, which adapt and change and are increased in number by globalization itself.

Re|thinking the world as a complex, adaptive system is analogous to the sixteenth-century adjustment in which humanity began accepting the world as round rather than flat. Acting as if the world is flat works for a lot of things, but leads to missing out on opportunities – such as circumnavigating the globe. To act on the idea of 'the world is round' requires a paradigm shift in collective common sense. It is similar to the more recent scientific development of different sets of laws in physics – those of Newton, which help explain and predict everything in terms of large body dynamics, and those of quantum physics, which reveal the inherent uncertainty in structures and dynamics at the subatomic scale. Both sets of laws are useful for certain purposes, but neither set on its own can be used to explain our complex world and wider universe. Even Einstein struggled to consolidate these theories. Today it is accepted practice to work with both, rather than to bet on one.

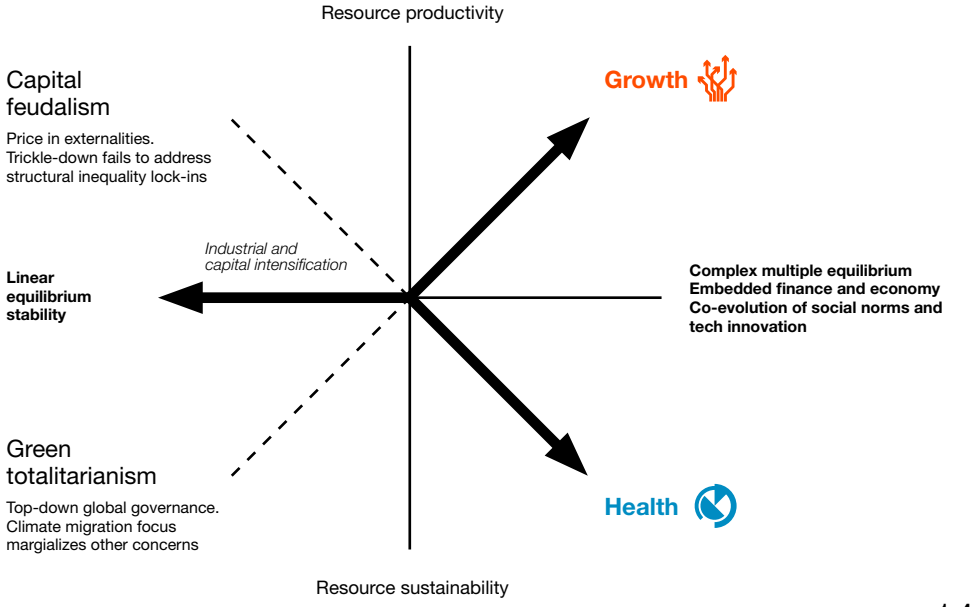
What is important to realize is that while complexity has become more familiar as a way of thinking, it has failed to penetrate deeply into policy-making and the wider spheres of life. From the perspective of complexity, we have a conceptual crisis – a crisis in failing to harness new frameworks of thinking that help us see and navigate the world. We need a new economic theory of our interconnected world and a new way of thinking about policy-making, heading towards a complex systems view of the world as a whole – a ***Health*** frame.

At the same time, not having such a new world, we can do a lot with first-order action. That is, we can increase efficiency even if we don't deal with the linkages. In a ***Growth*** frame, we focus on what we can do well now because we don't have time to wait around for a new global ecological myth to take over from the global economic myth within which we operate. We can improve physical resource productivity through moving capital from labour to technology. For a third of the world there's been a remarkable escape from pestilence and extreme poverty, but what about the majority? Will increasing resource productivity be enough to meet the needs of the majority? A pathway of greener growth is about how we move forward efficiently and with agility. It's about economies of scale and increasing prosperity through a trickle-down of improvement from the top.

Health operates with a very different dynamic, which stresses the functional value of diversity and inclusivity. The world of ***Health*** is not about speed but about the capacity to respond in multiple divergent ways because you are never sure how one will play out – a kind of portfolio approach that hedges bets as a way of dealing with uncertainty over time and sustains trust between diverse interests and actors. In ***Health*** you can't rely on trickle down in the global system; systems redesign is already under way that reflects the co-evolution of technology, institutions, and social norms and behaviours. Not only that, but economic prosperity in such a system is not entirely adequate to human flourishing. It is a foundation – but only a foundation.

These different futures frames also raise different sets of nightmare scenarios. From within ***Growth***, the world of ***Health*** can threaten a kind of green totalitarianism; from within ***Health***, the world of ***Growth*** looks like a form of capitalist feudalism, with the 1% taking more resources and power from the 99%. From within each scenario, we look into a rear-view mirror, fearing that the dystopia of the 'other' will catch up with us and become our future. But neither of these dystopias gives us cause to act. They force us into a posture of crisis – that the future is something to fear and avoid rather than to engage with and create.

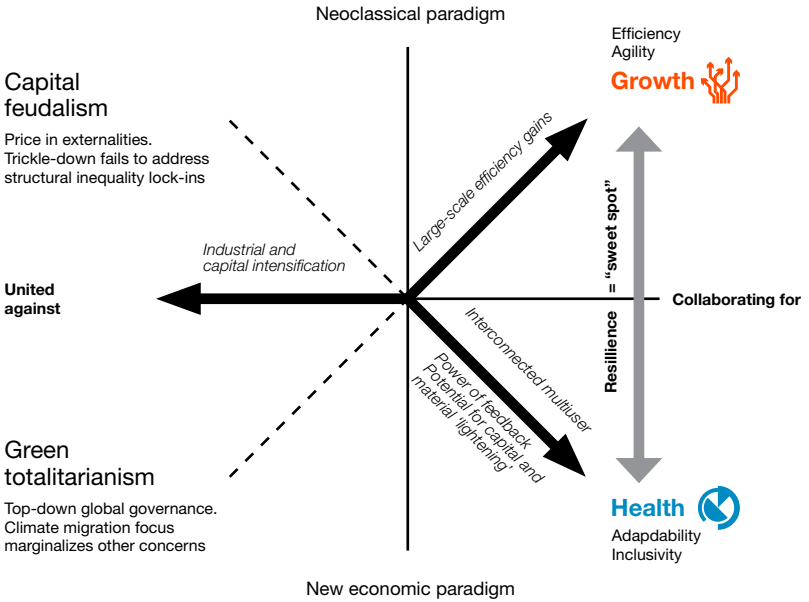
Dystopia in the Rear-view Mirror



Looking forward, ***Growth*** and ***Health*** also offer alternative interpretative frames for guiding action in shaping the future, with each operating as a 'paradigm' with its own coherent set of assumptions. Looking back, these alternative future frames are also motivated by the desire to avoid two dystopian outcomes.

A New Futures Map

Navigating path dependency and systemic transitions towards sustainability



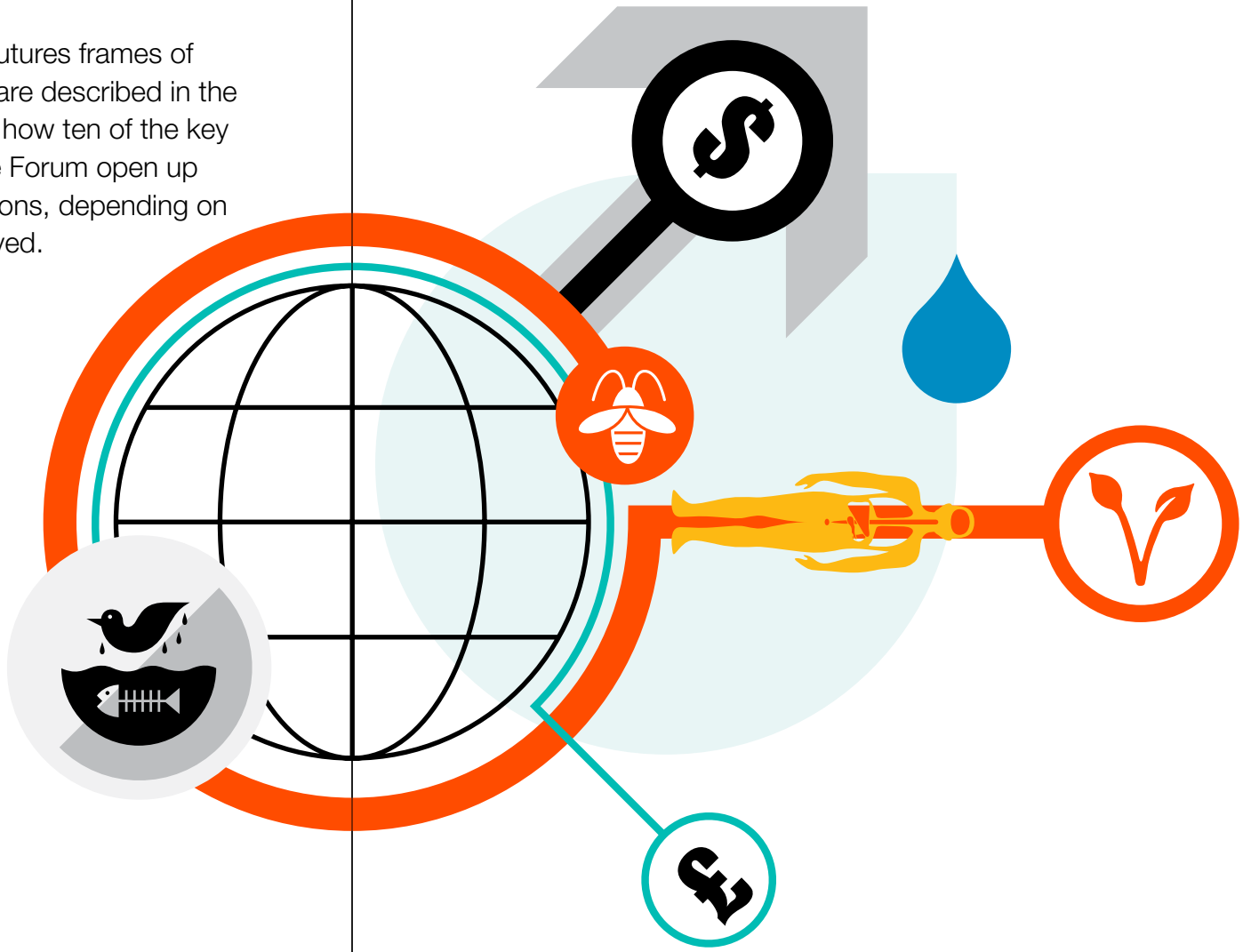
The Re|Source 2012 conference itself, not surprisingly, seemed to offer more ways forward in a ***Growth*** frame than within a ***Health*** frame. We're familiar with the emphasis on productivity and resource efficiency of the ***Growth*** world, and moving forward within that world extends what has worked for us in the past by adding new tools, such as transparency, or pricing mechanisms for carbon and water. ***Health*** is not as familiar, and most of the thinking within this paradigm is not yet mainstream, but increasing attention to concepts of resiliency and transformability are evident in many different communities, including economics, business, and national security.

In Part Two **("Re|Form")**, we interpret the presentations and discussions during the World Forum in the context of the two futures frames. We conclude that the Forum's centre of gravity was more ***Growth*** than ***Health***, but that hints of ***Health*** were evident.

In Part Three **("Re|New")**, we demonstrate how these futures frames can be harnessed to develop alternative, plausible scenarios. Scenarios, in turn, can be used to develop the leadership agenda, to forge a shared and deeper systemic understanding, and to provide a new platform for cross-sectoral leadership and collaborative action. These new approaches to leadership and action are essential for enabling a more effective role for enterprise in a more globally interconnected world. They are also necessary for navigating the fundamental sustainability transition in the context of more turbulent changes, in order to avoid environmental catastrophes.

Re|Form

In this section we apply the futures frames of ***Growth*** and ***Health***, which are described in the previous section, to illustrate how ten of the key themes discussed during the Forum open up different questions and solutions, depending on which futures frame is deployed.



Water

Background

Water is a critical natural resource with special properties that make it central to the resource nexus. It is an essential input to many industrial processes as well as critical for human, livestock, and ecosystem life. Compared to other resources, water has very low substitutability – while energy can be delivered in multiple forms, and mineral inputs can be altered through chemistry, water is required in a more or less pure form for many purposes.

In addition to its biophysical properties, water is also distinguished from other resources in terms of its social, political, and economic positioning. Water is often regarded as a social, and sometimes sacred, right, and hence is extremely politically sensitive, especially for low-income groups. These factors, as well as the high energy costs required to transport it long distances, mean that water is rarely priced in relation to either its economic value or its availability.

Yet while water may be local, the resources are deeply interconnected through technology choices. Intensive agriculture and coal-fired power are two of the most water-hungry processes that are similar the world over – change those, and global water availability is impacted.

In terms of absolute availability, the world does not want for water per se – 71% of the earth's surface is covered in water, amounting to approximately 1,338,000,000 km^3. Freshwater comprises 2.5% of global water, of which two thirds is locked in ice caps and glaciers, 30% is in groundwater, and a mere 0.3% (approximately 179,000 km^3) is contained in the lakes and rivers that provide the bulk of human water use.[4]

Water Stress and Shortage

A country or region is said to experience 'water stress' when annual water supplies drop below 1,700 m^3 per person per year. At levels between 1,700 and 1,000 m^3 per person per year, periodic or limited water shortages can be expected. When water supplies drop below 1,000 m^3 per person per year, the country faces 'water scarcity'.

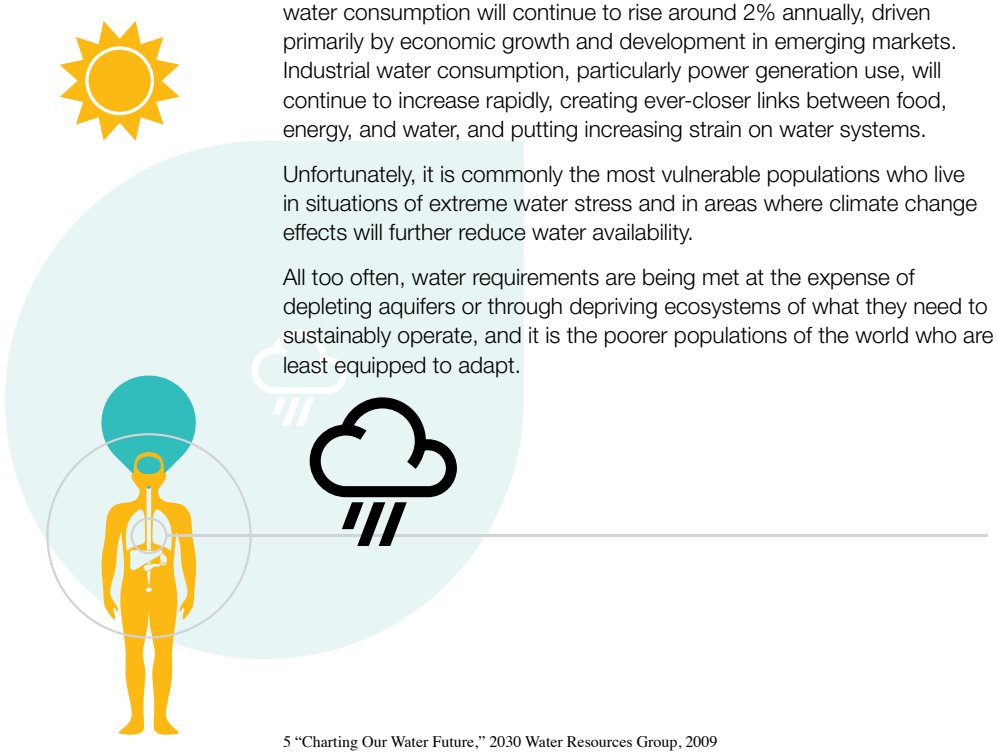
4 U.S. Geological Survey, http://ga.water.usgs.gov/edu/earthwherewater.html

Such global, aggregate numbers do not reflect the reality of accessible, reliable, and sustainable availability of water, both globally and for particular populations. Existing accessible, reliable, sustainable supply has been estimated at a mere 4,200 km^3, with extremely uneven stress on different water basins due to differing hydrological, climate, population, use, and management patterns. Meanwhile, current global freshwater consumption from agricultural, industrial, and household use is somewhere around 4,500 km^3, meaning that in aggregate, the world is exceeding its sustainable freshwater supply, with significant regional variations.[5] In addition, water pollution as a by-product of industrial and municipal processes often severely degrades the quality of existing flows.

Since 1950, while the world's population has risen 2.5 times, water demand for households and agriculture has almost tripled, and grain output has risen 3.4 times.[6] Meanwhile, demand from thermal energy production has risen 40 times, and water for other industrial uses 5.2 times. This dramatic growth in industrial 'water mining' means that industries extract more groundwater by mass than oil, gravel, or other mineral resources.[7] Projections indicate that without efficiency gains, water consumption will continue to rise around 2% annually, driven primarily by economic growth and development in emerging markets. Industrial water consumption, particularly power generation use, will continue to increase rapidly, creating ever-closer links between food, energy, and water, and putting increasing strain on water systems.

Unfortunately, it is commonly the most vulnerable populations who live in situations of extreme water stress and in areas where climate change effects will further reduce water availability.

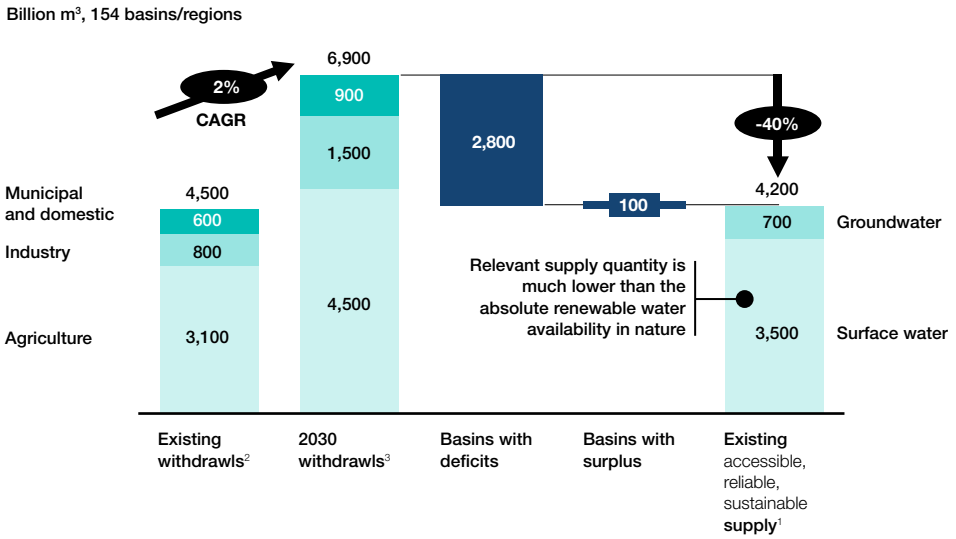
All too often, water requirements are being met at the expense of depleting aquifers or through depriving ecosystems of what they need to sustainably operate, and it is the poorer populations of the world who are least equipped to adapt.



5 "Charting Our Water Future," 2030 Water Resources Group, 2009
6 Noted by Peter Brabeck-Letmathe, Chairman of the Board, Nestlé S.A. in "A Thirst for Growth" at Resource 2012.
7 J. Barth, V. Filimonau, P. Bayer, W. Struckmeier, P. Grathwohl, "Global Water Balance," Linkages of Sustainability, Eds. T. Graedel, E. Van der Voet (London: MIT Press, 2010), pp. 221–41. See also J. Schornagel, F. Niele, E. Worrell, M. Böggemann, "Water Accounting for (Agro)industrial Operations and Its Application to Energy Pathways, Resources, Conservation and Recycling, Vol. 61 (April 2012), pp. 1-15; available at http://www.sciencedirect.com/science/article/pii/S0921344911002783.

Water Crisis

Aggregated global gap between existing accessible, reliable supply and 2030 water withdrawals, assuming no efficiency gains.



[1] Existing supply which can be provided at 90% reliability, based on historical hydrology and infrastructure investments scheduled through 2010; net of environmental requirements
[2] Based on 2010 agricultural production analyses from IFPRI
[3] Based on GDP, population projections and agricultural production projections from IFPRI; considers no water productivity gains between 2005-2030

Source: Water 2030 Global Water Supply and Demand model; agricultural production based on IFPRI IMPACT-WATER base case

Growth

The core ***Growth*** story for water focuses on the significant opportunities for increased efficiency of water use that can redress global imbalances while creating economic returns.

"Water management is a bargain"[8] – it has high returns in that it costs less than the results of no management. In ***Growth***, countries that are highly exposed to water shortages follow Singapore's lead in developing long-term, centrally directed approaches to water management that focus on the centrality of water by building highly efficient infrastructure for water capture, storage, and use, pricing water according to the long-run marginal costs of the next available drop, and investing in technology to improve the economics of water supply for both populations and the government.

As case studies developed by the Royal Commission on Dams had shown years earlier, the majority of water challenges worldwide are solvable through applying existing technologies, creating sensible policy reforms, and providing high returns for infrastructure investment. The challenge in most cases is not that there is too little physical water to be shared among users, but that unsustainable practices are allowed to continue thanks to a complex set of political, economic, and social drivers that prevent change and shift the burden to future generations, the environment, or poor stakeholders.

In ***Growth***, national water productivity drives multi-stakeholder investment that leads to greater economic returns. Changes in policy, pricing, preferences, and technology lead to investments in water that generate a positive return that is realized across multiple sectors and stakeholders. The lowest-cost approaches to lowering demand or increasing supply, such as irrigation scheduling in agriculture, are applied first, followed by more expensive interventions, such as wastewater recycling. Such interventions are compared against scenarios to assess the impact of government policies on water demand and how this affects the economics of adoption for both governments and end-users. A rich knowledge base, sophisticated modelling, and repeatable analyses enable such work.

8 V. Balakrishnan, Minister for the Environment and Water Resources, Singapore in "A Thirst for Growth" at Resource 2012.

Unfortunately, the ***Growth*** approach fails to provide solutions for two set of water risks: first, some river basins – notably, the Ganges, Indus, and Euphrates – are under such stress that they become unable to meet human demands placed upon them, even with the rational application of highly developed technologies and management practices. Second, the world of ***Growth*** fails to account for low-probability, high impact risks such as extreme flooding or catastrophic climate change. Thailand's experience of unintended consequences during the early 21st century – where physically and economically devastating flooding was partially caused by high dam levels designed to offset shortages – are repeated in various forms. The efficiency-based approaches of ***Growth*** are too often caught out by unexpected volatility.

Health

The problem is global, but the solutions are local.

Glen Dagger, Senior Vice President and Chief Technology Officer, CH2M HILL and President, International Water Association, Re|Source 2012

In ***Health***, water supply and demand are seen as functions of complex, interconnected systems that span the physical, technological, economic, political, and social domains. In this context, 'management' of global water is a chimera that, if pursued, is likely to result in new and unanticipated trade-offs, particularly given the inability for ecosystems to have a real voice in debates over water allocation.

The world of ***Health*** does not ignore efficiency-enhancing measures; it simply operates with a different set of drivers and decision points. For example, rather than relying primarily on economic incentives, policymakers focus on social drivers and shifting norms for behaviour change. Rather than maximizing supply, the focus is on the development of adaptive regulation designed to minimize local demand. Rather than forecasting, governments and local managers of water supplies pay attention to the knowledge that emerges from local sensors and system pattern recognition.

In ***Health***, ensuring that there is adequate water is explicitly linked to energy access and food production. For example, networked communities across South Asia collaborate to spread the use of low-cost cooking technologies that reduce wood and charcoal burning in poor populations, measurably reducing black carbon levels that affect current and future water supply from the Himalayas, while simultaneously improving health outcomes and reducing deforestation. Scheduled irrigation and water conservation for agriculture is a point of pride for smallholders and industrial agricultural operations alike in the search for sustainable yields, not an imposition or a tax to be avoided or a short-term 'winner takes all' dynamic.

Meanwhile, water pricing is not imposed by national governments but rather demanded by populations and provided by innovative and locally adapted partnerships among communities, utilities, the private sector, and regulators via performance-based contracts that ensure higher water quality and more reliable supply.

The Water & Sanitation for the Urban Poor (WSUP) Approach

Water & Sanitation for the Urban Poor (WSUP) is a non-profit partnership between the private sector, NGOs, and research institutions focused on solving the global problem of inadequate water and sanitation in low-income urban communities. It brings lasting solutions to low-income areas by working in partnership with service providers, including water utilities, local authorities and businesses and the communities they serve. WSUP strengthens the capacity of service providers to deliver sustainable citywide water and sanitation services, promote good hygiene, and raise the environmental standards of low- income communities.

Energy

There is no shortage of resources.

Andrew Gould, Chairman, BG Group plc, Re|Source 2012

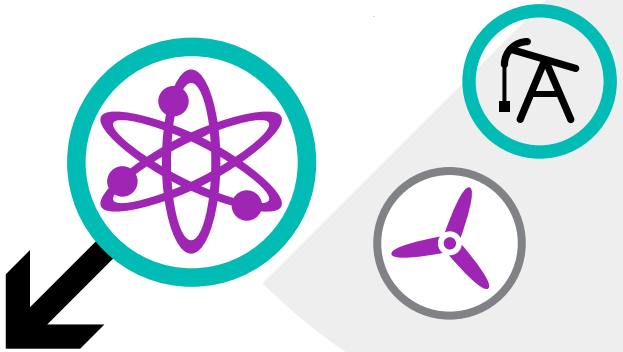
Background [9]

Energy is a critical resource and an essential ingredient in maintaining and growing our societies and economies. The IEA projects energy use to increase by 33% from 2010 to 2035, with fossil fuels to increase by 23%. This increase is expected to come almost entirely from outside the OECD.

We have an abundance of energy supply. There is no physical resource problem to 2050 – only problems related to political access, distribution, and adequacy of investment.

Energy security is required to ensure economic growth at the lowest cost to society (for demand holders). Energy security is at the heart of *maintaining social stability and political power* by maximising value for natural resources (for most of the exporting resource holders).

Energy is implicated in the *longer-term effect of climate change* caused by green house gas (GHG) emissions from fossil energy, and it is also implicated in terms of uncertainties around land use changes. Policy instruments vary depending on the objective but include subsidies, fuel taxes, CO_2 pricing, usage charging, city/infrastructure design, influence on social consumption norms, efficiency standards, royalties, taxes, OPEC, and FDI in technology.



9 All data given in this section is either the author's analysis or taken from "Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs," McKinsey Global Institute and McKinsey Sustainability and Resource Productivity Practice, November 2011.

Oil: At present consumption rates, we have 55 years of reserves, including unconventional reserves such as oil sands; at an annual growth rate of 1.2%, we have 40 years. However, from roughly 2020 to 2040, underlying depletion physics will lead to a plateau in which supply availability will be much lower than latent demand, followed by a very long tail in production. OPEC holds 70% of the world's oil resources. Only 7% is freely accessible to free-market actors (International Oil Companies [IOCs] and Independents), while 75% is controlled by governments via national oil companies (NOCs). The remainder is accessible via NOC-IOC/Independents partnerships. When it comes to the new unconventional energy sources, public acceptance is an issue.

Natural gas: At present consumption rates, we have 250 years of resources; at an annual trend growth rate of 2%, we have 75 years. Gas will thus plateau much later than oil. Only 7% of gas is freely accessible to free-market actors, while 56% is controlled by NOCs via their governments. The remainder is accessible via NOC-IOC/Independents partnerships. The recent unconventional gas revolution reminds us that technological progress and innovation open up new resources. They also humble us through a reminder that our forecasts can be completely wrong, as the US shale gas revolution took the industry largely by surprise – reframing the situation from an expected deficit to a bonanza in a few years. Again, public acceptance is an issue.

The New Abundance

According to the literature, there is a 'significant risk' of a peak in production of conventional oil before 2020, and a peak is 'likely' before 2030. After the peak, production is expected to fall 2–4% a year. But there is plenty of oil in unconventional places (for example, the deep ocean off Brazil and the Arctic) and lots of unconventional oil (heavy oil or shale oil) and unconventional gas (via hydraulic fracturing or ocean hydrates). Without significant technological developments, exploitation of most of these reserves will be expensive and difficult to expand fast enough to compensate for an early peak in conventional oil production. The debate on the effect this will have on hydrocarbon prices continues. Confidence in continued high prices would presumably lead to increased investments in turning coal and gas into oil – as well as in renewables.

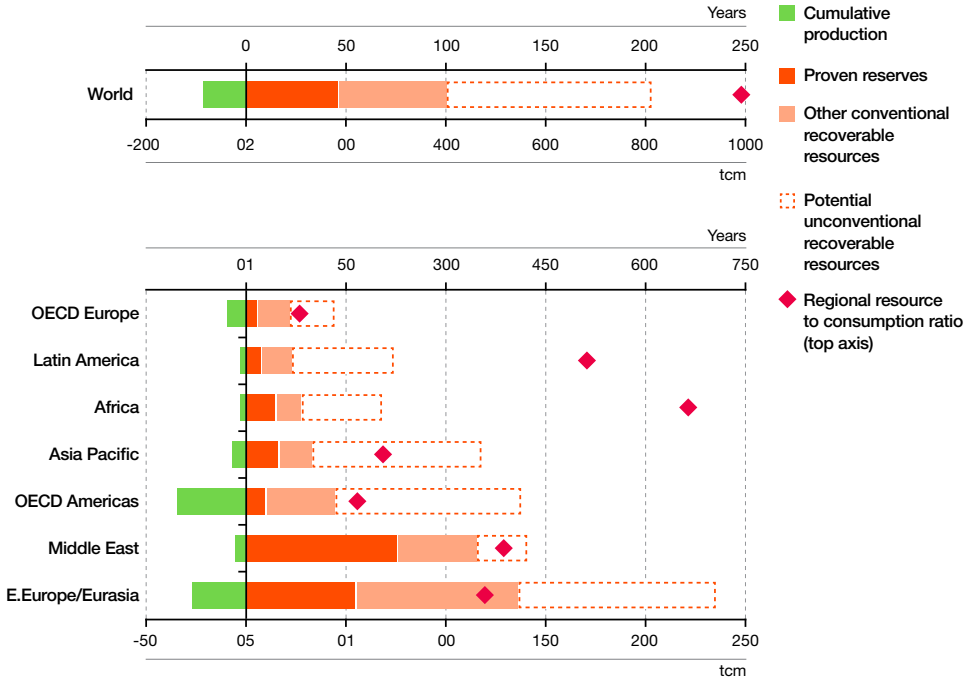
Coal: At present consumption rates, we have 140 years of resources; at an annual growth rate of 1%, we have 75 years. This resource is freely traded, with the largest deposits being in North America, China, Mongolia, Australia, South Africa, and Colombia. Coal, of course, can produce local air pollution via SOx, NOx, and particle emissions. Coal is strongly associated with global warming: for example CO_2 emissions from coal are twice that of emissions from gas-fired generation. In addition, coal plants not located on coasts produce a significant water footprint.

Nuclear: We have sufficient uranium ore to meet demand for 100 years or more. Nuclear power raises issues of societal acceptability, ever-spiralling costs, long-term storage of waste, and the size of the cooling water footprint for non-coastal power stations. Cost issues arise from not having plants built regularly and of societal risk aversion, driving out schedules and demanding ever more technology. Nuclear presents a dilemma between social acceptability (fear of accident) and the need for cost-effective energy security and low emission electricity. At present, there is an under-investment in R&D for fusion technologies.

Renewables: We have enough solar and wind resources for 9 billion people to have a European lifestyle. In addition, we have sufficient biomass potential to replace 50% of our present oil consumption on an equivalent basis. Biomass, however, competes with land and water use for other purposes. Costs for *solar photovoltaic* have been dramatically reduced and are rapidly reaching on-grid parity. The decentralised nature of solar PV challenges existing grid topologies and business models. The issues include costs, location away from major demand centres, intermittency, lack of storage, and inadequate transport technologies. For *concentrated solar power (CSP)*, water usage must be addressed through technology solutions such as liquid salts and self-cleaning mirrors, and the water footprint limits desert use. Onshore, *wind energy* is competitive with most sources. Issues include costs for grid connection and intermittency, offshore construction costs, footprint, and social acceptability near houses and in nature.

The New Abundance

Recoverable gas resources and production by region and type, end-2010.



Notes: Cumulative production to date is shown as a negative number, so that the total of the bars to the right indicates remaining recoverable resources.

Sources: Cedgaz (2010); USGS (2000 and 2008) BGR (2010): USDOE/EIA (2011); IEA estimates and analysis.

Growth

The solution will be technology, not policy-led.

Professor Ernie Moniz, Director, Energy Initiative and Director, Laboratory for Energy and the Environment, MIT, Re|Source 2012

In ***Growth***, diverse partnerships push forward advanced technologies in order to develop more oil and gas at more remote locations and in technically and environmentally difficult areas. Governments, who are mostly concerned about energy security, welcome these partnerships. However, tolerance for mistakes is low, with societies, in effect, saying, "Fail, and you will pay compensation as never before."

To deal with the increasing complexity of markets and requirements for regulation, governments turn to the industries themselves, where the expertise lies. The big players, who are often active in existing resource plays and emerging technologies (once found or developed by smaller players), come forward with proposals to introduce more stringent regulations, which serve to satisfy the demand for zero failure, but which also make it much more difficult for new entrants to enter the market.

A favourite tool for delivering energy security in demand-holder countries is a free and competitive market, which ensures sufficient diversity of supply at lowest costs. However, major resource holders continue to find ways to ensure maximum value for their resources, by, for example, continuing their subsidized domestic energy systems. Subsidies in demand-holding countries are often opaque when it comes to standards, feed-in tariffs,[10] or other obligations. Opacity is required, as the marginal cost-pricing principle does not deliver new investment in infrastructure, particularly in electricity and transmission systems.

Companies increasingly focus on reducing their environmental footprints, mainly driven by efficiency (reducing waste and thereby costs), but also to ensure their licenses to operate.

Nevertheless, the supply-driven focus for delivering energy security and the private responses for increasing efficiency are not enough to cope with the unyielding demand growth from the emerging economies. As the price mechanism becomes more and more unpalatable to the lower income households in the developed nations, citizens begin to call for demand policies such as tax incentives to share private transport, incentives for living close to work, charges for congestion, and increased capacity of public transport.

10 A feed-in-tariff is a policy mechanism designed to accelerate investment in renewable energy technologies. It achieves this by offering long-term contracts to renewable energy producers, typically based on the cost of generation of each technology.

Health

In ***Health***, policy is designed not reactively, as in ***Growth***, but with more balance upfront in demand as well as supply measures to ensure security of supply. Gradually, too, the maximizing of short-term economic growth and return on investment is emphasized less in judging companies and nations. Policymakers and industries look more at steady, sustainable improvements in living standards. The precautionary principle is important, and increased transparency increases trust as well as a greater tolerance for genuine mistakes in learning processes. However, for existing mature technologies and practices, the 'zero tolerance' for failure is as high as it is in ***Growth***.

In ***Health***, energy companies, governments, wider business and civil society stakeholders design and roll out regulations to cope with increasing complexity. This produces huge tensions between developed and developing nations, sometimes spilling over into the streets in bouts of nationalist pride to protect deep-rooted cultural values deemed too far from what is considered 'correct' in this modern world.

Markets continue to play a crucial role in a globalizing world, but the cost of the transition of the energy system is made much more transparent. More and more people, especially in developing nations, begin to pay the full costs of newer, more sustainable solutions. The benefits of low marginal-cost power, more resilient supply, better balance of payments in consumer countries, and lower health care costs become apparent slowly, over time. Offsets in income tax are designed to steer the behaviours in the right direction, but, as always, there are unintended consequences. What most clearly characterizes the energy system in ***Health*** is the shift to 'built-in' rather than 'bolt-on', such as compact city design, segregated traffic lanes to encourage low-carbon transport, logistics optimization, dematerialization, and the emergence of more service-driven economies.

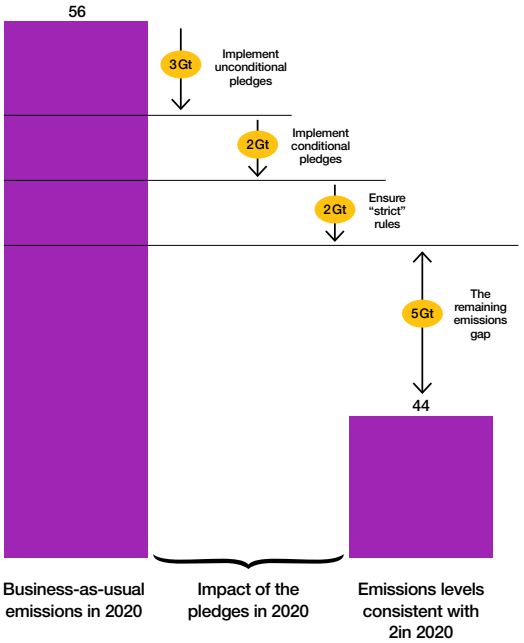
Climate Change

Background

The first Earth Summit, in Rio in 1992, gave rise to the United Nations Framework Convention on Climate Change (UNFCCC) and the formation of an Intergovernmental Panel on Climate Change (IPCC). On the basis of the best available climate science of the time, the Kyoto Protocol to the UNFCCC was agreed, which required industrialized countries to reduce emissions on average by 5.2% below 1990 levels, by 2012.

Despite improvements in the IPCC climate science and regular updates of implications for policy makers, intergovernmental negotiations on climate change have become characterized by political gridlock, with questions about differentiated responsibilities revealing tensions and divides within and between the positions of developed, emerging, and developing nations. The slowness of reaching any agreement to a legally binding successor to the Kyoto Protocol catalysed the Copenhagen Accord in December 1999, a non-binding document endorsing the continuation of the Kyoto Protocol.

The Climate Gap
Emissions pledges and goals.



Source: "The Emissions Gap", UNEP, 2010.

The Copenhagen Accord calls for deep cuts in global emissions, pointing out that these cuts are required "so as to hold the increase in global temperature below 2°C" and calls for an assessment that might lead to a revision of the long-term goal of holding the increase to below 1.5°C. The Accord also includes targets for developed nations to provide the capital and the incentive for developing nations to help reduce their carbon intensity and to help accelerate the transfer of clean technology and capital tailored to each developing country's needs. Since 1999, 140 countries have associated themselves with the Copenhagen Accord. Of these, 85 countries have pledged to reduce their emissions or constrain their growth up to 2020.

In spite of this progress, UNEP recently reported that a "gap" is expected in 2020 between emission levels consistent with current modelling of a 2°C limit and those resulting from the Copenhagen Accord pledges. The size of the gap depends on the likelihood of a particular temperature limit and how the pledges are implemented.

Meanwhile, despite slow progress in the international policy sphere, a number of grassroots initiatives, such as the C40 Initiative and the Transition Towns movement, have picked up the climate change agenda.

The Climate Gap

The aim of the Kyoto Protocol was to have a 'likely' chance (greater than 66%) of staying below the 2°C temperature limit. To have a 'likely' chance of staying below the 2°C temperature limit, global emissions should be around 44 $GtCO_2e$ (range: 39-44 $GtCO_2e$). But according to business-as-usual projections global emissions in 2020 may be around 56 $GtCO_2e$ (range: 54-60 $GtCO_2e$). This leaves a gap of about 12 $GtCO_2e$ (range: 10-21 $GtCO_2e$).

Growth

In ***Growth***, a coalition of the willing, which is pushing forward climate change mitigation and resource security agendas, finds common ground in shared concerns about market failures for environmental goods and services. A key tool in tackling climate change is the pricing of carbon and the creation of a market to incentivize mitigation responses, such as improving energy efficiency of existing infrastructure and promoting the uptake of clean technology. Climate change is perceived as a challenge to be solved by technology, driven by getting the pricing signals to work correctly. Environmental issues are framed as 'externalities' and brought 'inside' by creating ad hoc pricing mechanisms or taxes.

While carbon pricing is the obvious first step, progress is largely at a standstill when it comes to establishing a clear and stable, global regulatory framework within which the price mechanism can ensure economically efficient reductions. Meanwhile, business leaders actively strive to reduce the carbon footprint of their global supply chains in response to the growing environmental activism of urban middle class consumers who sense climatic variability as the harbinger of climate change. On the other hand, while understanding the need to attend to an individual firm's environmental footprint, corporate leaders are still primarily focused on delivering the short-term returns on capital expected from an increasing number of individual and institutional shareholders.

As global agreements appear to be inadequate for ensuring that emissions targets are reached, a coalition of banks, institutional investors, and business leaders step forward to establish the world's first global carbon trading mechanism. Despite initial teething difficulties in carbon accounting and verification, trading of carbon is unleashed, and a couple of carbon bubbles later, a relatively stable global price is established.

Coca-Cola Enterprises

At RelSource 2012, John Brock, Chairman and CEO of Coca-Cola Enterprises, Inc., asserted that sustainability is seen as an opportunity and is "at the heart of what we do – we don't make investments without considering sustainability." Coca-Cola Enterprises' goals include that by 2020:

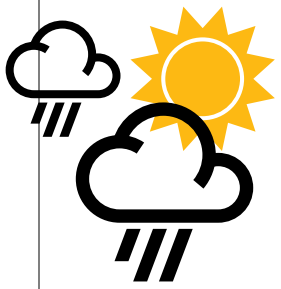
Coca-Cola's carbon footprint will be reduced by a third; water consumption will be reduced from 1.4 litres per litre of product to 1:1; and 100% of packaging will be recycled or reused. "We view ourselves as a growth company but with a very low carbon, zero waste profile."

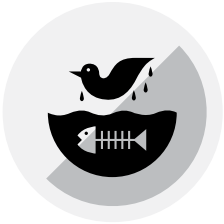
Health

The effects of climate change are most keenly felt at the local level, particularly in developing nations. This claim has been championed by the C40, originally a group of 40 cities around the world that are acting locally and collaboratively to reduce greenhouse gas emissions. The group has now expanded to 58 affiliated cities and aims to make a global impact. The formation of the C40 can be interpreted as an early sign of a polycentric governance frame for climate policy, such as advocated by Nobel Prize-winning economist Elinor Ostrom.

Under a ***Health*** framework the climate is only one part of a complex interlinked nexus of food-energy-water-climate-population. You cannot solve one part without affecting all the others. These linkages are explored to develop co-benefits in policies and actions that affect the nexus.

Unlike the 'trickle down' approach of ***Growth***, leadership and innovation in ***Health*** flows both ways, with a great deal of emphasis on innovative grass-roots investment models for local communities and entrepreneurs to tackle local resource challenges.





Acumen Fund

If you look at Ghana, the World Bank and other agencies have spent over $60 million on a national land registry system, but you can count in hundreds the number of parcels that have been registered or certified. We've invested in a company that will register smallholdings at $100 a pop – already 1500 have been registered.

Jacqueline Novogratz, Founder and CEO, Acumen Fund

The Acumen Fund is a non-profit, global venture fund that aims to solve poverty through the potential of entrepreneurs. These entrepreneurs operate in the areas where the markets won't go and governments have failed. The Acumen Fund links these entrepreneurs to 'patient capital' – long-term investment capital, often backed in the early stages by philanthropy, which measures its success by long-term social impacts and only secondarily on the profitability and long-term viability of those companies that it is building.

Land Security

Background

The question of food security is not about shortage per se, but rather other issues such as distribution, markets, and use of potential resources.

President Paul Kagame, Republic of Rwanda, Re|Source 2012

The surge in farmland and commodities investments is causing widespread concern about 'land-grabbing'[11] and the acceleration of biodiversity loss, water depletion, soil erosion, and human rights abuses. Given resource demands and the limits to how much fertile land is available, these investments are expected to grow substantially over the next decade. Fund managers in New York and London increasingly see farmland as a 'real asset' that offers portfolio diversification at a time of global market volatility. And governments in countries such as China, where water scarcity is already compromising domestic food production, see a secure and stable supply of resources as a matter of national security.

Earth Security Initiative (ESI)

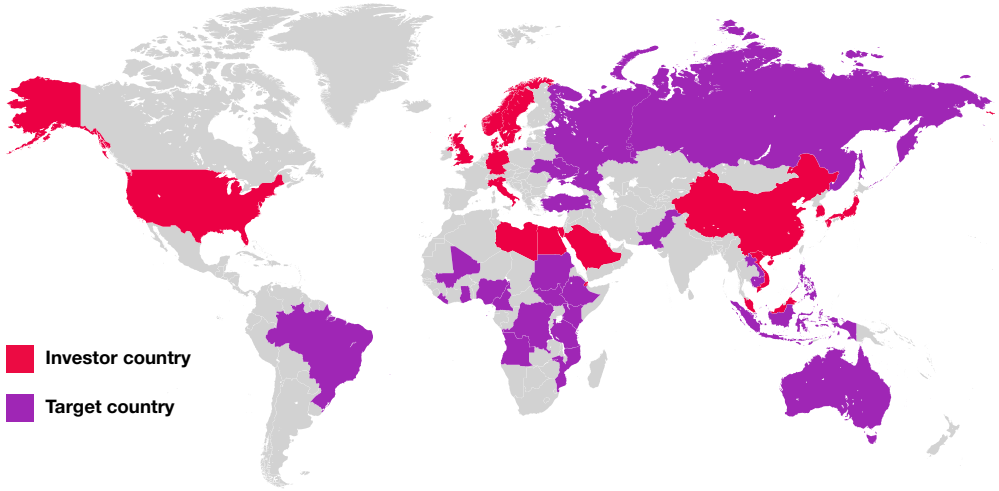
The competing demands for fuels, food, water, and materials ultimately depend on a single, finite asset: land. In the next decade, the growing interest of investors in land investments will critically define food security, economic growth and environmental conservation goals. The ESI is a platform that translates the risks and opportunities associated with land-use change to investors. With the support of inter-disciplinary research and integrated data it brings together stakeholders to discuss how land investments can contribute to long-term security. The ESI created The Land Security Agenda, a framework for evaluating the investor and country risks in farmland, and the opportunities to create long-term value. The agenda argues that keeping pressures on land within sustainable thresholds will be increasingly difficult unless financial markets, companies, and governments adopt a series of proposed measures to incorporate resource limits and human security more effectively into their capital allocation decisions.

11 The term is not without irony, when contrasted with the tactics historically wielded by the former colonial powers whose descendants mainly profess it.

These trends are resulting in a global rush for farmland where the soil is still fertile and water is still available. In just ten years, over 200 million hectares have been reportedly leased to investors for agricultural development by host governments, who are often accused of ignoring the interests of their own populations. In places like Sudan, Mali, Mozambique, and Ethiopia, this development has raised widespread concerns over forced evictions, social vulnerability, and dwindling water resources. In other places, such as Australia, the recent news that over 10% of its farmland is already in the hands of foreign investors is raising a contentious political debate. Countries such as Brazil and Argentina have already erected legal barriers in relation to the amount of farmland that can be owned by foreigners. Land use matters are also a deeply political issue in domestic politics. In 2012, the death of poor tenant farmers and police officers in Paraguay following a violent conflict over a land tenure dispute resulted in the overthrow of the country's president.

The world's population gets about 75% of its sustenance directly, or indirectly in the case of meat, from just four crops: maize, wheat, rice, and soybeans. A recent global crop-yield analysis has revealed that warming temperatures have already diminished the rate of harvesting of these crops over the past three decades.[12] In grain-producing hubs, including the United States, Ukraine, and Russia, droughts have compromised harvests, raising concerns in global markets that export restrictions might be imposed, leading to possible political unrest.

Investor and Target Regions and Countries in Overseas Land Investment for Agricultural Production – 2006 to May 2009

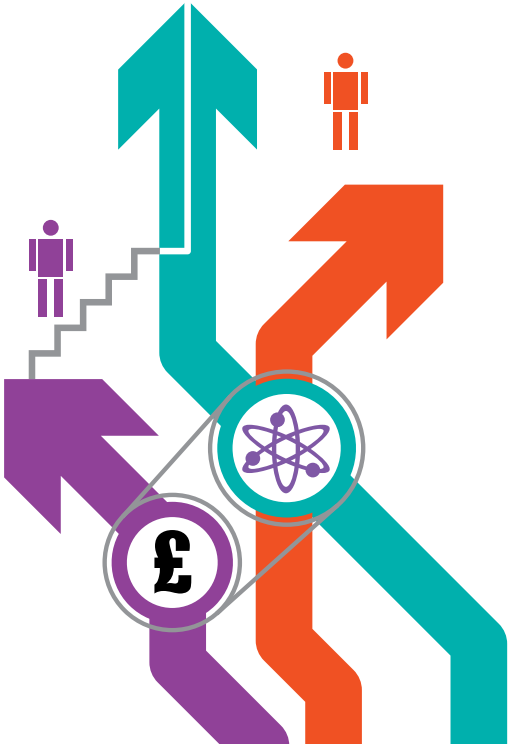


12 David Biello, "Cereal Killer: Climate Change Stunts Growth of Global Crop Yields," *Scientific American* (May 2011), http://www.scientificamerican.com/article.cfm?id=climate-change-impacts-staple-crop-yields.

Growth

In ***Growth***, land-related initiatives focus on ensuring that the land required to meet the demand for food, fuels, and materials is managed intelligently and is legally, politically, and socially stable. Investors, companies, and governments minimize the externalities created for local communities, local economies, and the environment in new ways. More and more land is subject to private ownership, and property rights extend to oceans, incentivising marine-based enterprise (mining, water, food, energy) as a means to overcome limits to growth. Attention to land rights, soil erosion, and water availability, figure centrally in business strategies, and due diligence processes are informed by the growing public debate. In land-related sectors, gaining and maintaining a 'social license to operate' by minimising 'impacts' dominates business.

Non-government organizations evolve frameworks designed to help land investors and companies improve their risk-management strategies and support social stability. The growing practice of quantifying resource limits increases the understanding of emerging risks. Business and investors focus on managing the expectations of various stakeholders while governments attempt to redress the negative impacts of land investments for local communities and natural resources. Cross-sector dialogue helps improve everyone's understanding of the risks and limits of land assets. Meanwhile, as global companies increase their share of world markets, popular sentiment against foreign investments in land begins to grow.



In ***Growth***, economies of scale, the measurement of environmental footprints, Footprints of value chains, and efficiencies in land productivity are heralded as signs of progress. The focus is on a 'more' economically efficient resource use on a domain-by-domain basis, and better results in mining, food, and water production, both onshore and offshore, resulting in more virtual water transfers via global trade. The debate between 'big vs. small' farming still dominates the domain of agriculture and food security. Companies and investors manage the growing political risks around national sovereignty by entering joint ventures or taking direct controlling stakes with domestic funds in farmland, forestry, biofuels, and mining.

A second green revolution in Africa results in a mass migration of unskilled labour to jobless cities, adding to the pressure borne by megacities across the continent. The continued focus on export markets creates public revenues through export tariffs and modernizes agricultural sectors while at the same time leading to the mismanagement of food security and livelihoods. Non-agricultural sectors, like mining and energy, increasingly compete for the same resources. In places like Australia, a growing tension between agricultural and energy companies in their use of water creates complex resource governance challenges that cut across government ministries. In other cases, like Brazil, mining and energy companies vertically integrate in the agriculture sector to produce biofuels with which to meet their growing costs of energy. Managing these trade-offs becomes increasingly difficult for governments, which rely on the growing role of corporations and public-private partnerships to help regulate resources more efficiently.

Health

In ***Health***, land-related initiatives, while not ignoring resource stewardship, emphasize land quality rather than land management, as opposed to the ***Growth*** focus on 'more'. ***Health*** incorporates the value of biodiversity and resilience of ecosystems as ways to increase resilience to weather uncertainties. The agenda is based on a more inclusive approach to land tenure by the poor, which begins to redefine capitalism as large companies work in partnership with local producers. Many of the ideas are based on the work of Peruvian economist Hernando de Soto,[13] who found that what distinguishes those countries that succeed at capitalism from others that fail is the legal structure of property and property rights. At one time, he argues, every developed nation in the world has undergone a transformation from the predominantly informal ownership of land to a formal, unified, legal property system. Developed countries seem to have forgotten that this is what has allowed people to leverage property into wealth.

13 Hernando de Soto, "The Mystery of Capital: Why Capitalism Triumphs in the West but Fails Everywhere Else," New York: Basic Books, 2000.

In this scenario, land-related initiatives explore how ecological limits and human security may propose a more fundamental reformulation of business, markets, and regulation. Cross-sector dialogue helps companies, investors, and governments understand how to deploy and regulate capital in a new way, where redefining land ownership becomes the centrepiece to ensure the stewardship of resources and livelihoods. The focus is on business creating value with stakeholders, focusing on win-wins and valuing co-benefits rather than simply managing its impact on them. Governments take a proactive approach to reform and regulate land use with the goal of enabling long-term value for their populations by improving quality and encouraging strategic investments that modernize and upgrade the agricultural sector.

A focus on win-win production contracts helps aggregate and improve the capacities of individual poor farmers, providing them with skills and technology. Just as in the transport sector, business strategies are designed based on distributed networks. Using the model of car-sharing schemes in large cities or distributed electricity re-charging networks, agricultural business models better integrate the role of small-holder farmers into a radical rethink of their value chains, comparative advantage, and long-term viability. In ***Health***, a networked approach to land tenure and productivity renders the 'big vs. small' farming discussion less important. The focus on the health of small individual nodes leads to surprisingly productive large systems.

While the agriculture sector is the largest consumer of water, the resource trade-offs with other land-related sectors, such as mining and electricity generation, persist. Minerals prospecting and hydropower plants place strains on the irrigable land available. To deal with this complexity, governments create regulation hubs that coordinate government ministries to ensure that resource demands across sectors remain within limits. Water-scarce countries like Singapore, China, and Saudi Arabia, aware of the critical role that land plays as a resource nexus for water and energy production, lead the way in designing global regulation hubs that also support smallholder farmers in developing countries through international production contracts.

Changes in ***Health*** are inevitably uneven, as some experiments succeed while others fail. The resulting inequities increase global tensions, and equity and access issues are exacerbated. Price controls emerge in some regions in an attempt to stabilize the system, but while the challenge is global, given the inter-connectedness of global food and commodities markets, the politics of food and production remains starkly national, with most countries having to find their own dynamic balance between land use and food security.

Infrastructure

Background

Any human activity that involves energy provision, fresh water of a given quality, storage, transport, communications services, or physical support requires an infrastructure. While we usually think of infrastructure as man-made, the natural infrastructures of the ecosystem – for instance, the nexus of rivers, lakes, and forests that water utility companies rely on for water recycling filtration and delivery of their raw material – often form the basis of the man-made infrastructures that drive the modern economy.

Important though it is, infrastructure has not always developed on the basis of careful planning, as demonstrated by the instances of canal mania and railway booms in economic history. The need for infrastructure in order for political and corporate empires to get where they are going often drives investment. Think of the 1st century (AD) Fosse Way in the UK, a Roman road that still astonishes for its unswerving directness; the Grand Canal of China, still the longest canal in the world, more than 2000 years on; or the sewage system Joseph Bazalgette built for London 150 years ago, which allowed MPs to come to work without having their noses assailed by the Great Stink. Many pieces of manmade infrastructure are monuments to power, and all of them, directly or indirectly, happen to rely upon the ecosystem.

In the modern economy, infrastructure plays a number of fundamental roles. For example, it facilitates economic activity by making it possible for people to move themselves, their stuff, and their information. It facilitates access to energy, water, and other resources. With its limited capacity, it regulates the rate at which resources are used and the allocation of such resources to different users. In this way, human infrastructures mimic some of the functions played by the planetary ecosystem.

However, there is a key difference. Natural infrastructures form slowly and are met by ecosystem checks and balances. The checks and balances shaping man-made infrastructures are largely political and economic, but not ecological. Thus, more roads are built in response to congestion even though more roads are known to encourage yet more traffic, with all of the environmental impacts that follow. Water-based infrastructures designed to deliver power or water often redistribute water within the ecosystem as well as between countries or regions. The drying up of the Aral Sea, caused by a massive irrigation project, is an extreme example. Time will tell whether the water-based infrastructures within the Amazonian rainforest (such as the several dams[14] planned for the Amazon basin, which happens to contain the largest river system on the planet, ten times larger than the next one down) are to become the largest monument to human folly in the context of infrastructure building.

14 Michael Smith, "Brazil's All-in Bet on Amazon Dams Jeopardizes Economic Growth," Bloomberg News, 11 April 2012. Accessed on September 9th 2012. http://www.bloomberg.com/news/2012-04-11/rousseff-roils-amazon-as-brazil-hydropower-makes-people-homeless.html

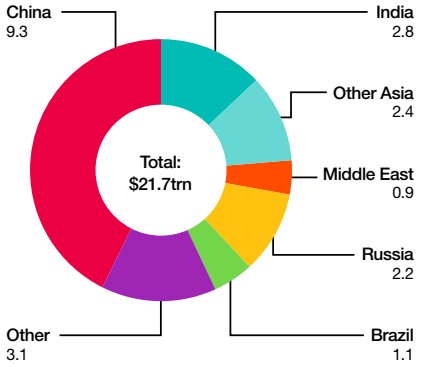
As populations grow and require more energy, water, storage, transport, and communication to drive their economies, the obvious response is to increase supply by expanding supply side infrastructure. Infrastructure is built on both a grand scale and a piecemeal, project-driven basis. As an example of this piecemeal approach, the UK's High Speed Rail 2 (HS2) project does not appear to incorporate a plan for energy infrastructure that might be needed to support its environmental goals.

Once any kind of infrastructure is built, it sets a pattern of usage in the resources it delivers to the user, sometimes forcing investment in other pieces of man-made infrastructure impacted by the knock-on effects of higher volumes. In the natural ecosystem, infrastructures regulate resource usage, but the only inbuilt regulation furnished by man-made infrastructures is to maximize resource usage until the capacity buffer is reached (unless the human regulator steps in). At full capacity, economic considerations tend to demand greater investment in maintenance of overloaded infrastructures.

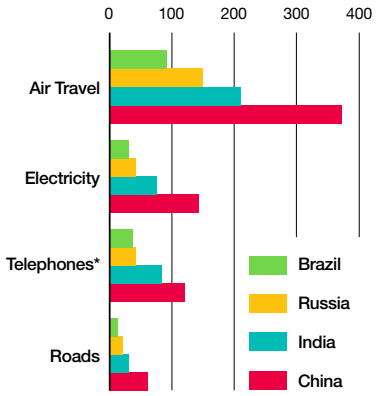
Utility regulation has the job of keeping several irreconcilable spinning plates in the air – on the one hand, encouraging firms to price energy or water so that demand is managed and social needs such as universal access are met, and on the other, making sure investment and maintenance deliver an infrastructure that is fit for purpose at a cost the economy can afford.

A Bridge to the Future

Infrastructure investment in emerging markets 2008-17 forecast ($trn)



Growth in infrastructure demand 2008-17 forecast (%)



Sources: Morgan Stanley; Goldman Sachs; *The Economist*; www.economist.com/node/11488749
*Fixed and mobile

Growth

In ***Growth***, conventional infrastructure facilitates throughput until limits are reached. Infrastructure itself serves to stimulate trade, helping to lock in the consumption growth model. In the absence of global regulatory systems for the global free trade system, infrastructure gradually leads to a destruction of the global commons.

Meanwhile, developing countries build more infrastructure as they grow, using the Western consumption and infrastructure models that they have imported. In this way, infrastructure designed for throughput hardwires the Western model in developing countries. In China, more infrastructure means more coal-fired power and more nuclear on a mega-scale with mega-projects to meet the fast-growing demand from mega-cities.

The democratized structure of the new communications infrastructure at first appears to be reshaping the political economy and facilitating a shift towards a better balance between economic and environmental concerns. But this trend is discovered to be illusory because both the physical infrastructure that facilitates virtual activity and the physical activity generated by virtual activity rest upon an infrastructure designed on the growth model.

Health

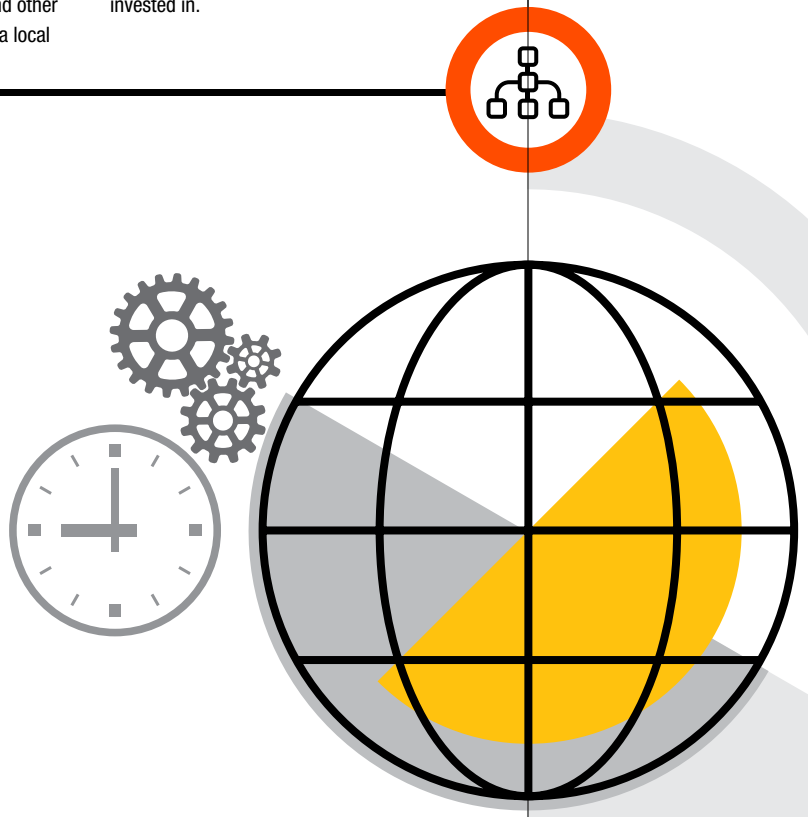
The world of ***Health*** recognizes the analogy between infrastructure and the human brain – with all its implications for the question of what we do with incumbent infrastructures. As the relatively unstructured infant brain matures, experience progressively hardens the most-used pathways. The rigid infrastructure in the adult brain confers speed and strength, but adaptation in response to disease or injury is often impossible. So it is with growth-driven, man-made infrastructure.

In response to this recognition, more countries begin to transform infrastructure through strong policy decisions similar to decisions made by a few around the turn of the century: Germany setting a solar power generation record, in spite of 'British-type' weather; or Costa Rica choosing to follow a renewable energy pathway instead of exploring for oil.[15] Along with these national policy decisions, regions and cities begin to move towards distributed infrastructure, and many communities experiment with local initiatives utilizing, for example, green energy, community gardens, bike pathways, and incentives for energy efficiency, including smart power grids. Even though these systems often cost more initially, they are seen to be more resilient, flexible, and frugal in the long-term.

15 Former U.S. President Bill Clinton, RelSource 2012.

Acumen Fund - Entrepreneurs Reaching Those Who Were Unreachable

Seven years ago the Indian government declared that 65 million people in the State of Bihar were economically impossible to reach with conventional electricity. Entrepreneur Gyanesh Pandey, backed by grant funding, spent three years experimenting to develop a successful micro-generation system. After failing repeatedly with solar, jatropha, and other sources, Pandey took rice husks, a local farming waste product, and gasified it into a source of electricity. Now able to build micro-grids in far-flung rural areas, he has reached 250,000 people with affordable clean energy. The process needs a government subsidy to get to an affordable price point, but Pandey now has a viable business model that capital can be invested in.



Business Models

Background

How do we ensure that resilience is properly priced?

Rowan Douglas, CEO Global Analytics, Willis Group, and Chairman, Willis Research, Re|Source 2012

Although a growing number of social entrepreneurs and traditional state-owned enterprises blur the distinction between a for-profit and a for-charity enterprise, in general, these two dominant business narratives have evolved over the centuries with corresponding legal structures. Of the two, for-profit enterprises tend to be the most efficient.

When it comes to economic activity, efficiency rules. Lean manufacturing and just-in-time delivery, among other best – that is, most efficient – practices help deliver wealth to some and opportunity to many. Meanwhile, the Internet is revolutionizing not only business but also service industries, including publishing, music, and education. Technological developments such as additive manufacturing, including 3-D printing, will likely also challenge current manufacturing models.

In this context, there is no shortage of solutions to the resources crisis. Responses range from the technical (such as insulation of buildings) through the behavioural (such as lowering consumption) to the financial (such as 'patient capital'). Given the demands of the economy, the question is not whether there are solutions but how you get from the solutions, in principle, to the application of solutions on a relevant scale?

And what role do government actions play in this? Business clamours for light and stable regulation, and politics affirms that this is indeed a shared aim. But even with proper regulation, how do we establish whether the rules are being followed? Some believe that "accountants will save the world,"[16] implying that increasing transparency and detailed reporting will deliver. Yet the process for setting the Libor index was completely transparent to competent regulators and still ended in tragedy. What alternatives exist to the simple assessment of compliance leading to transparency and the possibility of relevant action?

It is sometimes said that we will have 3 billion new middle class consumers on the earth by 2030.[17] Barring major epidemics, population will indeed grow – but how will these new people form their social norms of consumption? Is the middle-class taste for more resource-intensive goods a natural predilection? Or is it acquired, and if so, how? How might different tastes come about?

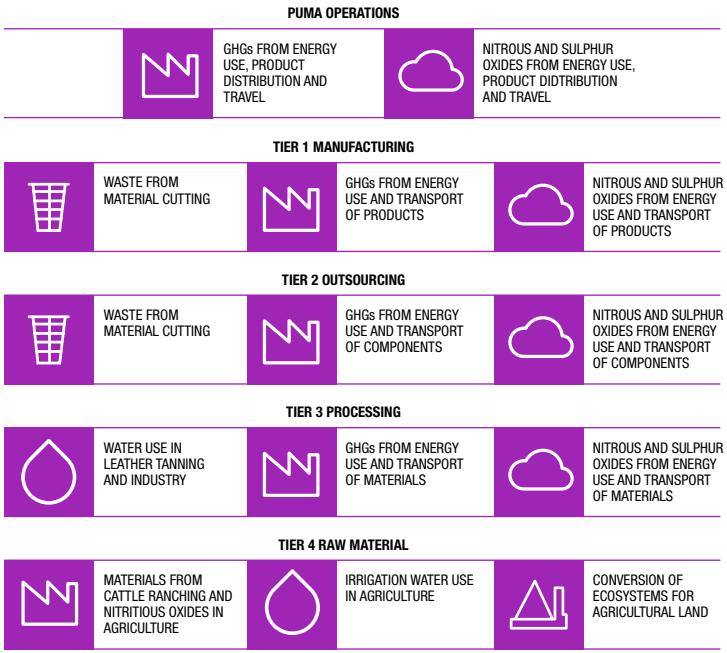
16 Peter Bakker, President, WBCSD, said this at Rio+20. http://bit.ly/OxCh37.
17 "Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs," McKinsey Global Institute and McKinsey Sustainability and Resource Productivity Practice, November 2011.

PUMA and the Environmental Profit and Loss Account (EP&L)

For the year 2010, inspired by The Economics of Ecosystems and Biodiversity (TEEB) study, PUMA undertook an economic valuation of its environmental impact, seeking to discover how much compensation PUMA would have to provide if nature was asking to be paid for the impact of PUMA's manufacturing process and operations during the fiscal year.

Presented like a traditional profit and loss account, the results revealed that if PUMA treated the planet the same as any other service provider, it would owe nature 8 million dollars. An additional 137 million would be owed from PUMA's supply chain of external partners, representing 94% of the total environmental impact.

PUMA's Supply Chain and Related Environmental Impacts



Source: "Annual Report 2011" PUMA Group

Growth

In ***Growth***, resource efficiency is seen as the next wave of innovation. For years, IT has delivered value through disintermediation, leading to new business models. In ***Growth***, resource efficiency is achieved through monetizing waste and turning things into services.[18]

While the supply chains crises created by Fukushima and the Bangkok floods in the early part of the century have led to reflection on the resiliency of supply chains, the benefits of the economies of scale from concentrating production easily outweigh the occasional disruptions from extreme events. Scaling-up solutions to the resource crisis are concentrated on industrial rollout at large scale and to issues identified by the power elites. Clarity, analysis, and willpower drive these growth scale-ups, including, for example, Desertech's concentrated solar power mega-project in the Sahara, which delivers 15% of Europe's power by 2033.[19]

Private industry continues to struggle with the vagaries of the regulatory environment, arguing that sub-optimal regulation is better than the ever-changing kind. In some geographical areas, such as in parts of Africa, and in some sectors, notably the financial sector, regulation enforcement continues to be haphazard. A growing global emphasis on transparency does begin to make regulation enforcement more reliable, as larger parts of the Global Resource Initiative framework become embedded in legal obligations.[20]

While local tastes continue to delight travellers, globalization carries on apace, with IKEA sofas and Starbucks coffee, among many other global brands, supporting the gradual homogenization of tastes. Billions of new consumers aspire to the life depicted through the ubiquitous global media channels.

18 James Bradfield Moody, author, *The Sixth Wave*, RelSource 2012.
19 Caio Koch Weser, Vice Chairman, Deutsche Bank Group, "Resource Efficiency = Shareholder Value." Panel, RelSource 2012.
20 www.globalreporting.org/

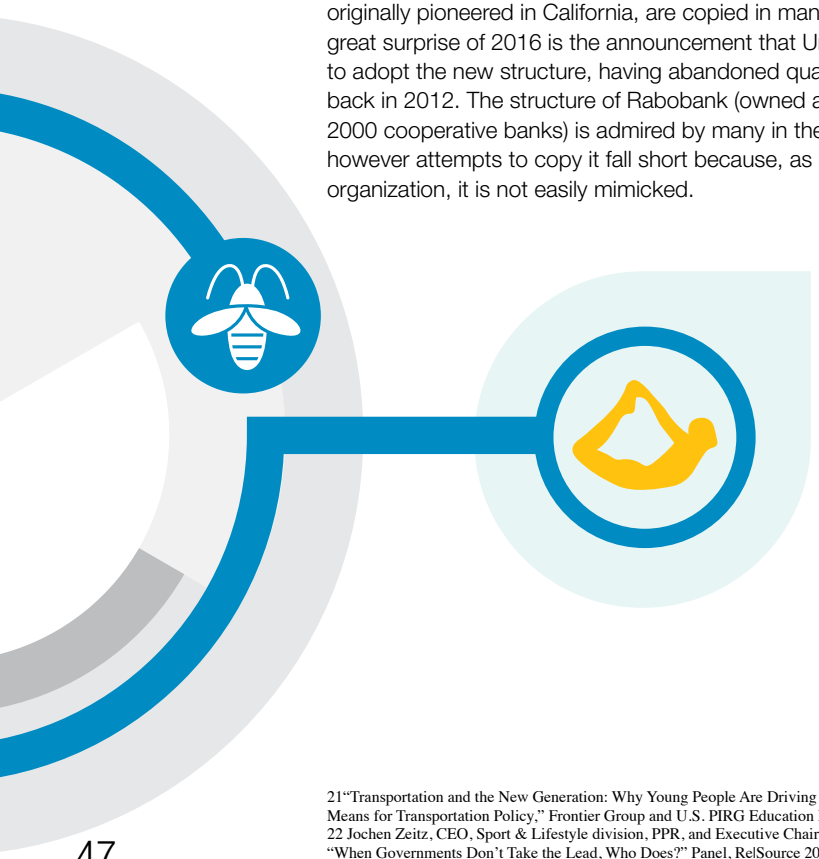
Health

A B-Corp structure is a real opportunity as the legal entity can declare its real purpose to stakeholders.

Former U.S. President Bill Clinton, Founder of the William Clinton Foundation, Re|Source 2012

In ***Health***, social norms are seen as very sticky, but ultimately dependent on their context. They co-evolve with policy and resources – for example, Internet use continues to lead young consumers to spend less time in cars, a trend first noted in 2012.[21] Social networks lead to the first major re-alignment of consumer tastes by presenting lower-footprint products and services as a status symbol. Business is even more bullish about the ability to drive a change in norms: "We can't wait for the consumer: after all, who invented the consumer in the first place? It was business."[22] Some political leaders also grasp the power of setting expectations to influence consumption habits.

Structure also influences norms. In ***Health***, for-benefit corporations, originally pioneered in California, are copied in many countries.[23] The great surprise of 2016 is the announcement that Unilever has chosen to adopt the new structure, having abandoned quarterly reporting back in 2012. The structure of Rabobank (owned and managed by 2000 cooperative banks) is admired by many in the financial industry, however attempts to copy it fall short because, as an emergent form of organization, it is not easily mimicked.



21"Transportation and the New Generation: Why Young People Are Driving Less and What It Means for Transportation Policy," Frontier Group and U.S. PIRG Education Fund, April 2012.
22 Jochen Zeitz, CEO, Sport & Lifestyle division, PPR, and Executive Chairman, PUMA SE, "When Governments Don't Take the Lead, Who Does?" Panel, RelSource 2012.
23 http://www.fourthsector.net/

Patagonia

On January 1, 2012, the first day that a California-based company could change its corporate status to become a Benefit Corporation, Patagonia reregistered its corporate status. Company founder Yvon Chouinard said in a press statement:

"Patagonia is trying to build a company that could last 100 years. Benefit Corporation legislation creates the legal framework to enable mission-driven companies like Patagonia to stay mission-driven through succession, capital raises, and even changes in ownership, by institutionalizing the values, culture, processes, and high standards put in place by founding entrepreneurs."

In ***Health***, solutions to the resource crisis begin with explorations of the differences in the nature of the crisis as different people experience it, and then scaling solutions from the bottom-up through networked structures. These activities are rooted in compassion, co-creation, and growth through connections. For example, solar-powered LED flashlights hanging from poles in Haiti, which were originally installed to increase safety for women, became the seed that grew into more renewable power for the island after more top-down efforts failed.[24]

This differentiated approach has consequences for transparency and regulation, which become increasingly adaptive to local conditions. Norms of reporting begin to emphasize a range of stakeholders, not just market analysts. While it is recognized that business needs stable regulations, those rules that have systemic impact are created within term-limited review structures. In ***Health***, there is a growing awareness that systemic insight is insufficient to appreciate long-term – or even mid-term – impact.

24 Former U.S. President Bill Clinton, RelSource 2012.

Subsidies

We are on a journey to a new world, and this journey is affected by many things – technology, business endeavour, and political will. But what is the place of subsidies in this journey? On one hand, some kinds of subsidies form one of the keys for opening up the new world that we are moving towards. On the other hand, some types of subsidies are among the biggest obstacles to making progress on this journey.

Lord Mandelson, Chairman, Global Counsel, Re|Source 2012

Background

As the delegates of Resource|2012 gathered in Oxford's exam school, a small group of Spanish miners were gathered underground in Santa Cruz del Sil in stifling conditions, having been there for the best part of two months as part of a sit-in to protest government subsidy cut-backs that would have a profound impact on the local economy and jobs market. Speaking at Resource|2012, former US President Bill Clinton referred to the success of the heavily subsidized German solar energy market, which drove solar PV down the cost learning curve, yielding global benefits.

Subsidies are many and varied. They can be good or bad, but once you've got them, they tend to stick and grow. Some of the largest fossil fuel subsidies are in oil-producing countries such as Nigeria, Venezuela, and Indonesia, where they are part of the social contract to share the energy bonanza with the population. Nigeria's attempt to reduce subsidies led to mass riots. Iran offers a rare example of relative success in backing out long standing practice.

Iran's Success in Reducing Local Oil Subsidies

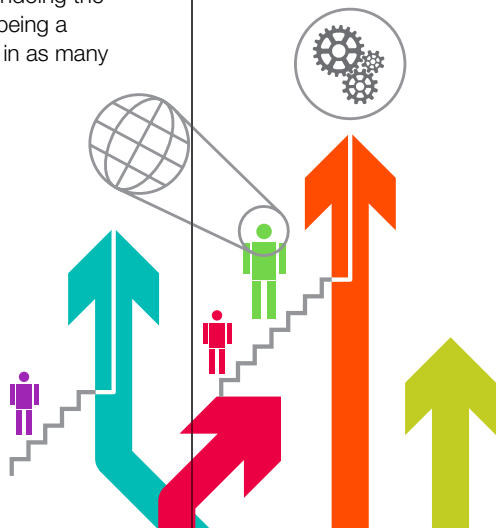
In 2011, after months of false starts, dire warnings, and political wrangling, Iran embarked on a sweeping program of cuts in its costly and inefficient system of subsidies of fuel and other essential goods, which has put a strain on state finances and held back economic progress for years. The logic was compelling: artificially low prices encouraged greater consumption, leaving less oil to export for cash. And the higher oil prices rise, the greater the 'opportunity costs' in lost exports. But the timing, whether for political or economic reasons, was never right to cut the subsidies. The subsidy cuts, which the International Monetary Fund says have amounted to $4,000 a year for the average Iranian family, began in earnest last month when the rationed price of gasoline jumped to about $1.44 a gallon from just 38 cents.

The issue of subsidies arose in every session of Re|Source 2012. The session entitled "The Economics of Resource Scarcity" considered tools and mechanisms to address market failure, including the idea of subsidies. The session on "Food Glorious Food" considered the range of significant social problems relating to the sustainability of food supplies – how to stimulate investment in agriculture, how to incentivize food producers to control environmental impacts, how to regulate global trade, and how to shift demand away from unhealthy to healthy foodstuffs. Some of these problems may have arisen because of misdirected subsidies (for instance, in agriculture), whilst others could be sorted out through carefully directed subsidies. Inevitably, the large subsidies directed towards fossil fuels were mentioned as a puzzling but persistent anomaly. As Spain's Asturian miners are all too aware, once subsidies are in place, removing them can be socially costly.

Some subsidies are not intended, and these are often non-monetary. The subtext of this conference was the problem of the non-monetary environmental subsidy enjoyed by providers and users of food, energy, and water resources, such as the agriculture, transport, energy, and consumer sectors. The effect of leaving the non-monetary environmental costs of these sectors uncovered amounts to the same thing as a significant financial subsidy. Some of the costs mentioned across the two days were: biodiversity losses and mass extinctions; destruction of ecosystem connections required for a healthy biosphere; deforestation in general, and very high-cost deforestation, such as the cutting down of the Amazonian rainforest to grow food; the emptying-out of key water resources with no thought for maintenance or replenishment; tonnes of water traded invisibly in crops exported from water-stressed regions of the world to those with plenty; emissions to air from energy use; and the emission of pollutants from other uses to land, water, and air.

The challenge is not only to remove the subsidies that damage the environment or create structural inequalities, but also to put in place subsidies – implicit or explicit - that incentivise sustainable enterprise and direct economic activity towards sustainable food, energy, and water provision. Ironically, the fact that there are at least two subsidy models – 1) planned financial subsidy and cross-subsidy (and unplanned financial cross-subsidy); and 2) inadvertent, uncontrolled, non-financial subsidy or cross-subsidy – gives rise to hope.

Enter the social entrepreneur. A social enterprise is an organization with its foot in four camps – the private sector, the social sector, non-monetary assets and liabilities, and financial assets and liabilities. In an effective social enterprise model, the organization's private sector customers or suppliers are able to compensate for intangible subsidies in its operating environment by cross-subsidizing its social sector customers. Non-monetary (unplanned) subsidies (externalities under another name), in their rightful place and properly managed, may be no bad thing. Indeed they have the advantage that they can be implemented in a distributed fashion, and can become system-wide. It's 'just' a matter of undoing the wrong thing in a few strategic places – the fossil fuel industry being a case in point – and doing the right things as often as possible in as many places as possible.



European Common Agricultural Policy

The Common Agricultural Policy (CAP) is a system of European Union agricultural subsidies and programmes representing 47% of the EU's budget - €50 billion in 2006. The CAP combines a number of subsidy levers, from direct payment for crops and land to guaranteed minimum prices, import tariffs, and quotas on certain goods from outside the EU. Reforms are currently underway (phased from 2004 to 2012) to reduce import controls and to transfer subsidies from specific crop production to land stewardship.

Growth

In ***Growth***, subsidies are seen as a tool in the economic armoury that could, depending on how and where deployed, help to restart economic growth. The tendency is to look for quick fixes, focusing on subsidising pre-existing infrastructure without re-analysing the problem.

Subsidies to encourage more fundamental shifts in the technological mix underpinning capital intensive and complex socio-technological systems, such as food, energy, mining, and transport, are less forthcoming than the imperative to provide more jobs in these sectors. The very public discussion on carbon markets, taxes, and trading gets bogged down in arguments over arcane technical aspects of economic models and in political grandstanding, lobbying, and protectionist agendas at a variety of scales. As a result, the removal of existing subsides from incumbent industries tends to get thwarted by political horse-trading. This is similar to the introduction of the EU ETS that was accomplished by the allocation, rather than auctioning, of permits to heavy energy users. This sweetening of any proposed action to the variety of interested parties results in layer upon layer of long-term economic subsides, both direct and indirect, that outlive the political will for the application first proposed.

This leaves a complicated and unfair system in place, with further efforts at balancing the system only compounding the issue. These subsides, often with competing aims and objectives, muddy the waters in terms of the true price of action or inaction and further entrench the status quo. They not only increase the challenge of identifying and taking action on environmental matters, but also create new challenges for governments in global trade and relations, as well as stifling entrepreneurs and innovation.

Health

The story of subsidies in ***Health*** is a story of the growing willingness of social and political actors to face the role of subsidies, especially hidden subsidies. As the public becomes more aware of the extent to which these subsidies shape the future through unintentionally encouraging particular forms of behaviour and harmful solutions over less harmful ones – fossil fuels over renewable sources of energy, for example – the political dialogue begins to change.

Interestingly, policy makers introduce new words to differentiate between structural subsidies to make things cheaper (still called subsidies) and those that are part of a purposeful attempt to fund the 'learning by doing' cost reduction period, being gradually phased out as costs come down. These become known as prosidies. In the ***Health*** world, this reframing has a significant effect as the essential differences between subsidies and prosidies become visible.

The growth in awareness of hidden or implicit subsidies is supported by a combination of social media and easily installed smart phone apps that foster transparency by making it easy to see the environmental 'pathway', including subsidies, travelled by any product that is purchased, from heating oil to oranges. 'Hit and run' campaigns are conducted by groups using social media to highlight one or another company to avoid 'subsidizing' (through purchasing their products) in any given week. In order to avoid being such a target, companies begin to publicize their own efforts to minimize the cost to the food-water-energy nexus connected to their activities.

At the same time that transparency and social-media-inspired activism become easier, a systems approach to the analysis of subsidies is adopted by most regulatory agencies as a way to spot unwanted cross-subsidies. Muckraking journalists compete to uncover the most interesting 'unintended consequences' of what has, up to now, been obscured from public understanding or even public view.

In ***Health***, the growing popularity of hybrid subsidy models, such as Social Impact Bonds,[25] results in a wide array of public-private and monetary-non-monetary financial instruments that begin to shift subsidies in profound ways. At the same time, better ways are found to gradually phase out subsidies that are creating unintended negative consequences. The results of better analysis, more transparency, and new ways of easing subsidy withdrawal are so clear that activists begin pressuring governments to apply some of the food-water-energy models to the analysis of social subsidies given to society at large by caregivers – and coming up with the solutions required to provide care for the growing number of the aged in many of the world's advanced economies.

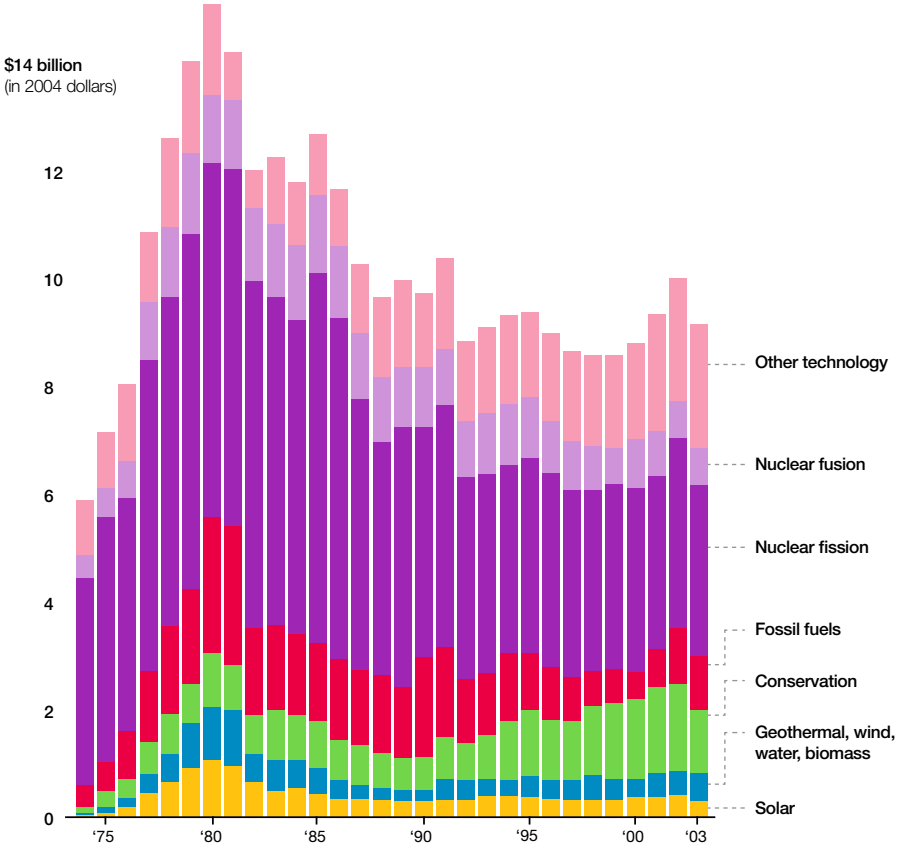
A Singapore Solution to Water Subsidies

"Our policy is to charge water at the long-run marginal cost of the next available drop, so today everyone pays a minimal price for the next available drop…desalinisation, no subsidies. We deliberately eschew subsidies for price and give poor families cold hard cash. Price sends the signal that water is a scarce and precious resource and worth investing in. If you're not going to run subsidies, you need a government that can generate a budget surplus that can be used to assist those who need it. This is a much more efficient and economically rational method of valuing resources while ensuring availability to all."
– Dr. Vivian Balakrishnan, Minister for Environment and Water Resources, Singapore

25 Also known as "Pay for Success Bonds" (US) or "Social Benefit Bonds" (Australia) in which non-government investors are rewarded for improving social outcomes and saving public sector money.

Total Energy Research Budgets of the Agency's Member Governments

Member countries of the IEA have long spent more money on technologies like nuclear power than on converting sunlight to electricity.



Sources: International Energy Agency

Economy

Background

Over the past century, progressively cheaper resources have underpinned global economic growth and business models. Although demand for resources such as energy, food, water, and materials grew, this was offset by expanded supply and increases in the productivity with which supply was used. The global prices of key resources varied greatly over the 20th century. Between 1985 and 2000 prices dropped to a new low point, halving in real terms from 1900, before rebounding in the following decade. With the exception of energy in the 1970's, the volatility of resource prices today is at an all-time high.[26]

MGI Commodity Price Index

(Years 1999-2001 = 100)

[1] See the methodology appendix for details of the MGI Commodity Price Index
[2] 2011 prices are based on average of the first eight months of 2011.

Source: Grilli and Yang; Stephan Pfaffenzeller; World Sank; International Monetary Fund (1MF); Organisation for Economic Co-operation and Development (OECD); UN Food and Agriculture Organization (FAO); UN Comtrade; McKinsey analysis.

26"Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs," McKinsey Global Institute and McKinsey Sustainability and Resource Productivity Practice, November 2011.

Emerging market demand will provide a significant opportunity for businesses, but will also heighten the risk of further disruptions from natural resource cost and availability, driven primarily by emerging market demand. Three billion middle class consumers (mainly in China and India) are likely to be added to the global economy over the next 20 years.[27] The growth of India and China is historically unprecedented and is happening at about ten times the speed at which the United Kingdom improved average incomes during the Industrial Revolution – and on around 200 times the scale. These citizens will escalate demand for cars (the global car fleet could double to 1.7 billion by 2030) and food (calorie intake per person in India could rise by 20% over the next 20 years).

At the same time, finding new sources of supply and extracting them is becoming increasingly complex and expensive, and there are increasing links between resources, which mean there is a risk that shortages in one resource can rapidly spread to other resources. There is also evidence that environmental factors are acting as a constraint on production. Food is the most obvious area of vulnerability, but there are others. For example, changes in rainfall patterns and greater water use could have a significant impact on the 17% of electricity supplied by hydropower, as well as fossil fuel power plants and water-intensive methods of energy extraction.

Coinciding with the changing resource landscape, the extent of the financial crisis has led to many calling into question the capitalist system and its focus on short-term thinking (including the use of natural resources). For example, the belief that business leaders need to manage against the current quarter has been exacerbated in the past 15 years by the drop in CEO tenures by almost half and the average holding time for shares being reduced from eight years to just four months.[28] Some have called for a long-term-oriented redesign of governance, management, and leadership.[29]

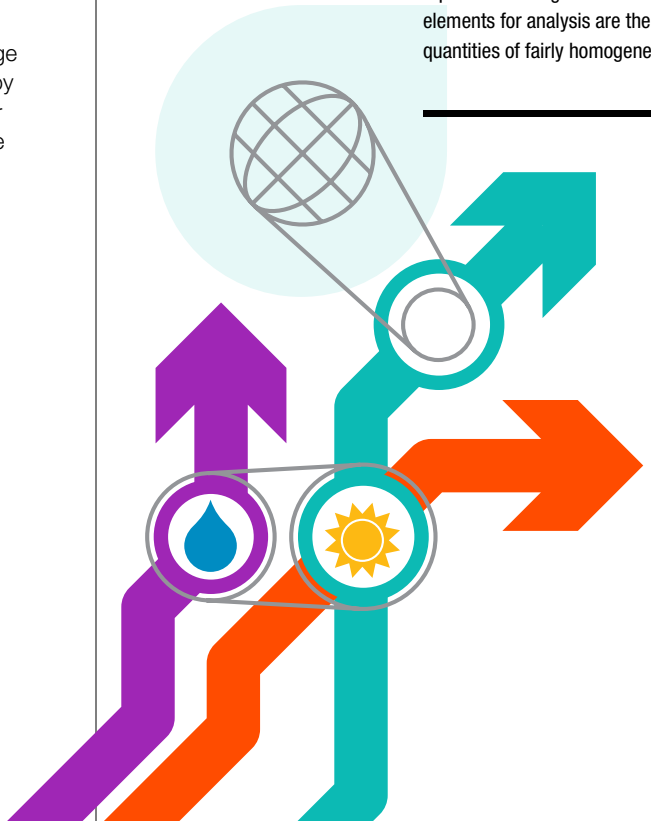
27 ibid.
28 Lynn Stout, Distinguished Professor of Corporate & Business Law, Cornell, RelSource 2012.
29 Conor Kehoe, McKinsey & Co., RelSource 2012.

Equilibrium vs. Evolutionary Systems Thinking

Two broad groups of theory characterise how economists set out to understand and predict economic phenomena:

• Equilibrium-based neoclassical theories place at their analytical heart the idea of perfect competition, an equilibrium state most recognisably depicted by the intersection of demand and supply curves. In this state, consumer preferences and production technologies are generally assumed to be determined outside the model, and a universal, unique outcome is always made possible through the assumptions of complete information and perfectly rational, optimising behaviour by representative agents. The main analytical elements for analysis are the prices and quantities of fairly homogeneous goods.

• Evolutionary-based theories model the economy as comprised of complex adaptive systems which, by definition, can never be in an equilibrium state, though periods of relative stability can exist. This incessant change takes place in an environment where information is costly to acquire and often incomplete, and where behaviour is understood as following observed 'satisfying' rather than idealised 'optimising' logic. Crucially, the institutional context of decision-making is explicitly considered, which means that the same policies or events can have different outcomes in different countries and markets.

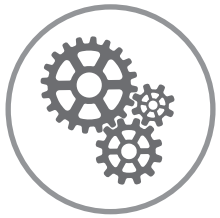


Growth

Step 1; let's make a lot of money. Step 2; let's use that money to save the planet.

Jeremy Grantham, Founder of GMO, Re|Source 2012

In ***Growth***, the foundations of neoclassical economic theory remain, driving resource productivity[30] to the top of the politician's agenda. The top-down approach to creating a leaner and more transparent economy is the objective for all industrialized nations. Inputs and outputs are priced appropriately, driving an impressive level of efficiency with very little tolerance for failure. Here the advantages and significant cost-savings associated with such efficiency easily outweigh any crises or shortcomings that may occur from time to time.



In ***Growth***, resource productivity offers tremendous opportunities for businesses in an economy where it can effectively be captured, becoming a basis for new competitive advantage and profitability. For example, research in 2011[31] identified opportunities to boost productivity worth around $2.9 trillion in 2030. The value of the opportunity would increase to $3.7 trillion assuming a $30 per tonne price for carbon and the removal of energy, agriculture, and water subsidies, as well as energy taxes. Capital investment associated with these productivity opportunities totals around $900 billion annually from a global perspective, and roughly 70% of these opportunities have returns greater than 10%.

However, capturing these opportunities is not easy. Only 20% of the resource productivity opportunities identified across energy, water, land, and materials are readily achievable, and an additional 40% are difficult to capture, facing many barriers to their implementation. These barriers include capital intensity, underdeveloped supply chains, agency issues, and information failures. New partnerships between firms in different industries and also between firms, governments, and civil society will be needed to tackle these barriers and scale solutions.[32]

Slow progress in tackling these barriers, particularly the regulatory issues, is likely to lead to a piecemeal approach to capturing these productivity opportunities. As such, ***Growth*** provides a continued risk of significant disruption to the economy from resource cost and availability, particularly given the increasing linkages between resources, the fragmented nature of supply chains, and the 'just-in-time' approach to production.

30 Resource productivity is defined as opportunities that either maximize the transformation of resources into productive inputs, or maximize the economic value achievable from a given volume of resources.
31 McKinsey Global Institute & Sustainability Resource Productivity Practice, Resource Revolution, op. cit.
32 "Accelerating Green Growth through Public-Private Partnership," the Global Green Growth Forum, June 2012.

Health

The OECD environmental group unofficially says that they cannot find an economic theory that usefully treats the finiteness of resources.

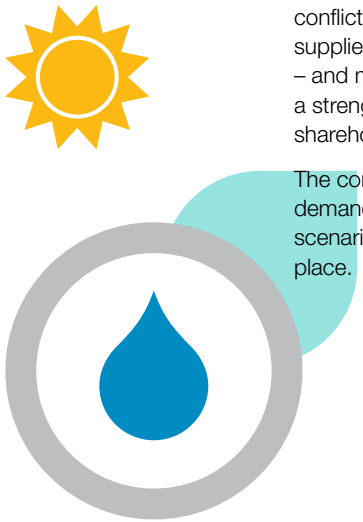
Jeremy Grantham, Founder of GMO, Re|Source 2012

In ***Health***, complexity/evolutionary economics provides the rationale for a system redesign, rather than just optimization. In particular, there is a move to a circular economy, longer-term decision-making governance models, and a greater focus on resilience, above and beyond profitability.

Health sees a shift from a linear production system to a circular economy – an industrial system that is restorative or regenerative by intention and design.[33] It aims to 'design out' waste. Devices from mobile phones to washing machines become part of a closed loop production process. Resource security concerns are abated, price pressures of resources are eased, new business models are created, and services become increasingly affordable to low-income households.

In terms of governance, there is a push towards long-term-focused behaviour, both within the organization and in capital markets. Earnings guidance comes to an end, and the providers of capital – most importantly, pension funds, insurance companies, mutual funds, and sovereign wealth funds – are convinced to hold and judge their investments on a long-term basis.

As part of these developments, there is a realisation that there is no conflict in serving the interests of various stakeholders – employees, suppliers, customers, creditors, communities, and the environment – and maximizing the company's market capitalization. There is also a strengthening of the ability and willingness of boards, CEOs, and shareholders to behave like real owners.[34]



The concept of resilience assumes greater importance, with stakeholders demanding to know the value at risk of companies from different resource scenarios and the mitigation and adaptation plans that have been put in place.

33 "Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition," Ellen MacArthur Foundation, 2011.
34 Dominic Barton, "Capitalism for the Long Term," *Harvard Business Review*, March 2011.

Governance and Leadership

Background

Optimistic? Pessimism is an excuse for paralysis and inaction. Being pessimistic is dumb and won't make you happy when you get up in the morning, not be bored putting one foot in front of the other.

Former U.S. President Bill Clinton, Founder of the William J. Clinton Foundation, Re|Source 2012

What's needed most of all is leadership.

Jacqueline Novogratz, Founder and CEO, Acumen Fund, Re|Source 2012

Historically, leadership was seen as an inborn attribute of an individual person – some are leaders, and others are not. A more recent view is that leadership is context dependent – some leadership styles work in one context but not another. Others have proposed that leadership is primarily in the interpretation and perception, rather than in the leader herself. While this debate may be explicit in the cloisters of Oxford or Berkeley, it is very much implicit in the handling of the Resource challenge. What individual leadership traits are valued and effective in the ***Growth*** and ***Health*** worlds?

While The Rt. Hon. David Miliband states that "Neither democracies nor authoritarian regimes have been successful at dealing with sustainability,"[35] Governor Yi of the Bank of China says that China's 12th five-year plan is very clear about the priority of climate policy and energy efficiency, demonstrating a top-down effectiveness that is sometimes the envy of democracies. Which public leadership structure is more effective at addressing the Resources challenge?

35 David Milliband, MP for South Shields and former Secretary of State for Foreign and Commonwealth Affairs, United Kingdom, Re|Source 2012.

While the systems of governance that form the context of leadership seem to diverge greatly, they also have great overlaps. The US system may be a 'checks and balances' grind, but it features a powerful presidency combined with significant individual state autonomy. The Chinese system may be authoritarian, but individual leaders are deeply bound into the fabric of the party. Governance in China can be described as top-down, or deeply interconnected, depending on how it is framed. The differences in governance between the ***Growth*** and ***Health*** worlds are as much a matter of perception and narrative as of structure.

That difference in narratives has a big impact on the collective cognitive capacity of ***Growth*** and ***Health*** societies. The value of leadership is measured through its impact. As a consequence the ability to act on insights matters. As Jeremy Grantham says, "In principle we can solve things, but we won't."[36]

Growth

While acknowledging its potential unforeseen consequences, ***Growth*** appreciates the effectiveness of top-down intervention. From this perspective, the one child policy is the greatest contribution to humanity and the environment, since it has avoided 800 million people who would otherwise be on the planet – population is something to be managed.[37] This top-down approach extends in particular to Resource questions as they become increasingly urgent. Leaders point to examples of the success of strong regulations such as the quick recovery of fishing stocks after the quota systems have been put in – although those in the ***Health*** world would have taken the perspective that populations are recovering because fish reproduce so quickly.[38]

In ***Growth***, the system works when leaders get the directives right. For example, shale gas has brought the oil and gas industry into people's backyards, with very poor initial planning, going from individual wells to horizontal drilling. Based on the golden rules for "The Golden Age of Gas" report by the IEA,[39] simply adding seven cents to the price of gas will address environmental concerns.[40] Knowledge and analysis-based action by leaders will trump opposition based on emotion and ignorance.

Good leaders in ***Growth*** are formed through training at top schools, but foremost through practice; their success comes from a clear accountability for a set of targets.

36 Jeremy Grantham, Chief Investment Strategist of Grantham Mayo Van Otterloo, Re|Source 2012.
37 Charles Tang, Chairman of the Brazil-China Chamber of Industry and Commerce, Re|Source 2012.
38 Jeremy Grantham, Chief Investment Strategist of Grantham Mayo Van Otterloo, Re|Source 2012.
39 http://www.worldenergyoutlook.org/goldenrules/
40 Andrew Gould, Chairman of BG Group, Re|Source 2012.

Health

While ***Growth*** appreciates the success of the one-child policy in China, in ***Health*** it is emphasized that Hong Kong has achieved fewer children per woman than China without such a policy. ***Health*** sees child numbers as driven from context, mainly through increased wealth and marrying later.[41] Population is viewed as an emergent phenomenon, which self balances, but the increased longevity of humans simply has outpaced the speed of adaptations of the balancing mechanism for a couple of centuries. As a result the balancing point has shifted from 1 billion to 9 billion humans – we are currently passing the point of "Peak Child."[42] In ***Health*** the leaders who have had an impact on populations are the ones who have led the education, health, and wealth revolutions, not those involved directly with population policy.

Governance is a messy thing. The CAFE[43] standards were raised by the Obama administration through a stakeholder process. In ***Growth*** this would not have stuck in the public imagination, because there had been no drama or blood on the floor.[44] ***Health*** extends governance to include Elinor Ostrom's concept of polycentric governance.[45]

Health recognizes emergent systemic effects. Leaders cannot always predict or even understand these effects. ***Health*** rejects the primacy of knowledge and analysis-based action, and appreciates the power of lock-ins and the importance of irreducible uncertainty. Leaders will get it wrong. For example, while shale gas is hailed as a big resource success in the US through unlocking large volumes of lower carbon fossil fuels, east coast coal has been flowing to Europe.[46] As a consequence, while increased gas consumption is hailed as a success for the climate, it seems the displaced coal is now simply being burned elsewhere. Leadership in ***Health*** is the ability to deal with messy realities and uncertainty.

Individual leadership competences in ***Health*** emphasize an explorative mind-set, passion, and the quality of being purpose driven,[47] rather than target driven – "Passion plus a bias for action."[48]

41 Hans Rosling, Founder and Chairman of the Gapminder Foundation, RelSource 2012.
42 http://www.ted.com/talks/hans_rosling_religions_and_babies.html
43 Corporate Average Fuel Economy – the US vehicle fuel economy standard.
44 Former US President Bill Clinton, RelSource 2012.
45 Elinor Ostrom, "Beyond Markets and States: Polycentric Governance of Complex Economic Systems," *American Economic Review*, 100(3) 2010, pp. 641–72.
46 Poppy Allonby, Fund Manager and Managing Director, Natural Resources Equity Team at BlackRock, RelSource 2012.
47 THNK leadership framework.
48 Former U.S. President Bill Clinton, RelSource 2012

Linkages and Hotspots

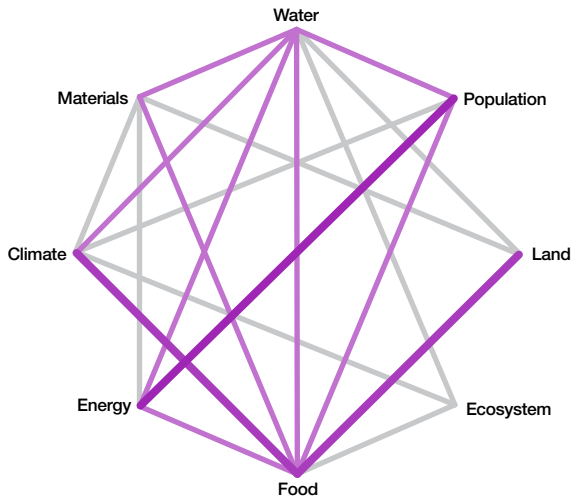
The discussions during the Forum revealed an interesting pattern of linkages between specific concerns and issues. During the World Forum panel sessions, for example, speakers referred to different key linkages between specific physical resources:

- The most commonly referred to bilateral linkages were energy and population, climate and food, and land and food. Water and food were the elements most discussed in relation to others, both with strong interactions with all other elements.

- The key 'hotspot' that emerged from the Forum was in the intersection of climate, energy, food, and population. This hotspot reflects concerns about land availability and use and linkages between biofuels production, fertilisers, food availability, and increasing meat consumption (with associated emissions and land use requirements) given increasing populations under conditions of climate change.

- Land and ecosystems were discussed with linkages to only a limited number of other elements (this despite the fact that the links between land and food were very commonly discussed). This limited interaction with other resources is indicative perhaps of how professionals view the issues surrounding these resources.

Linkages Discussed at Re|Source 2012

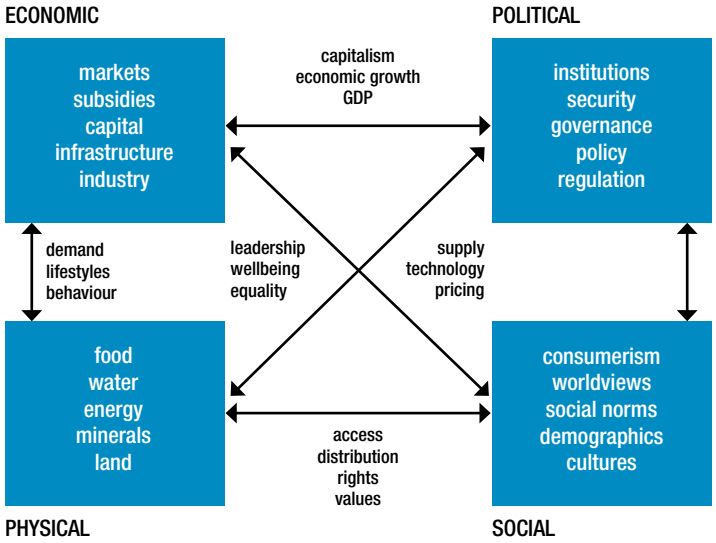


Thicker/darker line = heavily discussed
Thinner/lighter line = mentioned at least once

This pattern of linkages reflects the ***Growth*** futures frame – that is, a focus on physical domains. Mapping linkages within the ***Health*** frame would reveal connections between social and physical domains, in recognition of the co-evolution of technologies, institutions, and behaviours and social norms.

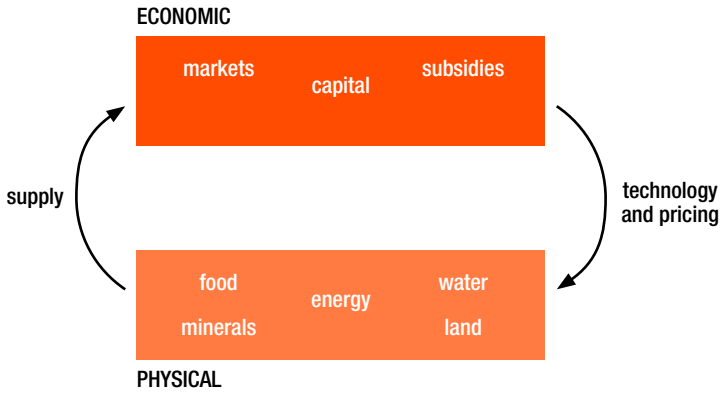
This mapping also reveals that delegates are already aware that resource security concerns need to be managed in terms of the health of connections not just the availability and access to physical domains on a resource-by-resource basis. In other words, delegates displayed an intuitive understanding of ***Health***.

Linkages from a Health Perspective

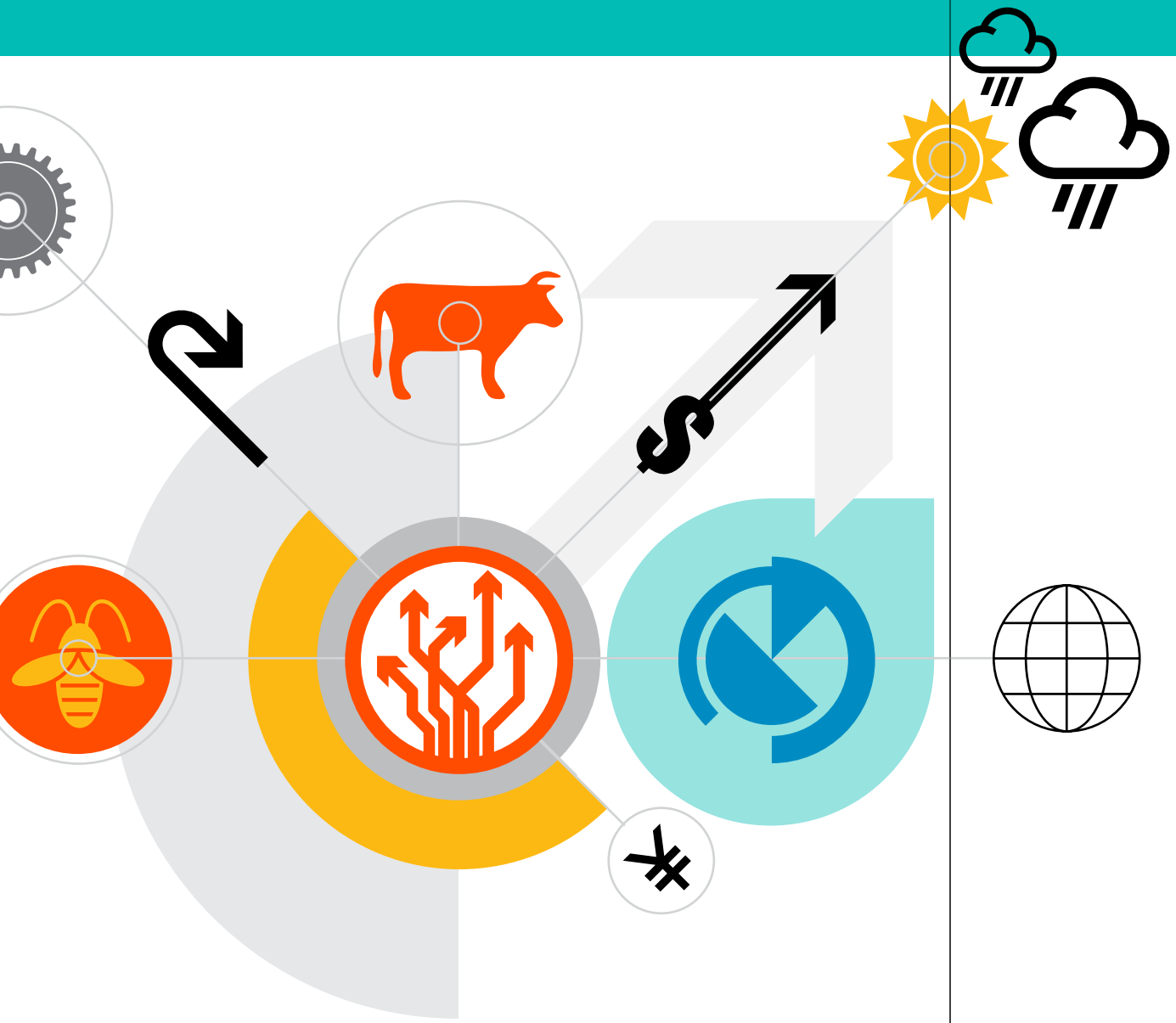


This mapping is useful for appreciating the 'perfect storm' characteristics of the linkages between food-energy-water that are being forged in an era of hyper-connected economic globalization and climate change. In the ***Growth*** perspective, it is assumed that technology and price are the key shapers of linkages and that the global perspective is vital for understanding future developments.

Linkages from a Growth Perspective



This mapping highlights the role of institutional innovation in the ***Health*** perspective, and the evolution of social norms and behaviour change in shaping linkages between physical resource domains. It shows the relevant feedback loops between social and physical, and economic and political domains.



Re|New

Our exploration of topics within the two futures frames – ***Growth*** and ***Health*** – reveal a differing emphasis on the nature and scale of change involved in meeting the connected challenges of resource security and climate change.

Growth Through Resource Productivity

Growth lies squarely within our current economic myth, which treats economy, society, and nature as independent or loosely coupled systems. Risks of climate change and resource scarcity can best be managed as separate concerns. Innovations in technology, the growth of environmental markets, the stimulation of behaviour change via market choices and pricing, and reasonable but limited government regulations are effective approaches to solving most resource management problems. Emphasis on enhanced resource productivity is the optimal approach to robust economic growth and reduced pollution.

Leadership in this complex world can be improved by coalitions of the willing – various groupings of well educated, or, at least, well connected, elites, who are best positioned to take into account the web of interconnections and steer the role of enterprise in a more fragile, globally connected economy. The priority is to make space for another 3 billion to join the consumer class by combining resource productivity and tapping into new abundances – shale gas, carbon capture and storage, and aquaculture. Overcoming constraints in supply capacity is also pivotal to the next phase of global economic growth and the flow of financial and natural capital needed for robust global supply chains.

In the ***Growth*** frame, we think of ourselves has not having reached the full technological maturity of the global economy's capacity for efficiency and inventiveness to solve our environmental problems.

Health of Linkages in Socio-ecological Systems

The ***Health*** frame steps outside our current economic myth, recognizing that resource productivity is a necessary but insufficient strategy for coping with the resource-climate stress nexus and addressing the eroding triangle of trust between business, government, and society. Nature, society, and economy are fragile, interconnected systems. Climate change, resource scarcity, exclusion, trust, and poverty are nexus issues that cannot be solved independently of each other. Securing systemic health requires attention to the linkages between social and ecological domains and the avoidance of irreversible thresholds that result in the interplay of first and second order effects that manifest across different scales of the stress nexus.

In ***Health***, optimization of resources on a silo-by-silo basis is the enemy of systemic resiliency. Cross-sectoral partnerships are key to addressing institutional voids and enabling systems redesign. These partnerships need to be multiple and overlapping rather than top-down – convening business, state, and civic society actors is key to ensuring the longer-term health of whole communities, regions, and nations. Sustainable enterprise can only be realized with more adaptive systems

of governance in which governments and businesses collaborate in developing the capacity of whole sectors and societies to cope with climate change impacts and planetary boundaries, whilst reducing structural inequalities and enabling social cohesion and trust to flourish. Co-benefits are essential to managing the health of connections between different actors in the system, as well as socio-ecological linkages and intelligent policy design with a view to both immediate and long-term needs.

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Summary of the Ten Themes from a *Growth* and *Health* Perspective

	Growth	Health
Water	Increased efficiency to address global imbalances in supply – Singapore's long-term centrally directed approach to water management	Multi-scale solutions to solve global problem – the reduction of charcoal use in SE Asia, protecting water catchments
Energy	Developments of mature technologies will prevent a 'peak' – the 'new' abundance of gas resources	Demand management through co-benefits – energy efficiency 'built-in' to urban areas
Climate change	Mitigation solutions pushed globally by governments through market forces - COP	Resiliency and mitigation championed at all levels of leadership – Acumen Fund assisting local entrepreneurs
Land security	Focus on intelligent land management to maximise returns – the 'green' revolution in wheat	Emphasis on land quality rather than management – co-operating small farmers to improve output rather than combining
Infrastructure	Building more to feed growth – coal power in BRICS	Focus on adaptive infrastructure to benefit in the long term – Costa Rica's Oil vs. Renewables policy
Business models	Resource efficiency is the new wave of innovation with benefits of scale first and foremost – Desertech's Sahara Solar for Europe project	Social norms are seen as sticky but context dependent. Consumer leads, not follows, business – the role of the internet in the social sphere
Subsidies	Discussion bogs down. Subsidies remain and possibly increase – carbon tax vs. carbon price	Subsidies are phased out but with some 'prosidies' to support R&D and the introduction of new technology– social impact bonds
Economy	Classical, efficiency-driven system with top-down approach – "Make money, then save the planet."	Complexity economics rationale with long-term view – no current economic theory addresses the finiteness of resources
Governance and leadership	The population is a problem to be managed – China's one-child policy	The population 'manages' itself and is a source of value – Hong Kong's high per capita income and low birth rate

The ***Growth*** and ***Health*** frames exist in parallel, and in using them we can see the current situation differently. In ***Growth*** the issue is how fast (first order) efficiency gains can take us in reducing the stress in the linkages between economic growth, resource security, and climate change. In ***Health*** the emphasis is on how far collaboration can enable systemic innovation and encourage a fundamental transition in global path dependency by harnessing systemic resiliency, rather than resource productivity, as a scaling logic. The role of markets and governments is necessary to both and differs in emphasis in each frame.

Growth:

- How fast can technology and price achieve efficiency gains and carbon emissions reductions?
- How can we establish markets and harness pricing to encourage new behaviours in resource consumption?
- How can we enhance the supply capacity of global resource supply chains?
- Who will invest in avoiding risks to climate, water, land security, and the ocean as we pursue new abundances?
- How do we design or retrofit socio-technical systems to be 'fail safe' under conditions of climate change and resource shortages?

Health:

- How can we restore the triangle of trust between businesses, governments, and societies?
- How can we assess the social, ecological, and financial resiliency of a system?
- Who will pay for managing the resilience of the wider systems on which individual firms and markets depend?
- Which business models and policy regimes provide or might provide space to prototype and scale up the transition to ***Health***?
- How do we design systems to be safe when they inevitably fail in the transition to new prosperity?

Beyond Frames: A Starting Point for Systems and Futures Thinking

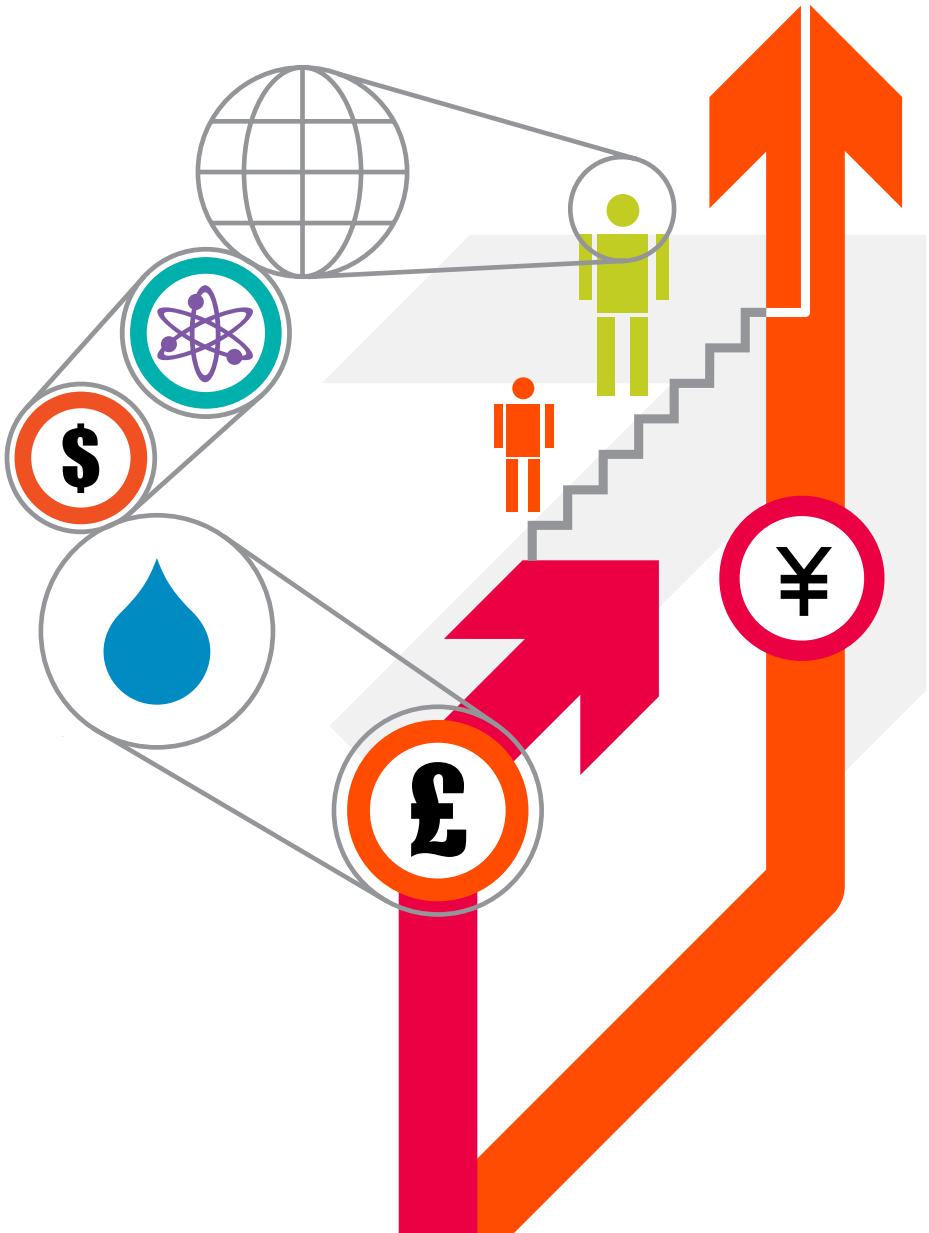
Engaging and navigating uncertainty, and grappling with the complexity, tensions, and turbulence implied in the resource-climate stress nexus requires a collaborative, systemic, and forward-thinking approach.

The ***Growth*** and ***Health*** frames help reveal and test deeply held assumptions that often remain implicit in discussing resource security and climate change challenges and in determining appropriate solutions. They offer a starting point for the development of more shared and systemic understanding.

These frames can also be harnessed to develop a shared systemic understanding through mapping the relevant system conditions, boundaries, and critical socio-ecological linkages involved in addressing resource security and climate change, and imagining plausible alternative scenarios to test the functionality and performance of the system under different future conditions. The specific details of the scenarios will vary. The key drivers of change selected as relevant by the users of the scenarios will reflect their underlying frames and specific situations. Furthermore, scenarios are always focused on the purpose in hand and on the interplay of factors and actors relevant to a specific time frame and focal scale – that is, the context of the scenario 'client' or user.

Scenarios 101

Scenarios consist of plausible stories of the future context of something for some purpose. They come in sets of two or more stories. Scenarios address the question: Where might the future take us, whether we want it to or not? Scenarios are not utopian or dystopian visions; they do not describe the future in terms of what future we would prefer. Scenarios focus attention on inherent uncertainty and help reveal and test assumptions about the developments in the wider context of a specific socio-ecological-economic 'system' – for example, a firm, an industry sector, or a nation state. Scenarios help to forge shared and systemic understanding and the common vocabulary needed to enable and support collaborative action. Scenarios encourage thinking about new possibilities in order to develop options suited to novel future situations and to enable adaptation to discontinuous change. Scenarios are not forecasts. Trends are the remnants of yesterday's futures. Scenarios encourage more systemic thinking about how and why the future might be very different from the past, - that is, what would cause big trends to bend or break.



To illustrate how one might move beyond these initial frames to develop scenarios, two generic scenario frameworks are described below, one for each framing.

In Growth, individual companies, governments, and coalitions of the willing focus on speeding up the rate of efficiency gains by optimization of parts – that is, resource productivity on a domain by domain basis, with climate change treated as a separate issue. A simple set of axes developed in the ***Growth*** frame, reflecting where the world might end up in 2050, could be the extent of productivity gains vs. the nature of climate change.

Reframing the Future: Illustrative Scenarios in the *Growth* Frame

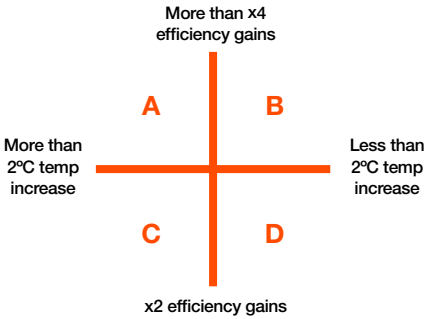
It's time to plan for a warmer world. Even doubling our current rate of decarbonisation would still lead to emissions consistent with 6 degrees of warming by the end of the century. To give ourselves a more than 50% chance of avoiding 2 degrees will require a six-fold improvement in our rate of decarbonisation.

PwC, "Too Late for Two Degrees," Low Carbon Economy Index, November 2012

Our analysis shows that there are resource productivity improvements available that would meet nearly 30 percent of demand for resources in 2030.

McKinsey Global Institute, "Resource Revolution: Meeting the World's Energy, Materials, Food and Water Needs," November 2011

A Scenario Framework using the Growth Frame



A. Lean, but Mean
In this scenario, higher than historical efficiency gains in resource productivity are still unable to overcome slow climate mitigation, resulting in a global average temperature rise of far more than 2°C. A shift in investment has secured improvements in resource productivity, keeping pace with growth in demand. However, the increasing impacts of climate change exacerbate water stress, thereby constraining the development of global food systems security and new energy sources such as shale gas and tar sands.

B. Broader Gains
In this scenario, a combination of carbon and methane mitigation through higher resource productivity has been effectively achieved. Stricter environmental regulation in the development of new abundances (for example, shale gas with carbon capture and storage) and methane emissions reduction in energy and farming have helped keep global average temperature increases below the 'safe level' of 2°C by 2050. The extended global economic recession and a series of supply-side shocks have catalysed transformations in national food and water systems, resulting in leaner, cleaner supply chains able to withstand the fast increasing pace of ecosystems stress and collapse.

C. Fat and Unfit
In this scenario, decarbonisation and eco-efficiency improvements in the global economy continue at historical rates of change. National security interests dominate, and incremental improvements in resource productivity are overwhelmed in the scramble for new abundances. Avoidance of resource constraints by extending commercial exploitation of resources into the oceans creates new risks to ocean health and increasing disruptions of marine and land-based communities. Marine enterprises (food, minerals, energy) flourish but with limited international coordination of ocean health effects. Post-Copenhagen inertia on the 'Son' of the Kyoto protocol results in the proliferation of climate-related supply shocks and supply chain disruptions. This is a volatile world with a stop-start global economy, a return to subsistence for the many, and greater gaps in human development. By 2050, it is clear that all boats are sinking.

D. Scramble for Survival
This scenario sees an extended period of global economic recession, which pushes back the timing of anticipated resource shocks, reducing the atmospheric carbon peak as historical gains in global resource productivity continue. Despite reduced climate impacts, increasing variability in weather patterns results in more extended drought, flooding, and extreme events impacting cities and rural communities alike. As familiar horsemen overwhelm the slowing global economy – famine, pestilence, and conflict – the scramble for survival is unleashed.

In ***Health***, the emphasis is on health of connections across supply chains and throughout whole communities and systems. A simple set of axes developed in the ***Health*** frame, reflecting where the world might end up in 2050, could be the number of people crossing the 'washing line' vs. the nature of governance.

Reframing the Future: Illustrative Scenarios in the *Health* Frame

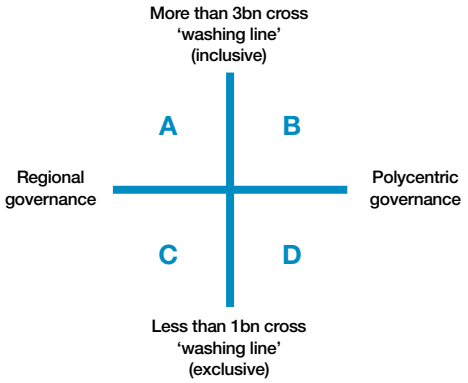
The resources over which we fight in the future will not be oil, gold and diamonds: the wars of the future will be fought over water, food and land.

President of Gabon Ali Bongo Ondimba, Lancaster House Conference on Climate and Security, March 2012

Climate and resource security is an issue that is so expansive that its impacts belong to various agencies and institutions, making coordination difficult.

Chris Biggs, Wilton Park Resource and Security Conference Report, March 2012

A Scenario Framework using the Health Frame



A. Networked Communities
In this scenario, supply-side demand for resources is managed by an emphasis on smarter cities and greater urban-rural harmony in localized solutions. Community scale adaptation and transformation attends to socio-ecological linkages and climate change adaptation, in turn, unleashing new models of greener and more inclusive national growth. The world becomes a patchwork of different regional regulatory frameworks and more diverse models of finance, business, and governance.

B. Inclusive Globalisation
In this scenario, the management of food, water, and energy systems is increasingly coordinated at an international scale, enabled through a complex and overlapping mix of adaptive, polycentric governance that attends to local-to-global socio-ecological linkages and planetary thresholds. Ubiquitous sensors and data collection enable improvements in real-time monitoring and pattern mapping, and provide a basis for managing the resiliency of global supply chains.

C. Walled Cities
In this scenario, resources are managed on a city-by-city basis, and national security concerns focus on urban-rural divides as the best cities succeed at the expense of other communities. Competition between global cities for resources causes political tension and high commodity-price volatility. Securing supply is seen as the most important task on the political and economic agenda. Under the disruptive influence of novel manufacturing processes, which negate the need for economies of scale, urban centres entrench and refocus inwards – aiming to ring-fence their power base at the expense of other urban areas within the region.

D. Worlds Apart
In this future, the Western greener growth model of capitalism clashes with the development needs of the poor in the emerging economies. As a result, per capita resource quotas are eventually agreed at an international scale. The associated transfer of resource ownership and natural capital to national governments unintentionally results in the suppression of billions of people across the world. Social inequality is at its worst in modern times, yet stability and resource security have been achieved for the wealthy few. Several emerging economies reject Western models of economic development and introduce new models of sustainable enterprise, leading to a more diverse global landscape.

Catalysing Collaborative Interventions

In the face of uncertainty, significant resource constraints, and climate change concerns, the capacity to learn with futures and forge collaborative leadership responsibility for the future has never seemed more pressing.

Catalysing and sustaining collaboration towards systems-level intervention is an approach to appreciating and addressing the resource-climate stress nexus. Facing these challenges requires a multi-method toolkit with elements of stakeholder mapping, convening, project management, futures thinking, systems mapping, systems redesign, prototyping, monitoring, and continuous learning. This generative prototyping and learning approach can be described using metaphors of seeing, seeding, growing, and transplanting in contrast to the usual metaphors of crisis and crossroads associated with the enterprise vs. environment agenda:

- Preparing the ground: convening a group.
- Seeing: developing a shared understanding of the dynamic system and identifying critical linkages, thresholds, and alternative future states.
- Seeding: identifying options for change and transition management.
- Growing: planting and cultivating options.
- Transplanting: scaling into new situations.

A Process of Managing Systemic Performance

The frames and scenarios described in this booklet are a part of the wider futures toolkit that can be harnessed to develop a shared and more systemic understanding of the resource security and climate change challenges facing communities, businesses, and governments across the world. To motivate action and track progress, the combination of frames and scenarios can be combined quantitative modelling to develop a deeper and more shared understanding of the system of concern, including critical socio-ecological linkages and thresholds of concern. Harnessing these new systemic insights in a further process of visioning and backcasting, in which alternative pathways for progress are identified by working back from an improved future end-state to the present day, identifying relevant options and milestones in the process.

In a world characterized by connected challenges and uncertain changes, it is also wise to keep an open mind about which future is unfolding, both in terms of the goal we aim to achieve (that is, how do we know we are on track) and in terms of the wider context in which the system we have come to understand is embedded. Monitoring progress towards goals together with intelligent horizon scanning – that is, using scenarios to develop early warning systems – can enable continuous learning.

This process uses a variety of futures methods such as quantitative modelling, intuitive logics scenarios, visioning, forecasting, and backcasting:

- *Framing:* developing a shared description of the problem situation and clarifying cross-scale linkages and the relevant key dimensions of the system (factors and actors). If relevant, framing can also reveal and respect different worldviews and underlying myths,
- *Scenarios:* Where might the future take us? How can we engage uncertainty, manage disagreement as an asset, and explore a limited set of plausible future contexts that might present further stressors and new shocks to the system?
- *Visioning:* Where can we take the future? How can we align values and avoid fragmentation by forging new common ground and identifying a shared vision of an improved future state that would meet the needs of all dependent stakeholders?
- *Backcasting:* identifying realistic pathways for progress and sequencing actionable options that connect the present to a more desirable image of the future.
- *Horizon scanning and early warning systems:* defining the problem situation, system boundaries, and relevant time horizons, and identifying signals and feedback mechanisms.

Reflections

Our increasingly populated and globally connected world is characterized by less predictable, more turbulent, and accelerating change. A plethora of new systemic risks have become evident, including environmental challenges such as global climate change, local water stress, and the collapse of fisheries and other ecosystems.

In this booklet we focus on the resource-climate stress nexus, a typical example of the complex and socially messy situations that arise from our most significant challenge: how to both prosper, in terms of economic growth, and flourish, in terms of longer-term climate stresses.

Meeting the food, energy, and water needs of present and future generations is an already daunting prospect, which places renewed emphasis on land ownership and security, on the one hand, and pressure to harness enterprise in the search for new abundances in new frontiers, including the marine and polar environments, on the other. The already complex and dynamic linkages between food-energy-water systems will be amplified and further stressed by global population increase in a climate-changed world.

Those working on environmental issues need to engage with those in the different worlds of business. New forms of public-private partnership have proliferated since the 2002 Second Earth Summit in Johannesburg. As new forms of social organization, enterprise, and governance continue to emerge in response to these new types of challenge, questions about effectiveness, rate of progress and scale of impact abound.

There is a growing recognition that 'business-government-society-as-usual' is sowing the seeds of catastrophic change and that sustainable enterprise cannot wait for 'predict and decide' but must navigate forward by engaging with irreducible uncertainties. Solving the problem requires fresh forms of collaboration that can reset the rules of the game.

Forging healthier linkages between growing prosperity and sustainable resource use cannot be achieved by working on an issue-by-issue or sector-by-sector basis. Business, policy, and civic communities need to find fresh and more effective ways of collaborating to address the connected nature of today's significant challenges and to do so on a more urgent basis and in a way that strengthens trust within and across the multiple and fluid circles of connection that characterize modern societies.

In facing up to the resource-climate stress nexus it is also clear that the future is the playing field of power. Deeper belief systems and myths are in play, which often manifest as a clash of contradictory certitudes about the fundamental nature of the challenges and changes required to mount an effective response.

To help see these challenges from within perspectives of the future, we outline two possible futures frames. The ***Growth*** frame sees the resource-climate stress nexus as a matter of moving faster to enable relative decoupling between growing prosperity and resource use. With an emphasis on productivity gains, the ***Growth*** frame focuses attention on profligacy, waste, market failure, and new incentives for redirecting investment and shoring up the triangle of trust between business, finance, and governments. The ***Health*** frame, in contrast, sees the problems in terms of absolute decoupling, of progressing further along a different trajectory of progress rather than simply faster in the established direction of travel.

The two frames we offer suggest that the resource-climate stress nexus requires a response that goes both faster ***(Growth)*** and further ***(Health)*** than ever before. Each frame offers a mind-set from which to imagine alternative future possibilities and inform new and better options for flourishing from prosperity.

Leadership responsibility for the future can be better exercised by framing and reframing, not simply forecasting. Taking time to consider *how* we think about the future, not only *what* we think about the future, opens an opportunity to learn 'with' futures and realize the role of the future in the present.

To encourage fresh collaboration and more reflexive forms of futures thinking that in turn catalyse and sustain an unprecedented scale of systemic adaptation and transformation, we offer what we hope will be welcomed as a better place to start to mature the debate, develop more and better options, and move forward with action that is in the self-interest of everyone on the planet.