

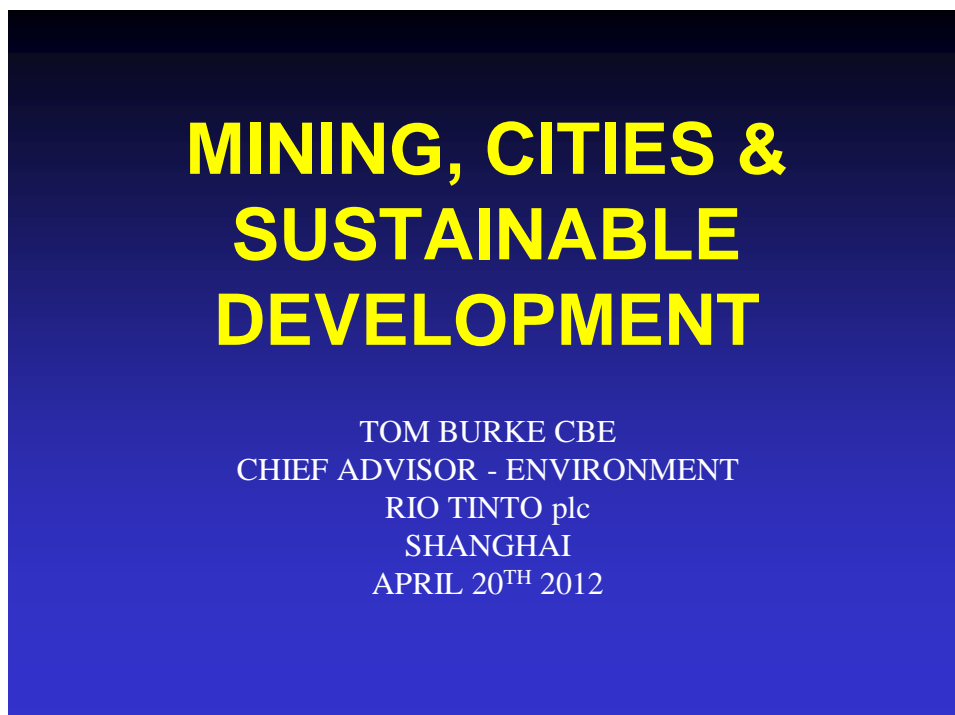
'MINING, CITIES AND SUSTAINABLE DEVELOPMENT'

REMARKS BY MR TOM BURKE CBE TO THE CHINA
EXECUTIVE LEADERSHIP ACADEMY, PUDONG

SHANGHAI

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1. TITLE SLIDE



Thank you for inviting me to give this lecture today. It is a great pleasure for me to be back in China and to be experiencing again the extraordinary scale and pace of change that is so astonishing to the rest of the world.

Mining and cities have more in common than you might expect. In recent years both have been challenged by the public to make significant

improvements in their relationship to the environment. Both have been asked to do more to contribute to society's transition to sustainable development.

And both have responded to these challenges.

The air is now cleaner in cities. More wastewater is properly treated. Recycling of raw materials is more comprehensive. Public transport systems are expanding.

Cities have done a great deal in these and other areas within their control to make life better for their citizens and more sustainable.

Mining companies have also significantly improved their environmental and social performance.

When I first came to work in the mining industry it was widely thought of as being dirty, dumb and dangerous. Indeed, I told it so in a speech I made to its leaders in Davos one year. No-one could argue that it is yet clean, clever and careful, but it is certainly a lot cleaner, cleverer and more careful than it was twenty years ago.

Again, this has been achieved by the industry doing better with those things it can control itself – air and water pollution, safety, relationships with its host communities.

In my lecture today I want to talk to you about some of the emerging challenges facing the global mining industry as it works to meet the growing demand for metals and minerals. Many of these challenges turn out to be the same as those faced by the world's exploding cities as they struggle to

improve the quality of life for their burgeoning populations.

These are challenges that involve factors and forces that neither the mining industry nor cities control themselves but which will determine whether or not they succeed. The financial crisis that erupted in 2008 and has caused so much turbulence in the world occurred because policy makers and economists underestimated the scale, urgency and systemic nature of the risks building up in the financial system.

Many of the same policy makers and economists are today underestimating the scale and urgency of a nexus of systemic risks posed by the growing insecurities over food, energy, water and the climate. Unless these systemic risks are successfully managed they threaten ability of both mining companies and cities to succeed.

I will tell you something of how the mining industry is beginning to think about these challenges in the hope that it might offer some insights into the way cities will need to respond if they are to continue to meet their citizens' expectations.

So, in this lecture I want to turn the focus outwards and ask not what mining companies and cities must do to succeed, but what they must get others to do if they are to succeed. It turns out that both miners and cities need the same things from others.

But first, let me say something about Rio Tinto and myself.

2. RIO TINTO

RIO TINTO

Iron	Diamonds
Aluminium	Borates
Copper	Titanium Dioxide
Coal	Gold
Uranium	Silver
Salt	Molybdenum

Rio Tinto is one of the world's largest and most diversified mining companies. The slide illustrates the range of metal and mineral products that the company supplies.

It invests in and operates large, long-term, cost-competitive mines.

Five strategic drivers are helping deliver Rio Tinto's strategy and achieve its vision: financial and operational excellence, growth, licence to operate, globalising the business, technology and innovation.

Its assets are currently concentrated in Australia and North America but most of the major investments in the project pipeline are in South America, Africa and Asia. Over 30% of Rio Tinto's sales are to China.

Ultimately, where Rio Tinto invests is determined by geology. Our search for the long life, low cost mines central to our strategy is taking us increasingly into new areas of operation. We then invest billions,

sometimes tens of billions, of dollars in holes in the ground that we cannot move. That puts a premium on the maintenance of social, economic and environmental stability which is why we attach so much importance to sustainable development.

This is not something we can manage ourselves, it can only be done in partnership with our host governments and communities. So we need not only to look inwards to our own performance in these areas but also outwards.

It is this fundamental commitment to a particular place that gives us something in common with cities as we look at the accelerating avalanche of economic, social and political change that is underway. We can no more move a mine than you can move a city. So we have an enormous stake in working to preserve long term stability in those countries where we mine just as you have in preserving long term stability in the China.

3. TOM BURKE

TOM BURKE CBE

NON-GOVERNMENTAL ORGANISATIONS

GOVERNMENT

BUSINESS

ACADEMIA

I am an environmentalist. I have worked on the full range of environmental issues for 40 years both nationally and globally. I began my career working in non-governmental organisations from the early seventies.

My academic background was half a degree in biochemistry and a degree in philosophy. Although I didn't know it at the time this turned out to be a perfect training for an environmentalist as first I learned to count and then I learned to argue.

After two decades of environmental campaigning with Friends of the Earth and the Green Alliance I went to work in government as a personal advisor to three Secretaries of State for the Environment.

In 1997 I left government to work in business. I have now worked part time for Rio Tinto for 16 years and also with other major companies such as Standard Chartered Bank and BP.

I am also a Visiting Professor at Imperial College, London and an Honorary Professor in the School of Laws at University College, London

Today I continue to work for Rio Tinto whilst also serving as a Senior Advisor to the Foreign Secretary's Special Representative on Climate Change, who is also visiting China this week. I am a Founding Director of the NGO, E3G, which has a long standing relationship with Chinese partners and has been particularly active in the promotion of low carbon enterprise zones.

The most significant lesson I have taken from all my experience is the crucial importance of governments, businesses and civil society working together to tackle this emerging nexus of systemic risks.

Governments provide the frameworks of policy without which investment will not flow. Businesses provide the innovation and delivery of solutions to the problems. Civil society provides the legitimacy and public support for the difficult choices that must be made if these problems are to be solved.

4. CITIES

CITIES

>50%

>75%

1 million/week

450 > 1 million

10 > 10 million

600 million

926 million – 2025

1 billion - 2030

More than half the world's population now live in cities and in some countries it is over 75%. By the middle of the century it will be more than 75% globally. Throughout human history the development of cities has marked the advance of civilisation. This advance is now at risk and with it the future of cities.

Cities are the centres of art, learning and culture. They are sources of immense creativity and innovation. They power economies, drive knowledge and skills ever upwards. They provide access to jobs and services of extraordinary value and diversity. For centuries they have delivered a higher quality of life to more people than is ever possible in rural areas.

It is not surprising that they have consistently been a magnet for migration both between and within nations. As a result they have grown larger ever more rapidly. More than a million people a week are moving into cities around the world.

In 1900, the London in which I live was the largest city in the world. Its population was six and a half million. Today it is about to drop out of the top twenty. Ten cities now have populations of more than ten million people and 450 over 1 million. In 1900 all of the top ten cities were in industrialised nations. Now only two are.

China's current urban population is 600 million. By 2025 it will be 926 million. The billion mark will be reached by 2030.

But this size has been bought at a price. Once upon a time cities directly controlled most of the hinterland on which they depended for food, energy, resources and markets for their manufactures. The city states of Italy or the myriad principalities of Germany were the result.

In the market near where I live in London there is still a board from the 19th Century detailing the tolls for driving the live sheep and cattle over London Bridge to feed the city's inhabitants.

Now cities no longer have any direct control over the far flung logistical networks on which they depend for food, energy, raw materials and water. Rather they rely on being able to generate sufficient revenues to buy them on global markets and ship them from every corner of the world. But to be able to pay for them they must be able to earn enough by selling goods and services into those same global markets.

These logistical systems themselves rely on huge, expensive and vulnerable reticulated networks of roads, power, pipe and rail lines, fibre optic cables

and the rest of the complex infrastructure that underpins a modern city.

Cities are also the dominant centres of governance and political power. They are, in effect, the key nodes in the operating system that makes all the astounding possibilities of 21st Century life – the applications if you like - work. Dysfunctional cities mean dysfunctional government and the chaos that accompanies it.

We have seen what happens when that operating system collapses. Five years on, and with all the capabilities and resources of the United States to hand, New Orleans is a long way from having fully recovered from hurricane Katrina. The turmoil we have witnessed across North Africa recently was triggered by sharp spikes in food and oil prices provoking urban populations into insurgency.

We are moving from an age of abundance to one of scarcity. Food, water and energy supplies are all under increasing stress. Demand for food is projected to double by the middle of the century. Almost half the world's population will be experiencing severe water stress within twenty years. Global primary energy demand will increase by a third in the same period and with it carbon emissions will increase by forty percent.

Climate change is a stress multiplier making it more difficult to tackle these crucial resource issues. Energy security, food security, water security and climate security are the interconnected substrates of the economy. They are the pillars of prosperity. As the stability of those pillars degrades so too do the prospects for the economy.

As these resource pillars become more insecure so the stress on the logistical systems and infrastructure that makes life in cities not only tolerable, but possible at all, grows. And with it, the cost of keeping them viable. Eventually these burdens will become unbearable and life in cities will go from being desirable to being intolerable.

5. COMMON AGENDA



Cities and mines reflect large fixed investments in geographically defined spaces—albeit on different scales. Both depend on national governments to play their full part in maintaining a stable context in which those investments can deliver value. If governments fail to play their part then the value of those investments will fall precipitously.

The first duty of any government is to maintain territorial integrity. Clearly governments which fail in this duty are no longer governments.

The second duty of a government is to maintain internal stability. If it cannot do that it rapidly becomes unable to discharge its first duty.

The third duty of a government is to maintain food, energy and water security for its citizens. If it is unable to this then it will not be able to maintain internal stability and thus to preserve territorial integrity.

Without climate security, it is now clear, the task of maintaining food, water and energy security will become progressively more difficult and eventually impossible.

In order to be able to discharge these duties as we progress further into this century governments must also maintain access to global markets and resources.

All of this may seem too obvious to be worth re-stating. But as I will argue in the rest of this lecture, governments everywhere are facing unprecedented challenges as they struggle to meet the rising expectations of surging populations.

Successful mining companies, like successful cities, will need to develop a more mature dialogue with national governments everywhere if these challenges are to be met in a timely and effective way.

6. ENDOGENOUS v EXOGENOUS RISK

**ENDOGENOUS
RISK**

v

**EXOGENOUS
RISK**

As we in Rio Tinto have begun to think about how we address this set of challenges we have found it useful to make a distinction between endogenous and exogenous risks.

One way to think of a successful mining company is as an effective manager of a basket of risks – some short term, some long term; some financial, some operational. Many of these are the familiar risks of any business – keeping control of costs, complying with a wide range of regulations, retaining key staff and expanding market share. Failure to manage any of these business risks impairs our primary duty to deliver value to shareholders.

Increasingly, however, we have found ourselves facing a widening spectrum of risks to our reputation, to our license to operate, to our access to resources, that demand a more thoughtful and strategic response.

As we have analysed our risk landscape we have found that some result from our own behaviours -

on safety, on investment decisions, on management appointments, on mine planning and operations for example. These are issues within our control. If we want to improve our management of these risks we can set ourselves tougher targets or more demanding key performance indicators and develop more robust internal processes.

Better management of these risks results from looking more closely at ourselves and arriving at a better understanding of what we do and how we do it. These are endogenous risks.

But the emerging risks to value for Rio Tinto are increasingly about what others do – or do not do. It is the actions, or failures to act, of politicians, policy makers, regulators, communities, civil society organisations, the media and so on that now also pose risk to our ability to deliver value.

This has made it much more important for us to look outward to ensure that we have a much better understanding of how and why others behave the way they do. It is these risks which we increasingly think of as exogenous risks and the question it raises for us is whether we are well structured to understand, mitigate and manage these risks.

Much of the rest of this lecture will focus on this emerging landscape of exogenous risk which poses as many questions for those managing cities as it does for those managing mines.

7. DEMOGRAPHIC DRIVER

DEMOGRAPHIC DRIVER

1

1.5

2.0

2.5

The interplay between the four numbers above will shape the politics of this century. It will define the changing landscape of risk and opportunity that governments, businesses, cities and individuals will have to navigate successfully if they are to thrive.

The 'one' is the billion or so people who make up the affluent of the world. They live mostly in Europe and North America and the other OECD countries with fast growing numbers of new entrants in China, India, Brazil and the other emerging economies. These are the people who have arrived. They have many assets and secure and relatively high incomes. They are the main drivers and beneficiaries of globalisation. It is also predominantly their success that is responsible for the present state of the global environment.

The 'one point five' are the emerging middle classes in much of the developing world and the less well off in the developed world. They are the new consumers. They have begun to acquire assets and

have steady but relatively lower incomes. They are in transition, becoming more affluent, healthier, better educated but they still have some way to go to enjoy the comfort and security of the one billion. Their success is driving the incoming tide of environmental pressure. McKinsey recently estimated their number might double by 2030.

The 'two' are the two billion new entrants into the global economy. They have no assets and insecure incomes. They are on the move, making up the economic migrants both within and between countries. Hundreds of millions have moved to the cities in recent decades so that more than half the world's population is now urban. Many live in the barrios, favelas, townships and their equivalents around the world. They are hanging on by their fingernails to their place in the global economy.

The 'two point five' are the three billion rural poor. These are the subsistence farmers and herders that have no economically valuable assets and too little cash for it to be reasonably called an income. Most of the billion undernourished people on earth are to be found among their number. They are the most vulnerable to shocks of any kind – price shocks, storms, droughts, conflict.

It is the aggregate of the choices the individuals in these four groups make – their personal, economic and political choices – that will drive the 21st Century. These aggregates and the complex interactions between them are the tectonic forces that will shape the landscape of risk and opportunity for everyone as the century progresses. They will not all be easily captured in conventional economic models. How well governments manage

their part in these transformations will determine how possible it will be for companies and cities to navigate them successfully.

Over half the world's population now live in cities. Most of the megacities in which the increasingly urban population live are coastal and vulnerable to the amount of sea level rise likely in this century. More immediately, those same cities are vulnerable to energy, food and water price shocks which can be politically destabilising. There is now clear evidence from around the world of the link between violent uprisings and food price volatility.

8. EXPECTATIONS



As average incomes rise, people become better educated and their expectations inevitably rise too. This raises the social and political cost of failing to meet those expectations.

Increasingly, Rio Tinto is looking to invest in greenfield sites – in Mongolia, Guinea, Mozambique – where one of the major benefits to the host country is a steep and sudden rise in real incomes and with it a rise in the expectations of our host community.

This has made it imperative for us to develop new ways of working with public authorities and community leaders in order to ensure that those expectations are met.

Cities attract migrants on such a large scale because of the expectation of rising incomes.

For both those managing both mines and cities failure to meet these rising expectations can quickly lead to dislocation.

9. ACE PEOPLE



Furthermore, as people become more affluent and better educated they become more confident. With today's information technologies they also become

more connected and better informed and more accustomed to making choice for themselves. Since these are exactly the kinds of people we need to work in modern mines and run our cities with all their myriad services this is to be welcomed. But it increases the price of failing to meet expectations – or, put another way, increases the exogenous risk.

This is particularly true as people become increasingly better connected. If we fail to deliver a high level of social and environmental performance, especially if we have a major accident, we can expect the whole world to know about it very quickly. This makes us less attractive a developer of resources and deters investors.

Cities face a similar challenge in maintaining their reputation as good places for inward investment should they acquire a reputation for failing to meet rising expectations.

10. GLOBALISATION

GLOBALISATION

the creation of a global information space

the creation of global capital markets

the creation of global markets for goods
and services

the creation of global rules systems

the emergence of global values

Globalisation is the key strategic factor which has enabled the extraordinary growth in affluence that is driving this rapidly changing landscape of exogenous risk. Without it, there would be no possibility of meeting the rising expectations of the three and a half billion people who are the emerging consumers. But we often forget that it is not a single force but a series of converging forces each with its own technological and analytic drivers.

Without the creation of a single global information space from the eighties onwards the creation of today's global capital markets would have been much slower. If there had not also been a continuous process of liberalisation of the markets for goods and services there would have been far less opportunity for that capital to pursue. Without the development of a global system of rules to manage finance and trade relations the confidence to make these markets work to the scope and volume that now sustains our prosperity would have been absent.

All of this is underpinned by the emergence of global values most dramatically expressed by the development of global brands.

11. OPPORTUNITY & RESPONSIBILITY

OPPORTUNITY & RESPONSIBILITY

globalisation of **opportunity** must be
accompanied by globalisation of
responsibility

just as....

nationalisation of **opportunity** was
accompanied by nationalisation of
responsibility

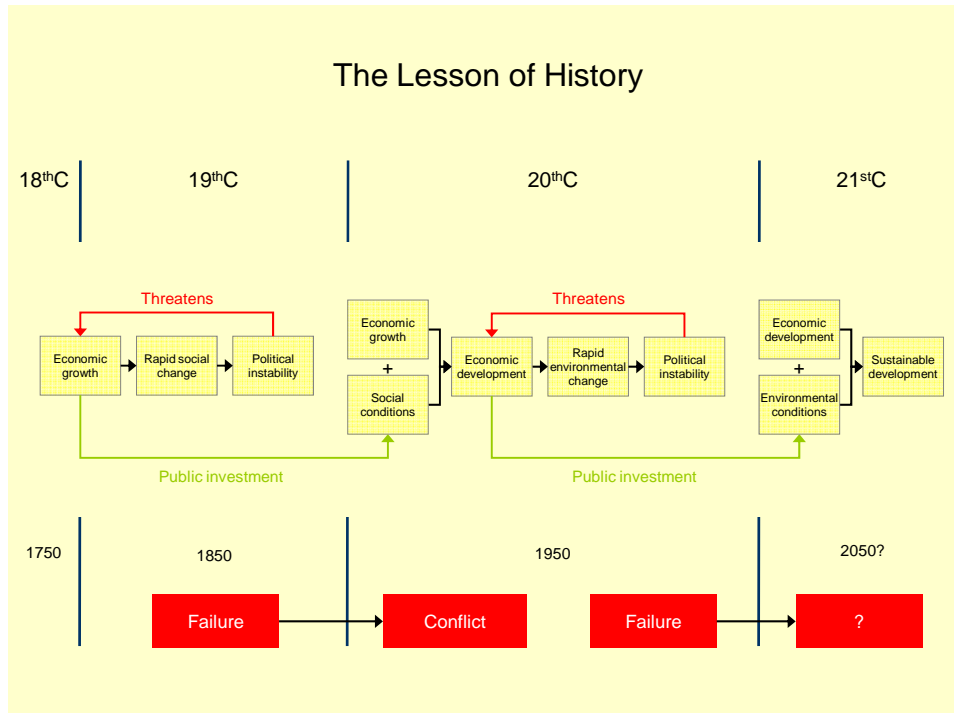
The world has moved rapidly to take advantage of the opportunities created by globalisation. But it has been less quick to take on the accompanying responsibilities. The result is that we are faced with the challenge of meeting ever rising demand and expectations with an increasingly degraded resource base.

We can see from history that the development of national standards on social and environmental behaviours only took place after we developed national economies for the first time in the 18th Century. This is a struggle that continues to this day.

But we have barely begun the process of globalising responsibility. Another way of describing this challenge is to think of it as making the transition to sustainable development. This is certainly an agreed goal of the international community but it is still a very long way from becoming a reality.

It is instructive to set the development of this idea in its historical context as we try to understand the challenges ahead of us.

12. HISTORY



From about the middle of the 18thC. there was a sustained debate, predominantly within Europe about how to make the economy grow faster. As the industrial revolution gathered pace under the stimulus of the Napoleonic Wars and the subsequent prolonged period of peace the answer became clear. If individuals are freed to pursue their own self-interest, the interests of all will be enhanced as the economy grows. As a formula for increasing economic growth there is no doubt that this argument was correct. As this liberal doctrine gained hold, economies did indeed grow rapidly.

But economic growth corrodes social ligatures. The complex, multi-dimensional relationships of relatively stable communities are replaced in the

creative destruction of capitalism by the simpler, transactional relationships of the cash economy. Cultural bonds with their complex patterns of mutual rights and obligations are replaced by economic bonds based simply on the ability to pay. Margaret Thatcher never understood that you cannot have both an increase in economic opportunity and a return to Victorian values because of the corrosive effect of rapid economic growth with its huge reliance on explicit transaction rules on culturally rooted implicit rules systems.

In the 19thC rapid economic growth led then in Europe, as it does now globally, to very rapid social change. This social change, unmediated by any attempt to ameliorate its impacts on the welfare of large numbers of people, led to growing political instability which threatened to undermine the engine of economic growth driving the changes. It is worth recalling that by 1848 Marx had already written the Communist Manifesto.

By the middle of the 19thC, as the dynamics of what we would now call a negative feedback loop became apparent, a new argument began. This new debate was about what needed to be done to maintain the social conditions necessary for the economy to continue growing. The answer that emerged over the next century was that some of the proceeds of that economic growth needed to be invested in maintaining the social conditions necessary for growth to be possible.

By 1870 Bismarck had already launched the world's first welfare policies. By the middle of the 20th Century this debate was over. It was accepted everywhere that government needed to invest in

health, education and social security if the social cohesion necessary for the economy to grow was to be maintained. Argument will continue forever about how much public investment should be made in welfare and about how that investment might best be made in order to avoid perverse outcomes. But there is no longer any argument, even in the most doctrinaire free market economies, that there is some need for this investment.

As a consequence there is subtle shift in the focus of public policy. Its purpose now becomes to promote economic development, that is, economic growth plus the public investment needed to maintain the social conditions for its achievement. This robust consensus emerges just at the moment when world population is about to grow from 2.5 billion to 6.5 billion a single lifetime. At this point a new argument begins as some farsighted individuals begin to grasp the impacts on the ecological foundations of the economy of a rapidly growing and increasingly prosperous population.

It is now clear that we must invest some of the proceeds of economic development in order to maintain the environmental conditions for that development to continue. Sustainable development is simply those patterns of economic development which do not undermine the social and environmental conditions on which they depend.

13. THE CHALLENGE

SUSTAINABLE DEVELOPMENT - THE CHALLENGE

- the task is to raise the population of the planet to 9 billion in forty years
- whilst raising real incomes
- without irreversibly undermining the productivity of the 7 ecological systems which provide the foundations of the economy

There have been many attempts to define sustainable development. I am perfectly happy with the original Brundtland definition of development that meets the needs of the today without undermining the ability of future generations to meet their needs.

Putting that into operational language makes the task that of delivering rising real incomes to a population of 9 billion people without collapsing the productivity of the 7 ecological systems which provide the foundations for the economy.

ECOLOGICAL FOUNDATIONS

croplands

rangelands

forestlands

wetlands

freshwaters

oceans

the atmosphere

Those 7 systems – croplands, rangelands, forestlands, wetlands, freshwaters, oceans and the atmosphere provide everything in our economy that is not provided by fossil fuels and non-fossil minerals.

If we degrade their productivity we inevitably degrade the productivity of our economy. And this is exactly what we have been doing as we have allowed globalisation of opportunity to outpace globalisation of responsibility.

We are facing real absolute resource constraints in relation to oil, to a lesser extent gas and to an even smaller extent on coal. But we are not and will never be absolutely short of energy. Fortunately, we already have available, if not yet deployed, the all the technologies we need to derive all of our energy services from other options provided we can solve the institutional and political problems of making the transition.

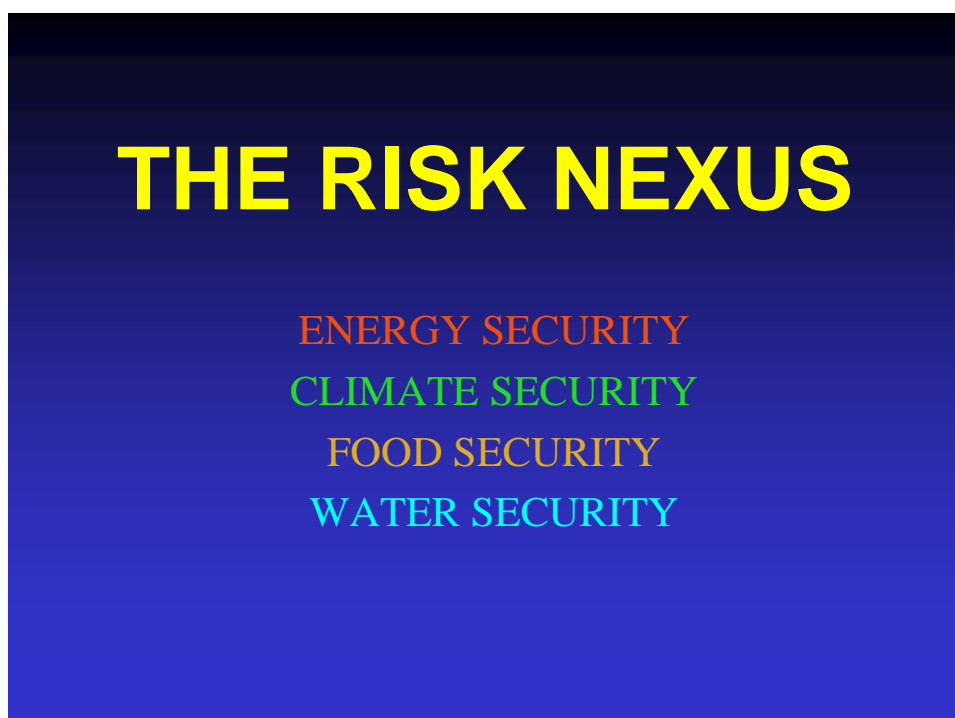
Nor need we fear absolute shortages of mineral resources though the cost of making them available will increase as the useful elements they contain become ever more widely dispersed.

We are far less well placed however to maintain a sufficient level of productivity in these 7 ecological systems to meet the growing demands of people.

14. ECOLOGICAL FOUNDATIONS

[See above]

15. RISK NEXUS



This combination of demographic, economic and resource pressures are already stressing the pillars of prosperity. That is the energy, food, water and climate security without which civilised life is impossible in any city or society. They are creating a nexus of risks which neither the managers of mines or cities can manage without much more

focussed and urgent action from national governments.

In our increasingly inter-dependent global economy most countries can no longer manage their exposure to these risks from within their own territory. This places an ever greater importance on the need to maintain the open, rules based, global trading system on which so much of the world's post-Second World War prosperity has depended.

After ensuring territorial integrity and internal stability preserving energy, food, water and climate security are the next most important imperatives facing governments. Any significant failure to maintain the pillars will quickly result in regime change whatever the nature of the regime in question. Governments everywhere are now finding this an increasingly demanding task.

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

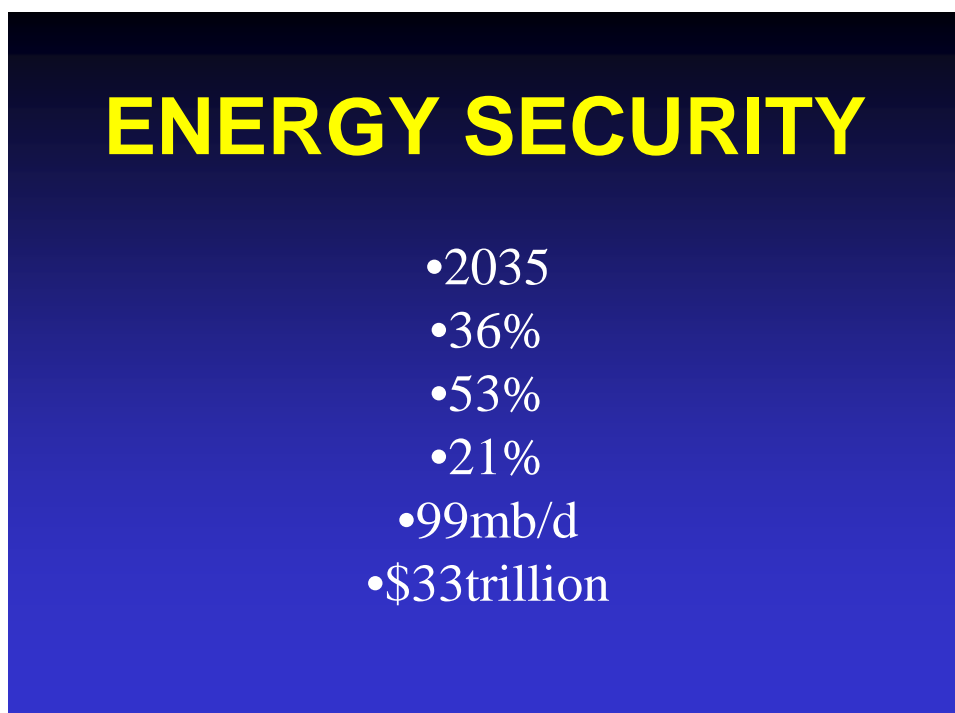
No government will put at risk energy, water or food security in order to achieve climate security. These are more familiar risks for governments to manage and are issues where policy failure has very immediate political consequences. Not surprisingly, for a majority of governments they currently take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

Nevertheless, loss of climate security acts as a stress multiplier on the other components of the risk nexus.

Allowing the more immediate to obscure the more urgent is not an uncommon cause of policy failure. We know from experience that it is possible for nations to recover from a loss of energy, water or food security, albeit it at great human and economic cost.

The same is not true for climate security. Once lost it cannot be regained. The time bound nature of the climate problem thus makes it more urgent, though less immediate, than the resource issues with which it is closely interlocked. This leads to a significant risk that without a far deeper understanding of the dynamics of this complex nexus of issues governments will adopt policies with perverse or contradictory consequences.

16. ENERGY



The World Energy Outlook 2010 projects global primary energy demand to grow by 1.4% a year initially, declining to 0.9% a year by 2035. This will lead to a 36% increase in primary energy demand, some 53% of which will come from fossil fuels.

By then fossil fuels will account for 74% of the world's primary energy mix with demand for gas rising faster than any other fuel. This will drive energy related carbon dioxide emissions up by nearly 21% at a time when they need to be reducing by almost twice that amount.

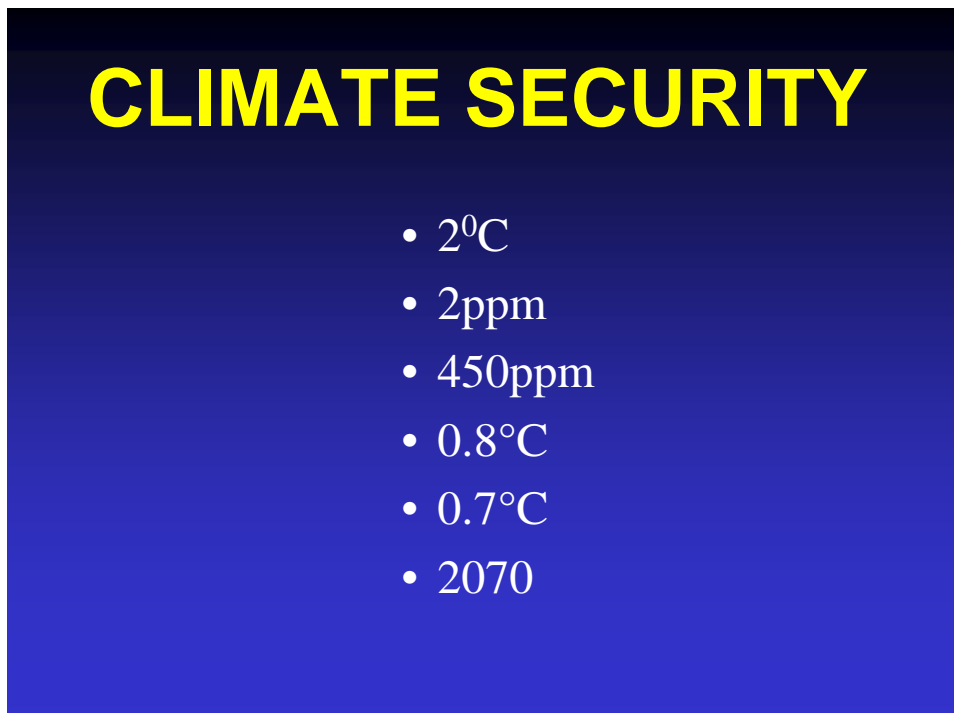
There is no imminent shortage of either coal or gas and both are more widely distributed geographically than oil thus lowering the political risks to energy security.

Oil is a different matter. The International Energy Agency (IEA) projections show oil demand rising to 99 million barrels a day by 2030. Debate rages over when we will experience peak oil – the moment when the amount of oil remaining to be found is less than that which has been used – but few oil analysts believe that production will rise much above 90 million barrels a day.

This is because for both economic and political reasons it is proving ever more difficult to match the rate of investment in new resources to the combination of the rate of decline in existing resources plus the increase in demand. This recently produced the unusual sight of the head of the IEA imploring government to do more on climate change in order to reduce the pressure on oil reserves.

The International Energy Agency (IEA) estimates that to meet the world's growing demand for energy will require an investment of some \$33 trillion between now and 2035. Doing so in a low carbon way would add over \$10 trillion to that cost but would also avoid the need to pay for more than \$8 trillion worth of oil.

17. CLIMATE



CLIMATE SECURITY

- 2°C
- 2ppm
- 450ppm
- 0.8°C
- 0.7°C
- 2070

Climate change is a consequence of providing our economy with the secure and affordable energy services on which economic growth depends largely by the extensive combustion of fossil fuels. The IPCC concluded in 2007 both that it was beyond doubt that climate change was occurring and that human activities were responsible. In the somewhat fractious public debate it is often overlooked that this conclusion, from the summary for policy makers, is agreed line by line by all the participating governments. In other words, not a

single government in the world disagrees with this conclusion.

These activities have led to an increase in the concentration of greenhouse gases in the atmosphere, principally carbon dioxide which alone accounts for about two thirds of the resultant warming. Some 85% of that carbon dioxide results from the combustion of fossil fuels. The rest comes from land use changes, including the burning of forests.

The remaining third of the greenhouse gases comes from a variety of industrial process and from agriculture. The concentration of carbon dioxide in the atmosphere is now 390 ppm, up from the pre-industrial level of 280 ppm. It is rising at a slowly accelerating rate of about 2.0ppm a year.

The IPCC concluded that to be very confident of keeping the eventual temperature rise to the 2°C, accepted by governments as the threshold of dangerous climate change, the carbon dioxide concentration would need to stabilise at 400ppm. If the other greenhouse gases are included and an allowance is made for the cooling effect of aerosols, it is estimated that a CO₂e concentration of 450ppm would create a 50-50 chance of staying within that limit.

The observed increase in global average temperatures above pre-industrial levels is 0.8°C. Even if all further greenhouse gas emissions were to cease immediately there would be a further rise of 0.7°C due to lags in the response of the earth system to carbon forcing.

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

The advice from climate scientists is that, if global emissions peak by 2015 and reduce quickly thereafter, there remains a reasonable chance of staying below the 2°C threshold. If global carbon emissions do not peak until after 2020 then they would need to decline by more than 5% a year to retain this chance.

The Hadley Centre estimates that a business as usual case on carbon emissions could lead to a rise in global average temperatures of some 4°C by as early as 2070. A 4°C rise in global average temperatures would lead to a 12°C+ rise in the Arctic.

18. FOOD

FOOD SECURITY

- Cereal consumption has doubled since 1970 but over 1 billion still undernourished;
- Demand will double by 2050;
- Second food price spike in 2010 again led to export controls and political disruption.
- Agriculture is responsible for a third of greenhouse gas emissions

The sudden and sharp spike in global food prices in 2008 was a timely reminder of the political importance of food security. It led to food riots in over 60 countries and, indirectly, to regime change in one. More alarmingly, the immediate reaction of several food exporting countries – as it was again in 2010 – was to ban food exports. Rising food prices in 2011 helped trigger the events of the ‘Arab Spring’.

Over a billion people remain undernourished despite a doubling of cereal consumption since 1970. As incomes rise, diets change to include more meat and dairy products whose production is itself increasingly grain intensive. The FAO expects the combined effect of population and income growth to lead to a doubling of world food demand by 2050.

Agriculture is the dominant human impact on land and water resources. About a quarter of the world’s ice-free land surface is used for crop cultivation or pasture. The current level of food production is

highly dependent on cheap energy, particularly oil and gas, along the whole supply chain from farm to consumer. Cultivation, processing, refrigeration, shipping and distribution are all energy intensive steps in this supply chain, becoming more so as the shift of rural populations into the cities continues.

This helps make agriculture a major emitter of greenhouse gases, responsible for about a third of the total from human activities – some 13 -15 GtCO₂e a year.

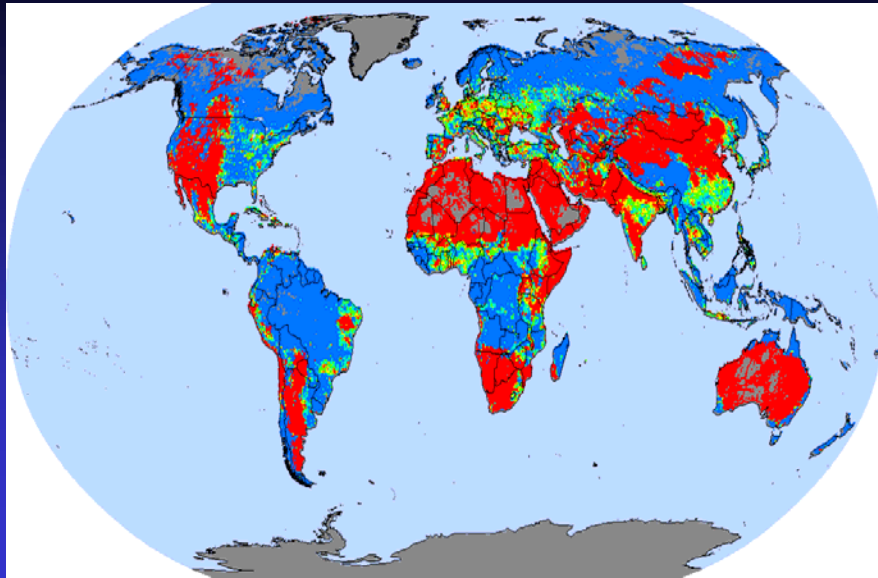
Climate change will increase the stress on food production. It is now clear that the temperature increase of 1 – 2°C to which we are already committed will reduce crop yields in seasonally dry and tropical regions. Researchers expect some benefits to crops and pasture in higher latitudes. Beyond the 2°C threshold, however, the likelihood is that there will be negative effects in all regions.

19. WATER

WATER SECURITY

- 2.8 billion people currently experience high water stress. Two thirds of China's cities, that is 400, already suffer water shortages;
- 70 rivers at maximum extraction;
- More than 250 rivers worldwide are depleted. In many years the Nile, Yellow, Indus, Rio Grande, Colorado, Oxus and Murray rivers do not reach the sea.

WORLD WATER SCARCITY



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

Agriculture is by far the largest consumer of water at 70%, industry, including energy, uses 23% and households about 8%. Although some 80% of agriculture is rain fed, the 18% that relies on irrigation has yields 2-3 times higher delivering over 1 billion tonnes of grain each year.

If the water environment becomes too severely compromised it will not be possible to sustain food production. 70 major rivers around the world are near maximum extraction levels to supply water for

irrigation systems and several, including the Yangtze, Colorado and Murray, struggle, and sometimes fail, to reach the sea.

Climate change adds further stress to the water system. In arid and semi-arid areas at low latitudes there will simply be less water available. Most dramatically, it will diminish the availability of water from glaciers. Across much of Central Asia, Latin America and South Asia rural livelihoods depend on glaciers. The glaciers of the Himalayas and Tibet alone feed seven of the world's greatest rivers – the Brahmaputra, Ganges, Indus, Irrawaddy, Mekong, Salween and Yangtze. They provide water to more than 2 billion people. These glacial water banks are already melting at an accelerating rate. In the 1990s, glacial mass fell at more than twice the rate of the previous decade.

Particularly difficult will be the increase in the variability of timing, intensity and distribution of precipitation. A future to which the past is no guide complicates the task of water infrastructure planners and inevitably increases the cost of its provision. It particularly destabilises subsistence farmers and pastoralists in arid and semi-arid regions.

In coastal areas, rising sea level is already leading to the salinisation of coastal aquifers. Flooding from extreme weather events damages both water quality and the integrity of water infrastructure.

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

as much as 1 metre a year in many parts of the world, more energy is needed for pumping. The increased use of desalination plants and large scale water transfer projects to maintain water security will further increase the energy intensity of water provision. Rising energy prices will thus have a significant impact on water security, especially in the poorer parts of the world.

20. SHARED DILEMMAS



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

These stresses on the pillars of prosperity are not unmanageable. Essential technologies and appropriate engineering skills are already in existence. It is also clear that there is no fundamental economic barrier to their management, although there are large barriers to the effective and timely allocation of the necessary capital.

The complexity and dynamic nature of the relationship between these pillars, however does present difficulties to public policy and to politics which are not yet well understood. Managing these interactions effectively will require the achievement of a step change in the level of policy coherence by governments at all levels from the local to the global.

The institutional structures governments currently have in place to tackle them treat each issue separately. Typically, energy, water, food and climate are each dealt with by different government departments and agencies. Each has a separate constellation of supporting professionals and cluster of related businesses.

This significantly increases the risk of policy cannibalism as the solutions to one problem add to the difficulties of another. The British government, for example, has consistently sought to drive energy prices down to deal with competitiveness and fuel poverty issues while driving them up to tackle climate change.

Threatened water security can be addressed by energy intensive desalinisation and water transfer projects but at the risk of undermining energy security by increasing dependence on expensive

imports. If the extra energy is provided by the combustion of fossil fuels that will undermine climate security and eventually the water security being sought.

If lower water security threatens food security by climate altered precipitation this can be compensated by the use of energy intensive agrochemicals and water transfer projects. But, if the additional energy is provided from fossil fuels this increases the risk of further altering precipitation patterns and raising temperatures, thus undermining both water and food security.

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

21. POLICY CHALLENGE

THE POLICY CHALLENGE

VOLUNTARY MEASURES

CARBON PRICES

TECHNICAL STANDARDS

INVESTMENT INCENTIVES

The intimacy of the entanglement of climate and energy policy means that an effective global policy on climate change requires a close alignment of national energy policies. Energy policies are closely held by nations. The European Union has not managed to create a comprehensive common energy policy even while successfully building a single market involving 27 nations.

Furthermore, most of the policy tools available to governments are designed to achieve change at the margin. Governments have little appetite for, or experience with, the scale of transformational change required to deal effectively with climate change.

Public policy makers are accustomed to the tension between certainty of outcome and certainty of cost since it is not normally possible to have both. This tension is particularly acute with climate change where the unique nature of the problem sets a high premium on certainty of outcome.

There are four main policy tools available to governments to tackle climate change and the other issues of the risk nexus: voluntary measures, carbon prices, technical standards, investment incentives.

Voluntary measures include codes of business practise, information provision, and behaviour change campaigns. There is little evidence that they have accomplished much and are very uncertain in outcome.

Carbon and other cost internalising measures, whether imposed by a direct tax on carbon, for example, or by a trading system, have been the most widely discussed policy of the available policy measures. There is little evidence to date that governments have been willing to set such prices, however created, at a level high enough to significantly affect the patterns of capital investment. These measures provide certainty of cost but uncertainty of outcome unless generated by a cap and trade policy. They are also often more difficult to coordinate internationally than technical standards as many nations resist what may be considered to be tax harmonisation.

Technical standards to reduce carbon emissions or improve resource productivity can be imposed at all stages in the value chain from primary production to end-user. A very wide range of technical standards are available covering everything from an emissions performance standard for power plant and vehicles to efficiency standards for consumer products or buildings. They provide certainty of outcome but increase uncertainty of cost. They are

often easier than prices to coordinate between nations but can be complex to administer effectively.

Investment incentives offer both certainty of outcome and certainty of cost but are resisted by governments facing increasing pressure on the public finances from elsewhere. They will become increasingly important for meeting the infrastructure, as distinct from technology, requirements of a carbon neutral and resource efficient economy. There is no prospect that private capital alone will finance such key elements of infrastructure as carbon capture and storage facilities, water grids or supranational smart grids.

22. INTEGRATED RISK MANAGEMENT



As I mentioned before, the complexity and intimacy of the links between energy, food, water and climate policy requires an unprecedented level of policy coherence at all levels of government and business. Without it there is a considerable risk that

policy gains in one area will simply annihilate those in another. Furthermore, the resultant confusion will make it impossible for businesses, especially those making the long-life, high capital investments central to resolving these problems, to plan with confidence.

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

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

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

nation can preserve all of the pillars by its own efforts alone.

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

The imperative to cooperate and to align domestic and foreign policy priorities much more closely emphasises the role of national leaders. It is only at this level that the authority to align national efforts to a cooperative purpose on the necessary scale exists. This will mean building the appropriate awareness and staffing not only internally but between nations. Similarly, business leaders will have to build the necessary capacity within their companies to play a fully informed part in this endeavour.

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

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

23. POLITICAL CHALLENGE

THE POLITICAL CHALLENGE

FISCAL CONSTRAINTS
ENANGLED INTERESTS
DYSFUNCTIONAL RELATIONSHIPS
POLICY CANNIBALISM
FALLING CAPACITY
CONSUMER RESISTANCE
DIVERSE VIEWS

Throughout the Cold War, many nations invested large amounts of their national income in deploying weapons they hoped never to use. When those weapons became obsolete they were replaced with new and more expensive weapons in several cycles over half a century. This was widely accepted as a justified diversion of resources from more

productive use in the face of a perceived systemic risk.

But this was possible because there was a very broad public understanding of the consequences of policy failure. No such broad public understanding exists in the case of the risk nexus. This makes the task of mobilising the necessary resources to tackle the problem more difficult.

This mismatch between the intensity and urgency of the effort required and the perceived remoteness of the threat to everyday life is a major obstacle to policy success. Governments and businesses are unlikely to find themselves soon being urged to more vigorous climate action by an aware and alarmed public.

Building the necessary political will be very difficult. Governments everywhere are both distracted and constrained by the current fiscal crisis. They are also faced with large and deeply entrenched economic interests, some of which are openly antagonistic to the policy measures needed to prevent dangerous climate change. They are also faced with dysfunctional relationships both between and within government and business and fiscal constraints that are leading to an accelerating loss of policy making capacity within governments everywhere.

The additional costs of making the transition to a carbon constrained and resource efficient economy are inevitably resisted by both businesses and consumers. This is a deterrent to robust political decisions at the best of times, but is a very strong

disincentive to most politicians in current circumstances.

24. **TAKER v MAKER**



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

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

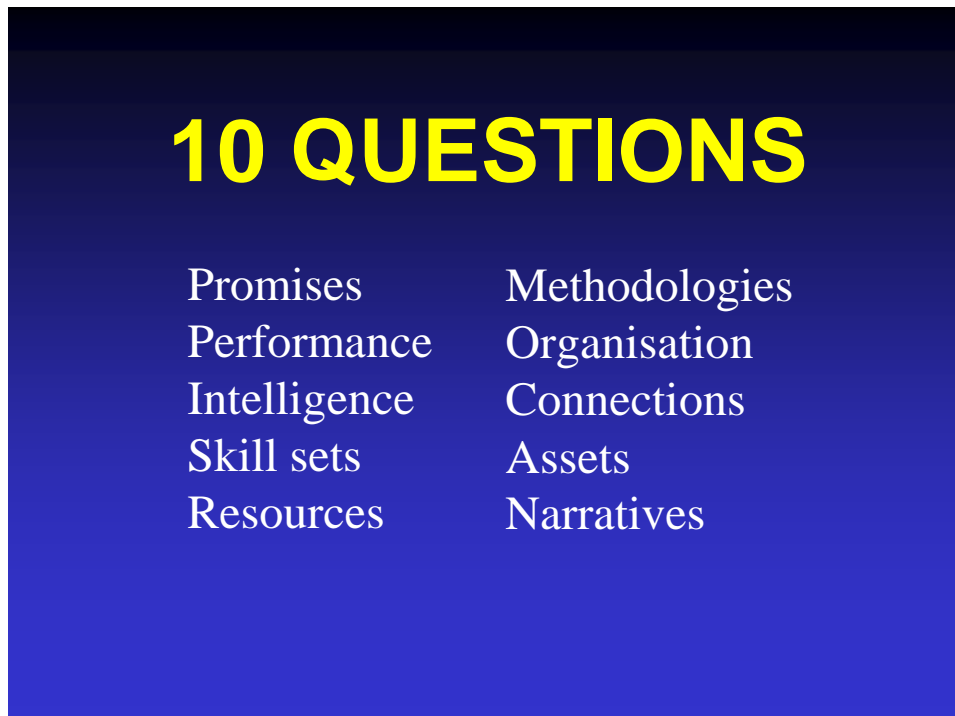
dilemma successfully the conditions will be created that make possible the preservation of food and water security and thus resource pillars of prosperity will be maintained.

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

Faced with the level of policy uncertainty offered by climate change the traditional corporate response has been to wait and see. This is especially true when it comes to making long life, high capital investments where the corporate instinct to risk aversion is strong. Response to public policy measures is limited and defensive aimed primarily at limiting impact on costs or revenues. Such prudence is typically rewarded by investors.

The risk nexus requires a more active response. Companies will need to make a strategic decision about whether to become a policy maker or remain a policy taker. This will entail making a judgement as to whether shareholder interests are best served by accepting whatever scale, nature and pace of policy response to the risk nexus governments find comfortable or whether the company should intervene to try and influence those factors.

25. 10 QUESTIONS



This prompts a set of critical questions for both companies and cities to answer, for example:

Are companies and cities taking effective steps to deal with their own carbon and resource productivity? Any perceived failure to walk the talk will lower public trust and reduce traction on policy.

Can continuous improvement be credibly demonstrated? Is there a clear track record of innovation in these areas?

Is there enough intelligence within the city or company on the nature, scale and immediacy of its exposure to the risk nexus?

Does the company or city have the necessary skill sets to interpret this intelligence and manage the risks?

Is the capacity to understand and manage these risks adequately resourced?

Are appropriate methodologies in place for properly assessing and valuing the exposures of the city or company's activities?

Are the right organisational structures in place so that the management of the risk nexus is fully aligned with other priorities?

Does the company have the right set and intensity of connections to other social actors seeking to shape the development of climate policy?

Is the full range of the city or company's assets, tangible and intangible, being fully leveraged to mitigate and manage exposure to the risk nexus?

Are there compelling narratives in use both internally and externally to fully mobilise citizens and employees to play their part in meeting this challenge?

I have suggested that cities and mining companies have more in common with each other than might be immediately obvious in facing the emerging risks of the 21st Century. At the heart of my argument has been the common feature that neither can move to avoid trouble and therefore require others, in particular national governments, to create a supportive context in which the exposure to these risks of both is within their capacity to manage. I have suggested that to manage these risks successfully they both need to look outwards to what others are doing as well as inwards to their own performance. And finally, I have concluded that both will need to encourage national governments to develop urgently more

comprehensive, integrated and coherent policy frameworks than are currently available.

I am conscious that all I have had to do this morning is offer advice and that it is you and your colleagues who must act on these issues. That is a far harder task. I hope this lecture has been of some help to you. Thank you.