

**Speech by the Rt Hon Simon Upton**

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***What sort of knowledge should Business School graduates  
have about green things?***

My father was a farmer. He lived very economically. When he died two years ago aged 87, he was still farming. His two cars were 38 and 42 years old respectively. His tractor – bought new in 1958 – was exactly my age. He wasn't poor. He just pre-dated the consumer culture. The idea of throwing anything away was anathema. In his farm sheds I discovered two disused ovens, four disused washing machines and eight broken kettles carefully stored away amidst a mountain of other hoarded junk after he died. His lifetime habits were a response to the Great Depression of the thirties and the wartime scarcity that followed. I sold it all to a scrap metal dealer for quite a tidy sum.

My father's life was not particularly remarkable. But the country and the century into which he was born were. Even though he pre-dated the arrival of electricity in his valley and rode to his first school on horseback, my father was born in what was at the time – and until the Second World War – the richest country in the world.

New Zealand today is the 51st richest country in the world<sup>1</sup> (on a per capita GDP basis at PPP). New Zealanders have become richer. But many hundreds of millions of people have become far richer still. There are almost 5 billion more people alive today than when my father was born in 1920.<sup>2</sup> The twentieth century saw population increase four fold, water abstraction increase nine fold, energy use increase 16 fold and economic output forty fold.

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<sup>1</sup> CIA World Factbook : <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html?countryName=New%20Zealand&countryCode=nz&regionCode=au&rank=51#nz>

<sup>2</sup> US Census Bureau: <http://www.census.gov/ipc/www/worldhis.html>

Two generations later we are living through what is being called 'The Great Recession'. It is a very different phenomenon and its effects differ widely from country to country. The question I have in my mind is this: in what way will the exit from the Great Recession shape today's children? And from the point of view of the people you teach, how will that exit shape tomorrow's consumers and voters?

My father's generation was frugal because plenty had vanished before their eyes. Even when affluence returned in the fabulous post war years, they never felt comfortable with the throw-away society. So are we going to resume the growth path of the past, in which soaring wealth is matched with soaring waste? Or are we going to find a way of pursuing growth while being frugal with scarce environmental assets?

We were only able to achieve the economic transformation that followed the last great economic collapse by developing the energy and food production systems that now underwrite the lives of 6.6 billion people. In the process we have had to transform vast areas of the earth's surface. And we have availed ourselves of supplies of energy that have transformed the way billions of people live. If we had not mobilised huge additional resources, their lives – assuming they would have been born – would have been particularly hard.

Let me illustrate the dimensions of that change rather starkly with this contrast:  
[slide]

This person's toil is fairly back-breaking. But it is in a good cause – subsistence. There are not a lot of inputs into this sort of agriculture other than time. Modern technological societies value time much more highly. This person in a tractor can achieve in one hour what would occupy a manual farm labourer for three weeks. But it's not really the tractor which has made the difference. It's our capacity to synthesize reactive nitrogen from the atmosphere. My favourite earth systems scientist, Vaclav Smil, has calculated that by the year 2000, about 40% of humanity was alive because the proteins in their bodies were formed by digesting food whose nitrogen came from the Haber-Bosch process for synthesizing ammonia. (He also calculates that in China, that percentage is probably nearer to 70%).

Of course, a world in which agriculture is no longer just about subsistence is a world in which the time that has been saved is available for other activities. And the richer you are, the more you will be inclined to use it consuming other resources. Let's take a look at the way the rich used to live. [slide] Here is what's left of one of the Emperor Hadrian's palaces. To run an establishment like this would have needed the energy output of maybe 6000 slaves. Slaves were cheap. There was a high level of wastage. Labourers in the fields had a life expectancy of 15 years.<sup>3</sup> And

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<sup>3</sup> Princeton/Stanford Working Paper: The Roman slave supply (2010): <http://www.princeton.edu/~pswpc/pdfs/scheidel/050704.pdf>

such were the limitations of the age, that there wasn't room for many imperial appetites.

Imperial appetites today are more commonplace. The inhabitants of this house will easily mobilise the energetic equivalent of 6000 slaves – half a megawatt – by the time you count in their household appliances, cars and recreational toys. The average American has the energetic equivalent of 100 slaves working for them 24 hours a day.<sup>4</sup> And of course there are many more emperors even if their empires are financial. There are, today, believed to be just over 1000 billionaires, 403 of them American and already 64 of them Chinese - many of whom live in grander houses than this one.<sup>5</sup>

But without going to these extremes, the average OECD citizen still mobilises many times more energy than her grandparents and 100 times more than a subsistence farmer in Africa.<sup>6</sup> The price of this release from drudgery has been a dramatic increase in the claims we make on the so-called ecosystem services provided by our planet such as food and water.

Now there was only so much damage the Emperor Hadrian could do. Regarding human labour as free and easily substitutable must have made the lives of slaves pretty brutal. The waste of human capability must have been staggering. The moral blind spot is for us hard to fathom.

We consider ourselves much more enlightened. We place an ever higher value on human life. But, at least until very recently, we've had our own blind spot. It is ecosystem services that we have regarded as free and easily substitutable. And it has led us to some equally spectacular waste about which we feel as morally ambivalent as the Emperor Hadrian did about his slaves. Let me provide a few examples.

- Every year, we take about 95 million tonnes of fish from the oceans. About 40% of that – or 38 million tonnes - is simply dumped. Much of this occurs under the unprepossessing title of 'by-catch'. In some fisheries (shrimp for instance) ten times as much catch is discarded as is landed. With fisheries targeting shark fins, 92% of the mass of what is caught is discarded.<sup>7</sup>

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<sup>4</sup> Encyclopedia of Human Thermodynamics (2010): <http://www.eoht.info/page/Energy+slave>

<sup>5</sup> Forbes (03/2010): [http://www.forbes.com/2010/03/10/worlds-richest-people-slim-gates-buffett-billionaires-2010\\_land.html](http://www.forbes.com/2010/03/10/worlds-richest-people-slim-gates-buffett-billionaires-2010_land.html)

<sup>6</sup> Encyclopedia of Human Thermodynamics (2010): <http://www.eoht.info/page/Energy+slave>

<sup>7</sup> "The Sunken Billions" (2009) World Bank, FAO Report: <http://siteresources.worldbank.org/EXTARD/Resources/336681-1224775570533/SunkenBillionsFinal.pdf>

- There are 1 billion cars and light trucks in the world.<sup>8</sup> With the exception of a tiny percentage of hybrid or fully electric vehicles, even the most efficient automobiles waste about 85% of the energy in each fuel tank. Only 15% of the chemical energy in an average litre of gasoline is converted into moving the vehicle.<sup>9</sup> The rest literally disappears into thin air.
- Global agriculture currently uses about 3 trillion cubic metres of water per year or 71% of global withdrawals.<sup>10</sup> Much of it is wasted. Global estimates of irrigation efficiency suggest that around 60% of irrigated water never reaches the crop.<sup>11</sup> It just runs off or evaporates.
- The UN recently estimated that over 50% of the food produced world-wide is “lost, wasted or discarded as a result of inefficiency in the human-managed food chain”. 10% of developed country greenhouse gas emissions come from food that is never eaten.<sup>12</sup>
- Finally there’s wasted energy. The avoidable waste of electricity used by electrical appliances in standby mode alone equates to the energy consumption of Italy or 1% of global carbon dioxide emissions.<sup>13</sup>

The important point to make about these numbers is not that they are shocking (which they are) but rather that they are entirely predictable. If things are free they tend to be abused. Hadrian’s slaves would attest to that. Free things aren’t worth measuring. And as accountants say (and I am married to one) what you don’t measure, you don’t manage.

- **What has all this to do with Business Schools?**

This is an (admittedly long-winded) introduction to my proposition that no graduate should leave business school without a very clear understanding that in the very near future there won’t be much in the way of natural resources or waste streams that doesn’t have to be very carefully measured – and managed. That is because there are planetary thresholds beyond which we could face some very costly feedback effects. Some of you may be familiar with the paper by Rockström *et al.* that attempts to describe some of the big thresholds. [slide] This is all about the amount of leeway we have with the global bio-geochemical cycles of which we are

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<sup>8</sup> Yale University Environment 360 (2009): <http://e360.yale.edu/content/feature.msp?id=2128>

<sup>9</sup> University of Washington Fuel to Wheel Efficiency Report: <http://courses.washington.edu/me341/oct22v2.htm>

<sup>10</sup> OECD, McKinsey & Company, The 2030 Water Resources Group (2010)

<sup>11</sup> World Resources Institute (2000): [http://earthtrends.wri.org/features/view\\_feature.php?theme=1&fid=17](http://earthtrends.wri.org/features/view_feature.php?theme=1&fid=17)

<sup>12</sup> UNEP, The Environmental Food Crisis (2009) [http://www.unep.org/pdf/FoodCrisis\\_lores.pdf](http://www.unep.org/pdf/FoodCrisis_lores.pdf)

<sup>13</sup> International Energy Agency, Gadgets and Gigawatts (2009) <http://www.iea.org/w/bookshop/add.aspx?id=361>

ourselves a part. My father's generation had much more room for manoeuvre than we have today or my grandchildren will have by 2050 when population will likely exceed 9 billion.

This will be a world in which atmospheric, terrestrial and ocean 'space' for the absorption of waste will be much more constrained. One way or another there will be prices on resources and waste streams that are currently 'free'. None of this is new - the OECD, for which I work, has devoted most of its existence to stating the obvious: that if socially and environmentally costly behaviour is made more expensive, it is likely to be curtailed. But after nearly 20 years of arguing the merits of pricing greenhouse gas emissions, progress is painfully slow. By and large, governments don't do things because scientific papers say they should. Neither do businesses.

So how might Business Schools make the case for more frugal resource use in a world where prices don't currently communicate scarcity? It's all about managing risks (a defensive strategy) and seizing opportunities (a growth strategy). Let me say a word about each.

- **Defensive reasons**

- Licence to operate: present or future risk of regulation (and what that could do to shareholder value.

As and when regulators respond to tightening environmental constraints there is likely to be a large re-distribution of shareholder value. There will be winners and losers at the level of industry sectors, and within sectors at the level of companies. The winners are more likely to be those businesses that take the care to understand environmental risks from a broad perspective.

The eventual pricing in of carbon emissions is the most visible source of risk. With a few exceptions (such as inside the EU ETS) the price of carbon remains close to or at zero. This undermines a key incentive for innovation in emissions reductions technologies. The market simply isn't pricing in any likelihood that the situation will change anytime soon. There is a real prospect that the price will stay close to zero and then all of a sudden jump to a much higher price once the risk of climate catastrophe is recognized.

The consequences of mis-priced risks should be reasonably front-of-mind in the light of recent events. One root cause of the recent financial crisis was the mis-pricing of a systematic risk. Carbon emissions represent the ultimate systemic risk.<sup>14</sup> The fact that they remain unpriced doesn't mean shareholder value is not at risk. The equity market typically focuses on issues with quantifiable and near-term impacts on financial performance. It is only just beginning to recognize the magnitude of impact

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<sup>14</sup> Litterman, Bob. Author of the Black-Litterman Global Asset Allocation Model "Carbon Emissions Prices and Sovereign Wealth Fund Benchmarks", Remarks at Columbia University (October 2010)

the transition to a low carbon global economy will have on companies' competitive positions and long-term valuations.

The introduction of carbon emissions trading, initially in Europe and more recently in other regions, is starting to provide investors with a basis for assessing the impacts of climate change on financial performance in carbon-intensive industries.

But what happens if, in response to outlier events or new science, regulatory action is stepped up? At a carbon cost of US\$60/tCO<sub>2</sub>e, a recent report<sup>15</sup> finds that as much as 10% of the total cash flow of listed companies could be transferred from companies with below-average carbon efficiency to those with above-average efficiency. Some 90% of this cash flow transfer occurs in just a handful of sectors: oil & gas, airlines, other transport, chemicals, mining, steel & aluminium, power utilities and non-power utilities. Given that carbon costs may rise significantly higher than US\$60/tCO<sub>2</sub>e, it is clear the impact on industry structures will be significant. At US\$150/tonne, the total value of global carbon emissions would represent more than five times the aggregate earnings of publicly listed corporations across the globe or about 15% of global GDP.

But these unpriced environmental risks are not confined to climate change. Access to water is another. As they wait for governments to step into the regulatory breach, institutional investors are increasingly demanding that companies do a better job of reporting their water usage. This goes beyond the simple physical risk of water shortages or degraded water quality. Competition for water can bring with it uncomfortable political situations.

According to a recent report<sup>16</sup>, there are over 300 companies that operate in emerging markets in which water regulation does not currently exist but where water risk may impact on the viability of operations in the not too distant future. For example, a recent report estimated that if a Texas Instruments or Intel Corporation semiconductor chip plant had to shut down due to temporary water unavailability the revenue loss could run to as much as \$200 million in a given quarter.<sup>17</sup>

In August last year the Norwegian government's \$400 billion pension fund announced that it would begin requiring the 1,100 companies in its portfolio of holdings to meet certain defined minimum standards of water risk reporting and management.

- Risks to the business from direct effects of resource depletion or collapse

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<sup>15</sup> Goldman Sachs, GS SUSTAIN: "Crossing the Rubicon: Our investment framework for the next decade", (2010)

<sup>16</sup> RiskMetrics Group, ESG Review of Water Sector, (2010)

<sup>17</sup> Klop and Wellington, JPMorgan Chase (2008)

Then there are the direct risks of resource depletion or collapse. In principle, businesses should be best placed to make assessments about these risks. Unlike fickle electoral moods, potential scarcities in the physical world should lend themselves to tidy research and analysis. And it is true that some resources, like water or fish, are pretty well understood by those who exploit them. But some of the potential processes of global change are so complex that the capacity to assess them is unlikely to exist within even the very largest companies.

Take for example the insects that provide essential pollination for growing around 70% of the world's most productive crops. The recent TEEB report estimated that pollination services are annually worth about \$190 billion. Bees of course don't send invoices. But when they're not there, the costs are real. The spread, since 2006, of something called Honey Bee Colony Collapse Disorder is estimated to have cost US farmers \$15 billion so far. A systemic failure like this does not lend itself to purely private management.

There are plenty of impressive numbers coming out of climate change assessments. The insurer Allianz has estimated that current assets at risk in the north east USA to a 1 in 100 year storm surge amount to \$1.4 trillion. But if sea level rise commenced in earnest, a sea level rise of 20 inches could place assets worth \$7.4 trillion in jeopardy. Globally the value of at-risk assets in 136 key coastal cities worldwide could be as much as \$28 trillion.<sup>18</sup>

The question I am left asking myself is whether muted action – either by regulators or companies – is a result of genuine uncertainty or human disbelief faced with risks on a scale we have never previously encountered. I suspect it is a mixture of both. Some of the numbers are certainly eye watering.

In July this year, UNEP estimated that human damage to the natural world in 2008 carried a price tag of between \$2tn and \$4.5tn. A second study, for the UN-backed Principles for Responsible Investment (PRI), puts the cost considerably higher at \$6.6tn, or 11% of global economic output. This, the study noted, compares with a \$5.4tn fall in the value of pension funds in developed countries caused by the global financial crisis in 2007 and 2008. With numbers like these floating around, businesses need to be well informed about some of the pressures that could disrupt their world.

- **Positive reasons**

- Improved profitability through reducing waste

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<sup>18</sup> [http://knowledge.allianz.com/climate\\_tipping\\_points/climate\\_en.html](http://knowledge.allianz.com/climate_tipping_points/climate_en.html)

I won't spend too long stating the obvious under this heading. Reducing waste pays as innumerable breathless studies show. This is the 'easy' way to the hearts and minds of businesses who may not be too worried about sustainability. Here's a typical factoid: Lighting represents almost a fifth of electricity consumption. The IEA estimates that 38% of that consumption could be saved cost-effectively by phasing out conventional incandescent lamps in favour of their efficient new replacements. For outdoor lighting, replacing inefficient mercury vapour lamps could reduce energy costs by 40% and show a rate of return of around 50%.

The interesting question, of course, is why easy low-hanging fruits like this remain unplucked. There will in theory come a time when resource scarcity and environmental costs are so heavily priced in that businesses will make these investments. But in the meantime, there is competitive advantage and environmental payback lying unharvested in the field. Business schools could be doing useful work understanding the many regulatory, institutional and behavioural rigidities that can stand between businesses and unlocking these gains.

#### ➤ Responding to consumers

Responding to consumers is an apparently 'business friendly' rationale for wising up on the environment. A recent systematic review of the research by the Network for Business Sustainability and reported at the OECD provided some important insights about what drives consumer behaviour.<sup>19</sup>

Consumer knowledge of firm sustainability appears to be really important. Negative firm behaviours (acting unethically or irresponsibly) have more impact than positive firm behaviours. Consumers are often unaware of positive information, in part because they can't confidently identify it. This suggests businesses need to strike a delicate balance between legitimately informing consumers of their positive sustainability actions, whilst not being perceived as over-emphasizing modest claims.

The study indicated that reliable research in this area is relatively scarce. There is some evidence to suggest that some consumers may already be willing to pay a higher price for products and services which enhance social or environmental well-being. Other evidence suggests that consumers will demand a discount for 'unsustainability' and that it is greater than the premium for sustainability. Consumer willingness to make socially conscious choices appears to be more common than a willingness to pay premiums.

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<sup>19</sup> <http://www.oecd.org/dataoecd/17/11/43399842.pdf>

It would be fair to say that the defensive rationale of protecting a brand from attack by consumer action groups and environmental NGOs is a more potent consumer-oriented rationale for taking environmental issues seriously. And it would be reasonable to conclude that consumers are likely to be better informed in the future than they are today so the risks of what you don't know being able to hurt you have upside risk.

Interestingly, the current economic environment doesn't appear to have lessened consumer interest in environmental issues. The National Geographic "Consumer Greendex," a sustainable consumption index which monitors 17,000 consumers in 17 countries, indicates that environmentally friendly behaviour by consumers has increased in 10 out of 17 countries over the past year.

Furthermore, it has now increased from 2008 levels in all but one of the 14 countries polled in both 2008 and 2010. Perhaps not surprisingly, the top-scoring consumers of 2010 are in the developing economies of India, Brazil and China where environmental problems are more palpable in a day-to-day sense. By contrast, consumer behaviour in America ranks as the least sustainable of those countries surveyed since the survey began three years ago.

- **What the OECD is doing in this space**

Responding to consumers is an apparently 'business friendly' rationale for wising up on the environment. Consumers are also voters so perhaps I should say something about the reasons governments might have for acting – or failing to do so. Governments find it easiest to act when there are immediate and proximate risks to deal with.

Swift decisions may be costly. The possibility that swine flu represented the beginning of a deadly pandemic saw the need for eventual mobilisation of 4.9 billion doses of vaccine, but only 350 million were administered globally. France alone ended up stockpiling 94 million doses of vaccine for a population of 64 million at a cost of \$1.25 billion, only used 5 million and ended up cancelling 50 million.

That must have been a boon for vaccine manufacturers. But where businesses are implicated in crises, the costs can be heavy... The recent disaster in the Gulf of Mexico saw the US Government<sup>20</sup> mobilise over 2,500 vessels and over 25,000 personnel and bring heavy pressure on BP to place \$20 billion in an account for

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<sup>20</sup> <http://www.restorethegulf.gov/release/2010/09/17/ongoing-administration-wide-response-deepwater-bp-oil-spill>

victims. In total, BP has so far booked total charges of \$40 billion with its final liability still unresolved.

More distant problems pose greater challenges. Add uncertainty into the bargain and the case for deferring action grows – a case that some companies find all too easy to promote to governments. Turn the risk into a global one where uncoordinated action will yield inferior or even negative sum results and the temptation to urge delay becomes irresistible. The current climate negotiations, now 18 years old, are testament to that.

When the EU established an emissions trading scheme in the aftermath of the Kyoto Protocol, optimists predicted the rapid spread of similar mechanisms throughout the OECD. An ETS is widely regarded as a first-best policy tool. It was hoped that the vigorous uptake of such mechanisms would stimulate a growing and internationally integrated market in emission permits. Coupled with the Clean Development Mechanism, which was designed to allow the purchase of offsets in developing economies, policy enthusiasts like me envisaged the progressive mobilisation of hundreds of billions of dollars of investment globally in emissions reduction technologies.

That has not occurred. You are presently in the only country outside of Europe to have enacted an ETS. Attempts to enact schemes in the USA and Australia have foundered. There have been some limited regional scale schemes in the USA but essentially, policy ambition has been thwarted by the politics of imposing what are believed to be unevenly distributed costs to cure a far distant problem. Competitiveness concerns dominate. If this proved a difficult selling job in buoyant times it is, on the face of it, much more difficult in the current climate. Governments in many rich countries are now confronting the triple challenge of record unemployment, unsustainable fiscal deficits and low growth.

The temptation to put the short term ahead of the long term is obvious. And we are not without disturbing examples. Spain recently received EU approval to double aid to its coal industry until the end of 2014 in the face of disturbingly high unemployment. Everyone knows that this is not the way forward. But fears about competitiveness and unemployment abound and without some fresh thinking and a different way of telling the story, governments are going to continue to struggle.

The OECD's contribution to the tool kit is our Green Growth Strategy which we are working to release next May. It will be an explicit attempt to situate the case for environmental action within a growth context. Our report will start from several premises:

- We take it as given that governments are not going to sign up for growth-denying policies. Finance and Economy Ministries make this abundantly clear!
- We accept the analysis of a wide variety of economists, like Stern, that the costs of insuring against grave, long term disruptions to the planet's life support services are worth it.
- And we start from the premise that there are vast opportunities to make more efficient use of scarce resources and that consumers are not indifferent to price signals.

From these premises we will be outlining a policy tool kit that makes the case for a much greener growth path. Without prejudging what will be in the final report, I can say that there will be quite a bit of material that has a familiar OECD ring about it – the need to eliminate subsidies that promote wasteful use of resources and damage the environment, the use of taxes to modify behaviour and the importance of research and innovation. We have good evidence to show that increasing taxes on environmentally undesirable waste streams works. Let me give you a couple of examples from recent OECD work.

Sweden was among the first countries to seriously address pollution from Nitrous Oxides that cause smog. Back in 1992 they introduced a charge and after just a couple of years, emissions fell by a third. Power plants used a variety of different technologies depending on what the best fit was – and the least costly – for their particular context. New technical solutions also emerged, and a large number of patents were taken out by Swedish companies. If, instead, Sweden had mandated the use of specific technologies, it would not have given room for innovation – the scope for green growth would have been limited. In this sense shifting part of the tax burden onto pollution aligns with the logic of business: it creates market demand for entrepreneurs to develop and sell new smarter and cleaner technologies and promotes green growth.

Innovation, by the way, doesn't just occur in laboratories. Ten years ago, Switzerland introduced a tax on Volatile Organic Compounds because these chemicals used in cleaning and precision machinery were found to have adverse health effects. One documented result was innovation in how to clean machinery used for paint making, printing and metal cutting. Such practical innovations can hardly be targeted via R&D support; rather they are promoted by putting a price on pollution – while cutting other taxes.

If Rockström's assessment of the risks is half right, we can plausibly claim that the opportunities are commensurably vast. The question is how we transition from a model of economic growth that has tended to forget about the environmental

externalities (or leave them for another day or another generation) to one that seeks a dramatic reduction in our ecological footprint through internalising those pressures. That transition is as much about political economy as it is about policy tools – probably more so. Which brings me to the political environment in which businesses are likely to be operating.

- **Dealing with sovereign power**

From where I sit, businesses have much more leverage than they had a generation ago. And much more exposure. Governments have peeled away many layers of control from outright ownership of key economic assets to regulation. Trade liberalisation and the intensifying globalisation of economic activity have further limited the power of sovereign control. The indebtedness of many developed world governments makes their leverage weaker still.

On the other hand, in the face of serious disruptions or actual crises, the use of sovereign power to co-ordinate and where necessary commandeer assets and resources remains unchallenged. And it is specifically *sovereign* power I am talking about, not initiatives emanating from multi-lateral institutions. We need multi-laterally agreed responses more and more, but they are hard to come by. Governments will be pushed to act by circumstances and popular opinion. And their actions in times of crisis can be necessarily costly as the case of BP demonstrates.

Companies can react to the risk of regulatory intervention in a number of ways. They can wait until a regulatory crisis emerges and fight whatever comes their way. At the other extreme they can seek to portray themselves as leaders and seek to shape the thinking of regulators. Or they can be somewhere in the middle of the pack – fast followers is I believe the euphemism.

All approaches carry risks. Companies are, by definition, vested interests. They possess interests in which they have invested. Changing the status quo will carry costs. It is the way in which companies lobby to protect or at least minimise the damage to those interests that should be of particular interest to Business Schools. Egregious self-interest can backfire particularly if it is dependent on the purchase of fickle political patronage. Equally, claims that the positions a company advances are entirely coincident with the public good are going to be very hard to sustain. Private and public interests don't necessarily converge – at least within the same time spans.

Governments and businesses are involved in managing the same risks from different perspectives. Businesses – and the business schools that shape the attitudes of executives - could do much to improve their persuasiveness with governments by communicating a coherent understanding of environmental risks and the policy tools

available to deal with them. I am often struck by the dichotomy between business enthusiasm for the principle of market-based instruments and the completely allergic reaction that greets actual proposals to implement them. I hear executives say they are in favour of “pricing ecosystem services” to “create market incentives”, but sceptical about the notion of environmental “taxes”. Use the carrot, not the stick, is the common refrain.

Governments often find carrots – like subsidies – electorally easier. But they are often complex, costly to administer and lead to worse outcomes. A recent OECD case study showed that where energy-intensive firms negotiated climate change agreements in return for an 80% reduction in climate levies in the UK, they tended to be less energy efficient and less innovative than firms that paid the full tax.

Economic instruments can also have interestingly positive consequences for the human capital firms deploy. A recent OECD survey of 4000 manufacturing facilities found that when governments used market-based instruments such as taxes rather than technology-based standards, firms were more likely to appoint senior management or financial officers to run the firm’s environmental strategy. This in turn led to greater investment in environmental R&D and more integrated solutions to environmental problems.

By successfully arguing against taxes or emissions trading schemes, businesses can push governments in the direction of alternative schemes that are less effective and much more costly to the economy at large. And if public sentiment turns, in the face of really costly problems, even more costly and draconian schemes are likely to be imposed in a climate which may be very unfriendly even to reasonable and responsible arguments.

- **So what sort of knowledge should Business Schools impart?**

What sort of teaching and research should be being pursued with these environmental challenges in mind? Five possibilities emerge from my comments:

- A solid grip on the science of global systems and the key resource dependencies on which global civilisation depends. Business scholars could link up with engineers, environmental scientists and lawyers to better enable managers to recognize the extent of the challenges and opportunities posed by environmental risks.
- The study of risk management could be tailored to reflect the sort of unpriced systematic risks represented by growing scarcity of ecosystem services. Financial risk is familiar territory for many of you. But other risks of an

extremely low probability but high impact such as the physical world may throw at us should be equally part of the Business School research canon.

- A comprehensive account of the rationale for regulatory intervention to reduce environmental externalities and the world of trade-offs in which businesses will operate including the role of lobbying.
- A much better understanding of the relationship between in-house innovation and regulatory environments.
- A better understanding of how regulatory environments influence the deployment of human capital and management responsibilities.

What you contribute in teaching and research is likely to have a powerful influence on the way we exit from this 'Great Recession'. Much commentary is focused on the changing distribution of global economic power and the multi-lateral architecture for dealing with it. This will be important. But the growth trajectory unleashed in the middle of the last nineteenth century and resumed following the last great economic upheaval of the mid-twentieth century is the bigger narrative. The question is whether we can green the dynamics of that trajectory so that the sort of growth we generate is compatible with the ecosystem services on which we rely. Business Schools should have a lot to say about that.