



cutting through complexity

Expect the Unexpected: Building business value in a changing world

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In this report we offer a starting point for discussion. We present a system of ten sustainability megaforges that will impact each and every business over the next 20 years. We want to build awareness that these forces do not act alone in predictable ways. They are interconnected. They interact.

Disclaimer:

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Foreword

Businesses today are operating in an ever more interconnected and globalized world. Supply chains stretch across continents and are vulnerable to disruption. Consumer demands and government policies are changing rapidly and will impact your bottom line if your business does not respond.

Against this background of complexity we face a new set of challenges. For 20 years or more we have recognized that the way we do business has serious impacts on the world around us. Now it is increasingly clear that the state of the world around us affects the way we do business.

This report shows that population growth, exploitation of natural resources, climate change and other factors are putting the world on a development trajectory that is not sustainable. In other words, if we fail to alter our patterns of production and consumption, things will begin to go badly wrong. How wrong and for whom, is also explored in the report.

Intergovernmental treaties are yet to solve the issues and, at a national level, the transition to sustainable growth remains a goal rather than an achievement. The concept of “green growth” has gained ground but we still lack a precise understanding of how we can achieve it along with higher standards of living within the limits of our planet.

Corporations are, of course, not passive bystanders in any of this. Our report shows that global megaforges are likely to bring significant threats and opportunities.

The resources on which businesses rely will become more difficult to access and more costly. There will be increasing strain on infrastructure and natural systems as patterns of economic growth and wealth change. Physical assets and supply chains will be affected by the unpredictable results of a warming world. And businesses will be confronted with an ever more complex web of legislation and fiscal instruments.

But this is not the whole story. Consumer and investor values are changing. And as they change more corporations are recognizing that there is profit and opportunity in a broader sense of responsibility beyond the next quarter’s results. The bold, the visionary and the innovative recognize that what is good for people and the planet will also be good for the long term bottom line and shareholder value. Competitive advantage can be carved out of emerging risk.

At KPMG’s network of firms we have always been at the forefront of developments that shape business behavior. We are working with organizations to help them understand the forces at work that will influence markets and impact profitability in the medium to long term.

This means moving on from old notions of corporate responsibility focused purely on protecting and enhancing reputation. It means being aware that your business stand to be affected as supplies of fresh water decrease and costs of energy rise and ecosystems decline. Knowing what those effects will be and how your business can manage them successfully means developing a sophisticated understanding of these factors and how they work.

In this report we offer a starting point for discussion. We present a system of ten sustainability megaforges that will impact each and every business over the next 20 years. We want to build awareness that these forces do not act alone in predictable ways. They are interconnected. They interact.

At KPMG, we encourage businesses to understand this system of forces; we help them assess the implications for their own organizations and to devise strategies for managing the risks and harnessing the opportunities. We can never know the future. But it is good business sense to be prepared for the possibilities: to expect the unexpected.

This report cannot provide all the answers, and does not set out to, but it does suggest approaches that we believe will help to build business value in a changing world. We hope it provides a useful springboard for new thinking, debate and above all business action to deliver a future that is both sustainable and profitable.



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A business environment **more complex and fast-moving than ever**

Globalization, digital connectivity, accelerated consumption and disparate prosperity have combined with ecological decline, a lack of global sustainability governance and resource scarcity to transform the playing field for businesses. As a result, today's global business environment is more complex, uncertain, volatile and fast-moving than ever before. We begin this report by exploring major changes to the business environment since the Rio Earth Summit in 1992.

A global system has emerged from local economies, accompanied by a shift in the balance of power from the economic powerhouses of the industrialized world to emerging market giants. The world's population has grown hugely and most people now live in cities. Hundreds of millions have moved out of extreme poverty and similar numbers have joined the global middle class, adopting in the process more resource-intensive diets and lifestyles.

There are significant opportunities for business as a result of these changes but climate change, resource constraints, water scarcity and many other factors also remind us that we are approaching – if we have not already exceeded – the planet's ability to satisfy our appetite for growth.

That is why the central challenge of our age – decoupling human progress from resource use and environmental decline – will also be one of the biggest sources of future success for business. The corporate world was involved in creating these challenges and needs to know how to deal with them, not least because we now live in a hyper-connected and more transparent world where corporate behavior is increasingly held to account in the court of public opinion.

Globalization

Over the last 20 years, the amount of money flowing across borders grew at more than three times the rate of global GDP. International trade and foreign investment more than tripled; trade in



natural resources grew six-fold; and internationally-traded financial assets such as bank loans, bonds, and portfolio equity soared by a factor of 12.¹

These dry figures translated into stronger economic growth across the world and enormous opportunities for business through the development of new markets and access to labor. Businesses benefited from exceptionally low interest rates, which allowed them to borrow cheaply and drove a major increase in trade, mergers and acquisitions. Cheap commodities and cheap labor led to a surge in economic growth in the industrialized world without the inflation that usually accompanies such growth.

At the same time, the emerging markets providing these resources also grew much more quickly, taking millions of people out of poverty and creating new markets for companies in both the developed world and emerging markets. Living standards rose rapidly, but they did so unequally and to the detriment of the environment in many areas.

However, globalization also made the financial sector more volatile as illustrated by the 2008 US subprime mortgage market shock, international

credit collapse and global recession the impacts of which continue to be felt. The financial crisis accelerated the shift of economic, financial and political power toward the developing world, in particular to dynamic emerging market nations such as China, India and Brazil. Being present in these low-cost and high-growth middle-income economies has come to be seen as increasingly central to corporate success.

Digital connectivity

The digital age began in earnest around 1995. Some 15 years later, it is an everyday fact of life for most of mankind. The combination of this digital revolution and globalization has shaped the world more profoundly and more rapidly than any other technological development.

It has created new markets and transformed old ones, enabling companies to cut costs and become more efficient. However, it has also made corporate reputations more fragile than ever. News of corporate fallings can reach an audience of millions within minutes and the damage done can last for years: witness the Gulf of Mexico oil spill.

“ Digital connectivity has created new markets and transformed old ones, enabled companies to cut costs and become more efficient. ”

¹ The World Bank, *World Development Indicators* (Washington, DC: World Bank, 2011); The World Bank, *Global Economic Prospects* (Washington, DC: World Bank, 2010); The World Bank, *Multi-polarity: The New Global Economy* (World Bank, 2011).

rose by 23,000 percent

Mobile phone subscriptions rose by 23,000 percent from 1992, to 5 billion by 2010

Source: United Nations Environment Programme, *Keeping Track of Our Changing Environment: From Rio to Rio +20* (1992-2012) (Nairobi: UNEP 2011).

added 200 million

India and China together added 200 million mobile phone subscribers during the year 2010 alone

Source: United Nations Environment Programme, *Keeping Track of Our Changing Environment: From Rio to Rio +20* (1992-2012) (Nairobi: UNEP 2011).

grew by 29,000 percent

The number of Internet users grew by 29,000 percent from 1992 to 2 billion people in 2010. Facebook, launched in 2004, had more than 800 million active users by 2011 who sent over 200 million messages per day.

Source: United Nations Environment Programme, *Keeping Track of Our Changing Environment: From Rio to Rio +20* (1992-2012) (Nairobi: UNEP 2011).

expanded by 50 percent

Global data flows expanded by 50 percent during 2010 alone, and Cisco forecasts a 26-fold increase in global mobile data traffic by 2015.²

Source: CISCO, *Cisco Global Cloud Index: Forecast and Methodology, 2010–2015* (San Jose, CA: CISCO, 2011).



A new generation of “digital natives” have become far more active and discriminating consumers – companies need to be seen to do the right thing and are under growing pressure to be more transparent and accountable about what they do and why.

Many corporations are still wary of this development, but by making information available to others, they are often seeing it themselves for the first time and are discovering opportunities to improve business models.

Accelerated consumption

Consumption has gone into overdrive since Rio 1992 as *Figure 1* illustrates.

Resource use has grown faster than the population, which itself surged by 1.5 billion people to 7 billion by 2011.³

Over a billion people moved into cities during this time and a new middle class emerged, especially in Asia, with more resource intensive diets and life-styles.⁴ Even though the world economy became about 20 percent more efficient per unit of output over the past two decades, this could not counter the absolute growth of resource use and CO₂ emissions.⁵

According to World Wildlife Fund (WWF) and Global Footprint Network, we used resources and produced CO₂ during this 20 year period at a rate 50 percent faster than the Earth can sustain.⁶ If we are already “living beyond our means” but at the same time 3 billion people need to rise out of poverty, then the central challenge of our age must be to decouple human progress from resource use and environmental deterioration.

² CISCO, *Cisco Global Cloud Index: Forecast and Methodology, 2010–2015* (San Jose, CA: CISCO, 2011).

³ United Nations Population Fund, *The State of World Population 2011* (New York: UNFPA, 2011).

⁴ United Nations Environment Programme, *Keeping Track of Our Changing Environment: From Rio to Rio + 20* (1992–2012) (Nairobi: UNEP, 2011).

⁵ United Nations Environment Programme, *Decoupling Natural Resource Use and Environmental Impacts from Economic Growth: A Report of the Working Group on Decoupling to the International Resource Panel* (Nairobi: UNEP, 2011).

⁶ World Wide Fund for Nature, Institute of Zoology and Global Footprint Network, *Living Planet Report 2010: Biodiversity, Bio-capacity and Development* (Gland, Switzerland: WWF International, 2010).



This challenge creates significant opportunities for business, partly within their own operations. But the real prize comes through helping others to “decouple.” Examples include renewable energy, which enables the production of low-carbon energy, drip irrigation technologies that help farmers to produce more crops using less water, electric vehicles that facilitate low-emissions motoring and software that helps everything from aircraft to buildings to work more efficiently.

Disparate prosperity

Since 1992 there has been unprecedented human social and economic progress, even among the worst-off. While some indicators worsened, such as rates of HIV infection and numbers of slum-dwellers, people have mostly become healthier,

wealthier, better educated, better fed, more empowered and live longer (see *Figure 2*). The lives of women and girls changed dramatically during this period, with research indicating progress in the areas of literacy, health and economic participation.⁷

At the same time, gaps in gender equality persist, especially with regard to child mortality, school enrollment, access to economic opportunities, and voice and agency within society. The World Bank has emphasized that gender equality lies at the heart of smart development given its central role in enhancing productivity, making institutions more representative, and improving development outcomes for the next generation.⁸ Prosperity has eluded 1.5 billion people living in countries affected by conflict.⁹

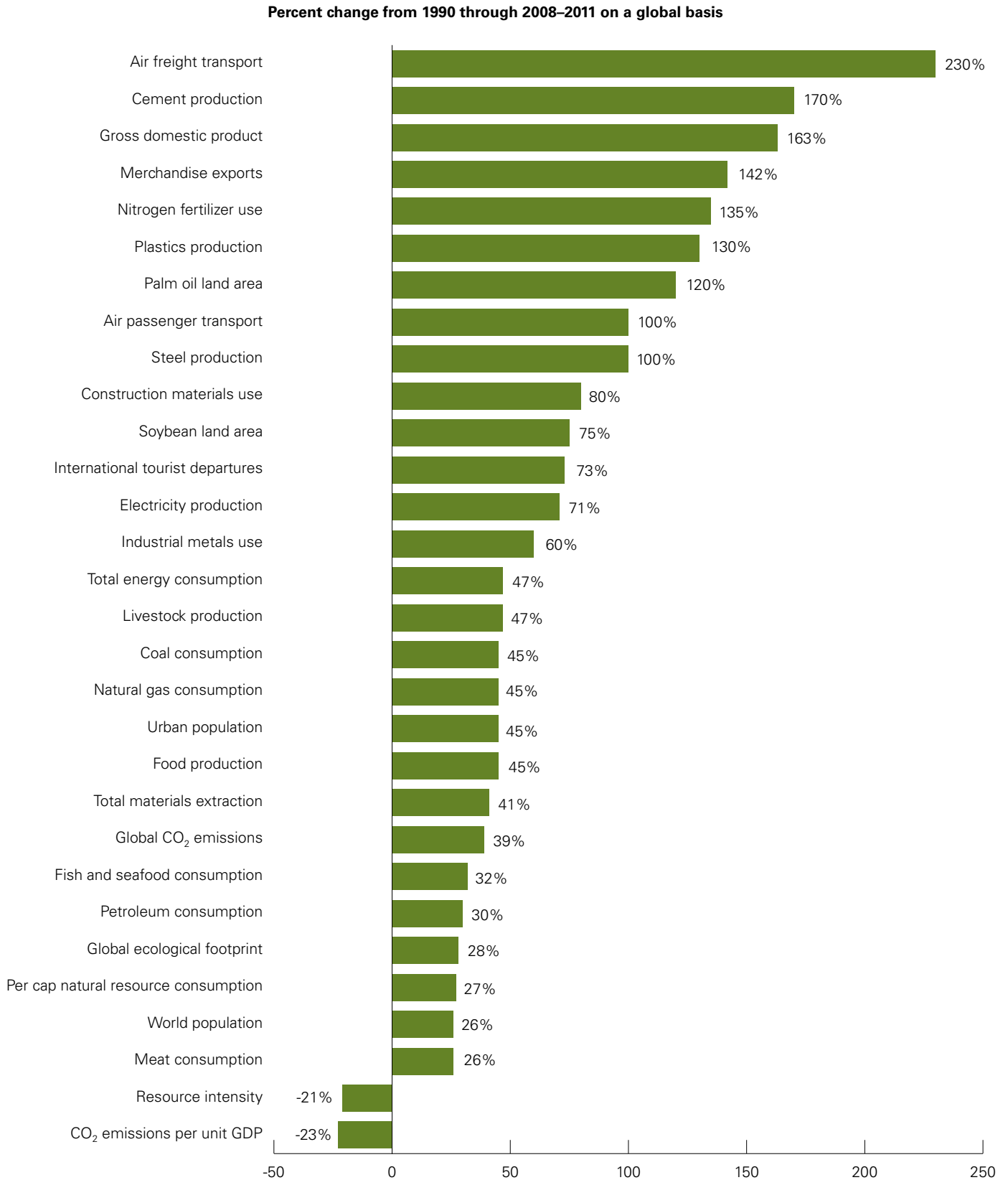
“The central challenge of our age must be to decouple human progress from resource use and environmental deterioration.”

⁷ United Nations Department of Economic and Social Affairs, *The World's Women 2010: Trends and Statistics* (New York: UN, 2010).

⁸ The World Bank, *World Development Report 2012: Gender Equality and Development* (Washington, DC: World Bank, 2011).

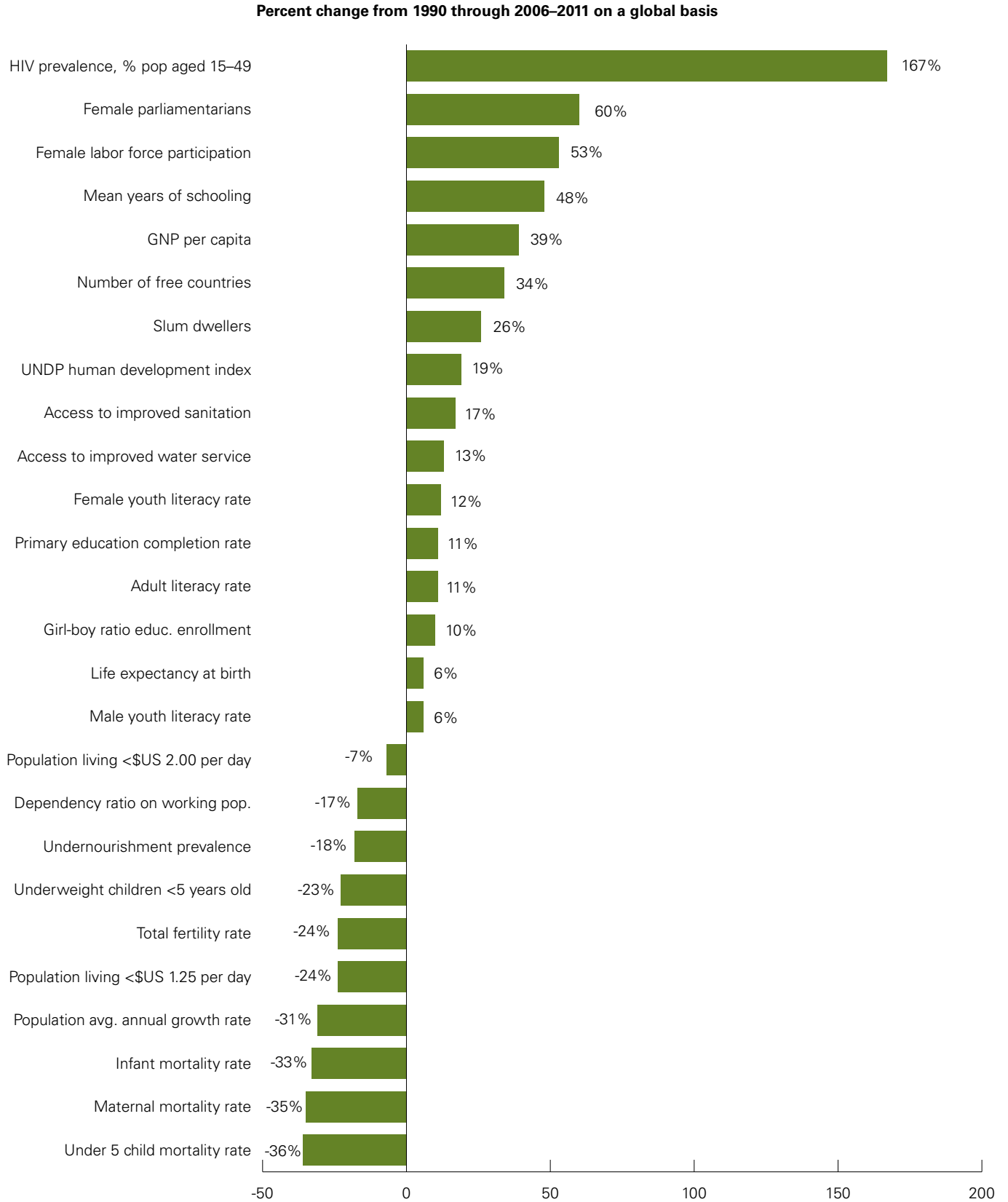
⁹ The World Bank, *World Development Report 2011: Conflict, Security and Development* (Washington, DC: World Bank, 2011).

Figure 1: Accelerating human footprint on natural systems and resources



Sources: UNEP, World Bank, Worldwatch Vital Signs, WWF, SERI, UNDP, FAO, IEA.

Figure 2: Human social and economic progress



Sources: UNEP, World Bank, UNDP, Freedom House, WHO, ILO, UN-Habitat

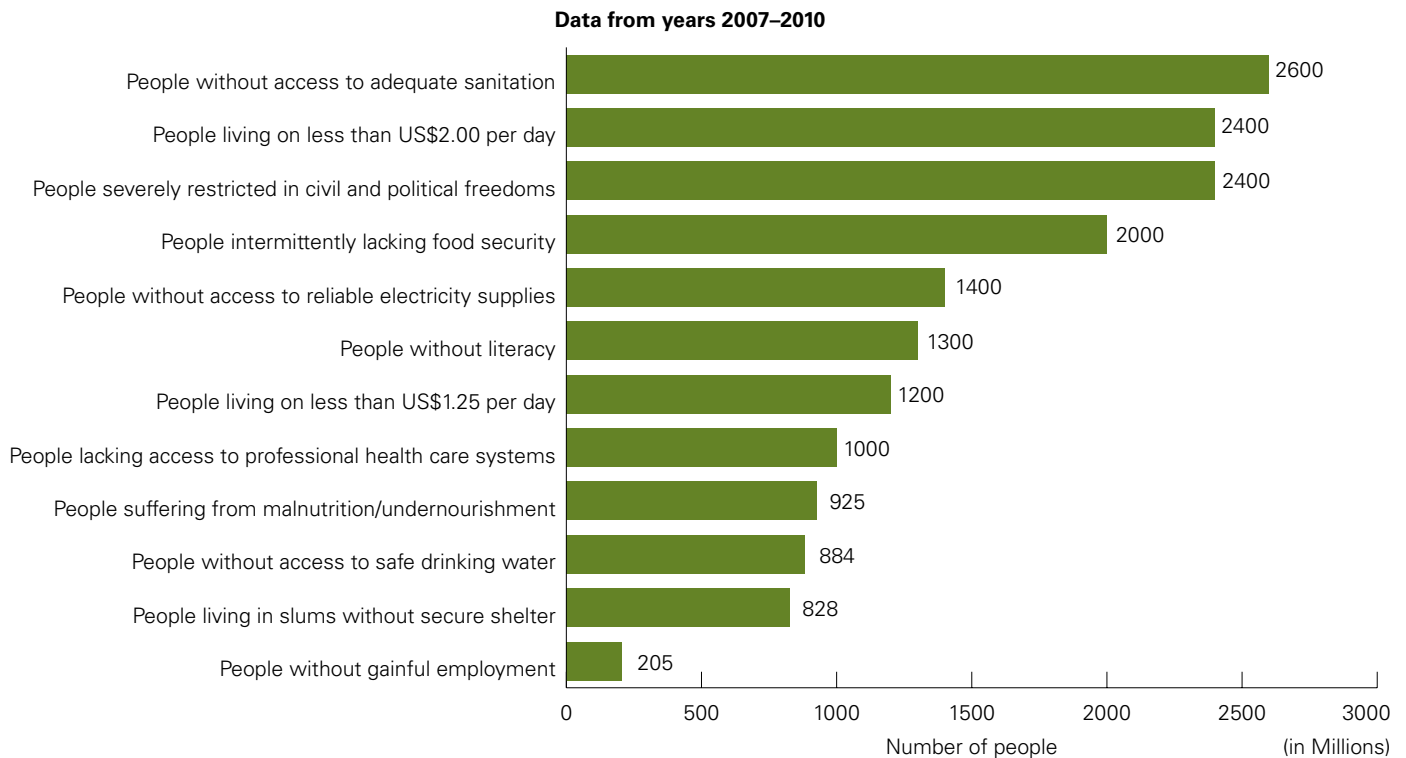
Between one quarter and one third of the world's population remains in a state of persistent deprivation, especially in Sub-Saharan Africa (see *Figure 3*). It is not only the least developed countries that are suffering; an estimated 72 percent of the world's poor now reside in populous middle-income countries such as Pakistan, India, China, Nigeria and Indonesia where they confront malnutrition, disease, illiteracy, and other challenges of extreme poverty.¹⁰

In the advanced economies, there has been a growing call for a more inclusive system of global capitalism as evidenced

by the "Occupy" movement that spread around the world in 2011. Persistent inequality is not only wrong, it is bad for business – it prevents huge swathes of the population from being workers and customers and it increases the risks to business from the type of instability and unrest that were seen in the Middle East and North Africa in 2011.

Today business is being asked to do more to fight global poverty and has responded with pioneering micro-credit and "base-of-the pyramid" (BOP) corporate initiatives. Much of the movement involves "social entrepreneurs"

Figure 3: Persistent human deprivation



Sources: FAO, World Bank, UNDP, UN-Habitat, ILO, Freedom House, WHO, UNESCO

¹⁰ Any Summer, *The New Bottom Billion: What if Most of the World's Poor Live in Middle-Income Countries?* (Washington, DC: Center for Global Development, March 2011).

experimenting at the local level.¹¹ Larger multinational companies exploring the growth and innovation opportunities of more inclusive business models include CEMEX, Danone, DuPont, Proctor & Gamble, SC Johnson, Unilever and Vodafone.¹²

Ecological decline

Mankind has caused more extensive and rapid changes to ecosystems in the last 20 years than at any other time in human history, thanks to ever-growing demand for resources. There is substantial evidence that ecosystems are struggling to provide the needed services that

populations have assumed will always be there. The UN's Millennium Ecosystem Assessment warned that "human activity is putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted."¹³

The damage includes loss of biodiversity, acidification of oceans, less productive cropland, desertification, tropical deforestation, and declines in wetlands, mangrove forests, sea-ice habitats, salt marshes, coral reefs and more.¹⁴ This hits the world's most disadvantaged and vulnerable people hardest.

“Persistent inequality is not only wrong, it is bad for business.”

Figure 4: Climate change since 1992

The 20 years since Rio 1992 according to UNEP¹⁵ have witnessed:

- a **36 percent** increase in global CO₂ emissions
- a **9 percent** increase in average CO₂ concentration in Earth's atmosphere
- an increase of **0.4–0.6 degrees** Celsius in mean surface temperature relative to historical means (1951–1990)
- 18 of the **20 hottest** years on record
- melting of ice sheets and thawing of permafrost in northern latitudes
- steady warming of ocean waters by nearly **0.5 degrees Celsius**
- global sea level rise of **2.5 mm** per year from thermal expansion
- growing acidity of the world's oceans threatening marine life
- rapid diminishment of mountain glaciers in terms of annual mass balance, and
- steady decline in the annual minimum extent of Arctic sea ice.

¹¹ United Nations Development Programme, *Creating Value for All: Strategies for Doing Business With the Poor* (New York: UNDP, 2008) and Muhammad Yunus, *Building Social Business: The New Kind of Capitalism That Serves Humanity's Most Pressing Needs* (New York: Public Affairs Books, 2010).

¹² Ted London and Stuart L. Hart, *Next Generation Business Strategies for the Base of the Pyramid* (London: FT Press, 2010).

¹³ Millennium Ecosystem Assessment, *Living Beyond Our Means: Natural Assets and Human Well-Being: Statement from the Board* (New York: MEA/United Nations, 2005).

¹⁴ Secretariat of the Convention on Biological Diversity, *Global Biodiversity Outlook 3* (Montreal: CBD, 2010).

¹⁵ United Nations Environment Programme, *Keeping Track of Our Changing Environment: From Rio to Rio + 20 (1992–2012)* (Nairobi: UNEP, 2011).

“ Companies in all sectors need to prepare themselves for a world where raw materials may be in short supply. ”

Scientists are growing more concerned that the Earth is approaching thresholds or tipping points that could have abrupt, irreversible and catastrophic consequences. These include combined sea level rise, impacts of monsoon interference on India, Amazon drought and die-back, increased aridity in Southwest North America, loss of glacial freshwater supplies especially in Central Asia, and conversion of coral reefs to algal dominated systems.¹⁶

Business is both heavily involved in causing this damage and likely to be increasingly affected by the consequences. It is clear that responses to these challenges must include reducing greenhouse emissions and becoming more resource-efficient. As a result, carbon and ecosystem service-intensive industry sectors such as energy, heavy industry and agriculture are likely to face increasing regulatory and consumer pressures to reduce their impact. At the same time, “clean technologies” such as renewable energy are likely to be among the biggest industries of the future.

Resource scarcity

Shortages of a number of key resources are becoming apparent, from arable land, fresh water and metals to fossil fuels. Companies in all sectors need to prepare themselves for a world where raw materials may be in short supply and subject to price volatility, including large price rises and increased disruption to supplies.

For example, by 2008, 80 percent of marine fish stocks were considered over-exploited or fully exploited, prompting a massive surge in aquaculture, especially in Asia.¹⁷

Soil erosion has been taking place at several times the natural replacement rate, the amount of available arable land per person has dropped substantially and agricultural productivity has slowed.

At the same time an area the size of Western Europe – has been sold or leased to international investors in order to produce crops or biofuels for export back to wealthy, food and fuel-insecure nations.¹⁸

These factors contribute to instability and volatility in food and biofuel supplies, but also create opportunities for companies that can, for example, improve crop yields, reduce land degradation or sustain fish stocks.

More than 4 billion people are now living in water-stressed (defined as less than 1700 cubic meters of water available per capita/year) and water-scarce (defined as less than 1000 cubic meters per capita/year) regions while water tables, soil moisture levels and water quality levels are declining rapidly in many dry-land areas.

There are also concerns about supplies of hydrocarbons, fertilizing minerals such as potassium and phosphorous and rare-earth minerals (such as neodymium, yttrium and cerium) as well as the capacity of the world’s forests and oceans to absorb carbon.¹⁹

After a century of persistent and steady falls in real commodity prices, analysts began to suggest that the world had entered into a prolonged “super-cycle” of rising and more volatile commodity prices. The knock-on effects included supply disruptions, lower growth, higher inflation, export restrictions, new regulations, conflicts over resources and currency instabilities.

¹⁶ Johan Rockstrom, et. al., “A Safe Operating Space for Humanity,” *Nature*, Vol. 461 (September 2009, pp. 472-475) and Tim Lenton, et.al., for Allianz and the World Wide Fund for Nature, *Major Tipping Points in the Earth’s Climate Systems and Consequences for the Insurance Sector* (Gland, Switzerland: WWF, 2009).

¹⁷ United Nations Food and Agriculture Organization, *World Review of Fisheries and Aquaculture* (Rome: FAO, 2010) and United Nations Food and Agriculture Organization, *The State of World Fisheries and Aquaculture* (Rome: FAO, 2011).

¹⁸ Bertram Zagema, *Land and Power: The Growing Scandal Surrounding the New Wave of Investments in Land* (Oxford, UK: Oxfam International, September 2011).

¹⁹ Richard Heinberg, *Peak Everything: Waking Up to the Century of Declines* (Gabriola Island, BC, Canada: New Society Publishers, 2007).



This age of resource constraint²⁰ is set to be a fact of life for all businesses in years to come. Companies need to prepare for this and have a strategy to deal with it, through measures such as reducing resource use, increasing recycling of resources, identifying alternative sources of supply or finding substitute materials. The argument is most commonly seen in the case for improving energy efficiency but in the future companies will have to improve resource productivity across a range of inputs. They will also need to improve efficiency in the use and disposal phases of products and services.

Lack of global governance continues

The number of signatories to multilateral environmental agreements has increased by 330 percent since 1992²¹ and yet many of the agreements achieved at the Rio Earth Summit 1992 and Johannesburg 2002 UN conference have still not been implemented or enforced. Attempts to establish global rules have been outpaced by the growth of global challenges such as climate disruption, declining fisheries, biodiversity loss and health pandemics, along with the increasing interconnectedness of global finance, agriculture and resource extraction.²²

“This creates opportunities for companies that can improve crop yields, reduce land degradation or sustain fish stocks.”

²⁰ Peter Schwartz, et. al., *Winners and Losers in the New Commodity Price Regime* (San Francisco: Monitor, 2011).

²¹ United Nations Environment Programme, *Keeping Track of Our Changing Environment: From Rio to Rio + 20 (1992–2012)* (Nairobi: UNEP, 2011).

²² Brian Walker, et. al., “*Looming Global-Scale Failures and Missing Institutions*,” *Science*, Vol. 325 (September 11, 2009, pp. 1345-1346).

“ The business community needs clear global rules, powerful regulatory incentives and a level-playing field to support it in moving to sustainable growth. ”

Policymakers have been able to tackle thorny but often domestic-rooted problems such as the state of the automotive market but not yet system-wide problems such as global imbalances of trade or the eurozone crisis. The difficulties in securing coordinated global governance on sustainability have been clearest in the 20 years of negotiations that have attempted to forge a global approach to tackling climate change.

Although progress on low carbon technologies has been made in individual countries and regions, most notably in Europe, the levels of investment required for worldwide change have been missing.

At the same time, government subsidies for carbon-intensive industries have continued despite a G20 commitment to phase them out by 2020.

The business community needs clear global rules, for example on carbon emissions, powerful regulatory incentives and a level-playing field to support it in moving to sustainable growth. These incentives should include financing solutions that allow the longer term benefits of sustainability

to compete with other programs with a higher short-term payback; a way to measure the impact of sustainability programs; and clearer and more rigorous international regulation that will allow companies to plan with confidence.²³

How has business adapted to these global changes?

Twenty years after the Rio Earth Summit in 1992, sustainability has become a more important issue for companies and sustainability-related investments have grown substantially – Bloomberg New Energy Finance recently reported that the trillionth dollar of investment in clean energy had been made.

Furthermore, sustainability is increasingly being seen as a source of innovation and growth rather than simply cost reduction and risk management.²⁴ The Carbon Disclosure Project reported this year that companies with a strategic focus on climate change provided investors with approximately double the average total return of the Global 500 from January 2005 to May 2011.²⁵

²³ United Nations Environment Programme, *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication: A Synthesis for Policy Makers* (Nairobi: UNEP, 2011).

²⁴ KPMG International in cooperation with the Economist Intelligence Unit, *Corporate Sustainability: A Progress Report* (April 2011) www.kpmg.com

²⁵ Carbon Disclosure Project. (2011) *Global 500 Report*.

Recent polls of senior executives reveal that many of the world's largest 250 corporations are increasingly embracing sustainability as a core foundation of successful business and publicly report about their performance.²⁶

However, there remains a long way to go. In 2008, the world's 3,000 largest public companies by market capitalization were estimated to be causing US\$2.15 trillion of environmental damage, equivalent to 7 percent of their combined revenues and 50 percent of their combined earnings

(measured as EBITDA: earnings before interest, taxation, depreciation and amortization). Some 60 percent of these negative impacts were concentrated in the electricity, oil and gas, industrial metals and mining, food production and construction and materials sectors.²⁷

The next section of this report presents the ten sustainability megaforges that over the next 20 years will exert increasing pressure on businesses in all sectors and economies around the world.

“ In 2008, the world's 3,000 largest public companies were estimated to be causing US\$2.15 trillion of environmental damage. ”



²⁶ KPMG International in cooperation with The Economist Intelligence Unit, *Corporate Sustainability: A Progress Report* (April 2011) and KPMG International, *KPMG International Survey of Corporate Responsibility Reporting 2011* (2011), at www.kpmg.com.

²⁷ United Nations Environment Programme Finance Initiative and Principles for Responsible Investment Association, *Universal Ownership: Why Environmental Externalities Matter to Institutional Investors* (New York: UNEP Finance Initiative, October 2010) at www.unepfi.org.

02

Global Sustainability Megaforces

Over the next 20 years, businesses will be exposed to hundreds of environmental and social changes that could bring both risks and opportunities in the search for sustainable growth. For this report more than two dozen forecasts have been analyzed from international agencies, global think-tanks, national agencies and noted futurists in an attempt to identify those changes likely to have the greatest impacts on business. (See Appendix 2 for a list of sources).

“These megaforces act as a complex and unpredictable system, feeding, amplifying or ameliorating the effects of others.”

Emphasis was placed on the availability of quality numerical projections, key pressures causing global environmental and social problems and the most significant consequences of those pressures for natural and human security. The result is a set of ten global sustainability megaforces that will impact every business over the next two decades. They are:

1. **Climate Change**
2. **Energy & Fuel**
3. **Material Resource Scarcity**
4. **Water Scarcity**
5. **Population Growth**
6. **Urbanization**
7. **Wealth**
8. **Food Security**
9. **Ecosystem Decline**
10. **Deforestation**

A summary of these global sustainability megaforces follows. Each has important implications for business which must be understood, assessed and built in to long term strategic planning. Awareness and comprehension of each is vital but, as the next section of this report demonstrates, it is only the first step.

These megaforces do not function in isolation from each other in predictable ways. They act as a complex and unpredictable system, feeding, amplifying or ameliorating the effects of others. Business leaders seeking to manage the risks and harness the opportunities of the future must understand how these megaforces function and how they might affect their own organizations.

Climate Change

Climate change is the one global megaforce that directly impacts all others discussed in this report.



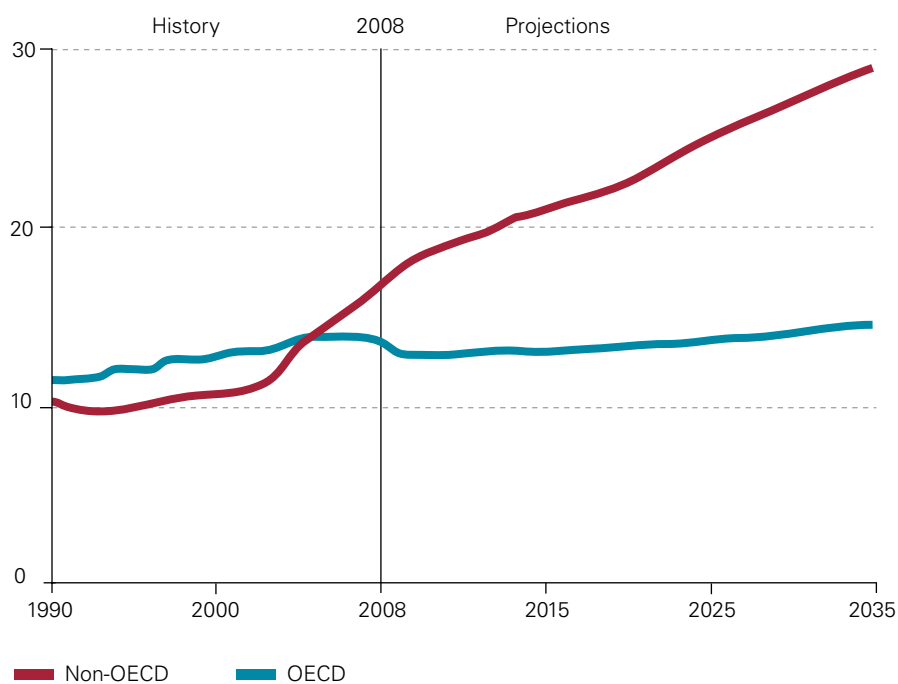
There are six key types of risk to business from climate change: physical risk, regulatory risk, reputational risk, competitive risk, social risk and litigation risk.

These risks include new laws and government initiatives to tackle climate change such as energy efficiency requirements and standards, carbon taxes, emissions cap and trade systems and fuel tariffs. Businesses may also be at risk of damaging their brands if they are seen to do the wrong thing, with the added threat of litigation if they fail to comply with legislation, or to disclose their carbon impacts.

Predictions of annual output losses from climate change range between one percent per year, if strong and early action is taken, to at least five percent a year if governments fail to act.

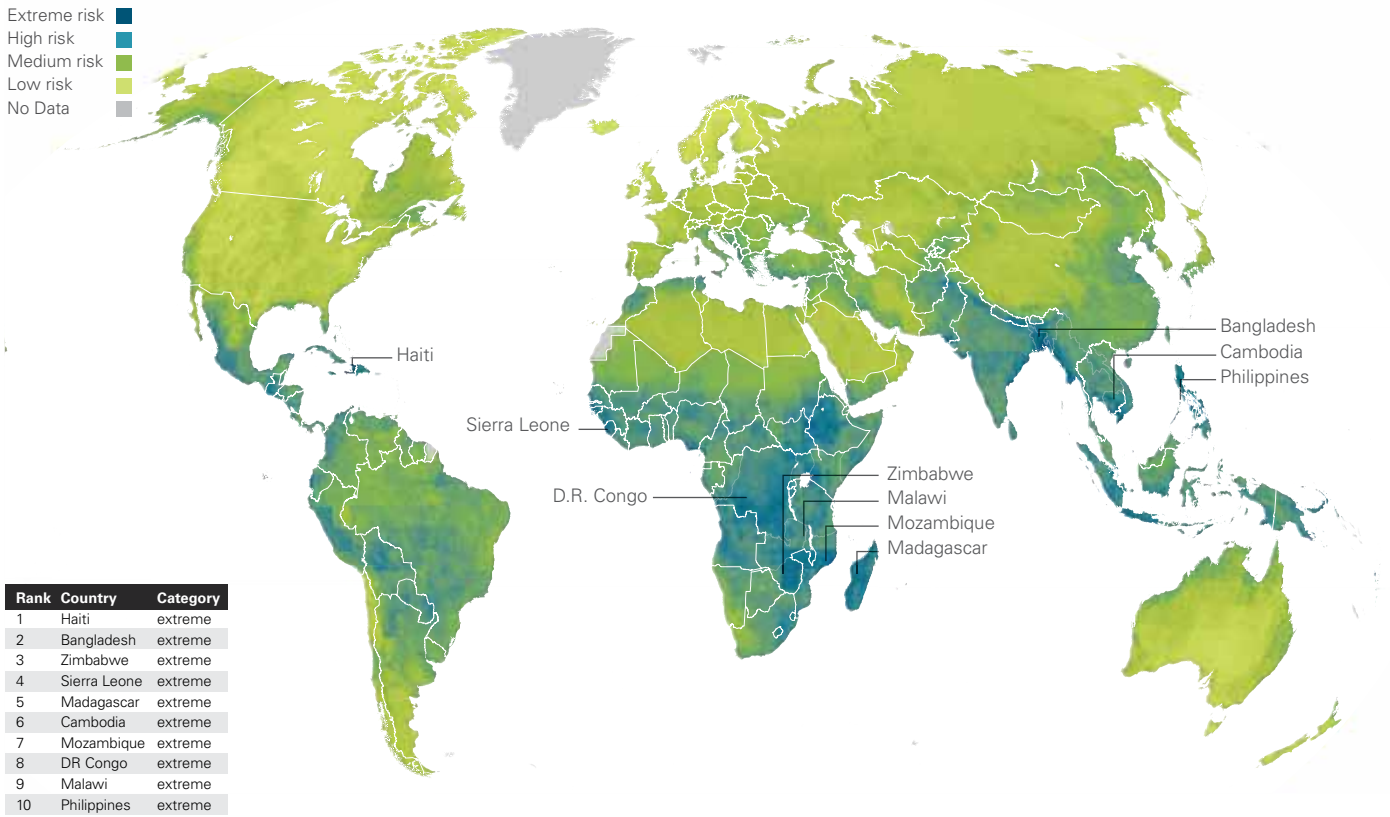
However, it is developing countries and the businesses that operate in them that are most vulnerable to climate change impacts even as their rapid industrialization increases their contribution to global CO₂ emissions (Figure 5, Figure 6).

Figure 5: World energy-related carbon dioxide emissions, 1990–2035 (billion metric tons)



Source: U.S. Energy Information Administration (EIA). (2011). International Energy Outlook 2011. EIA, Washington D.C.

Figure 6: Climate change vulnerability index 2012



Source: Maplecroft. (2012). The Climate Change and Environmental Risk Atlas. Available at <http://maplecroft.com>

The physical risks are considerable. The International Energy Agency (IEA) says that we are on course for a long-term global temperature rise of 3.5°C. This could cause ‘irreversible’ impacts including near-total deglaciation in the long term, contamination of groundwater supplies, water shortages for hundreds of millions of people, lower agricultural yields in many places and more malnutrition, infectious diseases and deaths from heat waves, as well as increasingly severe floods, droughts and storms.¹

Extreme weather events are set to become more frequent and up to one sixth of the world’s population could face disruption to water supplies and an increased risk of flooding from melting glaciers, mainly in the Indian subcontinent

and areas of China and South America – regions that are seen as the new driving force for the global economy. While agricultural yields could increase in higher latitude areas such as Northern Europe, elsewhere, particularly in Africa, falling yields could leave hundreds of millions of people without enough food.²

Sea level rises could cause flooding in low-lying coastal areas, displacing “tens to hundreds of millions of people” in places such as Southeast Asia, particularly Bangladesh and Vietnam, and small Caribbean and Pacific islands. Some of the world’s largest and richest cities, such as Tokyo, New York, London and Shanghai could also be affected. Human health could be affected as more people become vulnerable to mosquito-borne diseases, air quality worsens, and

¹ IPCC, *Contribution of Working Group II, 2007*

² IPCC, *Contribution of Working Groups I, II, and III, 2007*

more extreme weather events occur.³ Climate change is expected to also affect ecosystem health and biodiversity, in turn reducing land productivity and adding to food security stress and water scarcity.

Urgent action is needed to avoid such a global temperature rise, but because energy-related facilities such as power stations, buildings and factories last for many decades, “80 percent of the cumulative CO₂ emitted worldwide between 2009 and 2035 is already “locked-in” by capital stock that either exists now or is under construction and will still be operational by 2035;”⁴ according to the IEA.

Individual countries have started acting to cut emissions – China, Australia and South Korea plan to create carbon markets by 2015, for example, while many more have carbon reduction targets – but fragmented national responses require business to understand and comply with a complex and unpredictable patchwork of carbon legislation around the world. Meanwhile, international action on climate change has been slow and disjointed. A price on carbon has been established through trading systems such as the EU Emissions Trading System and the UN’s Clean Development Mechanism, but the carbon markets have been dogged by

political interference and the economic crisis. Progress was made at the 2011 UN climate conference in Durban, with all the world’s major emitters agreeing that they must cut emissions, but a new global deal – if it eventuates – will not be agreed until 2015 and will not come into force until 2020.

Nonetheless, the need to tackle climate change brings opportunity to innovators. The US\$100 billion-a-year Green Climate Fund (GCF) should make it easier to cut emissions and help developing countries to adapt to the effects of climate change. The GCF could lead to the creation of public-private partnerships in developing nations that can build green industries, create jobs, reduce poverty and improve infrastructure as well as tackle climate change.

Energy & Fuel

Fossil fuel markets are set to become more volatile and unpredictable because of higher global energy demand; changes in where fossil fuels are consumed; supply and production uncertainties; and increasing regulatory interventions related to climate change. All companies – regardless of sector, size, or location – will find it difficult to plan for and manage energy costs, especially those related to fossil fuel use.

“A new global deal – if it eventuates – will not be agreed until 2015 and will not come into force until 2020.”



³ IPCC, *Contribution of Working Groups I, II, and III*, 2007

⁴ International Energy Agency. 2011, *World Energy Outlook 2011 Factsheet*

“Vehicle and electrical appliance suppliers, manufacturers, and retailers must prepare for increased demand for their products at a time when policy is likely to raise energy prices.”

Companies that become more energy efficient and/or use more alternative and renewable sources of energy, however, would be able to lower their exposure to fossil fuel-related risks and improve their financial performance. The Carbon Disclosure Project last year highlighted the link between cutting emissions and financial outperformance.

While some businesses are moving slowly towards alternative and renewable sources of energy, most corporations continue to depend heavily on oil, coal and gas for power, fuel and raw materials. Just three percent of electricity generation came from non-hydro renewable sources in 2010 – including hydro, the total is 13 percent while 81 percent of power is fossil-fuelled. “There are few signs that the urgently needed change in direction in global energy trends is under way,” the IEA says in its *World Energy Outlook 2011*.⁵

Energy businesses must prepare for shifts in fuel mix due to policy, supply, and fuel prices. These businesses, particularly those involved in renewable energy, must also remain actively involved in policy debates that will impact both total global energy demand and the fuel mix through carbon or renewable energy policies. But other industries need to pay attention to the issue as well. Fossil fuel-dependent transportation industries such as aviation, shipping and manufacturers that use petroleum as a process input,

such as plastic or chemical producers, will need robust strategies and plans to address fuel price volatility and potential shortages. Vehicle and electrical appliance suppliers, manufacturers and retailers must prepare for significant energy consumption increases in the developing world, and adjust product design and development strategies accordingly.

All of these drivers create a market for companies that can help customers to become more energy efficient. Equally, companies that can bring low-carbon power to the world’s poorest people by “leapfrogging” large-scale utility infrastructure are well-placed.

The energy mix is likely to slowly change in coming years, but fossil fuels will continue to dominate world energy supply to 2035 (*Figure 7*), making up 75 percent of the energy mix – and in absolute terms, more fossil fuel will be consumed than today.

“World primary demand for energy increases by one-third between 2010 and 2035 and energy-related CO₂ emissions increase by 20 percent,” the IEA adds. It also projects that over the next 25 years, 90 percent of the projected growth in global energy demand will come from non-OECD economies.

Businesses in the OECD therefore face a situation where the dynamics of the global energy market are increasingly decided elsewhere.

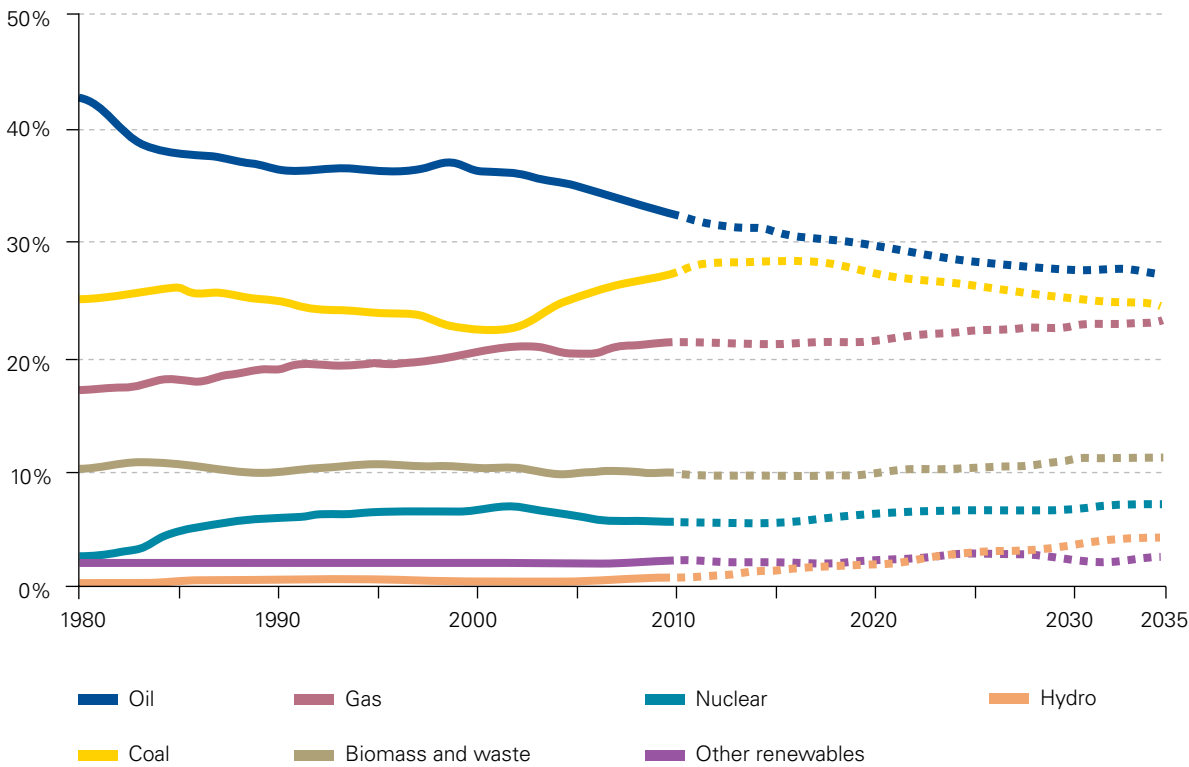
⁵ International Energy Agency. 2011, *World Energy Outlook 2011 Executive Summary*

The IMF's World Economic Outlook in April 2011 stated: "The increases in the trend component of oil prices suggest that the global oil market has entered a period of increased scarcity. The analysis of demand and supply prospects for crude oil suggests that the increased scarcity arises from continued tension between rapid growth in oil demand in emerging market economies and the downshift in oil supply trend growth."⁶

Proportionally, oil remains the leading source of fuel, but demand for natural gas is expected to rise most strongly. Nuclear energy is likely to grow by about 70 percent to 2035, led by China, Korea and India.⁷ The relative share of renewable energy sources, led by hydropower and wind, should grow faster than other energy forms but in absolute terms, total supply of renewables – at 18 percent – remains well below the level of any single fossil fuel by 2035.⁸

“Increased scarcity [of crude oil] arises from continued tension between rapid growth in oil demand in emerging market economies and the downshift in oil supply trend growth.”

Figure 7: Proportion of various energy sources in world primary energy demand



Source: International Energy Agency (IEA). (2011). World Energy Outlook 2011 © OECD/IEA, Figure 2.7, page 79. IEA, London

⁶ International Monetary Fund (April 2011) *World Economic Outlook*

⁷ International Energy Agency. 2011, *World Energy Outlook 2011 Factsheet*

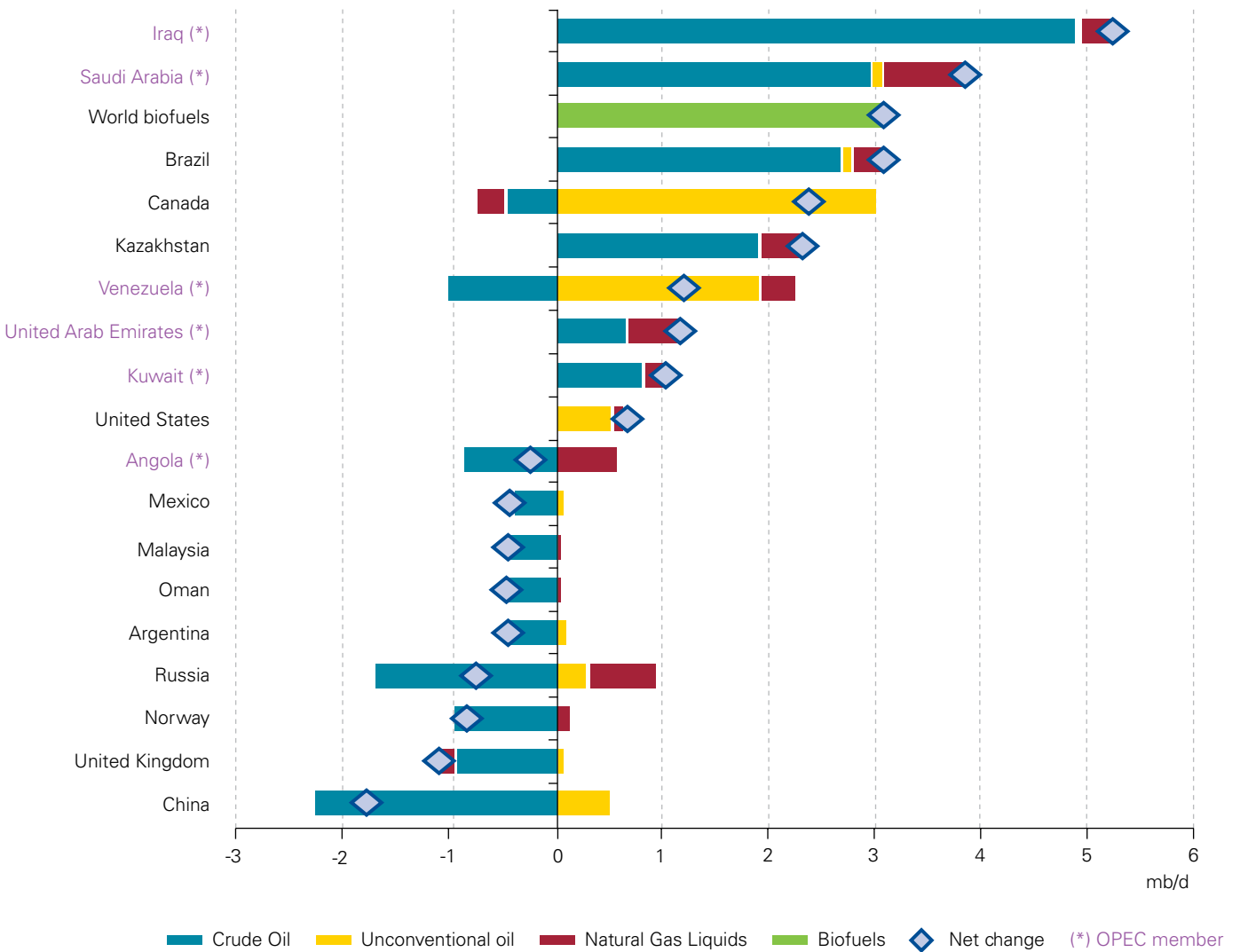
⁸ International Energy Agency. 2011, *World Energy Outlook 2011 Factsheet*

“The IEA predicts that the price of crude oil will rise to US\$120/barrel by 2035.”

The IEA predicts that the demands of transportation in emerging economies will lift oil consumption by 15 percent between 2010 and 2035. World oil production is predicted to reach 96 million barrels per day (m b/d) in 2035, 13m b/d up on 2010 levels, with a growing share coming from natural gas liquids and other unconventional

sources.⁹The Middle East and North Africa are set to provide most of the growth in oil output during this period, while other locations will turn to more costly and difficult sources (Figure 8). The IEA also predicts that the price of crude oil will rise to US\$120/barrel (in year-2010 dollars) by 2035.¹⁰

Figure 8: Major changes in global liquids supply, 2010–2035



Source: International Energy Agency (IEA). (2011). World Energy Outlook 2011 © OECD/IEA, Figure 3.17, page 124. IEA, London

⁹ International Energy Agency, 2011, *World Energy Outlook 2011 Factsheet*.

¹⁰ International Energy Agency, 2011, *World Energy Outlook 2011 Factsheet*.



One reason for the continuing dominance of fossil fuels is energy subsidies, which are large and widespread. Without further reform, the IEA reports that “the cost of fossil-fuel consumption subsidies is set to reach US\$660 billion in 2020, or 0.7 percent of global GDP.”¹¹ Yet all users of fossil fuels need to be aware of the increasing pressure to eliminate fossil fuel subsidies, which totaled US\$409 billion in 2010 about US\$110 billion more than in 2009 as a result of the increase in oil prices. Subsidies for renewable energy are predicted to continue growing, reaching almost US\$250 billion in 2035.¹²

Material Resource Scarcity

As developing countries industrialize rapidly, global demand for material resources looks likely to continue to increase dramatically. Over the next

20 years business is likely to face global competition for a wide range of material resources that become less easily available. The risks presented by resource scarcity also create opportunities to develop substitute materials, and to recycle and recover resources from waste products. Other opportunities include entering new markets, collaborating with other sectors, universities or government and discovering of new techniques or processes.

In 2030 it is predicted that some 83 billion tons of minerals, metals and biomass will be extracted from the earth: 55 percent more than in 2010.

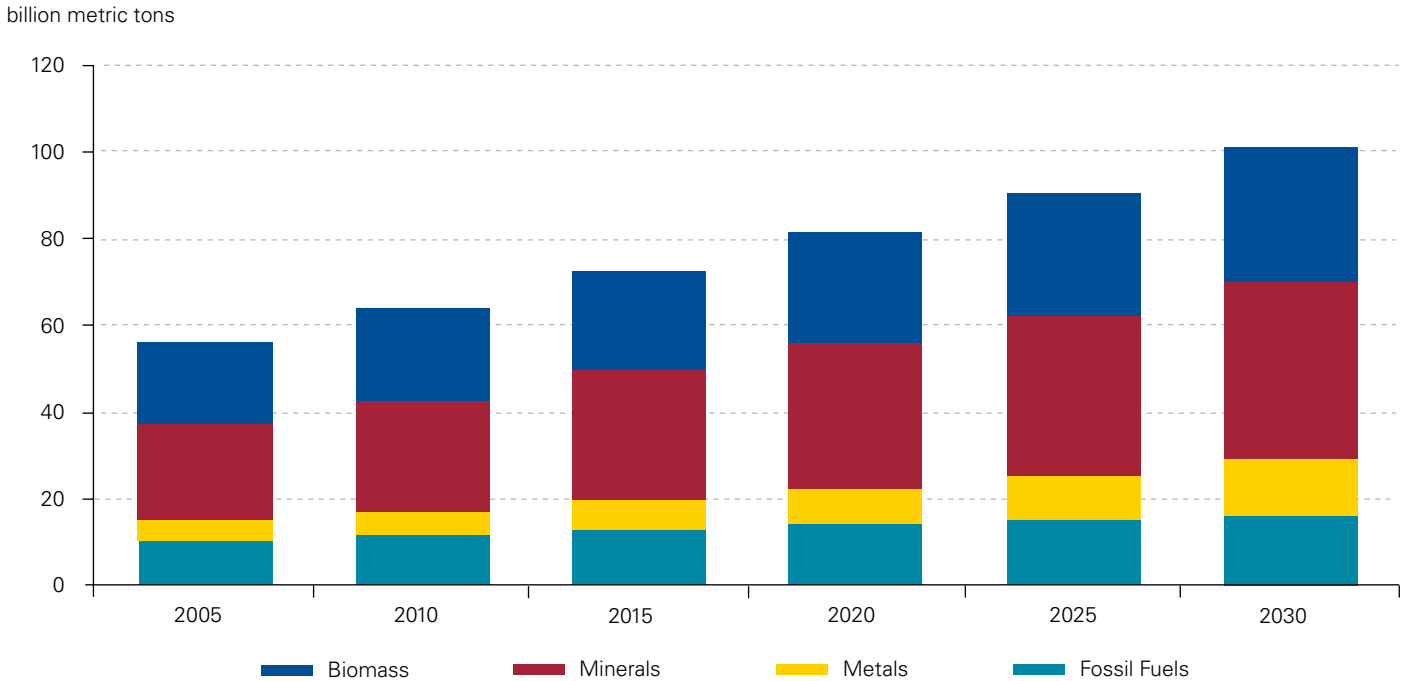
The message is clear: over the next 20 years, demand for material resources will soar while supplies will become increasingly difficult to obtain.

“ Demand for material resources will soar while supplies will become increasingly difficult to obtain. ”

¹¹ International Energy Agency, 2011, *World Energy Outlook 2011 Factsheet*

¹² International Energy Agency, 2011, *World Energy Outlook 2011 Factsheet*

Figure 9: Business-as-usual scenario on worldwide resource extraction, 2005 to 2030



Source: Sustainability Europe Research Institute (SERI), GLOBAL 2000, and Friends of the Earth Europe. (2009). *Overconsumption? Our use of the world's natural resources.* Vienna & Brussels.

“As supplies decrease, governments are likely to protect domestic interests by restricting exports.”

The uneven global distribution of material resources, from oil to land to fresh water, makes planning for the future even more complex. Countries without large domestic supplies must rely on imported materials; as a result investors could increasingly seek to acquire large scale land rights elsewhere in the world – particularly in Africa and South America – to secure supplies of minerals, biomass, agricultural production and even water.

As supplies decrease, governments are likely to protect domestic interests by restricting exports. This is already happening in China, which has tightened control on exports of rare earth elements. China supplies 97 percent of current rare earth demand.¹³ By restricting global supply and using more of these materials domestically, it has increased uncertainty around the security of future supplies but increased opportunities for other countries with rare earth resources such as the US.

¹³ British Geological Society (BGS). (2011). *Risk List 2011*.

Water Scarcity

Water scarcity for many businesses can be a major risk to growth and development (*Figure 10*).

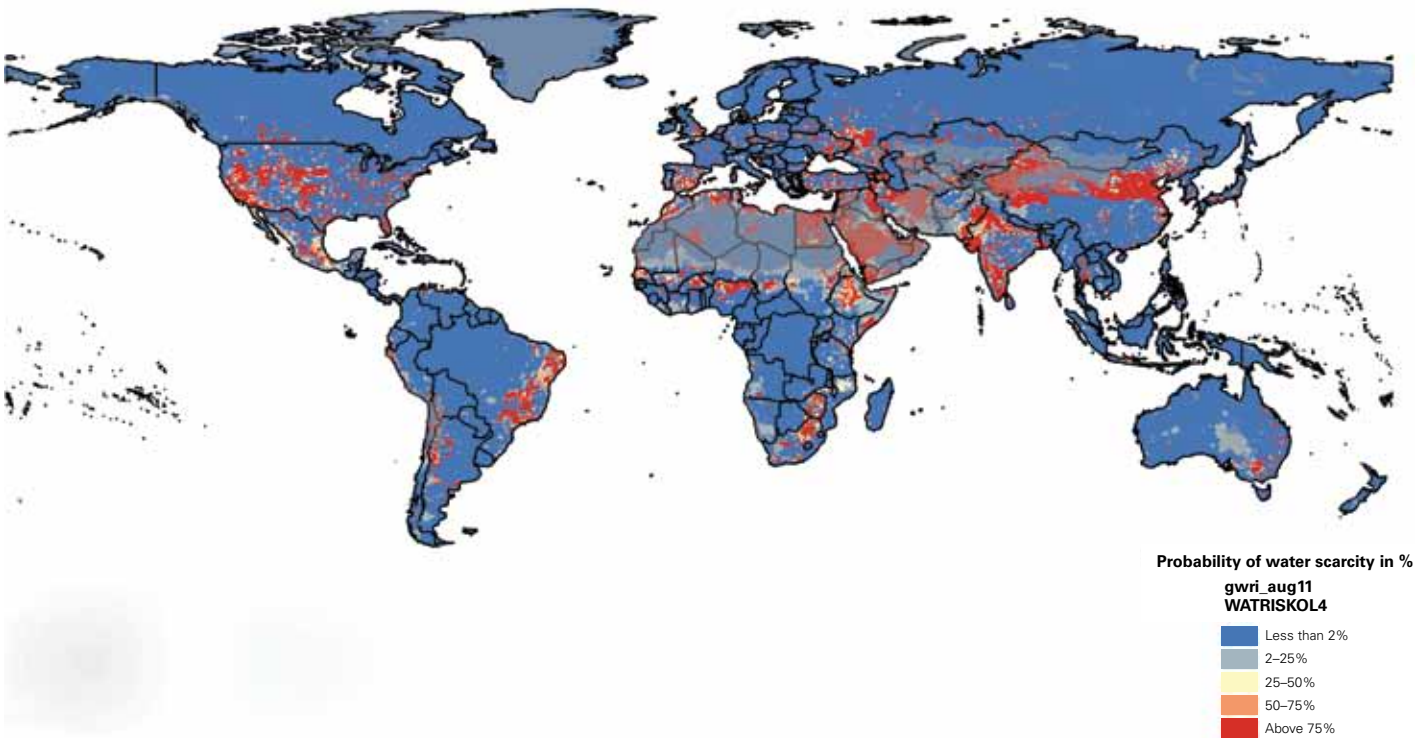
Businesses operating where freshwater is scarce may be vulnerable to water shortages, declines in water quality, water price volatility and reputational issues. They will have to share access to limited or dwindling water resources with municipalities through detailed water management plans and efficiency requirements, and are likely to be subject to regulations that aim to ensure adequate supply for local populations. Potential water shortages pose a threat to business growth and expansion, and conflicts over water supplies may create a security risk to both business operations and markets.

Indeed, according to the World Economic Forum, the projection for freshwater availability in 2030 bears potential for crisis and conflict, since water lies at the heart of everything that is important for human life: food, sanitation, energy, production of goods, transport and the biosphere. "The impact of a changing climate on water availability and quality is, in many regions, an immediate, tangible and local risk," the WEF says.

Increasing stress on the world's water supplies threatens to affect food and energy systems around the world due to the interlinked nature of the global economy. The 2030 Water Resources Group (2010) estimates that the global demand for freshwater will exceed supply by 40 percent by 2030 assuming average economic

“ Potential water shortages pose a threat to business growth and expansion, and conflicts over water supplies may create a security risk. ”

Figure 10: Water risk in 2030: probability of water scarcity in 2030



Source: Global Water Risk Index, Global Water Intelligence. (2011). Available at <http://www.water-risk-index.com/index.html>

“Lack of clean water in rural areas could reduce the amount of viable agricultural land, which would add to the pressure for people to migrate to cities.”

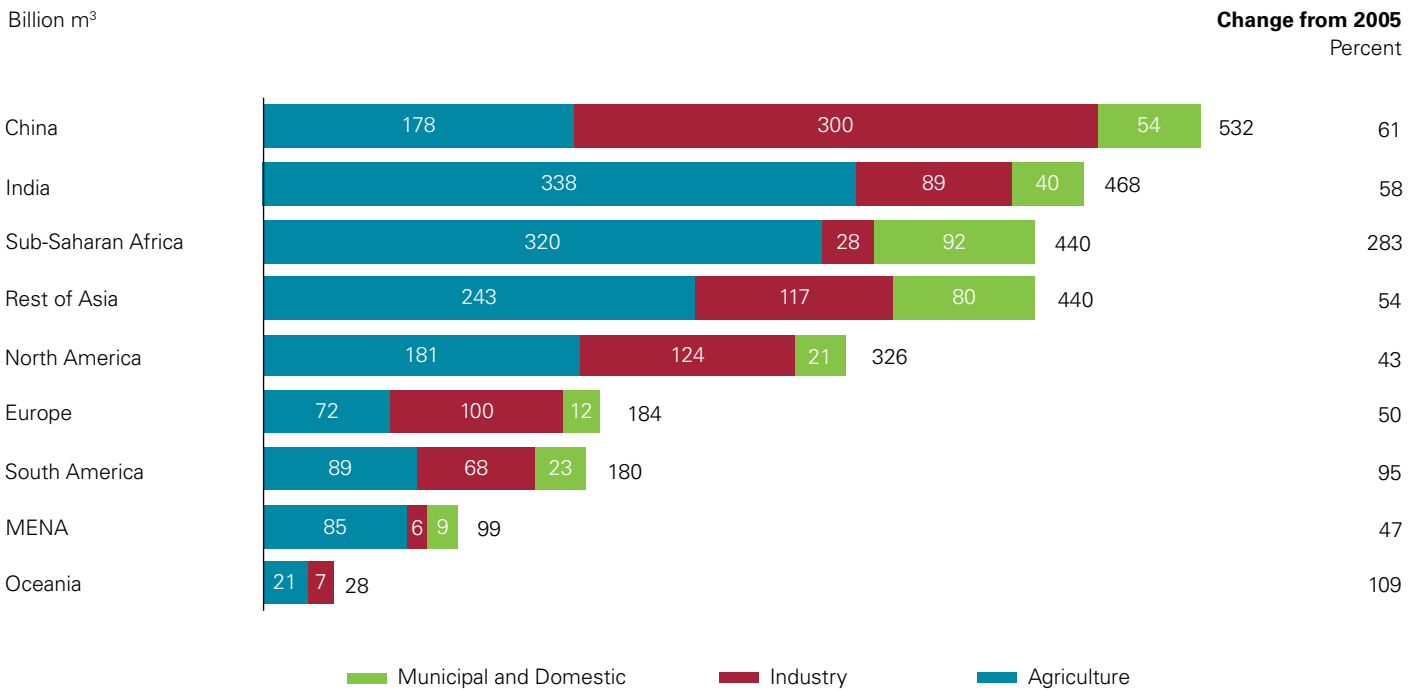
growth and no efficiency gains.¹⁴ The increasing demand for water is driven by population growth, increased industrialization in emerging economies such as China, and urbanization.

Figure 11 shows where water demand is predicted to rise most, both geographically and in terms of type of usage: municipal and domestic, agricultural or industrial. Agriculture in India, sub-Saharan Africa, and Asia (excluding China) is forecast to create the most additional water demand to 2030. In China, industrial demand for water will dominate to 2030; the country could account for 40 percent of extra industrial water demand globally.

Climate change puts further pressure on water availability and quality. More frequent extreme weather events caused by climate change, such as droughts and floods, are predicted to accelerate the deterioration of local freshwater supplies. Lack of clean water in rural areas could reduce the amount of viable agricultural land, which would add to the pressure for people to migrate to cities.

Companies that use water more efficiently or eliminate water use entirely through closed-loop processes and water recycling can save money and resources and reduce business risks.

Figure 11: Increase in annual water demand 2005–2030



Source: The 2030 Water Resources Group. (2009). Charting Our Water Future.

¹⁴ United Nations Environment Programme. (2011). *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*

Water-intensive sectors at the greatest risk from water scarcity include clothing, automobile, food and beverage, biotech/pharmaceutical, chemical, forest products, electronics, mining, refining and electric utilities.¹⁵

Population Growth

The number of people on our planet is predicted to increase to 8.4 billion by 2032 in a moderate growth scenario: a rise of some 20 percent from 2011.¹⁶

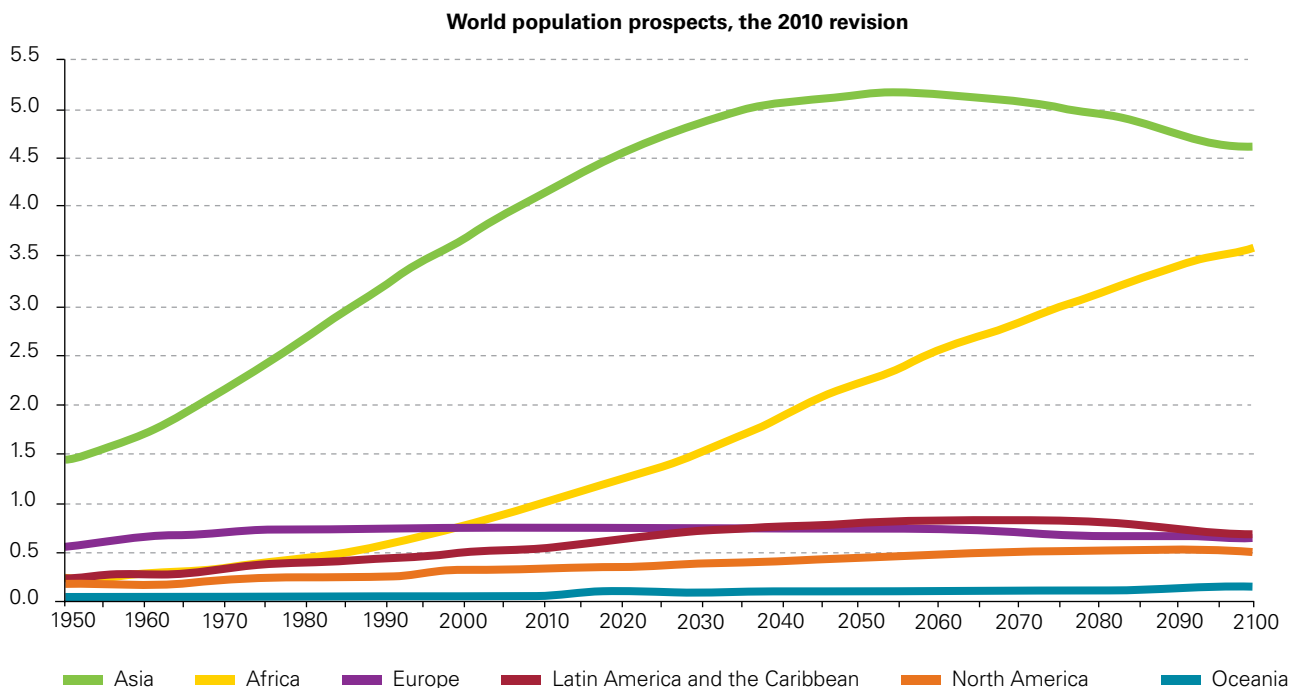
The populations of developing countries are expected to grow the most while

those of more developed regions, including North America and Europe, are expected to hold roughly steady. In 2032, almost two thirds (58 percent) of people will live in Asia and around one fifth (19 percent) in Africa (Figure 12).

Businesses can expect significant supply challenges and price volatility as a result of such a rapid growth in the number of people coupled with an increased use of resources.¹⁷ Population Growth will place intense pressures on ecosystems and the supply of natural resources such as food, water, energy and materials.

“Businesses can expect significant supply challenges and price volatility as a result of such a rapid growth in the number of people.”

Figure 12: Projected world population growth 1950–2100¹⁸ (billions)



Source: United Nations, Department of Economic and Social Affairs, Population Division. (2011): World Population Prospects: The 2010 Revision. UN, New York. Available at http://esa.un.org/wpp/Analytical-Figures/htm/fig_2.htm

¹⁵ Pacific Institute. (2007). *Pacific Institute’s Corporate Reporting on Water: A Review of Eleven Global Industries*.

¹⁶ United Nations, Department of Economic and Social Affairs, Population Division. (2011). *World Population Prospects: The 2010 Revision*.

¹⁷ Behrens, A., Giljum, S., Kovanda, J., Niza, S. (2007). *The material basis of the global economy. World-wide patterns in natural resource extraction and their implications for sustainable resource use policies*. Ecological Economics 64, pp. 444-453.

¹⁸ United Nations, Department of Economic and Social Affairs, Population Division. (2011). *World Population Prospects: The 2010 Revision*.

“Businesses will find opportunity in the increasing demand for affordable, accessible pharmaceuticals and healthcare.”

A lack of employment opportunities for growing young populations in developing nations could result in social unrest and instability. While this is a threat for business, there are also opportunities to create commerce and jobs, and to innovate to address the needs of growing populations for agriculture, sanitation, education, technology, finance and healthcare.

Meanwhile, in developed countries with stable populations but a growing proportion of elderly and retired citizens, businesses will face a shrinking workforce and fiercer competition for skilled workers. Financial challenges related to employee retirement benefits and pension funding will become more common as smaller workforces struggle to support the rising costs of ageing populations. As people live longer, conventions around working life, retirement and personal finance will be

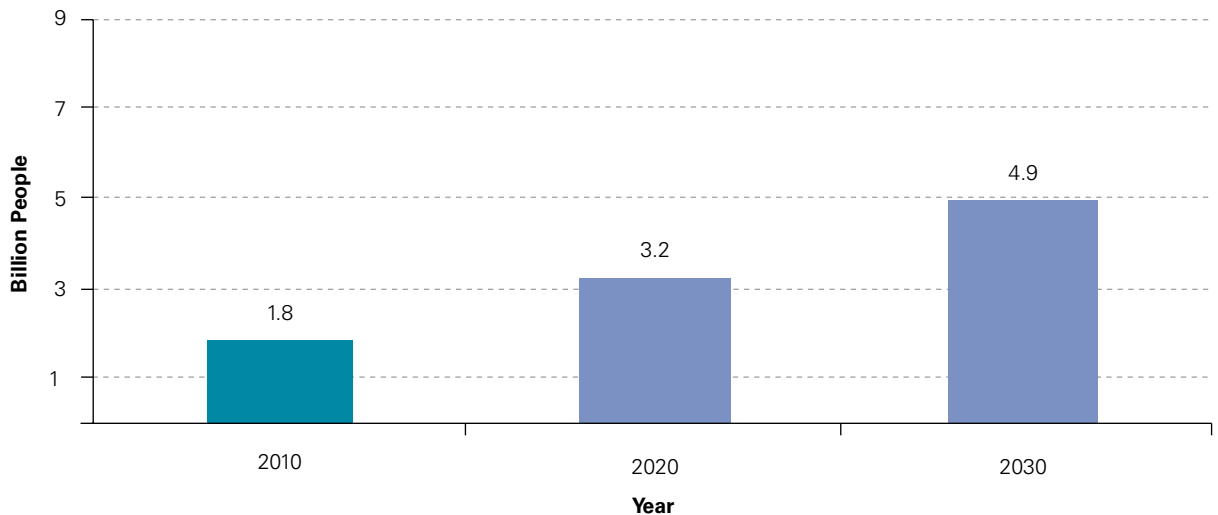
challenged. Businesses are likely to find opportunity in the increasing demand for affordable, accessible pharmaceuticals and healthcare, along with housing and mobility services for older people.

Wealth

The OECD defines the global “middle class” as those with purchasing power of between US\$10 and US\$100 per capita per day.¹⁹ This section of the global population is predicted to grow 172 percent between 2010 and 2030 (Figure 13)²⁰ resulting in a rise in overall global wealth over the next 20 years.

The challenge for businesses is to serve these new markets at a time when resources will become scarcer and more price-volatile. The greatest opportunity awaits those businesses that can provide products and services for a more resource-constrained world.

Figure 13: Growth of the global middle class



Source: KPMG International. (2012). Based on the data published in: OECD Development Centre. (2010). Working Paper No. 285: The Emerging Middle Class in Developing Countries © OECD, page 27

¹⁹ ibid

²⁰ Ibid

As workers in the developing world develop higher expectations and become more closely connected with the rest of the world, disparities between working conditions and wages in different countries are likely to become increasingly apparent. There have already been several industrial disputes in developing countries with workers demanding improved conditions and pay, and these are likely to become more common.

As a result, the advantages that many companies have experienced from “cheap labor” in developing nations are likely to be eroded by the growth and new power of the global middle class.

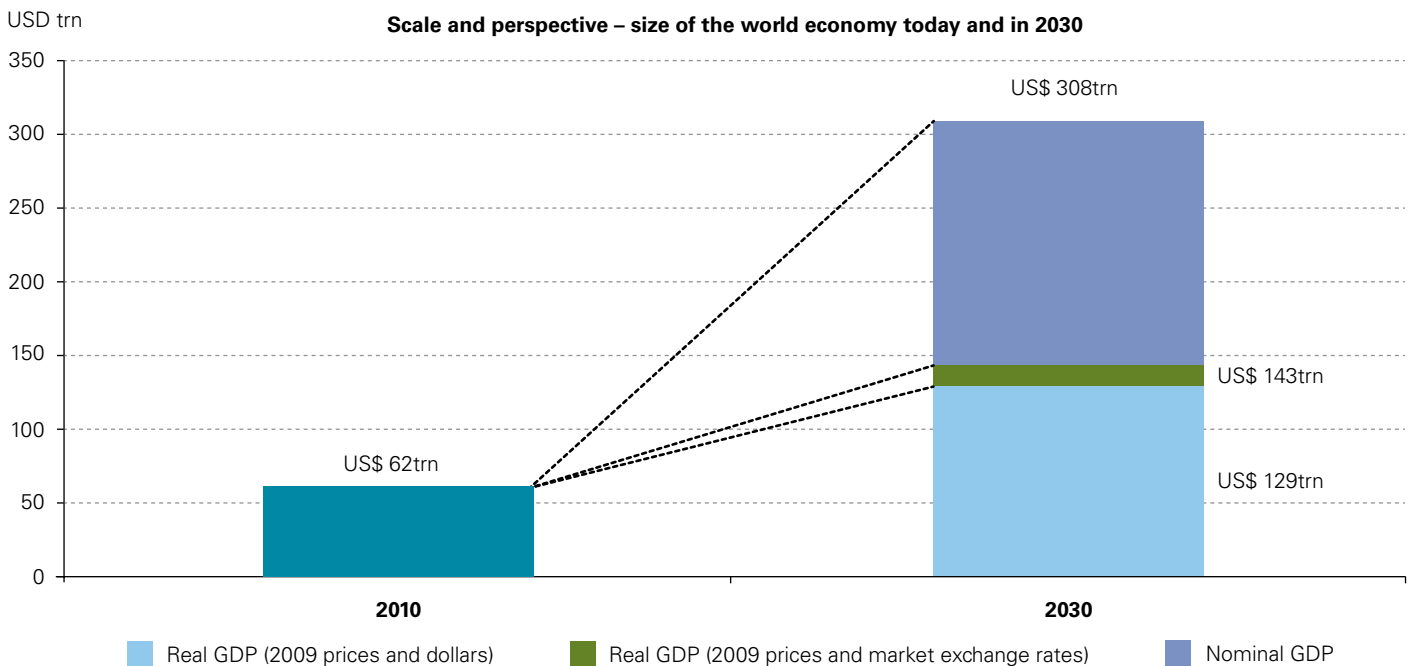
The emerging economies – especially China, Brazil, India, Mexico and Russia – could become increasingly influential²¹ as their middle classes grow and their share of global output is

predicted to grow from 36 percent to 45 percent between 2010 and 2025.²² In China, for example, consumption is expected to rise from 41 percent of the country’s GDP in 2011 to 55 percent in 2025.²³ This shift in spending power and lifestyle ambition presents huge opportunities for businesses, whose emerging market strategies are moving from a focus on foreign direct investment and offshoring to serving the demands of these newly empowered consumers.

Such growth projections are impressive, However, as incomes rise, resource use per capita also grows. Billions more middle-class consumers will emerge over the next 20 years driving demand for water, energy, food and material resources. Resource supplies, infrastructure and ecosystems will come under increasing stress.

“As incomes rise, resource use per capita also grows. Billions more middle-class consumers will emerge over the next 20 years.”

Figure 14: World economy (GDP) from 2010–2030



Source: Standard Chartered Bank (SCB). (2010). The Super-Cycle Report

²¹ Ibid

²² Ibid

²³ Ibid

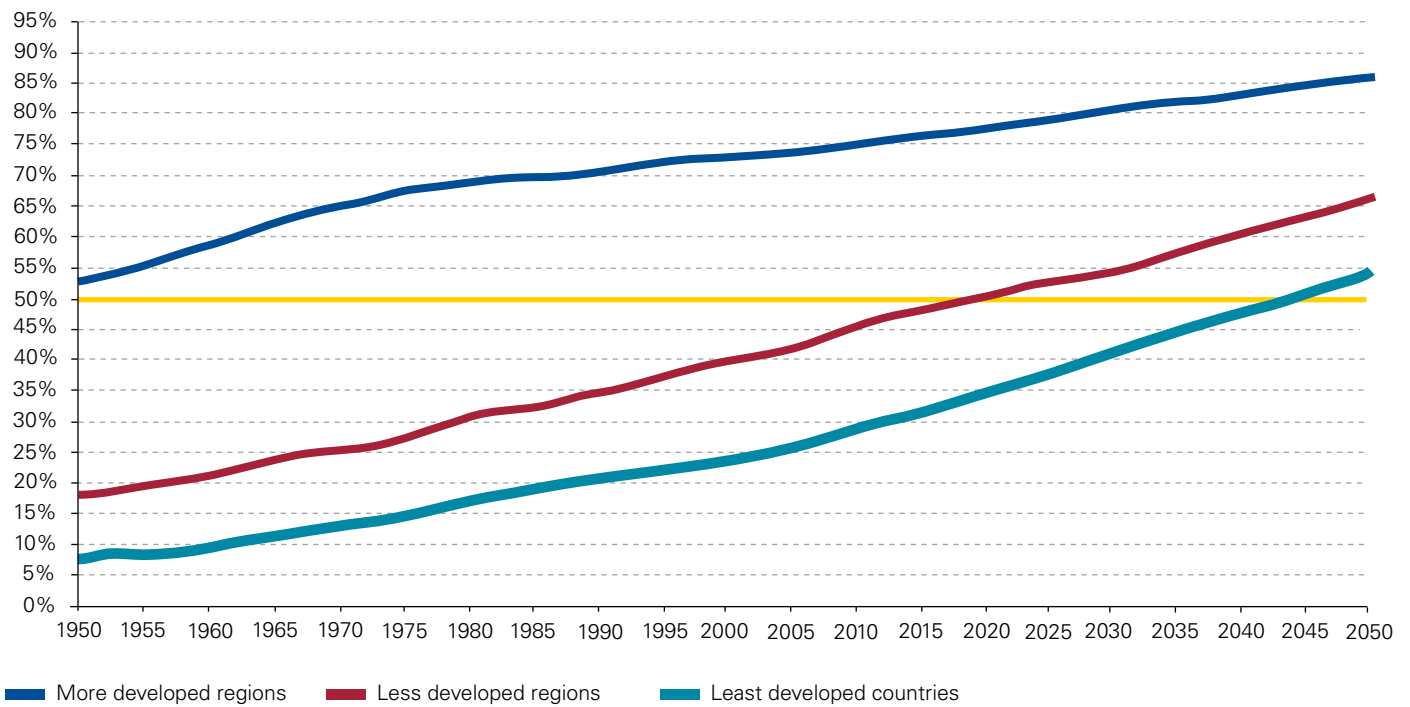
“Where improvements in urban infrastructure lag behind population and economic growth, slums expand and the gap between rich and poor widens.”

Urbanization

In 2009, for the first time ever, more people lived in cities than in the countryside.²⁴ By 2030 all developing regions including Asia and Africa are expected to have the majority of their citizens living in urban areas²⁵ and virtually all population growth over the next 30 years is predicted to be in cities.²⁶ The world’s urban population is predicted to reach almost 4.9 billion people by 2030 (Figure 15).

For these growing cities to be habitable, they will require vast improvements in infrastructure including construction, water and sanitation, electricity, waste, transport, health, public safety and internet and cell phone connectivity. Moving people and goods safely and efficiently through larger, densely populated urban areas will become more challenging and expensive and as cities grow there will be greater demands on scarce resources such as clean water and open green space.

Figure 15: World urbanization prospects, the 2009 revision (% of total population)



Source: United Nation, Department of Economic and Social Affairs, Population Division. (2009). World Urbanization Prospects: The 2009 Revision. UN, New York. Available at http://esa.un.org/unpd/wup/fig_2.htm

²⁴ UN Habitat. (2010). *State of the World’s Cities 2010/2011 – Cities for All: Bridging the Urban Divide*.
²⁵ UN Habitat. (2010). *State of the World’s Cities 2010/2011 – Cities for All: Bridging the Urban Divide*.
²⁶ UN Habitat. (2010). *State of the World’s Cities 2010/2011 – Cities for All: Bridging the Urban Divide*.



These requirements create opportunities for companies that can provide innovative ways to boost eco-efficiency, mitigate climate change, improve transit, alleviate poverty and reduce ecological footprints in areas of high residential and employment density. Cities also provide potential for business in terms of the number and diversity of available human resources.

Yet the integrated nature of the modern city requires companies to collaborate with each other, their suppliers, their customers, local and national governments and maybe even their competitors to provide the optimum solutions. IT could allow resources to be used more efficiently. Smart health systems that allow patients to consult their doctors over the Internet, for example, not only free up resources in the health service, they also reduce the amount of traffic on the roads. City-wide building management

systems and smart grids would be able to reduce power demand at peak times, reducing the need for expensive and polluting peak power plants.

Higher population densities in urban centers are likely to change economic and political dynamics, however, creating new challenges for businesses. Where improvements in urban infrastructure lag behind population and economic growth, slums expand and the gap between rich and poor widens. While the proportion of urban populations living in slums is slowly declining, the absolute number is predicted to rise to an estimated 889 million by 2020, an increase of 7 percent from 2010 levels.²⁷ Slums breed social instability and human conflict, yet even here, business can help by providing access to improved water, sanitation, housing, healthcare, education and employment opportunities.

“ Higher population densities in urban centers are likely to change economic and political dynamics. ”

²⁷ UN Habitat. (2010). *State of the World's Cities 2010/2011 – Cities for All: Bridging the Urban Divide*.

“Global food prices are predicted to rise by 70–90 percent by 2030.”

Food Security

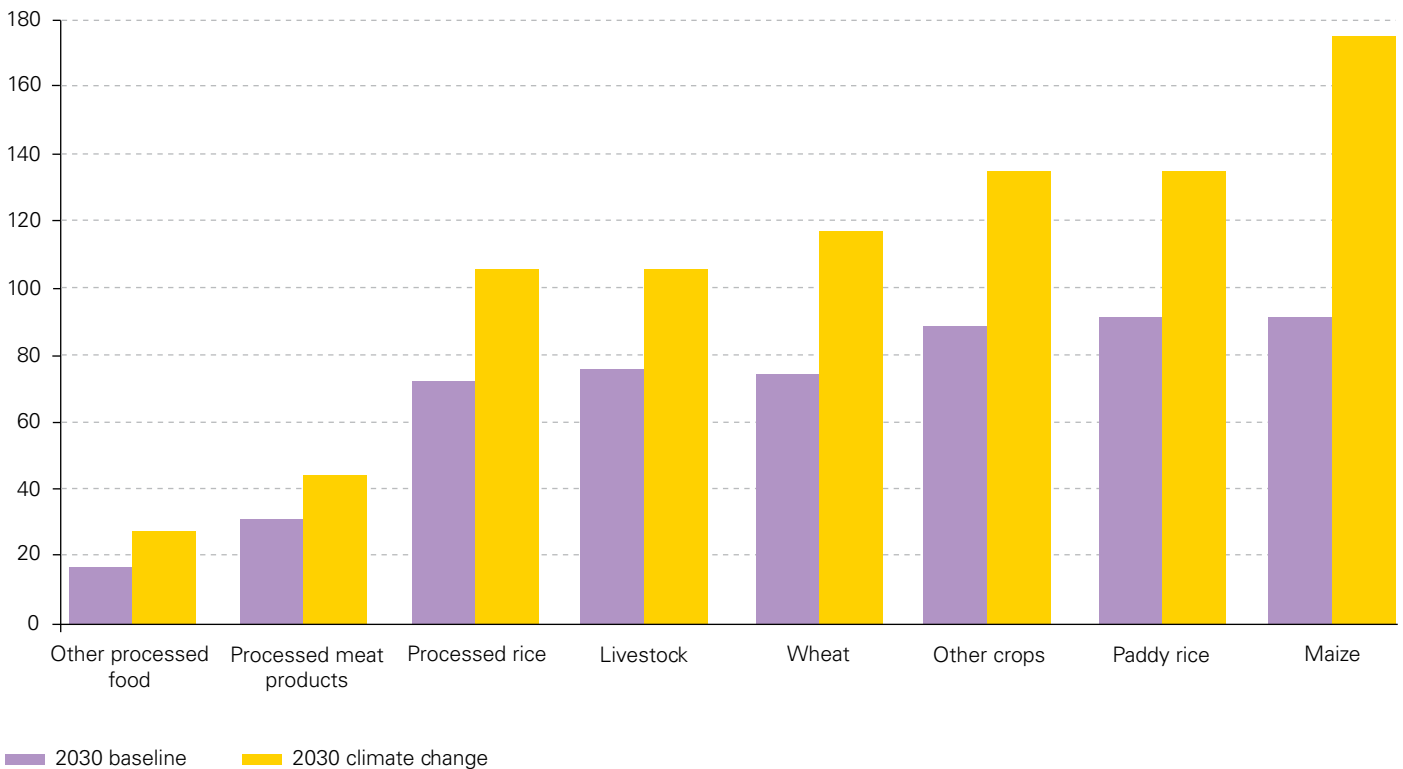
In the next two decades the global food system is set to come under increasing pressure from other megaforges including Population Growth, Water Scarcity and Deforestation. As a result, global food prices could to rise by 70–90 percent by 2030. When the potential effects of Climate Change are factored in, prices could rise even higher (Figure 16).²⁸

In water-scarce regions, agricultural producers are likely to have to compete for supplies with other water-intensive industries such as electric utilities and mining and with consumers.

Large agricultural producers will likely find a ready market in the growing global middle class, and the resulting increased demand for more expensive products such as meat and dairy. Modernizing agricultural techniques in

Figure 16: Real food price changes predicted over the next 20 years

Increase in world market export prices relative to 2010 (%)



Source: Oxfam International. (2011). *Growing a Better Future: Food justice in a resource-constrained world*.

²⁸ The material on page 12, from *Growing a Better Future: Food justice in a resource-constrained world*, 2011, is reproduced with the permission of Oxfam GB, Oxfam House, John Smith Drive, Cowley, Oxford OX4 2JY, UK, www.oxfam.org.uk. Oxfam GB does not necessarily endorse any text or activities that accompany the materials. Please see also the research notes here: <http://policy-practice.oxfam.org.uk/publications/download?id=442758>

the developing world, particularly Africa, may provide opportunity for producers of fertilizers and other agricultural inputs.

Demand for food is expected to increase most in developing countries with their fast-growing populations and this will spur an increase in domestic production to mitigate the rising cost of food imports. Patterns of production are likely to be driven by crop yields, water availability, governance and consumer preferences. However, food security depends not only on the amount of food produced, but also on access to that food. Access will be driven by economic

development, especially for the poorest people, who spend roughly half their income on food.²⁹

If they enjoy strong economic growth, political stability, increased agricultural production and integration into the world market, developing countries should be able to improve food security. Such conditions are by no means certain, however. Another challenge will be to redistribute food surpluses in developed countries to areas with greater need. The number of chronically under-nourished people rose from 842 million during the late 1990s to over one billion in 2009.³⁰

“ Demand for food will increase most in developing countries with their fast-growing populations. ”



²⁹ Oxfam International. (2011). *Growing a Better Future: Food justice in a resource-constrained world*.

³⁰ Food and Agriculture Organization of the United Nations. (2009, June 19). *1.02 billion people hungry*.

“ More companies are realizing how dependent their operations are on the critical services these ecosystems provide. ”

Ecosystem Decline

Historically, the main business risk of declining biodiversity and ecosystem services has been to corporate reputations. In recent years, food producers and retailers in particular have been targeted over the damage to ecosystems of their sourcing of certain products or raw materials, such as fish and timber.³¹

However, as global ecosystems show increasing signs of breakdown and stress, more companies are realizing how dependent their operations are on the critical services these ecosystems provide. The decline in biodiversity and ecosystems is making natural resources scarcer, more expensive and less diverse – increasing the costs of water and escalating the damage caused by invasive species to sectors including agriculture, fishing, food and beverages, pharmaceuticals and tourism.

Continued degradation of global biodiversity and ecosystem services could increase the pressure on these and other industry sectors. It would add to operational risk and, in certain locations, potentially jeopardize the long-term profitability and survival of some of the most-affected sectors such as forest products, agriculture and fisheries. Companies further up the supply chain or that operate “upstream” may be more susceptible to operational and regulatory challenges, while companies down the supply chain

often have a greater degree of public exposure and therefore to potential reputation risks.³²

By paying attention to biodiversity and ecosystem health, companies can recognize the risks and opportunities, anticipate new markets, mitigate their impacts, improve stakeholder engagement, and demonstrate leadership.³³

Pharmaceuticals is one sector that is increasingly focused on the implications of biodiversity and ecosystem decline.

Healthy ecosystems and diverse species are essential to many valuable and difficult-to-replace services ranging from fresh water and food to pollution filtration, carbon storage and pollination.³⁴ The benefits of ecosystem services are increasingly recognized – the UN initiative entitled The Economics of Ecosystems and Biodiversity (TEEB), estimates that the value of avoided greenhouse gas emissions from conserving forests is US\$3.7 trillion, for example, while insect pollinators contribute US\$190 billion a year to agricultural output.³⁵ The Convention on Biodiversity’s 2010 Nagoya Protocol commits governments to value biodiversity and integrate it into their strategic decisions.³⁶ As a result, almost 200 countries have committed to produce plans to stop the loss and degradation of natural habitats. Business will be in the front line of implementing these plans.

³¹ KPMG Climate Change and Sustainability Services. (2011). *Sustainable Insight: The Nature of Ecosystem Service Risks for Business*.

³² Ibid

³³ World Resource Institute. (2008). *The Corporate Ecosystem Services Review: Guidelines for Identifying Business Risks and Opportunities Arising Among Ecosystem Change, Version 1.0*.

³⁴ The Economics of Ecosystems and Biodiversity (TEEB), 2010, *Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions, and recommendations of TEEB*

³⁵ The Economics of Ecosystems and Biodiversity (TEEB), 2010, *Executive Summary*

³⁶ Convention on Biological Diversity. (2011). *The Nagoya Protocol on Access and benefit-sharing*.

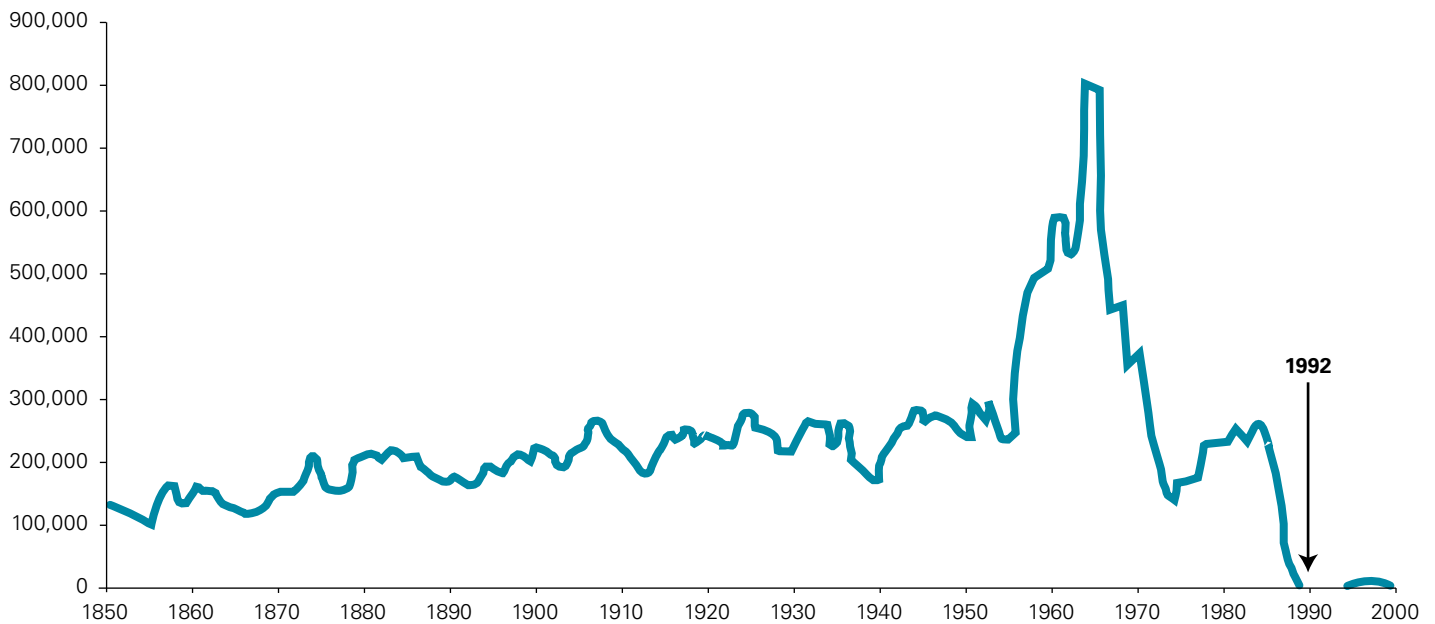
Exact biodiversity tipping points are uncertain. However, once this threshold is breached it is difficult, if not impossible, to return ecosystems to their former conditions. One of the most famous examples of this is the Newfoundland cod fishery, once so plentiful that fishermen joked you could step into the water and walk on

the backs of the fish. But having been fished for centuries, the area saw stocks collapse in the 1970s and then still further decline in the 1990s after decades of overfishing and they have still not recovered, partly because the ecosystem that previously supported the cod has changed in their absence (Figure 17).³⁷

“Once this threshold is breached it is difficult, if not impossible, to return ecosystems to their former conditions.”

Figure 17: Atlantic cod stocks

Fish landings in tons



Source: UNEP/GRID-Arendal. (2005). Collapse of Atlantic cod stocks off the East Coast of Newfoundland in 1992. UNEP/GRID-Arendal Maps and Graphics Library. (Accessed 2012). Available at: <http://maps.grida.no/go/graphic/collapse-of-atlantic-cod-stocks-off-the-east-coast-of-newfoundland-in-1992>

³⁷ Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-Being*. Washington, DC, USA: World Resources Institute.

“Cutting down forests – for agriculture, commerce or housing – directly reduces the supply of valuable natural resources and ecosystems services for business and the global community.”

Deforestation

Forests cover 31 percent of the world’s land surface and supply essential resources to local communities and the global economy, including timber, fruits and medicinal products. They also provide intangible but equally important services such as soil and water conservation, avalanche control and sand dune stabilization, as well as playing a vital role in reducing greenhouse gas emissions.

The timber industry and downstream industries such as pulp and paper are vulnerable to potential future regulation and market-based mechanisms such as Payments for Ecosystem Services (PES), which incentivize farmers and landowners to manage land for an ecological purpose. They may also find themselves under increasing pressure from customers to prove that their products are sustainable through the use of certification standards such as the Forest Stewardship Council (FSC), the Sustainable Forestry Initiative (SFI) and the Program for the Endorsement of Forest Certification (PEFC).

Agricultural industries seeking to meet higher demand for land-intensive products such as meat, dairy and even biofuels also need to be aware of the need to avoid sourcing products farmed on deforested land and to be able to prove they do so. Many developing countries are located in tropical forest zones where primary forests are uprooted to support the cattle, timber and paper, and palm oil industries.³⁸

Forests are crucial to the global carbon cycle – in 2010, they stored an estimated 289 gigatons of carbon, more than all the carbon in the atmosphere. However, deforestation means that this is 4.5Gt less than in 2005. Cutting down forests – for agriculture, commerce or housing – directly reduces the supply of valuable natural resources and ecosystems services for business and the global community. It also removes a vital carbon sink and reduces the world’s ability to contain climate change. It hits agricultural productivity, human and animal health and economic activities such as ecotourism. It also increases land degradation and desertification by destabilizing soils, increasing erosion and reducing the cycling of nutrients through soils, according to the UN Framework Convention on Climate Change.³⁹

Deforestation is increasingly being driven by the consumption needs of developed economies and rapidly expanding developing economies, according to the Prince Charles Rainforest Project. “In Indonesia and Brazil, the two countries accounting for nearly two-thirds of tropical rainforest loss between 2000 and 2005, a growing proportion of forest loss can be attributed to export-led commercial agricultural expansion,” it says. Palm oil, cattle and soybean production are the key commodities, but in other areas, cocoa, coffee and rubber production play a role, while mining and biofuels can indirectly contribute to forest loss. The global wood products industry is also a significant driver, both directly and indirectly by opening up the forest to other uses.

³⁸ Union of Concerned Scientists. (2011). *The Root of the Problem: What’s driving tropical deforestation today?*

³⁹ Joint Liaison Group of the Rio Conventions. (2007). *Forests: Climate Change, Biodiversity, and Land Degradation*



Forests are big business – wood products contributed US\$100 billion per year to the global economy from 2003–2007, accounting for some 45 percent of global wood production, while half of all wood used worldwide is burned as fuel.⁴⁰ The value of non-wood forest products, mostly food, is estimated at about US\$18.5 billion in 2005, although this is likely to be an underestimate because of the difficulty of valuing subsistence use of the forest.

The area covered by primary forests – those undisturbed by human activity – has fallen by more than 40 million hectares (an area larger than Germany or Japan) since 2000, mainly because of logging and other human intervention. If the destruction of forests continues on its current trajectory, the OECD projects that forest areas will decline globally by 13 percent from 2005 to 2030, mostly in South Asia and Africa.⁴¹

Reforestation with plantation forests is encouraging, but it does not support the rich biodiversity of a primary forest. Furthermore, most reforestation is

happening in temperate zones. Primary boreal and tropical forests are most vulnerable to unsustainable forestry practices and land conversion.⁴²

While agriculture could drive an increase in deforestation, industries that depend on biodiversity for innovation, such as pharmaceuticals, could suffer from continued primary forest loss and have an incentive to prevent it. Business opportunities may arise through the development of market mechanisms and other economic incentives through PES and the REDD+ (Reducing Emissions from Deforestation and Degradation) process.⁴³

The UN REDD+ initiative has the potential to create a global forest carbon market and system of incentives to keep forests standing. However, it remains unclear exactly what impact REDD+ will have because an international framework has still not been agreed, even though some progress was made at the 2011 COP17 conference in Durban.

“The area covered by primary forests – those undisturbed by human activity – has fallen by more than 40 million hectares (an area larger than Germany or Japan) since 2000.”

⁴⁰ Food and Agriculture Organization of the United Nations. (2002). *World Agriculture: Towards 2015/2030*.

⁴¹ OECD. (2008). *OECD Environmental Outlook to 2030*.

⁴² Ibid

⁴³ United Nations Environment Programme, 2011

“ Many predictions extrapolate current rates of change without fully taking account of the impacts of other sustainability megaforces. ”

Summary

The set of ten global sustainability megaforces presented in this report are set to significantly affect the way the world does business over the next 20 years. However, while existing trend projections provide some insights about a possible future, they should not be relied upon to tell the whole story. Many predictions extrapolate current rates of change without fully taking account of the impacts of other sustainability megaforces that will reinforce, compete with, or balance particular factors.

For example, increasing wealth and the growth of the global middle class will accelerate demand for consumer goods and services, putting further pressure on the natural and material resources needed to produce them. Regional freshwater availability will struggle to keep pace with the increased agricultural production necessary to feed the growing population. Urbanization predictions do not account

for the potential impacts of climate change refugees migrating from areas where water and food scarcity hit hardest. Food production projections rarely factor in deteriorating soil quality and the competing demands for agricultural land.

Individual trend projections prepared without consideration of the entire system of sustainability megaforces no longer provide an adequate basis for strategic business decisions or government policies.

The world is too uncertain and too complex to rely on linear forecasts; therefore, business leaders and policy makers should prepare for the unexpected. This means learning to look at the world in a new way that takes account of globally interconnected megaforces, the causal relationships between megaforces, feedback loops, effective intervention points and complex scenarios.

Figure 18: Summary of business-as-usual global projections

(Variously from 2008/2010 through 2030/2035)

| Megaforce | Indicator | % Change | Source |
|--------------------|--|-------------------|----------------------|
| CLIMATE CHANGE | Energy-related CO ₂ emissions | +20 | IEA |
| | Mean temperature rise | 0.5-1.0 °C | IPCC & Others |
| ENERGY & FUEL | Primary energy demand | +33 | IEA |
| | Net electricity generation | +84 | EIA |
| MATERIAL RESOURCES | Raw materials extraction (excluding fossil carriers) | +55 | SERI |
| WATER | Demand for water withdrawals | +53 | 2030 Water R. Group |
| | % Population under water stress | +39 | WEF |
| POPULATION | Total population | +20 | UN |
| | % Population 65 and older | +50 | UN |
| WEALTH | Middle-class purchasing power | +172 | OECD |
| | Real gross domestic product | +130 | Standard Chartered |
| URBANIZATION | Urban population | +44 | UN |
| | Urban land cover km ² | +110 | Seto, et. al. (2011) |
| FOOD SECURITY | Aggregate food demand | +50 | FAO |
| | Key staples food prices | +70 to +90 | Oxfam |
| ECOSYSTEMS | Terrestrial mean species abundance | -9 to -17 | CBD GLOBIO |
| | Human ecological footprint | +33 | GFN |
| DEFORESTATION | Net forest cover | -13 | OECD |
| | Amazon forest loss | +55 | WWF |

03

Acknowledging complexity – how sustainability megaforces interact

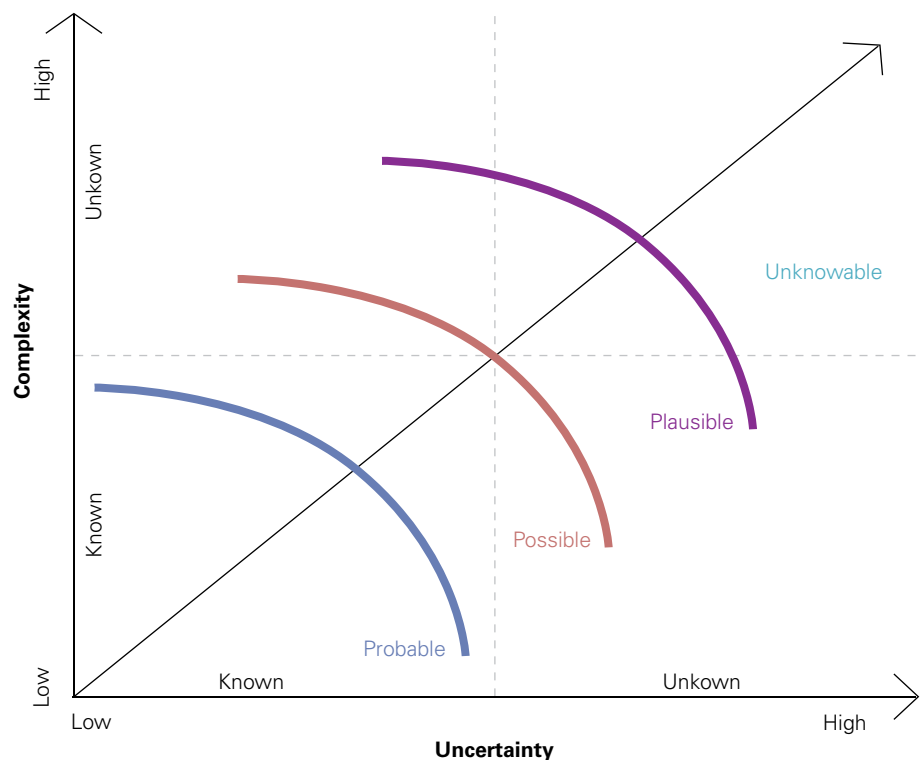
“ Many will find themselves increasingly in the challenging zone of improbable and unpredictable events. ”

The world is becoming more complex and uncertain

As outlined earlier in this report, factors such as globalization, digital connectivity and resource scarcity are forcing businesses to operate in an ever more complex world. This complexity is multiplied by unprecedented uncertainty, imperfect

information and rapid rates of change. The diagram below represents the loss of predictability as complexity and uncertainty increase. Few businesses still operate in the bottom left quadrant: “The Zone of Probability” defined by order, data, measurable risks and probabilities. Many will find themselves increasingly in the challenging top right zone of improbable and unpredictable events.

Figure 19: Going North-East



Source: Expect the Unexpected: Building business value in a changing world, KPMG International 2012



Businesses around the world are acknowledging complexity

To gain greater insight into how increasing complexity is impacting business around the world, KPMG International undertook a comprehensive study¹ of 1,400 senior corporate decision makers from 22 countries. The research clearly shows that the issue of complexity has risen to the top of the business agenda, with 94 percent of the executives saying that managing complexity is important to the success of their organization. The vast majority of executives say complexity has increased in the recent past, and most expect it to increase over coming years. These executives see complexity not only as a source of additional risk and cost, but most also believe that it is also creating new opportunities.

Interacting sustainability megaforges

While each of the global sustainability megaforges presented in the previous section of this report is significant in its

own right, it is important to understand that they are also closely interwoven with each other. To give just a few examples:

- Population Growth and Wealth increase Energy use which drives Climate Change
- Climate Change increases Water Scarcity and Food insecurity which combine to drive Urbanization as more people head for cities to escape deprivation
- Climate Change and Material Resource Scarcity drive Deforestation which in turn causes Ecosystem Decline
- Deforestation circles back to drive Climate Change as there are fewer trees to absorb carbon in the atmosphere.

The causes and effects of these complex relationships between sustainability megaforges are rarely proportionate, making it difficult to predict outcomes accurately; one cause can lead to many different outcomes, leading to surprises and unforeseen chain reactions.

“The causes and effects of these complex relationships between sustainability megaforges are rarely proportionate.”

¹ KPMG International presented the results of the *Confronting Complexity* study in 2011 at the World Economic Forum in Davos. As part of this research 1,400 senior executives were interviewed. They included CEOs, CFOs, and finance directors in a wide range of industries in 22 countries: Australia, Brazil, Canada, China, Denmark, France, Germany, India, Ireland, Italy, Japan, Mexico, Netherlands, Russia, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, the UK and the US. The complexity research data can be viewed from different angles via an interactive database at <https://www.kpmg.com/Global/en/WhatWeDo/Special-Interests/Confronting-Complexity/complexity-research-data/Pages/default.aspx>

“To thrive, or even just to survive, businesses increasingly need to understand the root causes of what affects their operations, not just the symptoms.”

Companies need to develop resilience and flexibility for this unpredictable future and build capacity to anticipate and adapt. Good management used to be about preparing for the expected, now it is just as much about preparing for the unexpected. To thrive, or even just to survive, businesses increasingly need to understand the root causes of what affects their operations, not just the symptoms.

Systems thinking around sustainability embraces the entire structure of megaforges rather than its individual constituents. It looks at patterns of change and acknowledges the growing importance of low probability but high impact events.

Problems experienced with first generation biofuels provide an example of how actions taken without a full understanding of the interconnected system can result in unintended consequences. Biofuels made from corn or palm oil, which were intended to reduce greenhouse gas emissions, have contributed to higher food prices by competing with food crops for land, are expensive and produce only limited GHG reduction benefits, according to the International Energy Agency (IEA).² They also accelerate deforestation, compete for scarce water resources in some areas and can have a negative impact on biodiversity. Furthermore, they are reliant on the dynamics of the agricultural commodities sector for the price of their inputs but on the oil market for the price of their outputs, which has led to price volatility.

“In most countries, policies that encourage the rapid growth of biofuel production have outpaced our understanding of the potential impact of biofuels on the environment, sustainable utilization of natural resources and food security,” says the International Energy Forum.³

Systems thinking is an important way to assess and manage new risks comprehensively and uncover risks that were previously unidentified. For example, a company may understand its direct dependency on water, but may not have thought about how the supply of its material resources could be impacted by increasing water scarcity.

Companies may already be using systems thinking in the business, for example in strategic planning, revenue management or supply chain planning but in our view it should be more applied as part of a proactive sustainability strategy. Because all businesses operate within their own set of variables, the individual systems approach will be unique to each business but the simplified examples given in this report serve to demonstrate the principles.

The systems approach to sustainability

A coherent picture of how sustainability megaforges interact and impact business can be built through the technique of “causal loop diagramming” (CLD).

In CLD, forces are linked by arrows labeled “S” – implying movement in the same direction and “O” implying movement in the opposite direction. If two forces are moving in the same direction, then an increase in one will cause an increase in the other. If they are moving in opposite directions, then an increase in one will cause a decrease in the other. Dotted lines represent relationships between forces that will take time to develop and therefore have a delayed impact. With links between forces mapped out, “causal loops” can be identified where a chain of forces circles back to increase or decrease the power of the original force. For example, more Wealth and Urbanization increases

² International Energy Forum (February 2010). *Assessment of Biofuels Potential and Limitations*.

³ International Energy Forum (February 2010). *Assessment of Biofuels Potential and Limitations*.

consumption of Water and Food. This reduces Water and Food Security, which then circles back to further increase Urbanization as more people migrate to cities to escape deprivation in rural areas. Several of these loops can be in train at any one time, further complicating the picture for business.

The nexus approach

The nexus approach has been widely used by the World Economic Forum, the German Federal Government and others to explore the driving forces behind the challenge of water security and its relationships with climate change, food and energy production.

For the purposes of this report we have developed three nexuses which together represent the challenges of sustainable growth. We believe companies will

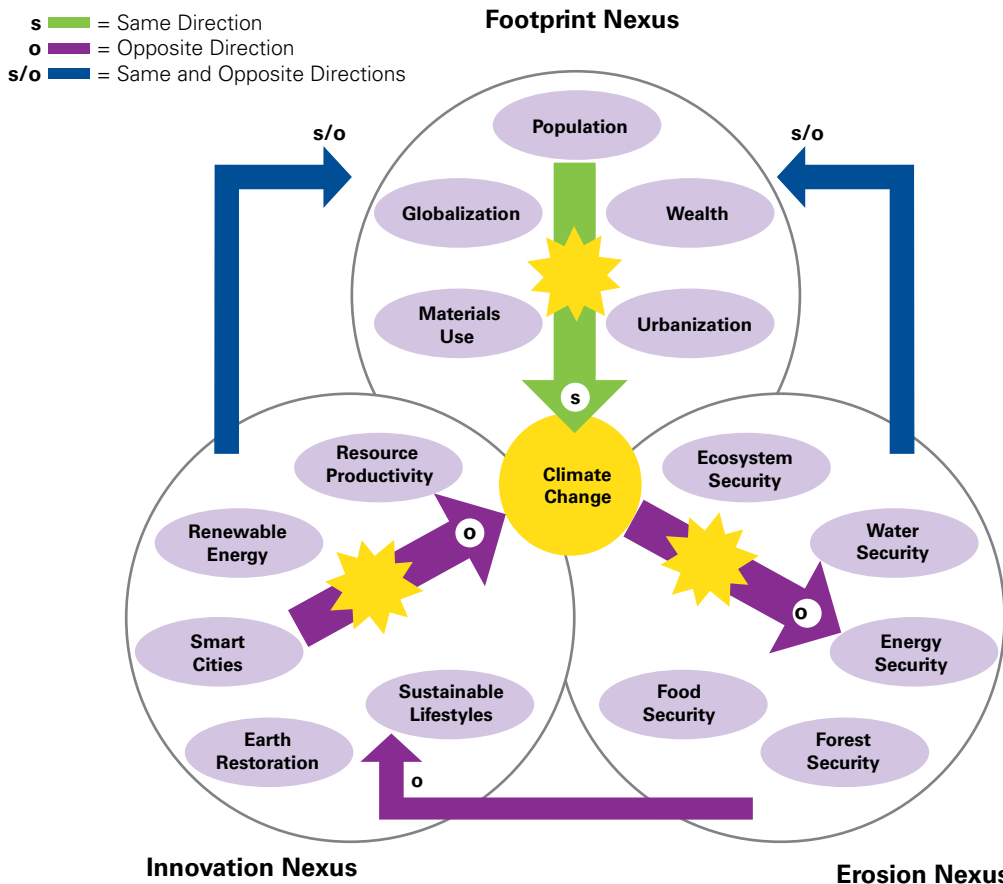
benefit from exploring these nexuses in their own organizational context:

- 1) The Footprint Nexus: the forces driving the escalating “footprint” of mankind on the planet
- 2) The Erosion Nexus: the resulting changes in the natural systems on which we depend
- 3) The Innovation Nexus: the opportunity to address sustainability challenges through business innovation

The Footprint and Erosion nexuses together create an imperative to increase resource efficiency and reduce dependency on commodities that are likely to suffer supply restrictions and price volatility. The Innovation Nexus provides the solutions that may enable businesses to do so. *Figure 20* below illustrates how the three nexuses are linked by Climate Change.

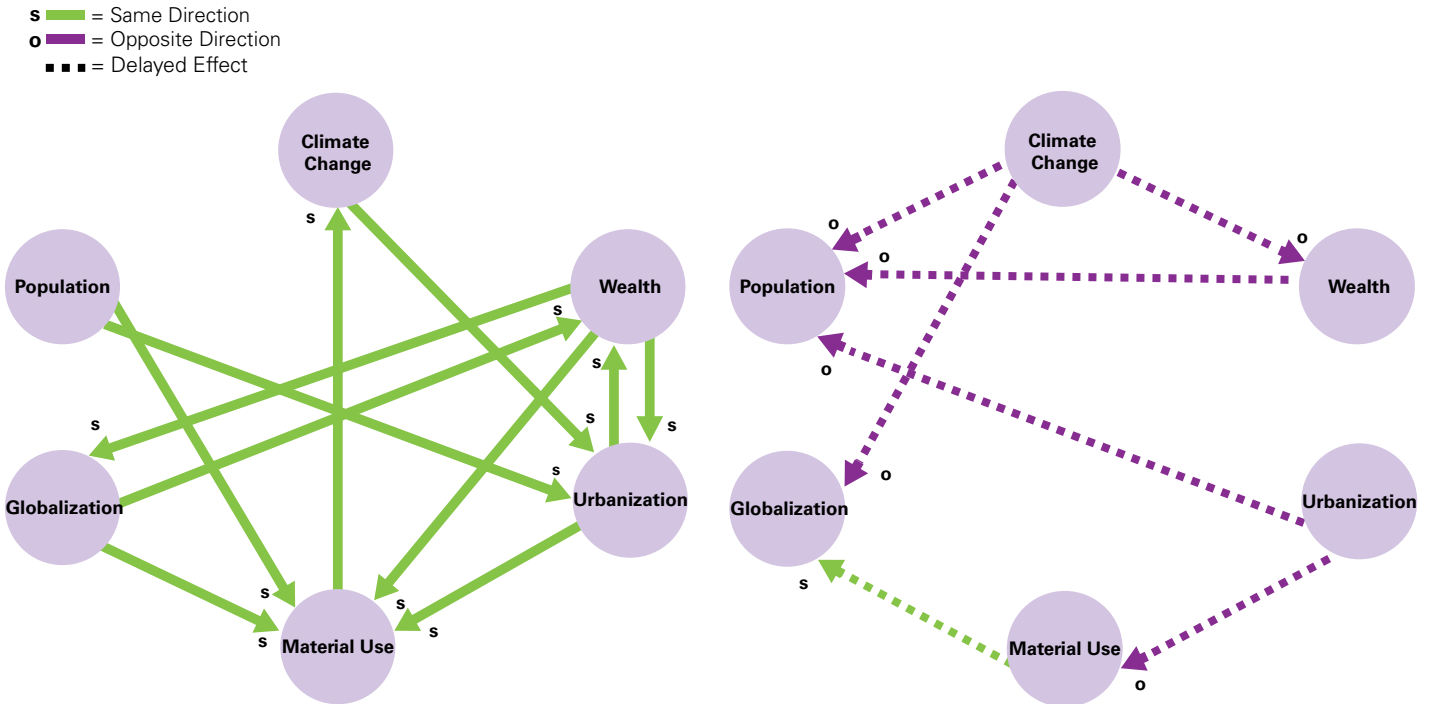
“The Footprint and Erosion nexuses together create an imperative to increase resource efficiency and reduce dependency on commodities that are likely to suffer supply restrictions and price volatility.”

Figure 20: The Nexus Approach



Source: Expect the Unexpected: Building business value in a changing world, KPMG International 2012

Figure 21: The Footprint Nexus



Source: Expect the Unexpected: Building business value in a changing world, KPMG International 2012

“As a result, the relationships between megaforges in the system will shift over time in often surprising ways that companies need to try to anticipate.”

The Footprint Nexus

The Footprint Nexus (*Figure 21*) helps companies to grasp emerging risks and opportunities, build resilience and flexibility to deal with surprises, and capacity to exploit unpredictable opportunities. The nexus helps us to understand that physical expansion for ever is impossible – something has got to give, and when it does business, will inevitably be affected.

It is a system whose causal relationships are mainly non-linear, meaning that the impact of events is neither certain nor predictable. As a result, the relationships between megaforges in the system will shift over time in often surprising ways that companies need to try to anticipate.

Central to this nexus are the mutually reinforcing relationships between Globalization and Wealth; and between Wealth and Urbanization. All three of those megaforges serve to drive up the use of Energy and Material Resources which in turn increases Climate Change. Shocks that could come from this nexus include:

- The failure of global commodities and resources to keep pace with demand from the growing Asian middle class, leading to substantially higher costs for these products;
- Declines in global GDP and trade flows if the adverse impacts of climate change emerge more severely or much earlier than predicted;

- An increase in the number of climate change refugees leading to an increase in slum dwellers and a consequent large scale shift from biomass to fossil fuel use; and
- More land purchases in Africa and South America by foreign investors seeking to secure food and raw materials.

Without interventions, this system increases Energy and Material Resource use and Climate Change until in the very long term balancing forces would come into play. For example, increasing Wealth leads to smaller families, slowing or even reversing Population Growth but creates new challenges such as the increased cost of healthcare as people live longer and the incidence of health conditions such as obesity and diabetes rises. Similarly, adverse impacts of Climate Change such as major rises in sea level could also act to reduce Wealth.

Companies can use the Footprint Nexus to understand how the world's future sustainability challenges may affect them – putting them in a stronger position to manage risks and seek out opportunities. Also, because radical interventions are required to stabilize the system, using the Footprint Nexus can help businesses to anticipate how government policy may develop and how they can prepare for and influence those policies.

The Erosion Nexus

The Erosion Nexus (*Figure 22*) helps companies to foresee the many ways in which climate change and its linked megafactors could affect their business. It helps to identify Climate Change future risk and develop strategic

responses, to reduce exposure to higher environmental costs and to discover potential synergies.

As with the Footprint Nexus, the Erosion Nexus also helps to anticipate future government policy. For example, with less water available, will governments legislate to increase prices, compel water-intensive industries to use less water or revoke licenses?

A key element of the Erosion Nexus is the complex sub-nexus linking energy, food, water and climate change. Difficult tradeoffs abound here.⁴ For example, using more coal and natural gas, and converting more agricultural land to biofuel production increases energy security but diverts water use toward energy production. It is also likely to accelerate forest and ecosystem loss, increase carbon emissions and impact global food supplies.

Moving, distributing and purifying water requires large amounts of energy; large amounts of water are needed to generate energy through the extraction, mining and processing of coal as well as in the cooling of power station generation systems. Huge amounts of both energy and water are required to prepare, fertilize, irrigate and harvest land in modern resource-intensive farming (accounting for approximately 70 percent of the world's freshwater use).⁵

Assessing the Erosion Nexus in a business context may generate insights such as:

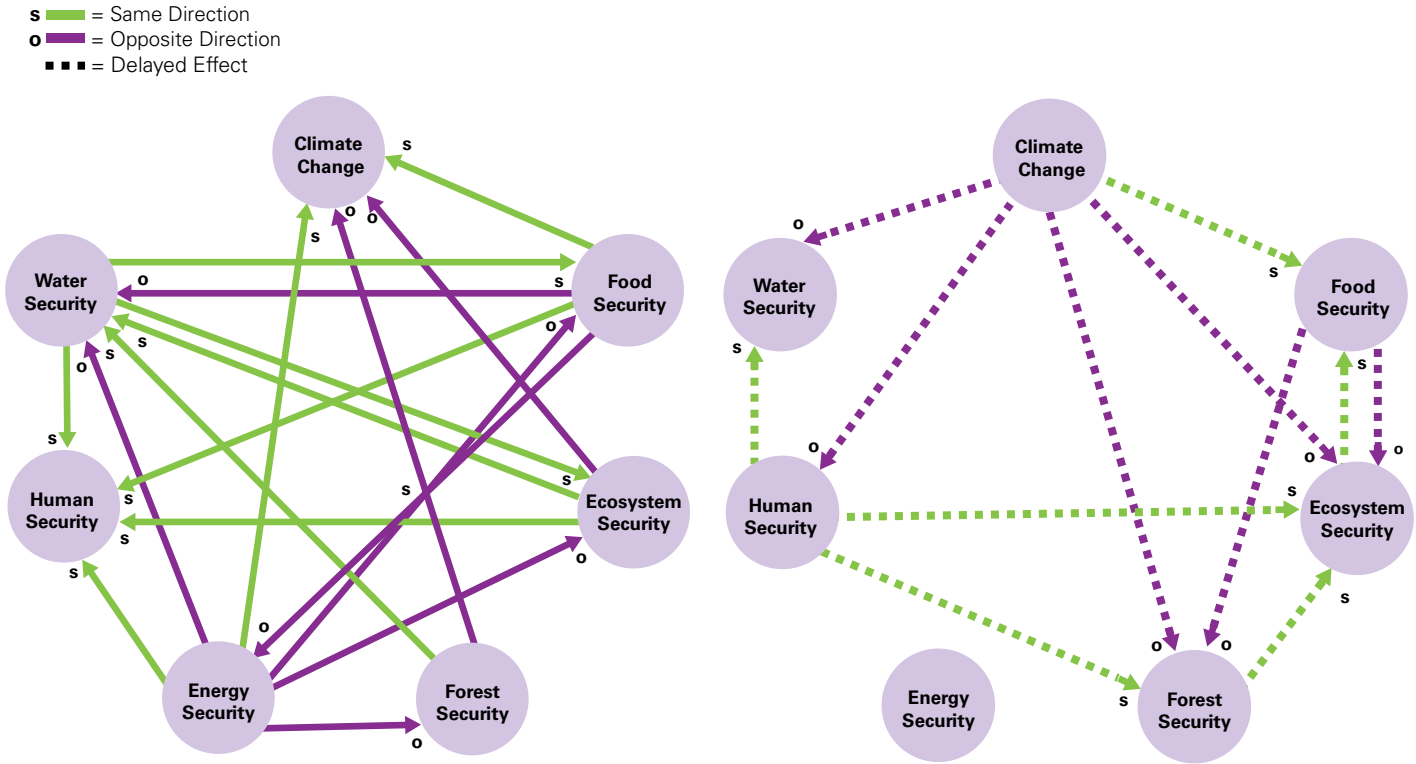
- Demand and supply stresses are likely to be concentrated in areas such as China and India that already experience massive challenges of water availability and agricultural productivity;

“Without interventions, this system increases Energy and Material Resource use and Climate Change until in the very long term balancing forces would come into play.”

⁴ Hoff, H., Stockholm Environment Institute. *Understanding the Nexus: Background Paper for the Bonn 2011 Conference: The Water, Energy and Food Nexus* (Stockholm: Stockholm Environment Institute, 2011.).

⁵ <http://www.fao.org/nr/water/news/clim-change.html>

Figure 22: The Erosion Nexus



Source: Expect the Unexpected: Building business value in a changing world, KPMG International 2012

“By considering the full system of sustainability megaforges, companies are more likely to avoid “quick fixes” that result in unforeseen problems.”

- Volatility in energy and food prices is likely to increase.
- Economic activity in areas vulnerable to high water, food and climate risks may struggle to secure insurance cover.
- Global economic activity would gravitate toward areas of greater freshwater abundance and arable land, and lower climate disruption.
- There are opportunities for innovations that reduce the resource intensity of goods and services.

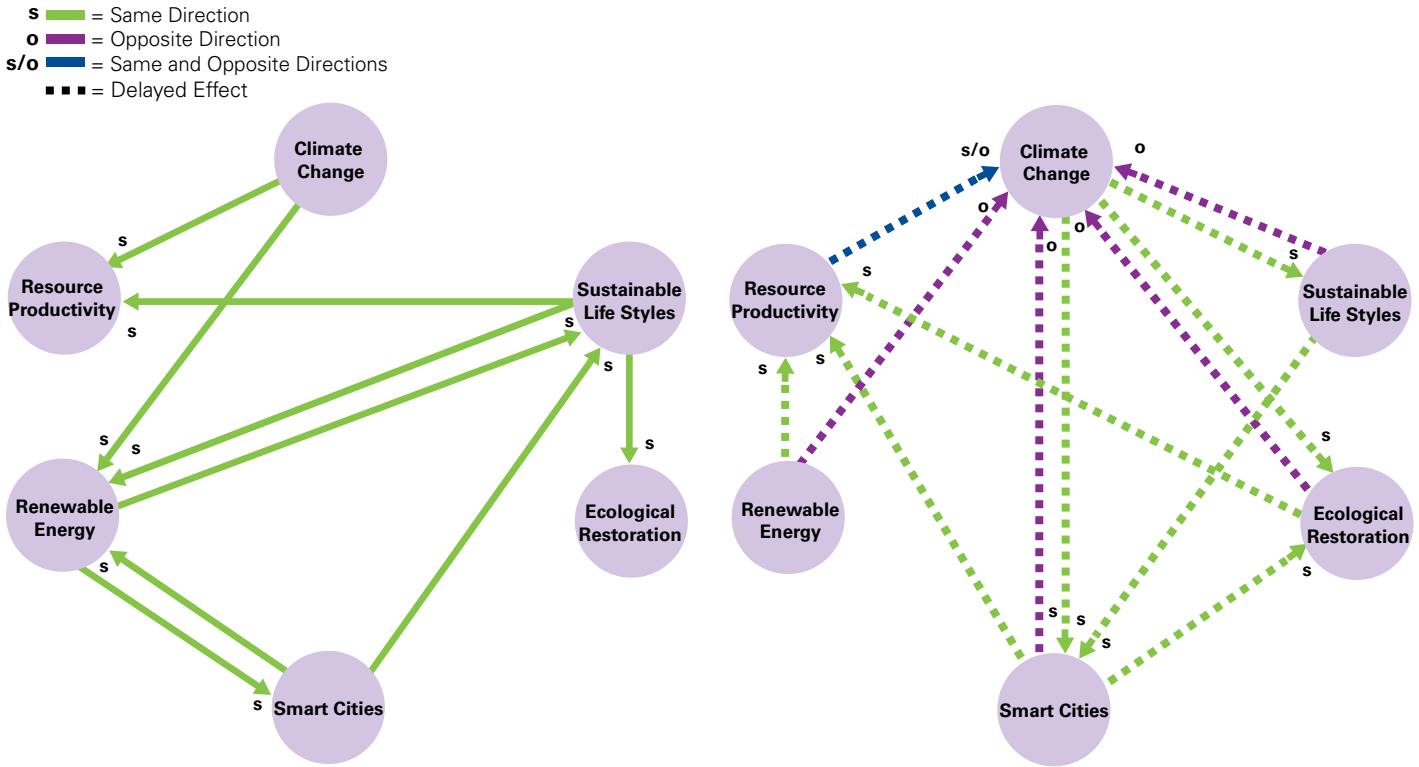
Companies seeking to manage risks by reducing their environmental footprints can use the Erosion Nexus to assess the broader and longer term

impacts their proposed actions may have. By considering the full system of sustainability megaforges, companies are more likely to avoid “quick fixes” that result in unforeseen problems and greater risks in the long term.

The Innovation Nexus

The previous two nexuses have shown how businesses can more fully understand the risks their organization faces from the system of sustainability megaforges. The Innovation Nexus (Figure 23) shows how companies can use the same systems approach to develop business opportunities by innovating solutions to sustainability problems.

Figure 23: The Innovation Nexus



Source: Expect the Unexpected: Building business value in a changing world, KPMG International 2012

This nexus suggests that sustainable lifestyles, ecological restoration, the use of ICT to create “smart” cities, renewable energy and resource productivity are among the key innovations required to avoid dangerous levels of climate change. Most of the links and loops in this nexus – especially among sustainable lifestyles, the digital connectivity needed to create smart cities, renewable energy and resource productivity – can work in synergy to amplify each other. The challenge is to bring about enough positive innovation to kick-start the “whole-system” transformation cycle.

Responses to the forces of the Innovation Nexus can be seen in the business community. One example is the area of urban infrastructure and cities. Cities are looking at ways to improve their infrastructures to become more environmentally friendly, improve residents’ quality of life and cut costs at the same time.

An increasingly connected system that links citizens to transport, health, education, local authority services and businesses will not only make cities more sustainable and efficient, but also more resilient to cope with the shocks and surprises highlighted in the Footprint and Erosion Nexuses.

“The challenge is to bring about enough positive innovation to kick-start the “whole-system” transformation cycle.”

“It is not so much the nature of the complexity a company faces that will determine its success, but the extent to which a company can effectively analyze its situation and bring resources to bear.”

The same will hold true for companies. Understanding the risks and opportunities highlighted by the sustainability systems approach should not only create new business opportunities, it should enable them to better navigate the challenges of the future.

Staying simple or using complexity as a stimulus

As it is unrealistic to expect complexity to decline in an increasingly sophisticated world, companies need to decide how to confront complexity. The KPMG International Confronting Complexity study suggests that broadly there are two strategies for dealing with complexity. You can either try to avoid it or embrace it.

There are organizations in every sector that have done well by keeping their business models simple. They do what they know, provide a valued set of goods or services in an efficient way, and avoid markets they don't understand.

The alternative view is that complexity is a necessary part of a vibrant and rapidly developing market. It drives innovation by presenting a constant stream of new problems to solve. It highlights areas of outdated thinking and forces businesses to improve constantly. This is a common view held by many of the emerging economy businesses. For these companies, cutting through complexity to focus sharply on the opportunities it presents is a major part

of their corporate strategy. These may not be comfortable strategies, and they require a personal commitment from managers determined to keep pace with rapidly changing environment.

KPMG's Confronting Complexity study also indicated that in the end it is not so much the nature of the complexity a company faces that will determine its success, but the extent to which a company can effectively analyze its situation and bring resources to bear. To this end companies need to seek ways to understand the impact of the system of sustainability megaforges. One way of doing this is to apply both quantitative and qualitative foresight techniques.

Potential disruptors: The climate-water-energy-food nexus

One potential disruptive systemic event is the possibility that Climate Change and Water Scarcity will combine with rising Energy prices to create a Food crisis.

Recent research indicates that crop yields decline at an increasing rate once temperatures rise above 84° F (for corn) to 86° F (for soybeans).⁶ In fact, just one day with temperatures 10° F above the optimal level is estimated to be as harmful to crop yields as 10 days that are 1° F above optimal. As both average and extreme temperatures continue to increase, crop yields in many parts of the world could fall.

⁶ Wolfram Schlenker and Mark J. Roberts. 2009. "Non-linear Temperature Effects Indicate Severe Damages to U.S. Crop Yields under Climate Change," Proceedings of the National Academy of Sciences, 106(7): 15594-15598.

Furthermore, climate change threatens to exacerbate water scarcity in much of the world. The combination of climate change and water scarcity could lead to a severe reduction in both food and beverage production. At the same time, water scarcity could raise costs and reduce production in several other water-intensive sectors, including electricity, chemicals and industrial metals. If energy prices continue to rise – which is likely as rapid economic growth continues in China, India, Brazil and other emerging nations – this would raise the costs of food production further.

In turn, declining food security is likely to have a series of serious consequences including rising healthcare costs, labor shortages, higher labor costs and more homelessness. Such factors are likely to increase global tensions over resources, and water wars could develop in water-stressed regions such as the Himalayas and Sub-Saharan Africa. Economic growth would be threatened by the increasing costs of labor and energy, and unemployment would grow. Social stability could be at risk.

This set of changes could create difficult challenges for many industries, as costs increase on several fronts at once. At the same time, certain sectors will find new opportunities to provide climate adaptation solutions, to offer potable water in innovative ways, and to better monitor and manage water usage and food production. The exact mix of risks and opportunities will depend upon how public policy responds to the emerging trends.

Climate change mitigation as well as adaptation, potentially driven by global agreements, should provide an array of opportunities for industry, although it will also impose additional costs on energy-intensive sectors. A lack of global policy action is likely to mean that climate-related innovation opportunities will be primarily linked to adaptation.

In dealing with change some firms will find it difficult to innovate effectively under challenging circumstances. Others will exploit the emerging opportunities, and disruptive technologies may overturn the existing order in the sector.

“ Certain sectors will find new opportunities to provide climate adaptation solutions. ”

04

Future Scenarios

“ Successfully navigating this turbulent future will require businesses to develop anticipatory awareness, adaptive capacities and resilient strategies and structures. ”

The previous sections of this report suggest that the next few decades will be marked by rising complexity, uncertainty, volatility and an accelerating pace of change. The future is set to become increasingly less predictable and full of surprises. Successfully navigating this turbulent future will require businesses to develop anticipatory awareness, adaptive capacities and resilient strategies and structures. Moving into a world of “unknown-unknowns” demands a shift of thinking away from predictable and single futures to plausible and multiple alternative futures.

Quantitative modeling can help to generate and explore varied scenarios of the future under conditions of moderate complexity and uncertainty. In this zone, our understanding of relationships is high and assumptions can be analyzed with the help of reliable data. With data, models can be calibrated and simulations and sensitivity analyses can be performed using methodologies such as systems dynamics or integrated assessment models.

Rigorous quantitative models can only be simplified representations of reality but they do enable businesses to explore the consequences of alternative assumptions, pinpoint uncertainties and define probabilities. They can also help

in examining trade-offs, understanding core dynamics and generating new questions and perspectives.

Figure 24 shows a sample of recent quantitative scenario exercises exploring futures for biodiversity loss, climate adaptation costs, energy policy and other sustainability issues.

The usefulness of formal mathematical modeling diminishes as horizons extend further into the future. The future essentially becomes unknowable but not unthinkable. Under these conditions, futurists generally turn to scenario methods based on qualitative story-telling or narratives. These are carefully crafted, plausible and coherent stories about the future which intertwine powerful driving forces, key uncertainties, shocks and transformational dynamics.

Businesses can use these stories to design strategies and take decisions which are robust under a wide range of possibilities. Hundreds of multiple qualitative scenarios have been created and are publicly available. *Figure 25* provides a brief overview of a dozen recent scenarios of value to corporate sustainability strategy. Some are general and useful to all industry sectors; others are of greater use to particular sectors.



Figure 24: Multiple scenarios based on quantitative modeling (For a full list of source documents see Appendix 3).

| Topic: | Author: | Report Date: | Time Horizon: | Key Message: |
|----------------------------|---|--------------|---------------|--|
| Biodiversity | Secretariat of the convention on Biological Diversity | 2010 | 2100 | Tipping points for large, rapid and irreversible loss of biodiversity; high variability in long-term projections |
| Climate adaptation | World Bank | 2010 | 2050 | Adaptation costs huge, especially in East Asia and the Pacific; need for robust strategies given climate uncertainty |
| Climate change | Moss, et. al. | 2010 | 2100 | The next generation of scenarios for climate change research and assessment by the IPCC |
| Energy policy | International Energy Agency | 2011 | 2035 | Without bold policy changes, great risk of “locking” into an insecure, inefficient and high carbon energy system |
| Food system | Foresight UK | 2011 | 2050 | Global food system must be transformed on the scale of the industrial revolution |
| Freshwater | United Nations | 2011/2012 | 2050 | Managing water on a global scale has become extraordinarily uncertain and risky given climate change |
| Green economy | UNEP | 2011 | 2050 | Investing two percent of global GDP into 10 sectors annually could greatly assist the transition to a low-carbon, resource efficient global economy |
| Population | United Nations | 2011 | 2100 | With only a small variation in progress toward lower fertility, world population in 2050 could be 10.6 rather than 9.3 billion |
| Renewable energy | WWF Intl. | 2010 | 2050 | A provocative scenario by which all of the world’s energy supply could be met by renewable energy by 2050 in an effective and cost-efficient manner |
| Resource decoupling | UNEP | 2011 | 2050 | Three scenarios for future global materials use; radical innovations needed to achieve resource and impact decoupling from economic growth and human welfare |

Figure 25: Multiple scenarios based on qualitative narratives (For a full list of source documents see Appendix 3).

| Topic: | Author: | Report Date: | Time Horizon: | Key Message: |
|-------------------------------|---------------------------------|--------------|---------------|--|
| Climate/development | Forum for the Future | 2010 | 2030 | Scenarios for low-income countries in a climate-changing world |
| Climate futures | Forum for the Future | 2008 | 2030 | Strategies that will work in a complex and uncertain world dominated by climate change |
| Global energy | Shell International | 2008/11 | 2050 | World has entered a huge “zone of uncertainty” on the gap between energy demand and supply |
| Global ecosystems | Millennium Ecosystem Assessment | 2005 | 2050 | Pressures on ecosystem services will increase globally with increased risk of nonlinear change |
| Global environment | UNEP | 2007 | 2050 | Risks of crossing thresholds and need to account for inter-linkages |
| Global mega-crisis | Halal/Marien | 2011 | 2033 | Classic debate between a global optimist and pessimist |
| Global pathways | Tellus Institute | 2010 | 2100 | The fundamental forces driving world development away from or towards sustainability |
| Map of the decade | Institute for the Future | 2010 | 2020 | How the near-term will be shaped by discontinuities and dilemmas |
| Urban mobility | Forum for the Future, et.al. | 2010 | 2040 | The future of mega-cities and solutions for urban mobility and accessibility |
| Technology/development | Rockefeller/GBN | 2010 | 2030 | The transformative role of technology in positive and negative ways in shaping resilience and equitable growth |
| Vision 2050 | WBCSD | 2010 | 2050 | Vision of a sustainable world in 2050 with pathways that will require fundamental changes in governance structures, economic frameworks, business and human behavior |
| Water and business | WBCSD | 2006 | 2025 | Three stories about the potential role of business in navigating the rapidly changing world of water |

The qualitative scenarios in *Figure 25* vary according to purpose, time horizon and content. Most of them, however, extend at the extremes from pessimism to optimism about the future. *Figure 26* classifies the scenarios referenced in *Figure 25* according to whether they emphasize collapse, growth, constraint or transformation. These four categories have emerged as the central organizing principles in many recent multiple scenario exercises.

Adding some “color,” the growth scenario could be considered to be brown; it represents conventional business-as-usual dominated by growth ambitions, market logic, complacency and natural system erosion. The world of constraint could be construed as green, implying regulations and reforms aimed at decoupling growth from natural resource consumption and adverse environmental impacts; this is a world of resource substitution, efficiency, conservation and protection. Much sustainability foresight work focuses on the consequences of brown versus green economic futures.

The most negative world of collapse is best captured by the color red and associated images of breakdown, conflict, crises, corruption, suffering, disorder and weak institutions. The most uplifting world of transformation is best contemplated as blue, with associated positive visions of revolutionary transitions toward harmony with nature, social justice, community, innovation and resilience.

These four possibilities for the future are not mutually exclusive. They are likely to mix in a variety of patterns, manifest and shift over time, and differ substantially across regions. Each plausible world is full of different risks and opportunities. Business leaders should ask three tough questions about the emergence of alternative brown, green, red and blue global futures:

- 1) How is our organization contributing, in positive or negative ways, to each of these possible futures?
- 2) Are our current strategies and structures robust to the consequences of these diverse futures?
- 3) Do we have the necessary learning, innovation and risk management capacities in place to navigate these possible futures effectively?

Using scenarios to build resilience is key to business survival in the presence of complexity and uncertainty and helps companies discover strategies for a range of plausible futures. Scenario analysis helps to identify systemic risks that may emerge from the interactions of sustainability megaforges and provides a context for identifying growth opportunities before they become mainstream. It deepens organizational learning by pushing beyond conventional wisdom and shifts thinking from specifics to generalities, and from what we know to what we don't know. A bibliography of scenario sources used to compile this section can be found in Appendix 3.

“ Scenario analysis helps to identify systemic risks that may emerge from the interactions of sustainability megaforges. ”

Figure 26: Scenario themes from qualitative narratives (For a full list of source documents see Appendix 3).

| Brown world: <i>Growth</i> | Blue world: <i>Transformation</i> |
|---|---|
| <ul style="list-style-type: none"> • “Markets First” (UNEP, 2007) • “Market Forces” (Tellus, 2010) • “Muddling Down” (Halal/Marien, 2011) • “Lock-Step” (Rockefeller/GBN, 2010) • “One Step Ahead of Disaster” (IFTF, 2010) • “Global Orchestration” (MEA, 2005) • “Reversal of Fortunes” (FFF, 2010) • “Environmental War Economy” (FFF, 2008) • “Planned-Opopolis” (FFF, 2010) • “Hydro-Efficiency” (WBCSD, 2006) • “Turbulent Teens” (WBCSD, 2010) • “Scramble” (Shell, 2008/11) | <ul style="list-style-type: none"> • “Sustainability First” (UNEP, 2007) • “Great Transitions” (Tellus, 2010) • “Rise to Maturity” (Halal/Marien, 2011) • “Clever Together” (Rockefeller/GBN, 2010) • “Super-Structured Systems” (IFTF, 2010) • “Adapting Mosaic” (MEA, 2005) • “The Greater Good” (FFF, 2010) • “Redefining Progress” (FFF, 2008) • “Communi-City” (FFF, 2010) • “Ocean: Interconnectivity” (WBCSD, 2006) • “Transformation Time” (WBCSD, 2010) |
| Red world: <i>Collapse</i> | Green world: <i>Constraint</i> |
| <ul style="list-style-type: none"> • “Security First” (UNEP, 2007) • “Fortress World” (Tellus, 2010) • “Decline to Disaster” (Halal/Marien, 2011) • “Hack Attack” (Rockefeller/GBN, 2010) • “Local Disasters/Regional Conflicts” (IFTF, 2010) • “Order From Strength” (MEA, 2005) • “Coping Alone” (FFF, 2010) • “Protectionist World” (FFF, 2008) • “Sprawl-Ville” (FFF, 2010) | <ul style="list-style-type: none"> • “Policy First” (UNEP, 2007) • “Policy Reform” (Tellus, 2010) • “Muddling Up” (Halal/Marien, 2011) • “Smart Scramble” (Rockefeller/GBN, 2010) • “Sustainable Paths” (IFTF, 2010) • “Techno-Garden” (MEA, 2005) • “Age of Opportunity” (FFF, 2010) • “Efficiency First/Service Transform” (FFF, 2008) • “Renew-Abad” (FFF, 2010) • “Rivers: Security” (WBCSD, 2006) • “Blueprints” (Shell, 2008/11) |



Global Sustainability megaforces: **A sectoral view**

“The environmental costs of business operations are rising rapidly.”

Introduction

This section of the report explores which parts of the economy and, specifically, which industry sectors face the greatest risks from global sustainability megaforces and have the potential to harness the greatest opportunities.

There follows both a quantitative and qualitative review of the business risks and opportunities facing 11 key sectors of the economy defined in line with the Industry Classification Benchmark (ICB) system:¹

- Airlines
- Automobiles
- Beverages
- Chemicals
- Electricity
- Food Producers
- Industrial Metals & Mining
- Mining
- Marine Transportation
- Oil & Gas
- Telecommunications & Internet.

¹ For full sector definitions see Appendix 1



Quantitative Review

For the purposes of this report, Trucost, an independent environmental research agency, has provided a data set based on the operations of over 800 companies between 2002 and 2010 (2010 being the most recent available data) and representing the 11 key business sectors listed above.²

Trucost's data uses a pricing methodology that calculates the cost to global society of environmentally-sensitive corporate activities. In this analysis, Trucost converts 22 key environmental impacts into financial value, drawing upon current environmental-economic research. They include: greenhouse gases (carbon dioxide, HFCs, nitrous oxide, methane, perfluorocarbons, sulphur hexafluoride), water abstraction and waste generation. Together, these indicators represent the bulk of the environmental footprint for most companies.

The conversion of environmental impacts into dollar sums of external environmental cost is a relatively new practice, but one that is gaining momentum. Some companies are now developing environmental profit and loss accounts based on this type of data, arguing that businesses will be most motivated to act on sustainability when

the costs of environmental and social impacts can be shown on financial statements.

That said, the data is not yet 100 percent exact and for this reason the analyses in this section of the report should not be taken as absolute, but rather as an indicator of growth in environmental footprints relative to earnings; potential vulnerability to environmental cost; and progress in reducing environmental intensity.

Qualitative Review

A meta-review has been conducted of more than 60 sector reports addressing the business risks and opportunities of the ten global sustainability megaforges. The reports come from a broad spectrum of sources, representing the views of a wide range of organizations such as investment banks, business associations, (re)insurance companies, consultancies, rating agencies and intergovernmental organizations. The reports were selected for review based on desk research in consultation with KPMG consultants and academics familiar with the literature.

The reports were analyzed against sustainability risk types and sector readiness. The selected list of reports

“Businesses will be most motivated to act on sustainability when the costs of environmental and social impacts can be shown on financial statements.”

² For more information on the data used and the methodology see Appendix 1

“ Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices. ”

is not exhaustive, but constitutes an informed selection and provides a fair representation of the dominant views on sustainability related business risks.

The main research findings are presented below.

Costs of environmental impact doubling every 14 years

The environmental costs of business operations are rising rapidly. The Trucost data indicates that environmental costs across the 11 sectors listed above rose by 50 percent between 2002 and 2010, from US\$566 billion to US\$854 billion.³

The fact that the environmental impacts of businesses in these sectors are intensifying is not surprising. Business both contributes to and is exposed to the sustainability megafactors identified in Part 1 of this report. Forces such as Population Growth, Urbanization, Wealth and Material Resource Scarcity are being driven by the expansion of economies, especially emerging economies. In turn, the growth of business activity contributes to Climate Change, Deforestation and the Decline of Ecosystems.

The data suggests the environmental costs of the sectors studied in this report are currently doubling every 14 years:⁴ a rate that is unlikely to be sustainable even in the medium-term.

These are the costs that a business incurs but either does not pay for (yet) or pays only part of. They include both the direct environmental costs of the production process and indirect upstream costs such as the energy, water and materials used by suppliers.

There is likely to be increasing pressure over the next 20 years for the price of

resources, products and services to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

It is therefore prudent for companies to expect to pay in the future a rising proportion of what today are mostly ‘off balance sheet’ costs. These external environmental costs could therefore represent near-future financial risks for companies.

Value at Stake: Sectors could see profits lost

The Trucost data indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake.

Figure 27 reflects earnings (EBITDA) against external environmental costs for each of the 11 sectors in 2010, and the percentage of these earnings that would be lost if companies had to pay for the full environmental costs of their production. Across these sectors, the average environmental cost per US dollar of earnings would have been approximately US41 cents in 2010.⁵

According to the data, Food Production had the largest environmental cost footprint of the 11 sectors in 2010 at US\$200 billion, followed by Electricity at US\$195 billion and Oil & Gas at US\$152 billion.⁶

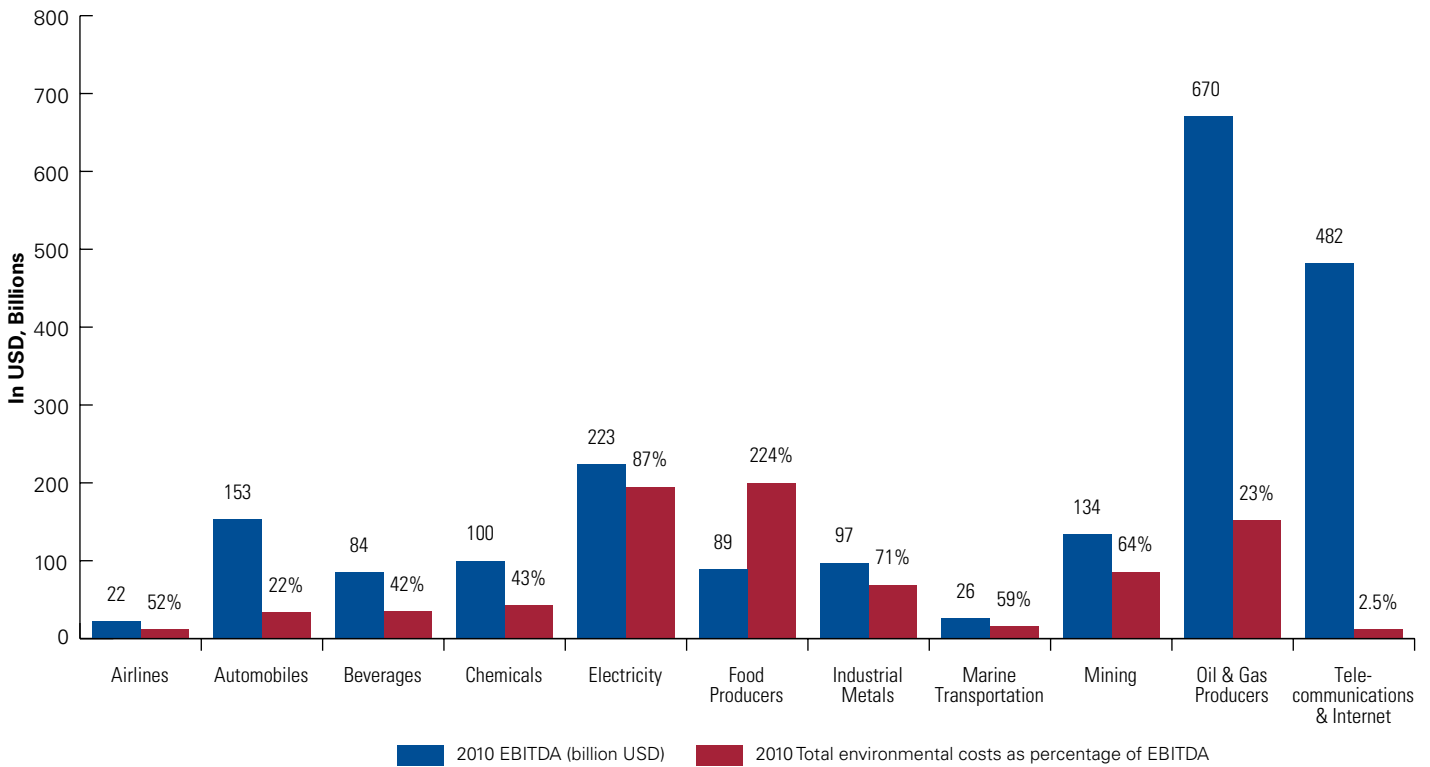
³ Trucost, 2012

⁴ Ibid

⁵ Ibid

⁶ Ibid

Figure 27: 2010 EBITDA vs external environmental costs



Source: Trucost 2012

As noted in *Figure 27* above, the environmental costs of the Food Producers sector could outweigh their entire earnings. For five other sectors – Electricity, Industrial Metals, Mining, Marine Transport, and Airlines – environmental costs could account for more than half their earnings.

In reality these costs would be passed on – at least in part – to end users rather than being borne by the producers alone. However the data gives an indication of the environmental impact of sectors and the potentially value at stake.

Exposure reduced, but driven mostly by rise in earnings

While the Trucost data suggests that industry earnings could be highly exposed to environmental costs, the 2010 figures in fact represent a reduction in the level of exposure over the last eight years. In 2002, the estimated costs of the same environmental impacts would have accounted for over 91 cents in every dollar of EBITDA across the sectors studied (compared with 41 cents in 2010).⁷

“The 2010 figures represent a reduction in the level of exposure over the last eight years.”

⁷ Trucost, 2012

“This reduction in exposure is for the most part driven by rapid growth in earnings rather than a reduction in or slowing of growth in environmental impacts.”

The greatest reductions in earnings exposure to environmental cost were seen in the Industrial Metals sector, followed by Marine Transportation, Mining and Electricity. This reduction in exposure is for the most part driven by rapid growth in earnings rather than a reduction in or slowing of growth in environmental impacts.

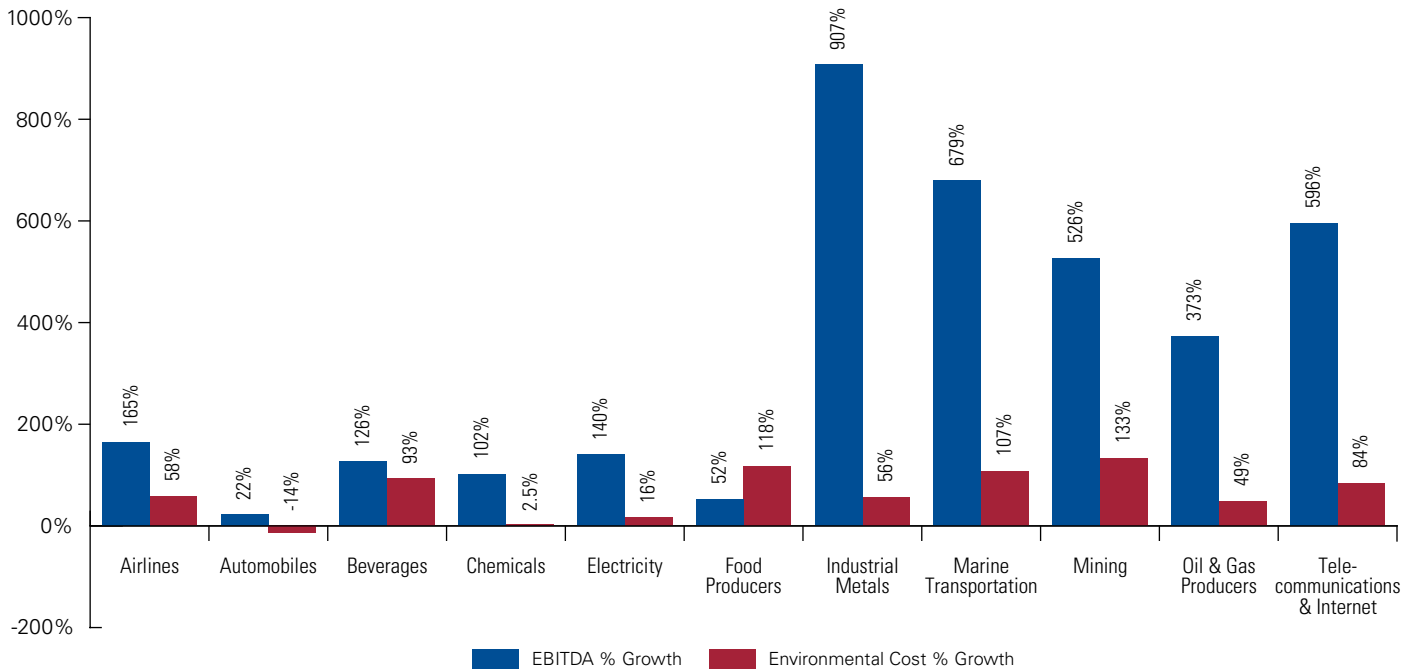
Environmental costs grew the most in the Food Producers, Mining and Marine Transportation sector, more than doubling in all three sectors between 2002 and 2010. In the cases of Mining and Marine Transportation this increase was far outpaced by growth in earnings which increased by 526 percent and 675 percent respectively, driven largely by Chinese and Indian demand for

resources, increased global trade and the growth of multi-continent supply chains.

Food Producers, in contrast, saw growth in environmental costs outstrip earnings growth.⁸

The only sector of the 11 to demonstrate a reduction in its external environmental costs over the eight year period was Automobiles, which witnessed a drop of 14 percent against an earnings increase of 22 percent over the period. Chemicals recorded a minimal rise in environmental costs of 2.5 percent against an earnings increase of 102 percent. Electricity was the third lowest in terms of growth in environmental costs over the period, with an increase of 16 percent compared with earnings growth of 140 percent.⁹

Figure 28: Growth in EBITDA vs growth in external environmental costs, 2002–2010



Source: Trucost 2012

⁸ Ibid

⁹ Ibid

Environmental Intensity: A clearer picture

A clearer picture can be gained by exploring how the “environmental intensity” of each sector has changed compared with changes in their environmental impacts.

Environmental intensity is defined here as the external environmental cost incurred per dollar of earnings (EBITDA).

As indicated in *Figure 29*, the size of the bubbles indicates the current (2010)

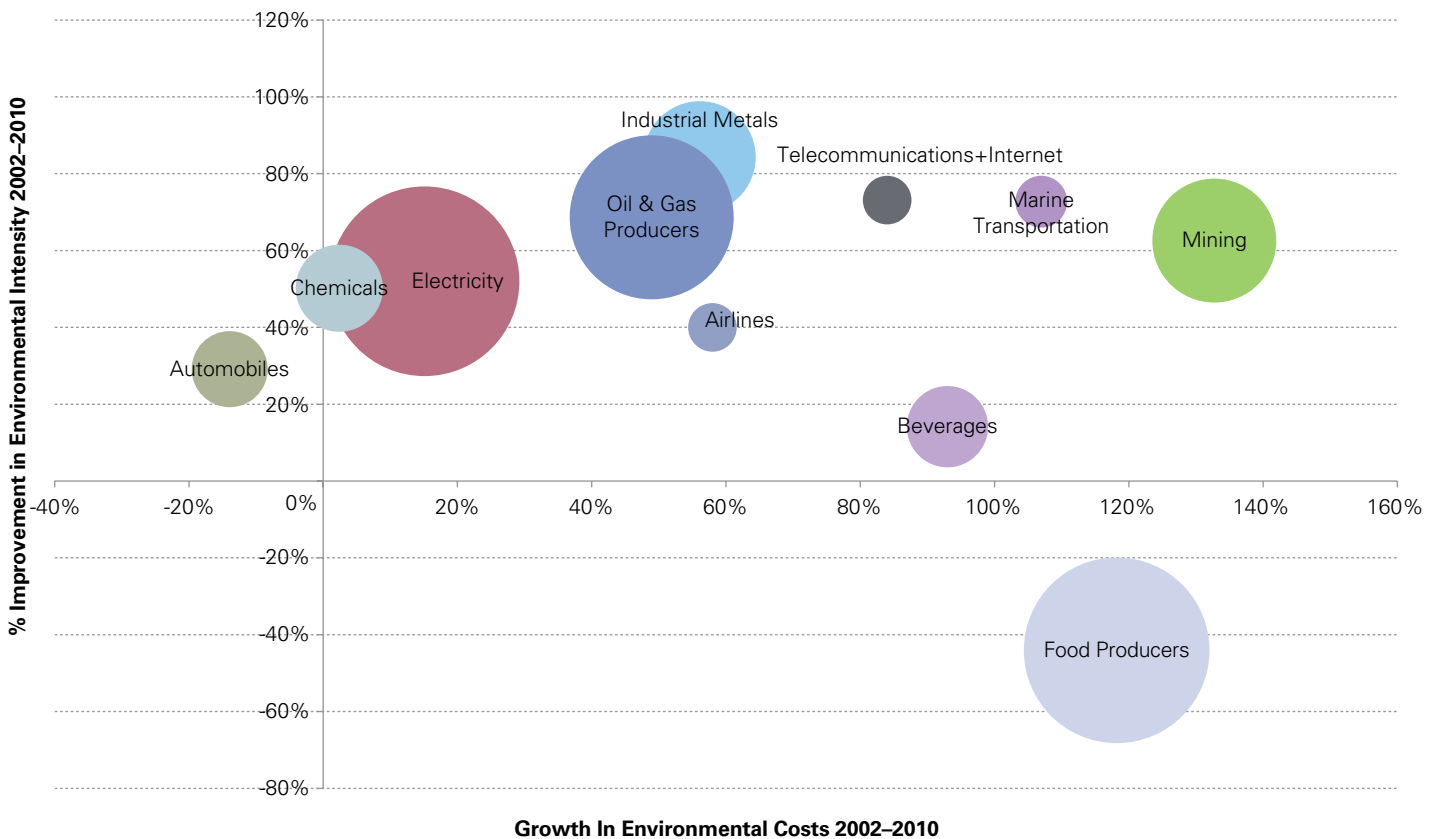
external environmental cost incurred by each sector, according to the Trucost data. The position on the chart indicates how much the environmental costs have grown over the eight years to 2010, as well as the change in the sector’s environmental intensity.

The chart – which should be taken as indicative rather than comprehensive – suggests that over this period Industrial Metals has achieved the greatest improvement of the 11 sectors in terms of its environmental intensity.

“ Electricity was the third lowest in terms of growth in environmental costs. ”

Figure 29: Total environmental cost 2010 vs growth in environmental cost since 2002 vs environmental intensity improvement

Size of circle indicates the sector’s total external environmental costs in 2010 in USD



Source: Trucost 2012

“It is likely that over the next 20 years businesses will be required to shoulder more of the financial costs of their environmental impacts.”

However, the sector’s significant growth in earnings over the period have helped it to gain this position on the chart. Its environmental costs are still large and continue to grow, although at a slower pace than sectors such as Mining, Food Producers and Marine Transportation.

Mining has also achieved significant improvement in its environmental intensity but has at the same time has recorded the largest increase in external environmental costs, indicating that its environmental intensity improvement is also due in large part to its growth in earnings.

A cluster of sectors – Automobiles, Chemicals and Electricity – have improved their environmental intensity while also achieving negative or low growth in the environmental costs they incur. This suggests that of the 11 sectors studied in this report, these three sectors are coming the closest to decoupling their economic growth from environmental impact.

The data indicates that Food Producers and Beverages have the lowest rates of improvement in environmental intensity with Food Producers the only sector that has become more environmentally intensive over the last eight years. The sector’s environmental costs are very high and growing rapidly, driven in part by increasing demand from the growing global middle class for resource intensive food products such as meat and dairy.

It is likely that over the next 20 years businesses will be required to shoulder more of the financial costs of their environmental impacts. If this proves to be the case, there are major challenges

and costs ahead for Food Producers. If producers pass these costs on to consumers, food price rises would result, exacerbating the sharp upward trend of recent years.

Many factors will affect the ongoing environmental intensity of all sectors including the continuing aftermath of the world financial crisis of 2008, the rate of economic growth in emerging economies, the environmental impacts of that growth and the strategies employed by business to reduce or reverse environmental impact.

Qualitative Review: Risks and readiness

The Trucost data in the previous section of this report indicated that a large proportion of earnings could be lost in most industry sectors, if companies had to pay for the full costs of their environmental impacts. It demonstrates how global sustainability megafactors could put company value at risk and emphasizes the importance for business of putting appropriate risk management strategies in place.

In this section, we explore a wider range of risks posed by the sustainability megafactors and ask how prepared sectors are to manage them. These risks are:

Physical Risks: the risk of damage to physical assets and supply chains from climate change-related weather events such as more severe storms and floods, strong winds and heat waves. This category of risk also includes exposure to long-term environmental trends, such as variations in water availability,

rising sea levels, or higher-risk extraction and recovery processes for scarce resources.

Competitive Risks: the risk of exposure to significant cost increases or cost volatility of key input commodities such as energy, fuel, water and agricultural products. This category of risk also includes exposure to shifts in market dynamics, such as a decline in demand for resource-intensive products and services driven by changing consumer preferences and/or legislation.

Regulatory Risks: the risk of increased costs and complexity for business from policies and regulations designed to limit the long-term effects of sustainability megaforges and encourage sustainable business operation. Examples include carbon taxes, emissions trading systems and fuel tariffs. In the absence of a global binding treaty on climate change, a patchwork of legislation is emerging on a municipal, national and regional level.

Reputational Risks: the risk of damage to corporate reputation and brand value among stakeholders such as consumers, investors, policymakers, employees and the media. Such damage can be caused when a company is perceived as failing to act appropriately in response to sustainability challenges. The Oil & Gas sector, for example, suffered reputational damage from the 2010 Gulf of Mexico oil spill.

Litigation Risks: the risk of litigation over environmental damage from accidents, spills and emissions or violations of sustainability-related legislation. This category also includes the risk of litigation over insufficient

corporate disclosure, as industry and financial regulators come under increasing pressure to strengthen and uphold sustainability transparency standards. Officers and directors could also be held to legal account for the impact of sustainability megaforges on shareholder value.

Social Risks: the risk of serious disruption to business operations and supply chains due to the societal effects of sustainability megaforges. Examples include mass migration as “climate refugees” try to escape the worst impacts of climate change; increasing incidence of conflicts over scarce resources such as water; and civil unrest driven by population growth and wealth inequality.

The level of risk has been assessed through a review of over 60 recent sector reports published by KPMG International, analysts, third party commentators and industry organizations. The level of references to the six risks outlined above were recorded and aggregated to provide an overall score of perceived sectoral risk and readiness.¹⁰

The level of sector readiness has also been assessed by the results of the KPMG International Corporate Responsibility Reporting Survey 2011.¹¹ Corporate responsibility reporting patterns – particularly the issues that companies report on and how – are one indication of the extent to which they have recognized and prepared for sustainability risks.

Given the methodology used, the findings of the risk and readiness assessment that follows here should

“We explore a wider range of risks posed by the sustainability megaforges and ask how prepared businesses are to manage them.”

¹⁰ This approach was pioneered in KPMG International’s 2008 report *Climate Changes Your Business*. Methodology can be found in Appendix 1 of this report.

¹¹ *KPMG International Survey of Corporate Responsibility Reporting*, 2011

“The level of sector readiness has also been assessed by the results of the KPMG International Corporate Responsibility Reporting Survey.”

be taken as indicative not absolute; risk exposure and readiness levels are perceived, not actual. Our intention here is to provide a relative indicator across sectors.

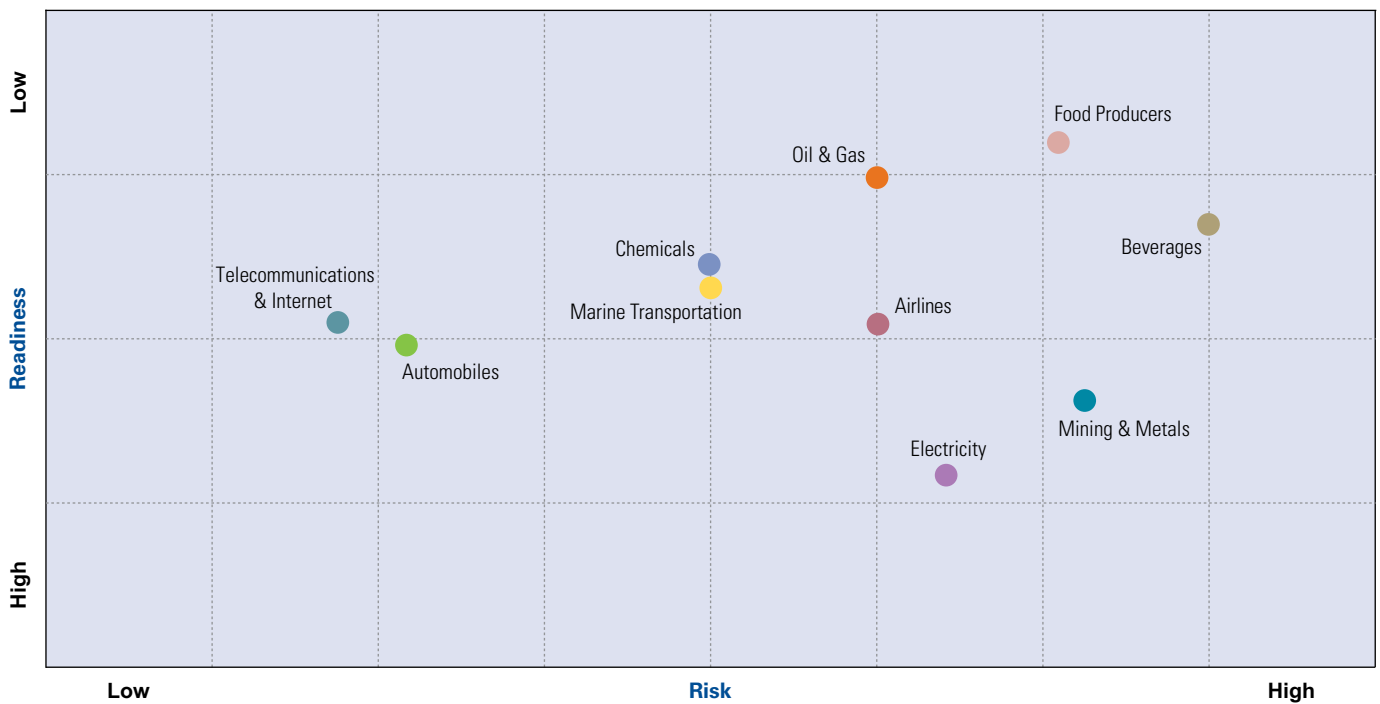
In *Figure 30* the horizontal axis represents the level of sustainability risk each sector faces while the vertical axis represents its level of readiness to manage those risks.

The two sectors perceived as being at highest risk from sustainability

megaforces, but least ready are Food Producers and Beverages. This supports the findings of the Environmental Intensity analysis which shows they have made the least progress in reducing their environmental intensity while their exposure to environmental cost is growing rapidly.

In a previous KPMG International study in 2008,¹² it was noted that strikingly little had been written about the consequences of climate change to the Food and Beverages sectors and that risk

Figure 30: Risk and readiness matrix



Source: KPMG International analysis, 2012

¹² KPMG International (2008). *Climate Changes Your Business*

levels were underestimated or under-reported. The risk/readiness review in this new report suggests growing market awareness of the sectors' vulnerability to sustainability megaforges such as Climate Change, Water Scarcity and Ecosystem Decline. The relatively low level of perceived readiness indicates also that the sector is not yet seen as having the governance or strategies in place to deal with the effects of these forces.

The Automobiles and Telecommunications & Internet sectors are, in contrast, perceived as being the least at risk and the most ready. This suggests awareness of the automotive industry's significant moves to comply with and anticipate emissions-reduction legislation and its drive to innovate lower-emission products. It is noteworthy that, although emissions from the Telecommunications & Internet sector are rising fast, its low risk rating may also be affected by perceptions that it stands to gain from the impacts of sustainability megaforges as a provider of technological solutions.

The cluster of sectors in the center of the matrix indicates that perceived sustainability risk remains high for sectors seen to have a high environmental impact such as Oil & Gas, Electricity, Mining & Metals and Airlines.

One of the surprises from this meta-review of third party analyses is that the level of readiness of sustainability risk from the Chemicals sector is not seen as higher. As noted in the previous analysis of the Environmental

Intensity, the sector has recorded minimal growth in its environmental costs over the last eight years despite significant increases in earnings. It has made significant progress in reducing greenhouse gas emissions, but as one of the most energy and water intensive industries it is still vulnerable to regulations limiting GHG emissions and water use.

Summary

The Trucost data indicates that the environmental footprint of the 11 industry sectors studied in this report is large and growing at an unsustainable rate of over 50 percent per decade. If these industry sectors were required to internalize their environmental impacts, earnings could be cut by over 40 percent. Pressure to do so is likely to increase as resources become more stressed.

Several sectors have made significant strides toward improving their environmental intensity and reducing the exposure of their earnings to environmental costs.

Some sectors traditionally associated with large environmental footprints, such as Chemicals and Automotive, have been the most successful in reducing environmental intensity. In contrast, the one sector whose environmental intensity has increased over the past decade is Food Producers.

“It has made significant progress in reducing greenhouse gas emissions, but as one of the most energy and water intensive industries and is still vulnerable to regulations limiting GHG emissions and water use.”

“Leading companies have well-developed internal systems for improving their environmental intensity and are investing into innovation.”

The 11 sectors can be grouped into four main categories:

High-Impact Industrials: One group – Oil and Gas, Electricity, Mining and Industrial Metals – has some of the largest environmental footprints of all sectors and faces significant risks, but is already developing processes for addressing these risks. These sectors are highly visible because of their large environmental footprints and have long faced social and regulatory pressure to reduce their impacts. Leading companies in these sectors have well-developed internal systems for improving their environmental intensity and are investing into innovation.

Technology Dependents:

A second group – Airlines and Marine Transportation – faces rapidly growing demand from emerging markets which is causing their footprints to grow. They depend heavily on investments in new technology to make major improvements, leaving them vulnerable to surprise changes in the effects of sustainability megaforges.

Solution Providers: The third group – Automobiles, Chemicals, and Telecommunications & Internet – appears well positioned to respond to the opportunities ahead. The economic challenges faced by the Automobile

sector in recent years have left it leaner and meaner, with relatively clear pathways forward as hybrid and electric vehicles gain traction. The Chemicals industry has made progress in cutting the growth of its environmental footprint, and sees many opportunities for greener products that in turn help their clients to lower their own environmental footprints. Telecommunications & Internet is arguably set for the greatest upside potential, with many opportunities to substitute information services for existing models of business.

Up-Hill Climbers: Food Producers and Beverages – are facing significant risks and have much work ahead to prepare for the challenges of the next two decades. These sectors have large and rapidly increasing footprints and are facing difficulties in managing them. Reducing their impacts together with their reliance on key resource inputs such as petrochemicals and water will be crucial for these sectors.

The next section of the report presents a deeper dive into the risks and opportunities facing each sector. In each case, we emphasize how sustainability megaforges affect the sector, the risks and opportunities ahead and the sector’s readiness to respond to them.



Airlines

Proactive and responsive – but margins make for vulnerability

Today's Airline sector is under unrelenting pressure from volatile fuel prices and competition; in recent years the industry has seen extensive consolidation as companies within the sector strive to become more resilient to both fuel price shocks and underlying economic uncertainty. Margins in the airline industry are thin and are highly susceptible to even minor fluctuations in costs.

Exposure to Global Sustainability Megaforces

Highly exposed to: Climate Change; Energy & Fuel; Population Growth; Wealth and Urbanization

Potentially exposed to: Food Security and Deforestation

Airlines' environmental impact: Driven by higher passenger and cargo demand

There is likely to be increasing pressure over the next 20 years for the price of

resources, products and services to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake. In the case of the Airlines sector, their data suggests that the environmental impact in 2010 amounted to US\$11.6 billion and would account for 52 percent of sector earnings.¹

These figures are hypothetical in that they assume business may in the future be required to bear the full

“ Margins in the Airline industry are thin and highly susceptible to even minor fluctuations in costs. ”

¹ Trucost, 2012. See Appendix 1 for methodology

“The sector has reduced its carbon intensity over the last decade primarily through more fuel-efficient “next generation” aircraft.”

environmental costs of their operations, but by making this assumption they provide an indication of the potential value at stake. In reality it is likely that such costs would be passed on – at least in part - to end users rather than being borne by the airlines alone.

***Trends, risks and opportunities:
Carbon reduction legislation set to become a reality***

The airline industry emitted 649 million metric tons of CO₂ in 2010 – representing approximately 2 percent of global emissions² – and the business is widely perceived as a high emitter of greenhouse gases. This portrayal is likely to continue but given the importance of air transport it is unlikely to result in either a drop in demand from consumers or government actions to constrain industry growth.

The International Air Transport Association (IATA) has committed to making the industry carbon-growth neutral by 2020 and to halving net emissions by 2050 from a 2005 baseline.³

The sector has reduced its carbon intensity over the last decade primarily through more fuel-efficient “next generation” aircraft that are estimated to have reduced the sector’s emissions by over 3 billion metric tons since 1990 compared with a business-as-usual trajectory. According to aviation trade body IATA, air transport has reduced its CO₂ emissions per passenger kilometer by 70 percent compared to the 1970s. However, the growth in demand for air travel is exceeding the gains in

efficiency. In 2010 emissions grew by 3.5 percent compared with a 1.5 percent annual increase in efficiency.⁴

The major climate change-related risk for the airline industry over the next 20 years is likely to be its exposure to increased operating costs from carbon reduction legislation such as emissions trading systems and carbon taxes.

From 1 January 2012, all airlines flying to, from and within Europe were due to be included in the EU Emissions Trading System (ETS) and required to purchase allowances for their carbon emissions.

A report by the UK’s Carbon Trust suggests that this could add up to US\$45 billion in costs if carbon is priced at US\$33 per metric ton. Profitability on the more price-elastic short haul routes is likely to be more impacted than on long haul; the most fuel-efficient airlines could see the ETS increase their profitability by up to 40 percent compared with average performers.⁵

While this legislation is being challenged by some airlines it is unlikely that the industry will secure an indefinite exemption from either the EU system or from other cap-and-trade systems that are likely to be developed in other markets in coming years.

Airlines are also susceptible to weather-related natural disasters, the effects of which are likely to increase due to climate change, according to scientists. For example, the Intergovernmental Panel on Climate Change has reported that the average wind speed of tropical cyclones is likely to increase.⁶

² <http://data.worldbank.org/sites/default/files/section3.pdf> – Page 184: World emitted 30154.7 million tons of CO₂ in 2010

³ IATA International Air Transport Association (IATA) (2011). *Aviation and Environment*. AGM Singapore, 7 June 2011. IATA, Geneva.

⁴ IATA Facts and Figures (December 2011) – Industry Statistics

⁵ Carbon Trust. (2009). *Fasten your seat belt*. London.

⁶ IPCC. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. (2011)

The sector also faces energy and fuel volatility risks

The cost structure of airlines is heavily dependent on the price of oil. For example, it is estimated that a US 1 cent increase in the price of a barrel of jet fuel adds approximately US\$200 million to worldwide airline fuel bills. Fuel costs absorbed 36 percent of revenues of US airlines in 2008, a year with a sharp spike in oil prices, whereas in 2011 fuel accounted for only 24 percent of revenues according to Standard & Poors estimates.⁷

Airlines are seeking to insulate themselves from the impact of volatile oil prices by upgrading their fleets to more energy efficient airplanes and retrofitting existing aircraft with lighter-weight cabin fittings and aerodynamic improvements. Boeing has forecast a US\$4 trillion market for new aircraft over the 20 years to 2030, predicting that 94 percent of the European fleet operating in 2030 will have been delivered after 2011.⁸

Several airlines have also started to explore the use of alternative fuel programs. Continental Airlines, KLM, Virgin Atlantic, Air New Zealand and Japan Airlines are among those that have piloted biofuel airplane programs and the EU has set a target that requires 10 percent of transport fuels to be sourced from biofuels by 2020.

Improvements in air traffic control systems such as continuous descent profiles, performance-based navigation and the opening up of more airways also offer fuel economy benefits. For example, the US Federal Aviation Administration's NextGen ATC upgrade is predicted to save US\$3.82 billion in fuel costs and reduce 14.3 metric tons of CO₂ emissions a year. Europe's proposed new Single European Sky (SESAR) system could reduce CO₂ emissions from aviation in the EU by 10 percent by 2020.⁹

Preparing for a carbon constrained world

Most major airlines are preparing for inclusion in the EU ETS by improving their monitoring, reporting and verification (MRV) systems. There has also been a significant increase in public reporting of sustainability performance by airlines (see section below). Some airlines have been involved in carbon market mechanisms such as the Clean Development Mechanism (which generates carbon credits through implementation of emissions reduction initiatives in developing countries) and Joint Implementation (which generates carbon credits through similar initiatives in countries that already have carbon reduction requirements) for some time.

“Most major airlines are preparing for inclusion in the EU ETS by improving their monitoring, reporting and verification (MRV) systems.”

⁷ Corridore, J. (2011). *Industry Surveys: Airlines*. Standard & Poors, New York.

⁸ Boeing Commercial Airplanes. (2011). *Current Market Outlook 2011–2030*.

⁹ SESAR. (n.d.). *Environment & SESAR*. Retrieved December 28, 2011, from SESAR:<http://www.sesarju.eu/environment/sesar>

“An industry-wide move towards biofuels may strain the current food supply ecosphere.”

The inclusion of airlines within the EU ETS – although controversial and vigorously opposed by some – is likely to presage a move worldwide to bring the sector within the bounds of carbon legislation. With further carbon-limiting legislation being developed in other parts of the world including China, Australia, Korea and South Africa, it is unlikely that the sector will succeed in remaining exempt forever.

The industry has recognized that it is in its interest to have a level worldwide playing field rather than coping with the complexity of dealing with a patchwork of carbon legislation in different markets. It is seeking negotiations between the International Civil Aviation Organization (ICAO) and governments to achieve a global framework of carbon legislation for airlines. But in the absence of a global approach airlines may need to deal with the complexity of emerging links between individual, national or regional carbon regimes.

While biofuel has the potential significantly to reduce the industry’s carbon emissions, its availability is limited and its cost is high. Moreover, an industry-wide move towards biofuels may strain the current food supply ecosphere by competing with traditional food crops for farmland. Deforestation may also emerge as a result of encroachment on woodlands and rainforests. However, the long-term

implications of more intensive biofuel use have yet to be quantified in detail.

In coping with fuel costs, airlines with the youngest fleets are often the best prepared. Many of the world’s newest airlines and fleets are in Asia; North American airlines have lagged but have been obliged to demonstrate a commitment towards fleet renewal. European legacy airlines occupy a middle ground: their fleets are somewhat younger than those of their North American rivals, although the troubled languishing eurozone economy may impact their ability to finance expensive large-scale fleet renewals.

The Airlines sector faces population growth, wealth and urbanization risks

By 2032 some 58 percent of the world’s population is predicted to be in Asia.¹⁰ This, combined with the rapid emergence of middle classes in emerging economies such as China, is likely to see an eastward shift for the airline business. Routes between the US, Canada, Western Europe and Japan comprised 75 percent of all worldwide air travel in the 1970s, but account for only 57 percent today and are predicted to drop to just 30 percent by 2032.¹¹

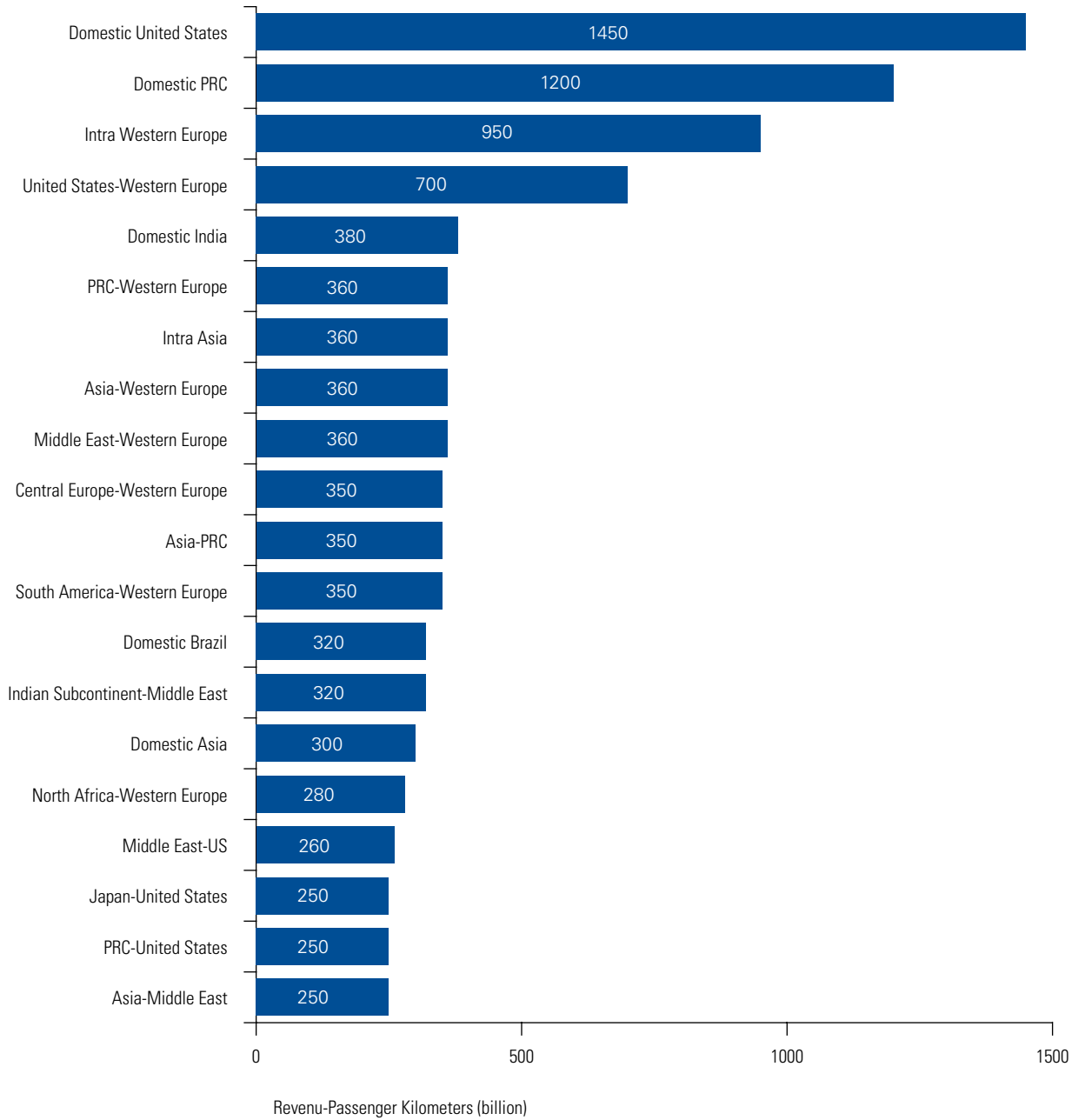
Domestic air travel in China and India is expected to grow dramatically over the next 20 years with the level of domestic air traffic in China coming close to that of the US by 2030 (*Figure 31*).¹²

¹⁰ Airbus. (2011). *Delivering the Future*. Airbus, Toulouse.

¹¹ Ibid

¹² Ibid

Figure 31: Airline traffic flows in 2030



Source: AIRBUS S.A.S. (2011). Delivering the Future: Global Market Forecast 2011-2030.

“Emerging markets which generally have a larger percentage of smaller, regional airlines thus lag far behind the traditional leaders in CR reporting.”

This growth is likely to strain the capacity of airports and increase air traffic congestion.

If there is continued congestion in worldwide air traffic, governments may opt to implement measures to manage demand such as restrictions or demand-based pricing on flights during peak hours, as busy airports such as London-Heathrow do at present.

Reporting and disclosure: Clear differences by size and region

The depth of sustainability reporting in the Airline sector varies widely across markets and by the size of company, according to research undertaken for 2011 KPMG International Survey of Sustainability Reporting which analyzed over 3000 reports from the largest companies in 34 countries.

Airlines in Western Europe and North America have an impressive reporting rate of 86 percent, however, companies in the emerging economies of Eastern Europe and Asia Pacific have reporting levels of only 29 percent and 50 percent, respectively, dragging the sector-wide average down to 52 percent. This is the lowest sector sustainability reporting rate of all 11 sectors included in this study. Upon closer inspection, the regional performance seems to be highly influenced by the size of companies.

Major airlines (with revenues above US\$ 5 billion) seem to perform well (94 percent) irrespective of their geographic location. However, smaller airlines (revenues below US\$5 billion), with an average reporting rate of 34 percent, are far less likely to report on their corporate responsibility (CR) activities. Emerging markets which generally have a larger percentage of smaller, regional airlines thus lag far behind the traditional leaders in CR reporting. Fuller CR reporting could help the fast growing regional airlines in Asia to understand better their own exposure to sustainability megafactors and be prepared to tackle those challenges using the experience of the larger companies.

Survey results indicate that the larger airlines are increasingly recognizing sustainability reporting as a business imperative. Close to 40 percent of reporters demonstrated financial gains of their CR initiatives (third highest among the 11 sectors) and a majority of airlines are using sustainability disclosure as a means to strengthen their reputations and relationships with their customers. Although the sector received a slightly below average score for communication and process maturity in our study, with most airlines gearing up to face the carbon legislative requirements the quality of disclosure is expected to improve significantly over the coming years.

Summary: Collaboration is key

Airlines form a crucial link in today's connected global marketplace. However, the industry is not immune to the increasing importance of acknowledging and dealing with its environmental impact. While only 2 percent of global emissions are airline-derived at present, that proportion is likely to grow as populations expand and grow more affluent in emerging economies.

Yet the Airline industry operates with very slim margins and cannot be taxed excessively without significant business impact, as evidenced by the unsuccessful Dutch air transport passenger levy where new tax revenue was offset by loss to the national economy due to a fall in passenger numbers.

The industry itself has been active in undertaking investments in new aircraft, airframe retrofits and lighter interiors. New aircraft promise double-digit percentage fuel savings over current-

generation aircraft, and airlines have been quick to realize that these operational cost savings also have knock-on environmental benefits. However, a comprehensive approach involving all stakeholders is needed to provide a sustainable roadmap for the future.

To stabilize and eventually reduce environmental impact, airlines must work collaboratively with administrative and regulatory bodies to ensure efficiency; bio-fuel must be produced in a sustainable manner at a price-point that allows for large-scale adoption by airlines; and national and regional emissions trading initiatives need to be implemented in a manner that does not unfairly penalize.

While it is unrealistic to think that the Airline sector can eliminate its environmental impact, it could provide an example of how an industry as a whole takes a pragmatic approach to the issues of climate change and sustainable growth.

“New aircraft promise double-digit percentage fuel savings over current-generation aircraft.”





Automobiles

A critical industry: in transition from vehicles to mobility

After the 2008 financial crisis that was nearly fatal to several large carmakers, the global Automobile sector has rebounded. Yet the economic environment remains uncertain and the industry remains under regulatory and consumer pressure for rapid change to a more sustainable pattern of operation.

The major climate change-related risk for the industry is the potential to be exposed to carbon reduction legislation such as carbon taxes or emissions trading systems which would result in corresponding increases in operating costs. High oil prices continue to affect consumer behavior, and concerns about climate change and reliance on oil are likely to increasingly shape policy.

Exposure to Global Sustainability Megaforces

Highly exposed to: Climate Change; Energy & Fuel; Population Growth; Wealth; Urbanization; Material Resource Scarcity; Water Scarcity

Potentially exposed to: Food Security; Ecosystem Decline

Automobiles environmental impact: Only sector to reduce impact

There is likely to be increasing pressure over the next 20 years for the price of resources, products and services to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake.

“High oil prices continue to affect consumer behavior.”

In the case of the Automobiles sector, their data suggests that the environmental impact in 2010 totalled US\$33.7 billion and would account for 22 percent of sector earnings.¹

These figures are hypothetical in that they assume business may in the future be required to bear the full environmental costs of their operations, but by making this assumption they provide an indication of the potential value at stake. In reality it is likely that such costs would be passed on – at least in part – to end users rather than being borne by the manufacturers alone.

**Trends, risks and opportunities:
Regulatory and consumer pressures set to grow**

In 2050 global passenger mobility (passenger kilometers travelled) is predicted by the OECD to be three to four times the level it was in 2000, fueled mainly by demand from non-OECD countries. CO₂ emissions are expected to rise less than mobility because of the increasing fuel efficiency of vehicles. However, average fleet fuel economy will have to improve significantly from around 8 liters/100km in 2008 to less than 4 liters/100km in 2050 for emissions from cars and light trucks to remain at the 2010 level, implying further intensive investment in efficiency gains and emissions reductions.²

The automotive sector is under constant pressure to reduce further the impact of the emissions of not only its vehicles but also its manufacturing processes. Companies have invested significantly in lowering the carbon footprints of automobiles over the last decade through innovations in alternative fuels and cleaner technology, with hybrid electric

vehicles (HEVs) and electric vehicles (EVs) surfacing as the leaders. There has also been progress in designing more efficient engines and new car body shapes that reduce wind drag, reducing friction in moving parts such as the drivetrain, and in using lighter materials to decrease the weight of cars and thereby increase fuel efficiency.

However, governments are enacting stricter CO₂ emissions guidelines and introducing market incentives for alternative fuel vehicles. European automakers will be required to reduce fleet-average emissions to 130g/km between 2012 and 2015 and the US and Canada will require cars to average 35.5 mpg by 2016. As KPMG's 2012 Global Automotive Executive Survey points out, environmental restrictions are also expected to increase within all BRIC emerging economies (*Figure 32*).³

In addition, governments are stimulating the uptake of electric vehicles. In August 2010 the Chinese government announced a plan to invest US\$15 billion in R&D for electric vehicles, pledging five million new-technology vehicles by 2020.⁴ Furthermore, the finance ministry in China announced it will waive sales taxes on electric and fuel cell cars manufactured domestically.⁵ The US has set a goal of 1 million EVs on the road by 2015 and Germany has pledged 1 million by 2020.⁶

KPMG's Global Automotive Executive Survey 2012 finds that while fuel efficiency remains the most important driver of consumer purchase decisions, it is becoming somewhat less important in the industry's agenda (*Figure 33*). In 2009, 96 percent of executives believed that fuel efficiency was an

“The automotive sector is under constant pressure to reduce further the impact of the emissions of not only its vehicles but also its manufacturing processes.”

¹ Trucost, 2012. See Appendix 1 for methodology

² OECD. (2011). *Transport Outlook 2011: Meeting the needs of 9 billion people*.

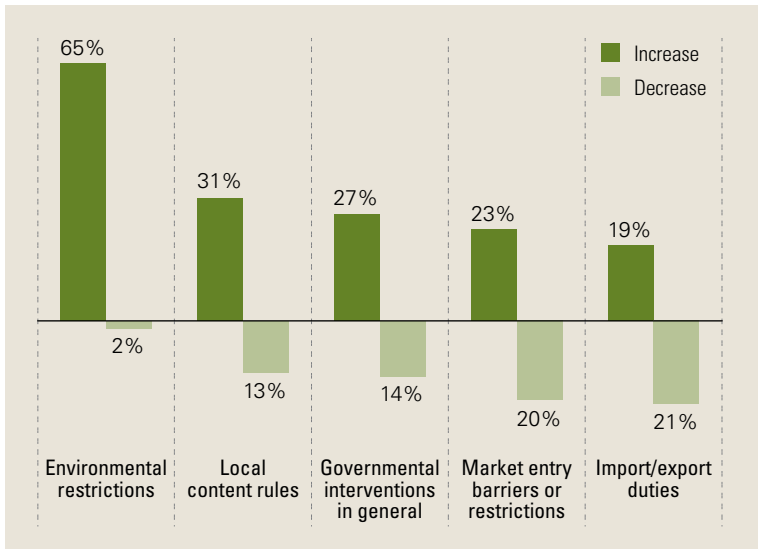
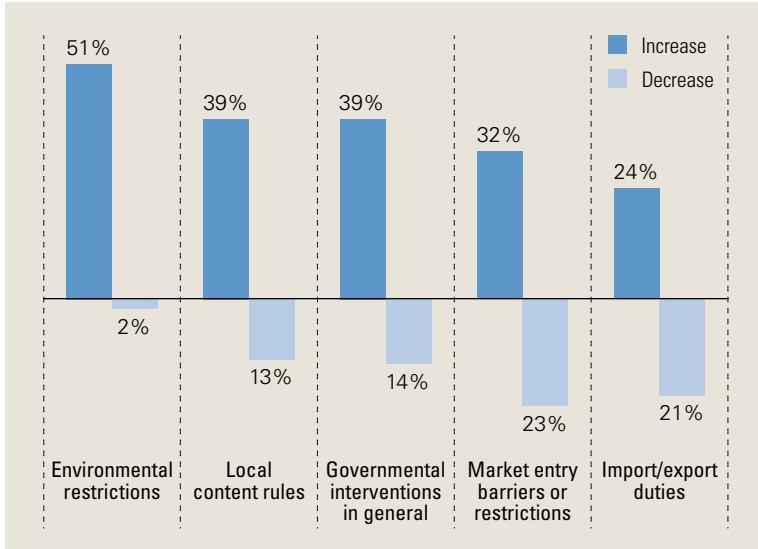
³ Economist Intelligence Unit. (2011). *World Automotive Outlook*. The Economist Group, London.

⁴ Ibid

⁵ Reuters. (31 December 2011). *China to waive sales tax on locally made EVs, fuel cell cars*.

⁶ Economist Intelligence Unit. (2011). *World Automotive Outlook*. The Economist Group, London.

Figure 32: Development of market conditions and barriers in the BRICs



Note: Percentage of respondents expecting conditions and barriers to remain the same are not shown
 Source: KPMG Global Automotive Executive Survey 2012

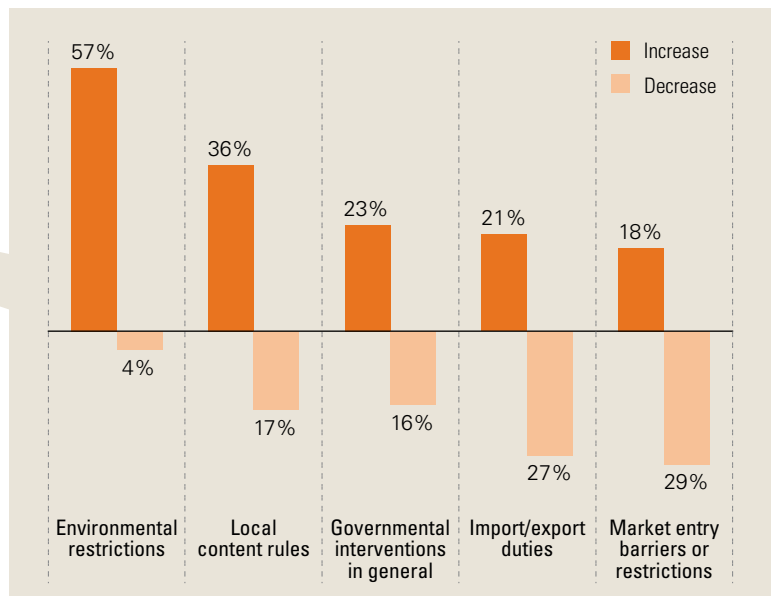
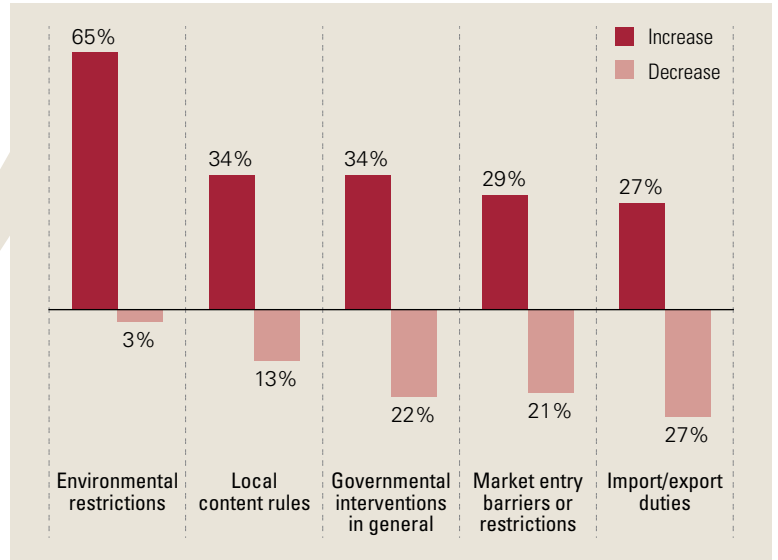
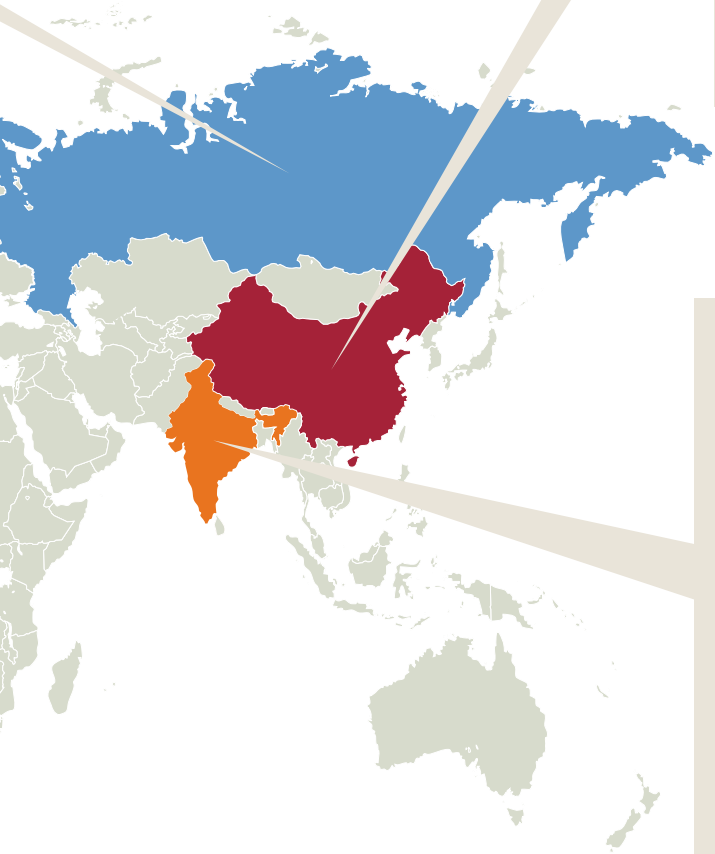
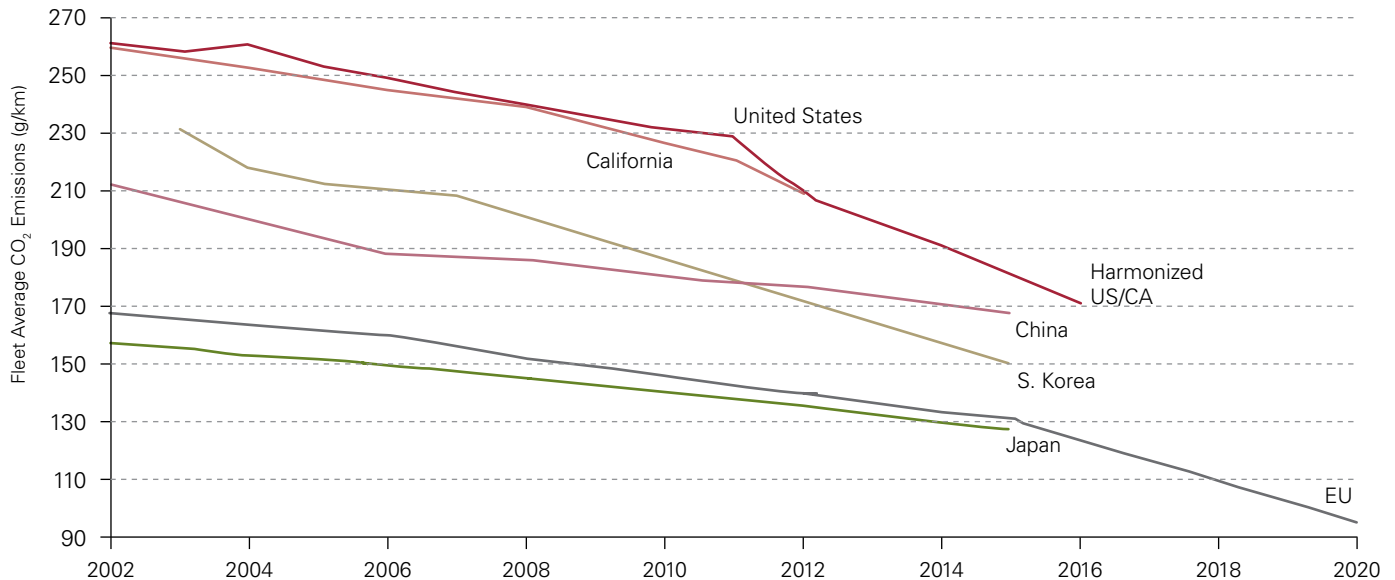


Figure 33: Summary of regional GHG emission targets

Source: International Council on Clean Transportation (ICCT). (2011). Global Light-Duty Vehicles: Fuel Economy and Greenhouse Gas Emissions Standards.

“Fuel efficiency and environmental friendliness remain the most important drivers of consumer behavior.”

important factor in consumer purchase decisions; by 2012 that had fallen to 76 percent. Executives’ ratings of environmental friendliness and the use of alternative fuel technologies as drivers of purchase decisions have also fallen, although more executives are rating enhanced vehicle lifespan as important to consumers. Nevertheless, despite the fall, the survey indicated that fuel efficiency and environmental friendliness still remain the most important drivers of consumer behavior.

It is therefore likely that consumers will continue to demand vehicles that are seen as environmentally-friendly. According to the 2012 KPMG Survey, executives expect electric vehicles to account for 15 percent of global registrations by 2025. However, there is

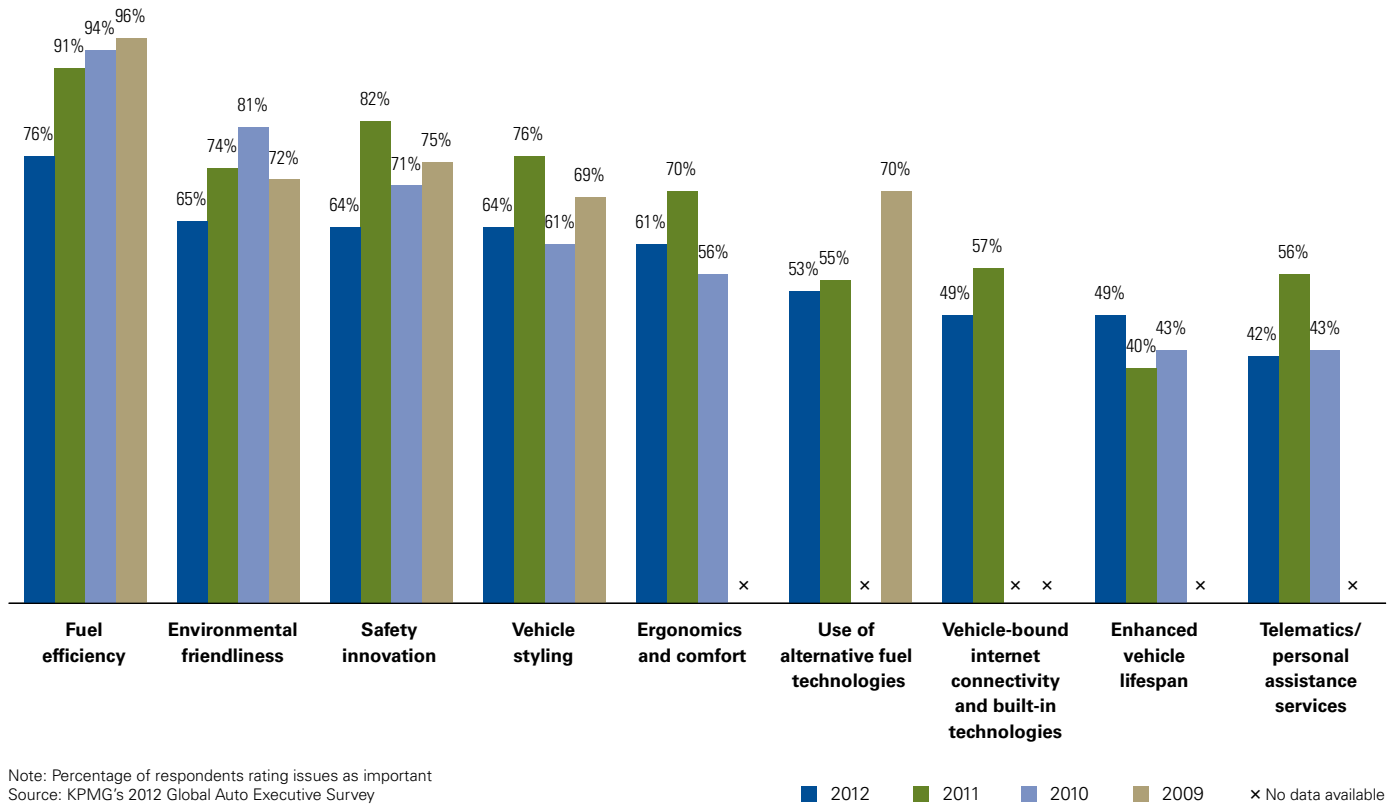
no consensus over what form of electric technology will predominate, although respondents thought that hybrids and fuel cell electric vehicles will outsell battery-electrified vehicles by 2025 (Figure 34).

Asian growth to fuel sustainability megaforges

Much of the recent growth in the automotive industry is due to rising demand in emerging markets, which is forecast to continue increasing at a rate more than sufficient to make up for lagging Western market growth. The share of passenger mobility in kilometers in non-OECD countries, including China and India, was only 46 percent in 2000, but is expected to grow to 78 percent by 2050.⁷

⁷ OECD. (2011). *Transport Outlook 2011: Meeting the needs of 9 billion people*.

Figure 34: Product issues influencing consumer purchase decisions



The size of the middle class in these emerging markets is predicted to increase significantly. According to the OECD the size of the global middle class could increase from 1.8 billion people to 3.2 billion by 2020 and to 4.9 billion by 2030. Almost all of this growth (85 percent) is expected to take place in Asia.⁸ For countries such as China and India, the increasing wealth of the population means that the demand for cars in these countries will increase and alter the nature of the market.

Several Asian companies have seized opportunities to acquire notable US and European brands. India's Tata Motors

bought Land Rover/Jaguar, and China's Geely purchased Volvo. These and other BRIC companies will increasingly threaten established market share in the near future: according to KPMG's Global Automotive Executive Survey 2012, China is likely to be exporting at least one million vehicles by 2013/2014.

At the same time, increasing car ownership in emerging markets will increase congestion, affect air quality and is likely to strain the capacity of current global infrastructure. Several Chinese cities, including Shanghai, have begun to restrict issuance of car licenses in an effort to reduce congestion and pollution.

“Increasing car ownership in emerging markets will increase congestion, affect air quality and is likely to strain the capacity of current global infrastructure.”

⁸ OECD. (2010). *The emerging middle class in developing countries*.

“All major automotive companies are reducing their overall fleet emissions.”

New city concepts such as Masdar in the United Arab Emirates are effectively car-free, with electric-only vehicles confined to underground roads. Other urban planning initiatives are likely increasingly to influence vehicle design, pointing to the need to design city-friendly cars and explore alternative mobility services such as car sharing. Several premium brands have already launched car-sharing and rental programs.

Alternative materials, alternative fuels

The Automobiles sector is currently reliant on several major categories of raw materials, and the industry continues to find it difficult to find economic substitutes for industrial metals and rubber. However, the use of biotechnology is being explored and increased use of bioplastics should allow cars to become lighter and car parts more biodegradable. Toyota has started to use Bio-PET, made from sugar cane, to replace conventional plastics in the interiors of its cars.⁹

Auto manufacturing also requires large amounts of increasingly scarce freshwater. As concerns over availability increase, supply is likely to be limited by competition and regulation, impacting operating costs for those who do not adapt. Water recovery and reduction systems could become necessities. Volkswagen's new plant in Chattanooga, Tennessee in the US incorporates an automobile paint shop which uses a waterless separation process for topcoat application.¹⁰

According a report by Hart Energy, demand for biofuels will increase from 80 billion liters in 2010 to roughly 180 billion liters in 2050.¹¹

However, increased production of biofuels carries potential legal and reputational risks. As biofuel prices rise, incentives to convert forested areas and former food cropland to biofuel production become greater and this in turn could lead to increasing political and campaign pressures on automakers.

Progress on emissions reduction

Driven by consumer demand and regulatory requirements, all major automotive companies are reducing their overall fleet emissions with the EU setting a standard of a fleet average CO₂ emission target of 130 g/km to be reached by 2012 and a longer term target of 95g/km, which will be effective from 2020.¹²

These CO₂ reductions will require more alternative fuel vehicles to be produced and sold, which in turn will require increased investment in alternative fuels and EV technologies. *Figure 35* indicates which new electric-related fuel technologies are expected to attract the most consumer demand by 2025, as forecast by industry executives polled in KPMG's Global Automotive Executive Survey 2012.

Disclosure and reporting: Progress in reporting levels

Even during the period of economic downturn that followed the 2008 financial crisis, the automotive sector has shown commitment to sustainability. It has the second highest reporting level, after Mining, among the 11 sectors included in this study. In fact, since 2008 the sector has overtaken several other sectors in terms of reporting. Based on research carried out for the KPMG International Survey of Corporate Responsibility Reporting

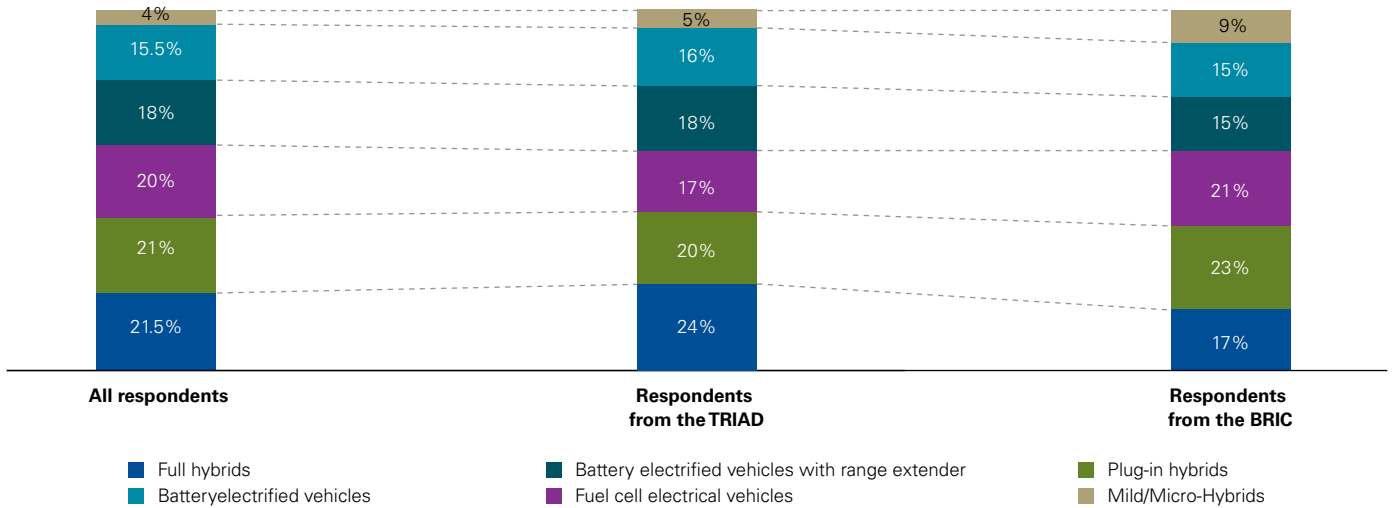
⁹ Toyota. (2011). *Sustainability Report 2011*.

¹⁰ Volkswagen Group. (2011). http://www.volkswagenag.com/content/vwcorp/info_center/en/themes/2011/05/Volkswagen_inaugurates_new_plant_at_Chattanooga_U_S_.html

¹¹ Hart Energy. (2011). *Global Biofuels Outlook 2010-2050*.

¹² European Commission. http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm

Figure 35: Electric vehicle technology attracting the most customer demand by 2025



Note: Percentage of respondents expecting the most customer demand
 Source: KPMG's 2012 Global Auto Executive Survey

2011,¹³ 78 percent of automotive companies report on sustainability. Unlike most other sectors, reporting levels in emerging markets and in the smaller companies do not vary greatly from traditional leaders in Western Europe and North America.

The number of Automobiles companies reporting on the financial value of sustainability has increased significantly since 2008 from 32 percent to 55 percent. Financial value reported includes both bottom-line cost savings from direct operational efficiencies and top-line returns from increased revenues and new markets for innovative products. Eighty percent of respondents specified in their reports that they offer sustainable or green products, reflecting the growth in electric and hybrid vehicles. Automakers are at least twice as likely as any other

of the 11 sectors, except Chemicals, to state innovation as key to sustainability reporting, ranking it above reputational and ethical considerations.

The Automobiles sector takes the top spot along with the Mining and Chemical sectors in its awareness of risks related to water scarcity. Eighty percent of the Automobiles reporters address the issue of water in their sustainability reports, over 40 percent of whom discuss adapting to changes in water availability and mitigating the impact of water scarcity on their stakeholders.

A majority of automotive corporate responsibility reports (77 percent) discuss sustainability issues related to their supply chain, a higher proportion than any other sector in this study. Close to three-quarters of these use

“ Unlike most other sectors, reporting levels in emerging markets and in the smaller companies do not vary greatly from traditional leaders in Western Europe and North America. ”

¹³ KPMG (2011). *KPMG International Survey of Corporate Responsibility Reporting 2011*

“A majority of automotive corporate responsibility reports (77 percent) discuss sustainability issues related to their supply chain, a higher proportion than any other sector in this study.”

sustainability codes in the selection, contracting or auditing of suppliers to monitor their adherence to aspects of the sustainability agenda that are beyond the company’s immediate control.

Summary: A total mobility solution is taking shape

The Automobiles sector has experienced an exceptionally turbulent period: the collapse of demand in the wake of the 2008 financial crisis forced companies to adjust rapidly to the changing environment. The current outlook remains challenging as economic instability and pressures from governments and consumers continue to rise, while costs of supply are increasing. The sector faces the difficult task of meeting consumer demand under continuous government scrutiny and changing legislation while keeping its costs under control.

Passenger and commercial vehicles contribute a significant share to CO₂ emissions that are generated through the manufacturing process as well through vehicle usage. Car makers need to reduce the use of carbon-intensive fossil fuels across their products and manufacturing processes within the next few years, which means new technology must be developed and implemented at a rapid pace.

Prices of basic materials have shown sharp fluctuations in the last few years and are expected to remain volatile. Although this implies a major risk for manufacturers, it also creates opportunities as manufacturers focus on developing alternative materials and using them in their vehicles.

Automakers are already highly sensitive to the prospect of rising costs related to greenhouse gas emissions and water in supply chains and operations, and many companies are already taking steps to address these issues. But the future winners in the Automobile sector may well be those companies that are doing more than just adapting an existing model. Automotive executives polled in the KPMG Global Automotive Executive Survey consider that the entire automotive value chain is changing from one shaped by vehicle-dominated solutions, to a new pattern shaped by multiple approaches to achieving personal mobility that is sustainable.

As a result, the near future could see a fierce corporate battle for dominance in the new automotive value chain. The winners could be automotive companies, but they just as well could be utilities capable of offering cost effective charging services. The imperative of sustainability is changing the automotive business radically: the result is that the near future may be very different from the recent past.



Beverages

Sector faces a multiple sustainability risk scenario

The global Beverages industry grew by 15 percent in 2010 to reach a value of just under US\$1.75 trillion and is forecast to have a value of US\$1.9 trillion in 2015.¹ However, despite ongoing growth, producers of soft drinks, bottled water, beer, wine, and spirits face challenges from a combination of global sustainability megaforges. Responding to these effectively will require a high level of preparedness.

Exposure to Global Sustainability Megaforges

Highly exposed to: Water Scarcity; Food Security; Climate Change; Population Growth; Ecosystem Decline

Partially exposed to: Energy & Fuel; Deforestation; Urbanization

Beverages environmental impact

There is likely to be increasing pressure over the next 20 years for the price of

resources, products and services to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

Data from Trucost Plc indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake. In the case of the Beverages sector, their data suggests that the environmental impact in 2010 amounted to US\$35.4 billion and would account for 42 percent of sector earnings.²

“ Responding effectively will require a high level of preparedness. ”

¹ Datamonitor. 2011. Industry Profile: Global Beverages.

² See Appendix 1 for methodology

“ Beverage producers depend on ready access to fresh, potable water as a key ingredient and also need water to irrigate agricultural inputs and to manufacture packaging. ”

These figures are hypothetical in that they assume business may in the future be required to bear the full environmental costs of their operations, but by making this assumption they provide an indication of the potential value at stake. In reality it is likely that such costs would be passed on – at least in part - to end users rather than being borne by the producers alone.

***Trends, risks and opportunities:
Water efficiency the key to survival***

Water Scarcity is the most critical resource risk for the sector. Beverage producers depend on ready access to fresh, potable water as a key ingredient and also need water to irrigate agricultural inputs and to manufacture packaging.

However, according to recent research, the world will face a gap in fresh water demand of 40 percent in 2030 (*Figure 36*). The issue of scarcity is gaining industry attention at the highest level. Nestlé’s chairman said in 2008: “... under present conditions and with the way water is being managed, we will run out of water long before we run out of fuel.”³

Until recently the Beverages sector has had relatively easy access to water in developing economies. However, the industry’s primary growth targets – Asia, Africa and Latin America –include some of the most water-endangered regions. As people in the developing world seek energy security, technical advancement and wealth, their own demands on the water supply are expected to increase. Governments and communities in countries such as Australia and Peru are already taking decisions and setting

priorities on who gets access to how much water; this trend is likely to become normality as water becomes more scarce. For example, one of the largest bottling plants in India was shut down by the government in 2004 and another was ordered in 2010 to reduce its water usage at one plant by 65 percent because of depleted water resources.

This trend suggests that Beverages companies are likely to face more limits on their license to extract and use water as well as increasingly complex systems of permissions to navigate.

Many international companies are proactively addressing the issue of local water management in plant locations. Beverage companies in India, for example, have formed an alliance to counter the growing campaigns against the industry. The Indian Beverages Association (IBA) works on a number of issues facing the industry including the growing challenge from farmers over water supplies, water pricing and pollution.⁴

Climate Change: Brings opportunities and risks

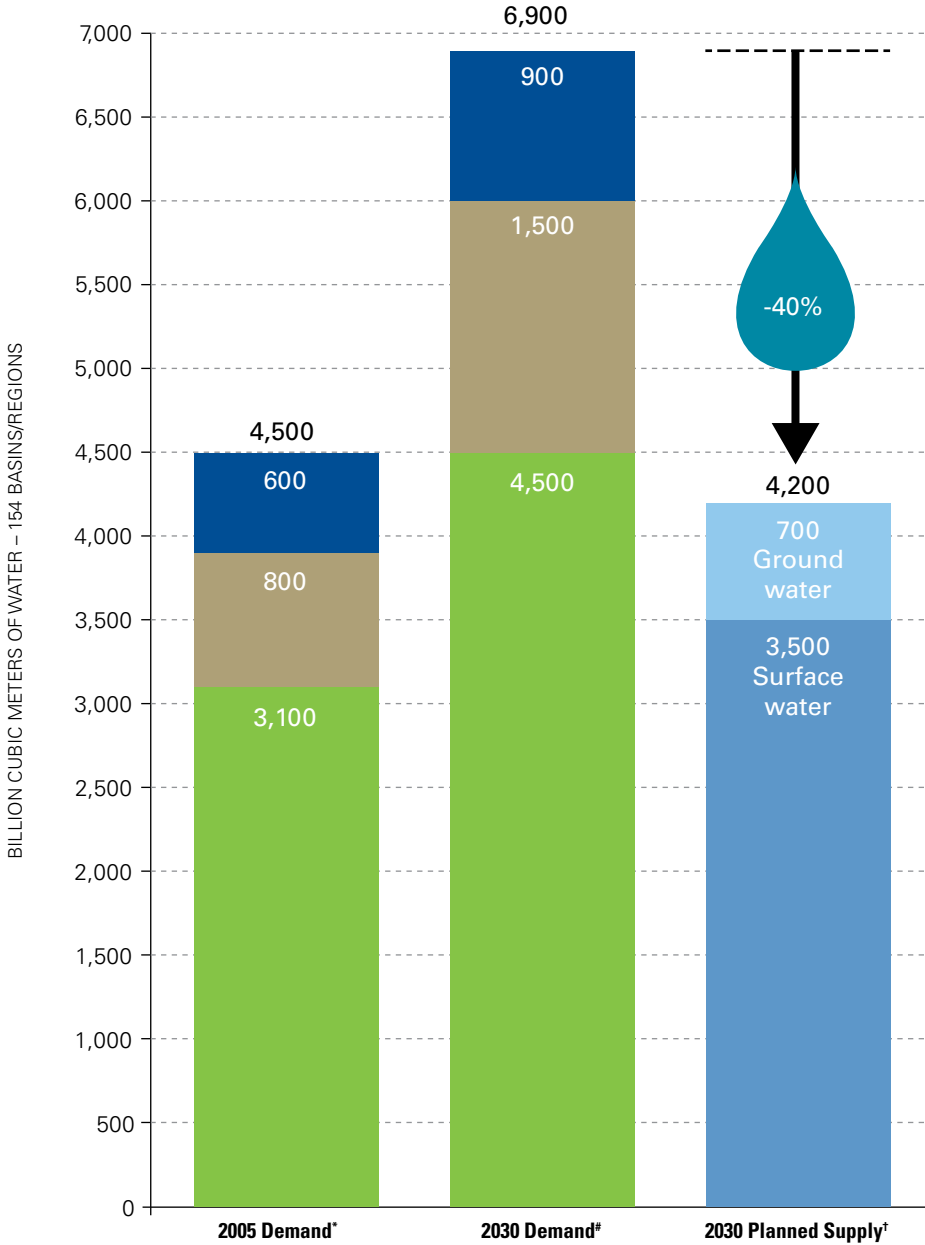
Some effects of climate change, such as warmer temperatures and more droughts, may bring opportunity for Beverages producers through increased demand for beer, bottled water and soft drinks. A growing developing nation middle class with higher spending power and lifestyle aspirations but limited access to safe drinking water is also likely to increase sales of bottled water. This trend has already been seen in India.⁵

³ The Economist. (2008). *A water warning*

⁴ Indian Beverages Association. <http://www.in-beverage.org/>

⁵ IBISWorld. (2011). *Global Soft Drink and Bottled Water Manufacturing*.

Figure 36: Global fresh water demand gap projected by 2030



“ Many international companies are proactively addressing the issue of local water management. ”

* Demand in 2005 based on inputs from IFPRI

Demand in 2030 based on frozen technology and no increase in water efficiency after 2010

† Supply at 90% reliability and including infrastructure investments scheduled and funded through 2010; supply in 2005 is 4,081 BCM per year; supply in 2030 under projected technological and infrastructural improvements equals 4,866 BCM per year; net of environmental requirements

Source: Ceres. (2011). The Ceres Aqua gauge: A framework for 21st century water risk management.

Domestic Industry Agriculture

Figure 37: The financial impact of climate change and water scarcity trends on beverages

| Value driver | | | Business risk | Timeframe of impact |
|----------------------------|----------------------------|---------------------|---|---|
| Agricultural inputs | Agricultural crop prices | Cost ↑ | Sugar and tea yields, major cost inputs for the soft drinks and tea sectors, are predicted to decline due to climate change and water scarcity. | Immediate (with increased likelihood in future) |
| | Processing costs | Cost ↑ | The beverages subsector is critically dependent on water for both processing and as a key ingredient; scarcity can create operational disruptions. | Immediate (with increased likelihood in future) |
| Reputation | Food safety problems | Cost ↑ revenue ↓ | Water quality is critical to avoiding contamination issues. Increased scarcity of high quality water supplies will increase the costs of avoiding contamination. An incident can lead to depressed sales. | Immediate (with increased likelihood in future) |
| | Community relations issues | Cost ↑ revenue ↓ | Bottled water and soft drink companies draw large amounts of water from the groundwater around their manufacturing facilities; putting them at risk for conflicts with other users. | Future |

Source: World Resources Institute (WRI). (2010). Weeding risk: Financial Impacts of Climate Change and Water Scarcity on Asia's Food and Beverage Sector.⁶

However, the **Climate Change, Food Security and Water Scarcity** megafactors combine to pose serious long-term risks for the sector. Higher temperatures and more extreme weather events threaten to impact ecosystem health and land productivity across the globe, and may alter growing conditions in key agricultural regions. These effects will be difficult or impossible to predict with any degree of accuracy and are likely to differ between regions, making the possibility of global solutions difficult.

As a result, the supply of raw materials to the Beverages sector is likely to be affected: especially key commodities like sugar, barley, corn and hops. Raw materials like these are the largest cost category for Beverage companies,

accounting for more than 50 percent⁷ of revenue for soft drink and wine producers and around 35 percent^{8,9} of revenue for beer and spirits.

Certain sub-sectors of the Beverages industry are particularly vulnerable to Food Security risks. Coffee and tea producers, for example, are already seeing changes. Starbucks reports that "in addition to increased erosion and infestation by pests, coffee farmers are reporting shifts in rainfall and harvest patterns that are hurting their communities and shrinking the available usable land in coffee regions around the world."¹⁰

Sugar production is especially susceptible to drought and water scarcity, which may intensify

⁶ Dana Krechowicz and Shally Venugopal, Weeding risk: Financial Impacts of Climate Change and Water Scarcity on Asia's Food and Beverage Sector, World Resources Institute, 2010

⁷ IBISWorld. (2011). *Global soft drink and bottled water manufacturing*.

⁸ IBISWorld. (2011). *Global beer manufacturing*.

⁹ IBISWorld. (2011). *Global beer manufacturing*.

¹⁰ Starbucks. (2012). *Tackling Climate Change*.

competition if the supply of sugar is reduced. As a result, producers of sugary beverages such as soft drinks and spirits may experience dramatic price volatility. Some of these impacts are already apparent. CERES recently reported that global sugar prices reached a 28 year high in 2010, in part because drought in India led to a 2008 sugar crop yield 45 percent lower than the previous year.¹¹ Exposure to price volatility and fundamental shortages exposes firms to physical, reputational and regulatory risks as communities realign priorities for survival.

The industry's exposure to commodity price volatility has led to large-scale purchasing agreements in order to stabilize inputs. Beverage producers who source key inputs through longer-term contracts may be less susceptible to supply chain risks over the short to medium-term, but in the long run industry profitability will depend on innovative planning, investment, and adaptation to stabilize inputs.

Population Growth and Wealth: Growing concerns around health

Population Growth and Wealth growth are changing consumption patterns. As the world population is set to grow to 8.4 billion by 2032¹² and the global middle class continues to grow with it, demand for beverages is predicted to keep increasing.

In developed countries there are growing concerns about the impact of high-calorie beverages on health – especially in relation to diabetes and obesity – and about the social implications of alcoholic drinks. Obesity is becoming more common worldwide; the World Health Organization (WHO) reports that in 2008, 1.5 billion adults, 20 and older, were overweight. Of these over 200 million men and nearly 300 million women were obese.¹³ High

fructose corn syrup, a key input for many Beverage companies, has recently been under attack as a driver of obesity.

Increasing demand in some markets for health and wellness-orientated products, coupled with raised awareness of environmental and social issues, represents a market opportunity for Beverage companies to increase the value of their products to consumers. It is also likely that the level of regulatory and financial risk to companies will grow as more countries introduce taxes to discourage the consumption of products high in sugar or saturated fat. For example, France introduced a soda law on the 1st of January 2012 by which 1 euro-cent of tax is added per container.

Global Beverages companies are being encouraged to expand self-regulation and co-regulation to respond to societal concerns around alcohol. Promotion of moderate drinking for adults and abstinence for minors has been practiced by some sector multi-nationals, but is generally lacking from local companies in developing countries.¹⁴

Ecosystem Decline: A growing concern

Ecosystems provide the clean water, arable land, fertile soil, nutrients and pollinators that are critical to all Beverage products so the breakdown of these natural processes could threaten production.

Energy & Fuel: Exposed to price volatility

The Beverages sector depends on fossil fuels, as they partly determine transportation and processing costs, and is therefore exposed to energy and fuel price volatility risks. Modern industrial agriculture also requires fertilizers and pesticides primarily derived from fossil fuels. Nitrogen fertilizers are typically manufactured from natural gas or coal

“Increasing demand in some markets for health and wellness-orientated products represents a market opportunity.”

¹¹ CERES. (2010). *Murky Waters? Corporate Reporting on Water Risk*.

¹² United Nations Department of Economic and Social Affairs. (2004). *World Population to 2300*

¹³ who.int/mediacentre/factsheets

¹⁴ Responsible Research. (2010). *Key risks facing the beverages industry*.

“ Global Beverages companies are being encouraged to expand self-regulation and co-regulation to respond to societal concerns around alcohol. ”

and are thus subject to price fluctuations in these areas.¹⁵

Reporting and disclosure: Disclosure level high, except on financial value

According to research conducted for the KPMG International Survey of Corporate Responsibility Reporting 2011, the reporting level of the Beverages sector (82 percent) is significantly higher than that of Food Producers (65 percent) and one of the highest among the 11 sectors. Levels of reporting drop significantly from the 100 percent seen in the US and Europe to 60 percent in South America and 62 percent in the Asia Pacific region.

The sector has one of the highest percentages of companies reporting on water (80 percent) and of these 70 percent disclose their water footprint and over three-quarters (80 percent) disclose their strategy for managing water use. However a lower percentage (39 percent) report on mitigating the impact of water scarcity on the company or its stakeholders such as local communities. Only one among the more 50+ companies surveyed disclosed the water footprint of its supply chain in its corporate responsibility report. On the other hand, close to 70 percent discuss broader supply chain sustainability issues beyond water and of those, two-thirds have developed supplier codes for use in selecting, contracting or monitoring suppliers on sustainability.

The Beverages sector as a whole can do more to exploit the business potential of sustainability. Less than 30 percent of the companies surveyed identified that they offer sustainable products and less than a quarter can measure the financial value of sustainability initiatives in terms of cost savings or revenues.

Summary: Multiple megaforce pressures, but water will remain dominant

Adopting efficient water management practices throughout the supply chain will become even more critical to the Beverages sector. Companies should be able to create significant impact by working with other water-intensive users in their supply chain as well as government agencies.

Health and social concerns on the part of consumers and government are likely to increase. Although research may lead to the development of healthier products and marketing can increase awareness of the consequences of excessive consumption, collaboration between other Beverages companies, retailers and government agencies is likely to be the most cost-effective and efficient approach.

Companies need to increase their efforts to reduce waste throughout their supply chain. An important waste category in the sector is the waste from packaging: containers are an important subset of all packaging waste and include glass, plastics, aluminum and liquid paper board. Beverage container waste comprises around 25 percent of total packaging waste, or 4 percent of the municipal and commercial waste streams. Around 53 percent of beverage containers are recycled.¹⁶ Government can play an important role by offering consumers more access to recycling facilities or creating a levy on packaging.

As the Beverages sector encounters pressures from the combined effects of multiple sustainability megaforges, companies can expect to be challenged to demonstrate resilient supply chain acquisition and logistics models, and even more effective methods of water management.

¹⁵ United States General Accounting Office. (2003). *Domestic Nitrogen Fertilizer Production Depends on Natural Gas Availability and Prices*.

¹⁶ Beverage Container Working Group. (2010). *Beverage container investigation: revised version*.



Chemicals

Total impact growth modest, emissions could be the point of vulnerability

The development and production of chemicals is a critical component of the global economy. Basic chemicals form the building blocks for many of the sophisticated plastics and manufactured fibers in use today. Major chemicals manufacturers are facing increasingly stringent legislation and a competitive dynamic that is shifting towards emerging markets. Strong demand growth in emerging markets is part of the longer-term trend of the eastward movement of the chemical industry's key end-customers such as textiles, automotive and construction companies.¹

China's chemical industry already accounts for 22 percent of global production and this trend is expected to continue as the demand for advanced chemicals and their byproducts in the Pacific Rim continues.² Higher feedstock

accessibility (particularly in the Middle East and China given its stated intention to utilize its vast coal resources), ready access to high-growth markets, and lower labor costs will all contribute to making emerging markets the drivers for growth going forward.

The Chemicals industry is currently responsible for approximately 5 percent of global man-made emissions.³ However, the sector produces a wide variety of products and technologies such as insulation materials, advanced lighting and agricultural products that reduce carbon emissions through their use. The International Council of Chemical Associations has calculated that for every unit of greenhouse gas (GHG) emitted through chemical industry production, the resulting products enable savings of 2-3 units.⁴

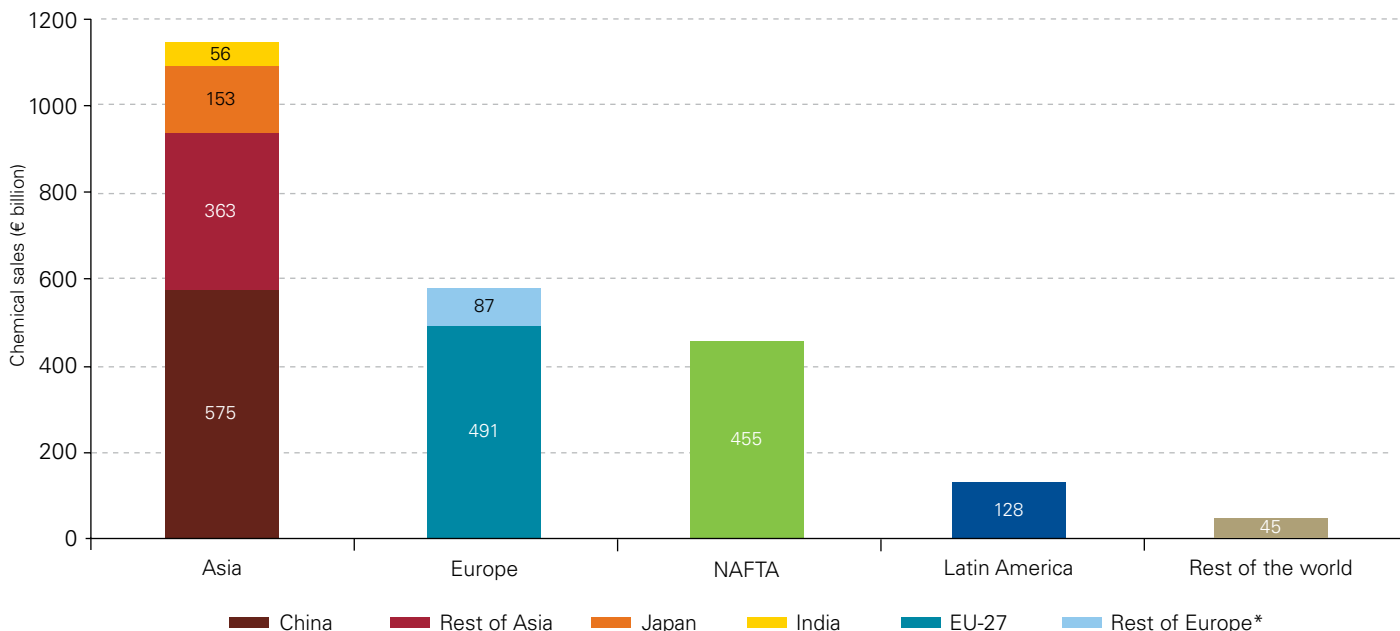
“Major chemicals manufacturers are facing increasingly stringent legislation and a competitive dynamic that is shifting towards emerging markets.”

¹ KPMG, “The Future of the European Chemical Industry”, 2010

² <http://www.chinaknowledge.com/Business/CBGdetails.aspx?subchap=3&content=10>

³ IPCC Assessment, 2007

⁴ International Council of Chemical Associations, ICCA. (2009). *Innovations for Greenhouse Gas Reductions*.

Figure 38: Global chemical sales by region

World Chemicals sales in 2010 are valued at €2353 billion. The EU accounts for 21 percent of the total.
 Source: European Chemical Industry Council (CEFIC). (2011). Facts and Figures 2011: The European chemical industry in a worldwide perspective.

“To thrive in the face of competitive and environmental challenges, industry leaders must fully leverage their lead in innovation, management competency, and global experience.”

Assuming sustained growth under a “business as usual” scenario, the Chemicals sector’s emissions are forecast to more than double by 2030⁵ and as result the sector is likely to come under pressure to further reduce emissions. To thrive in the face of competitive and environmental challenges, industry leaders must fully leverage their lead in innovation, management competency, and global experience.

Exposure to Global Sustainability Megaforges

Highly exposed to: Water Scarcity; Energy & Fuel; Climate Change

Potentially exposed to: Population Growth

Chemicals environmental impact: Impacts decoupling from earnings

There is likely to be increasing pressure over the next 20 years for the price of

resources, products and services to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake. In the case of the Chemicals sector, their data suggests that the environmental impact in 2010 amounted to US\$43 billion and would account for 43 percent of sector earnings.⁶

⁵ International Council of Chemical Associations, ICCA. (2009). *Innovations for Greenhouse Gas Reductions*.

⁶ See Appendix 1 for methodology

These figures are hypothetical in that they assume business may in the future be required to bear the full environmental costs of their operations, but by making this assumption they provide an indication of the potential value at stake. In reality it is likely that such costs would be passed on, at least in part, to end users rather than being borne by the producers alone.

**Trends, Risks and Opportunities:
Significant risks from water scarcity**

A major concern for the industry is **Water Scarcity** and cost. The regions expected to see the most demand growth for chemicals – South Asia, East Asia, and the Middle East – are also likely to face severe physical and economic water scarcity as a result of population growth, rapid economic development, and pollution. In the 20th century, the world’s population grew threefold, while fresh water consumption increased over six times.⁷ By 2025, developing nations are expected to increase water withdrawal rates by 50 percent, compared to an 18 percent increase in developing nations.⁸ This is likely to lead to significant increases in the cost of water utilities in the near future, especially for companies with operations in emerging markets.

There are significant reputational and operational risks associated with the use of water – notably in parts of the world where scarce water resources already impact the local community. There have been several examples across industry sectors where companies have either lost their licenses to operate, or have come close to it, under accusations that they have adversely affected the availability of water for local people.

Some Chemicals firms are exploring ways to reduce their water consumption

by sourcing waste water for secondary processes.

Energy & Fuel volatility is another major vulnerability of the sector with fossil fuels used both as feedstock and to supply energy for the production process. While the sector has made significant progress in improving its energy efficiency, it remains a high user of energy and thus susceptible to price fluctuations and insecurity of supply.

Oil and gas are still the dominant feedstocks for the chemical industry, but recent innovations have fueled the trend towards coal-to-chemicals and even bio-ethanol-to-olefins. China is leading the new trend of coal-to-chemicals as it has a minimal supply of petroleum and natural gas, but a large surplus of coal. This high dependency on coal, which is expected to continue for some decades, could represent a problem in relation to Climate Change, because coal is highly CO₂ intensive.

Climate change legislation could still impact despite industry improvements

An increased global focus on climate change poses regulatory risks that could erode profits within the sector, although many companies have already grasped emissions reduction as an opportunity for efficiency and cost reduction.

In the US and Europe, the Chemicals sector has reduced its energy and greenhouse gas intensity. In Europe, energy consumption remained about level from 1990 to 2008 and greenhouse gas emissions fell by 42 percent while production rose by 69 percent.

However, despite the industry’s progress in reducing GHGs,⁹ it remains one of the most energy intensive industries,¹⁰ and thus remains vulnerable to regulation on emissions. Even modest taxes on GHG emissions could reduce profitability.

“Some Chemicals firms are exploring ways to reduce their water consumption by sourcing waste water for secondary processes.”

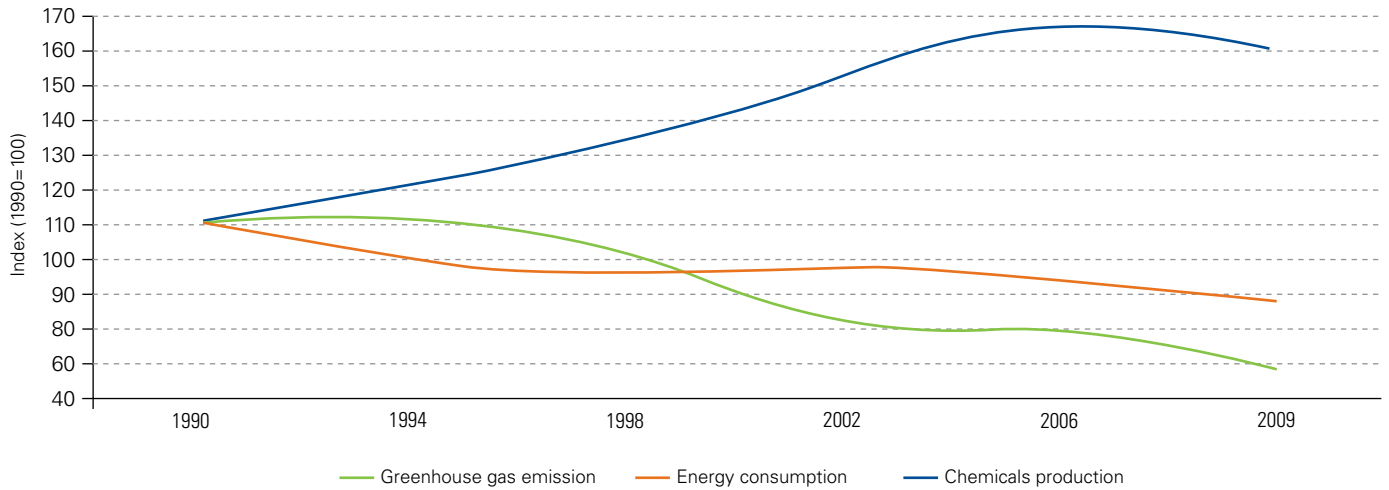
⁷ Tillson, Tim “Water Scarcity: What chemical companies need to know”, KPMG 2010.

⁸ Ibid.

⁹ Hadri, Moncef, “Facts and Figures 2010, The European Chemical Industry in a Worldwide Perspective”, Cefic European Chemical Industry Council

¹⁰ Ibid.

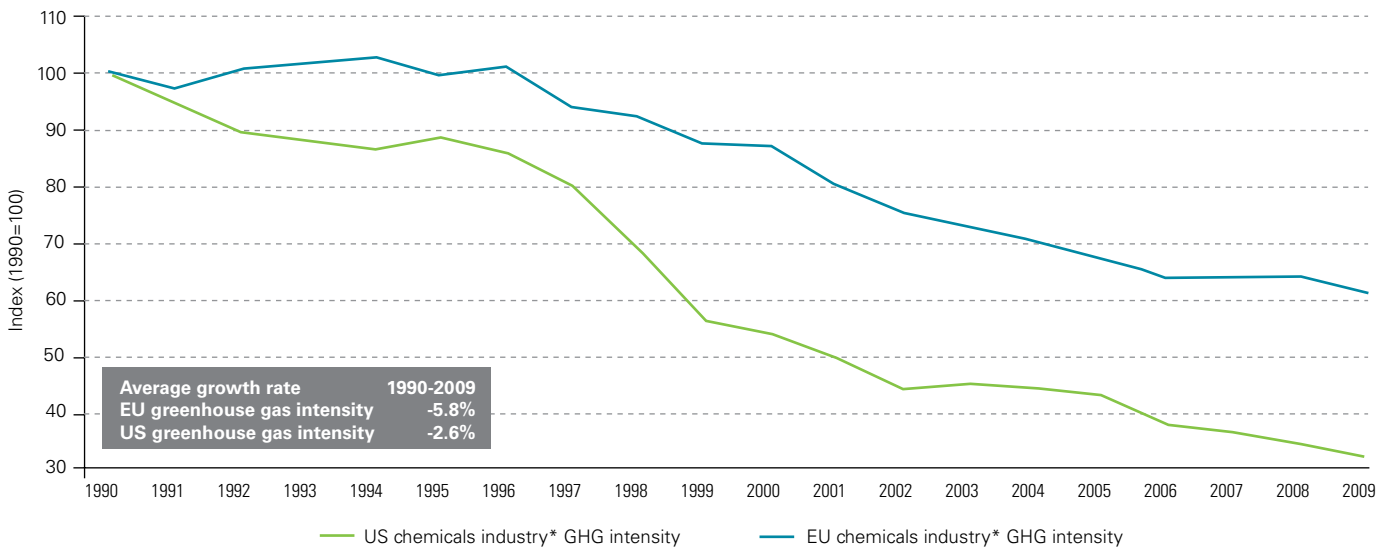
Figure 39: Chemicals production decoupled from energy use



* Including pharmaceuticals

Source: European Chemical Industry Council (CEFIC). (2011). Facts and Figures 2011: The European chemical industry in a worldwide perspective.

Figure 40: US/EU chemical industry GHG intensity: 1990–2009



Source: European Chemical Industry Council (CEFIC). (2011). Facts and Figures 2011: The European chemical industry in a worldwide perspective.

The industry is now increasingly focusing on downstream emissions reduction opportunities. As chemicals are an important component of many other industries, the sector is well positioned to serve as a solution provider to mitigate and adapt to climate change.

Population Growth could increase community resistance to chemical plants

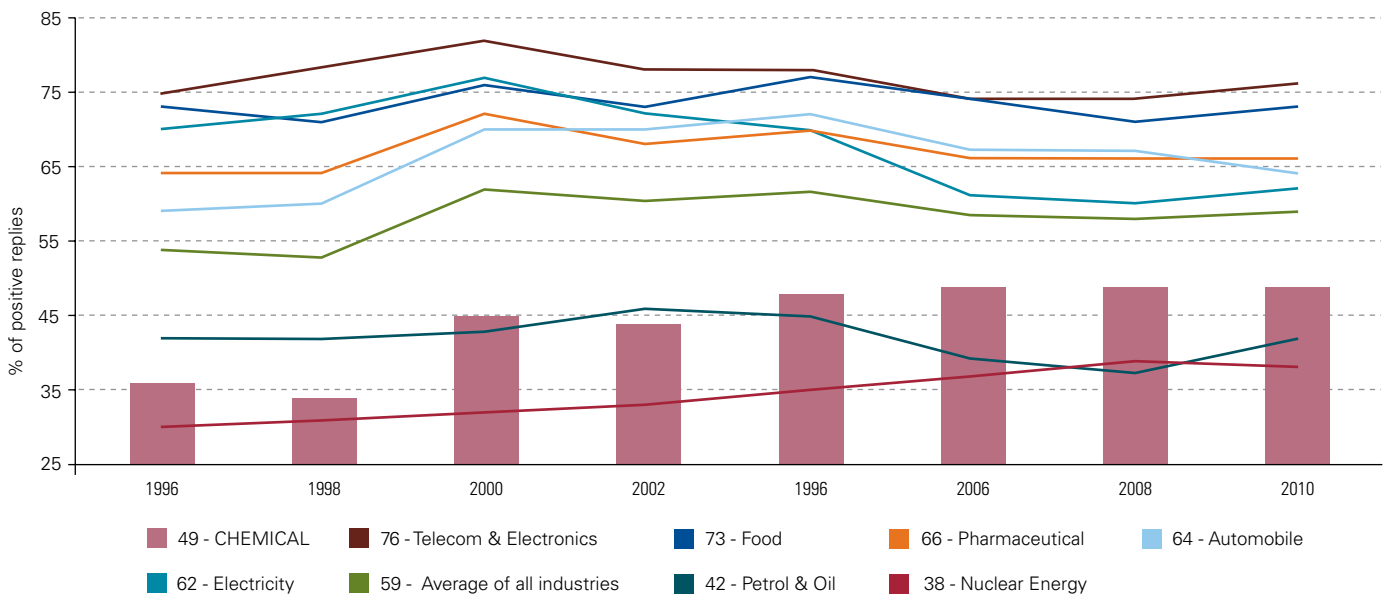
By 2050, the global population is predicted to increase to over nine billion, and to as much as 10 billion by the 2080s.¹¹ All else being equal, this translates into an increase in food, water, and energy consumption, as well as an increase in GHG emissions of over 28 percent by 2050. The bulk of this

increase is predicted to occur in regions that are already the most populated and least energy and water efficient – Africa, Middle East, and South Asia.¹²

As **Population Growth** and **Urbanization** continue, communities are increasingly sensitive to the potential environmental impact of chemical plants. An example is the 2007 relocation of a proposed paraxylene and terephthalic acid plant in the Chinese city of Xiamen. Even the potential of this plant to pollute prompted widespread anger from the local community, forcing the local government to order the plant’s relocation.¹³ *Figure 41* shows the European chemical industry’s public image in relation to that of other sectors.

“Communities are increasingly sensitive to the potential environmental impact of chemical plants.”

Figure 41: European chemical industry’s public image



Source: European Chemical Industry Council (CEFIC). (2010). Cefic Pan European Survey on the image of the chemical industry 2010.

¹¹ "World Population Prospects, the 2010 revision", United Nations Department of Economic and Social Affairs, Population Division, Population Estimates and Projections Section, <http://esa.un.org/unpd/wpp/Other-Information/faq.htm#q3>

¹² Ibid.

¹³ Global Non-violent Action Database, "Chinese residents force relocation of chemical plant in Xiamen, 2007", <http://nvdatabase.swarthmore.edu/content/chinese-residents-force-relocation-chemical-plant-xiamen-2007>

The chemical sector has taken several steps in recent years to improve public perceptions, for example through industry initiatives such as Responsible Care, the global industry initiative to improve health, safety and environmental performance. However, public perception of the sector continues to be a challenge as recent research from CEFIC shows.

Reporting and disclosure: Water use in the supply chain to be the next focus

Research conducted for the KPMG International Survey of Corporate Responsibility Reporting 2011, which analyzed over 3000 Sustainability reports in 34 countries, shows an overall reporting rate of 68 percent for the chemical sector. Although companies in Western Europe, US and Japan, the three traditional leaders in the industry, have a reporting rate of close to 90 percent, companies in non-Japan Asia including China and India have a reporting rate of only 25 percent. The reporting level also varies by size of the company. Large companies with revenues exceeding US\$5 billion have an impressive reporting rate of 85 percent, which falls to 59 percent for smaller companies.

The survey shows that 42 percent of all reporting companies (and 60 percent of large companies) derive financial value from their sustainability initiatives, suggesting that the sector is in a strong position to benefit from further reductions in energy use and greenhouse gas emissions. Also, 60 percent of reporting chemical companies have developed supplier sustainability codes; of those, one third have included the code in their supplier selection processes or as part of contracting procedure, and almost 40 percent have implemented audit programs to review suppliers' adherence to the code of conduct.

The KPMG survey also shows encouraging results regarding how

the sector deals with water. Of the 11 sectors studied for this report, the Chemical sector scores second highest (88 percent) in terms of addressing water in its corporate responsibility reports. It also has the highest percentage of companies (68 percent) that measure their water footprint. However, less than 1 percent report on water use by their supply chain. Most of the water initiatives undertaken by the Chemicals sector are operational, such as water reduction and water treatment rather than adaptation or mitigation strategies to deal with possible future changes in water availability.

Summary: Opportunity in innovation

The Chemicals industry is likely to continue its eastward shift, as emerging economies become a significantly greater market for chemicals, and as Asian and Middle Eastern firms capitalize on their advantages of easy market, labor, and resource access. Climate Change, Energy & Fuel volatility, Water Scarcity, and Population Growth are key challenges that threaten the profitability of industry players who do not anticipate global trends.

Given these challenges, European and US chemical companies have been moving in the right direction in terms of controlling energy consumption, reducing GHG intensity, and decreasing its water footprint. However, to remain competitive within the next two decades, it is imperative for companies in the chemical sector to further invest in resource substitution, efficiency and innovation.

As an 'industry of industries', the chemical sector is in a unique position to help other sectors improve their sustainability performance. It has the opportunity to not only reduce the negative side-effects of its industrial processes, but also become a critical part of the solution through innovations that enable sustainable development.

“As an ‘industry of industries’, the chemical sector is in a unique position to help other sectors improve their sustainability performance.”



Electricity

Water dependency remains critical

The world's electric utilities continue to operate in a highly regulated environment: their margins and operations are mostly government mandated. Utilities continuously evaluate their mix of electricity sources to manage fluctuating prices, reliability performance and environmental concerns.

Exposure to Global Sustainability Megaforces

Highly exposed to: Climate Change; Energy & Fuel; Population Growth; Wealth; Water Scarcity

Potentially exposed to: Urbanization

Electricity environmental impact

There is likely to be increasing pressure over the next 20 years for the price of resources such as energy and water to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such

as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake. In the case of the Electricity sector, their data suggests that the environmental impact in 2010 amounted to just over US\$195 billion.¹

This figure is hypothetical in that it assumes businesses may in the future be required to bear the full environmental costs of their operations, but by making this assumption it provides an indication of the potential value at stake. In reality it is likely that such costs would be passed on – at least in part - to end users rather than being borne by the utilities alone.

“ Utilities continuously evaluate their mix of electricity sources. ”

¹ See Appendix 1 for methodology

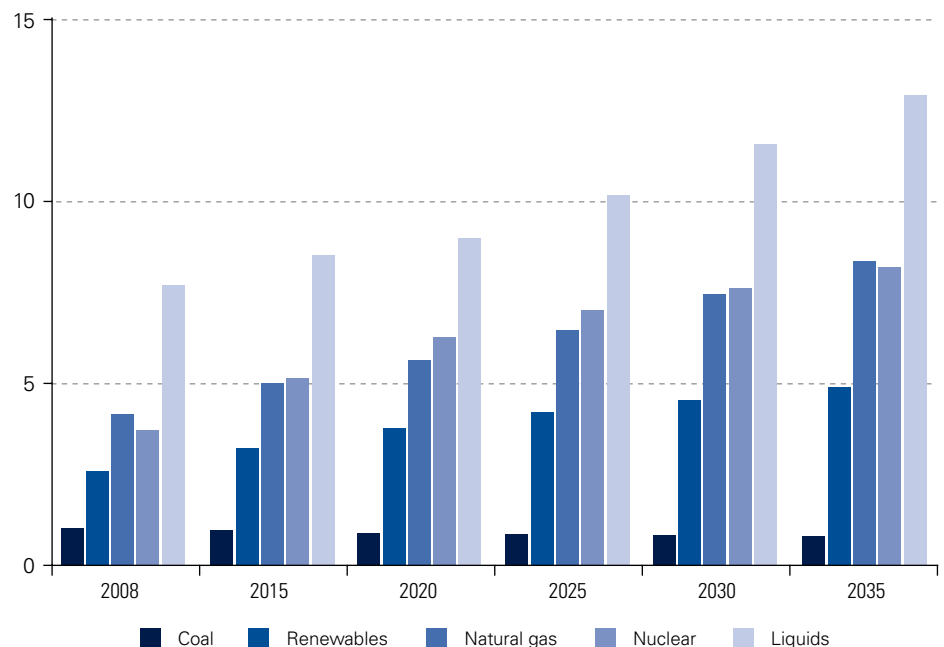
“Coal-fired generation accounted for 41 percent of the world’s electricity supply in 2011, with new installations being constructed primarily in China and India.”

Trends, risks and opportunities: Regulatory pressures are building and shifting

Coal-fired generation accounted for 41 percent of the world’s electricity supply in 2011, with new installations being constructed primarily in China and India.² Environmental concerns and commitments to renewable energy

are expected to drive coal’s share of electricity down to 34 percent of all generation by 2030,³ although in rapidly growing countries like China, India and Russia coal will likely continue to generate a significant proportion of power. Most of this shift is expected to be accounted for by cleaner-burning natural gas and renewables, primarily hydro and solar.

Figure 42: World net electricity generation by fuel type, 2008–2035 (trillion kilowatthours)



Source: U.S. Energy Information Administration (EIA). (2011). International Energy Outlook.

Electricity generation from oil has been in decline for a number of years as high crude prices (and the need to preserve crude oil stocks for transportation needs) have hastened a move towards coal and natural gas. In the US, recently discovered large shale natural gas reserves are expected to drive natural gas electricity generation. In the Middle East, many countries are attempting a switch to gas-generated electricity, in

hopes of preserving their oil reserves for high-value export. Similar trends towards natural gas can be expected to intensify if significant exploitable reserves are discovered in Europe.

The sector is exposed to **Climate Change** risks. Low emission nuclear power development has been hampered due to the financial crisis and the Fukushima power plant accident. In China, 160 planned nuclear reactors

² Center for Climate & Energy Solutions, 2010

³ US Energy Information Administration (EIA). (2011). *International Energy Outlook 2011*. EIA, Washington DC.

were put on halt after Fukushima, and all are now subject to an additional round of safety reviews.⁴ In May 2011, Germany announced plans to shut down all nuclear power plants by 2022. Furthermore, nuclear power projects are capital intensive and subject to public and private financing pressures.

Renewable energy sources are therefore likely to see the strongest growth; their share is expected to grow from 4 percent of current electricity generation to 13 percent by 2030.⁵ Most of this will be driven by climate change concerns and government subsidies. Solar and wind power are projected to show the strongest uptake. China intends on installing 50 GW of solar power by 2020.⁶ This should provide a major boost for solar panel manufacturers and may deliver the scale of production needed to further drive down the cost of solar panels.

Grid and transmission technologies have significant room for improvement: it is estimated that 6-8 percent of electricity is lost in transmission and distribution (in India, 30 percent of all electricity generated is lost in inefficient transmission networks).⁷ If the rollout of a comprehensive smart grid system is combined with an increased usage of renewable energy sources this could yield significant reductions in carbon emissions from electricity generation.

The implementation of Phase 1 of the European Union Emissions Trading Scheme (EU ETS) has raised the price of electricity in the EU for consumers. Carbon trading has already discouraged several European coal plants from being built and any further increase in the price of carbon may spur increased investment in renewables.

Population Growth risks and opportunities are also significant. As the major emerging economies continue their ascendancy, their consumption of electricity is likely to increase commensurately. In 2030, China is forecast to be consuming 26.8 percent of the world's power, compared to 19.1 percent by North America, versus 19.2 percent and 25 percent respectively in 2010.⁸ Global electricity demand is projected to increase by 60 percent between 2010 and 2030, with China and India fueling 70 percent of that demand.⁹

Electricity generation requires extensive consumption of water, exposing the sector to **Water Scarcity** risks. Electric utilities use freshwater to cool thermal (coal, gas, nuclear) generation plants, drive steam turbines and run hydroelectric dams. Today, electricity production consumes 8 percent of all freshwater withdrawn worldwide, and up to 40 percent of all freshwater withdrawals in the United States.¹⁰ Electric utilities are highly dependent on freshwater and any systemic increases in water demand or drought-like conditions could severely impede electricity production.

Droughts in developed nations have already shown a propensity to hamper electricity production. In 2003, a severe heat wave and subsequent drought in France prevented nuclear plants from cooling output water to the required levels, leading the French government to grant utilities a temporary exemption from the output water temperature requirements and cutting electricity exports by half. In China, a 2011 drought impacted electricity generation at

“If the rollout of a comprehensive smart grid system is combined with an increased usage of renewable energy sources this could yield significant reductions in carbon emissions from electricity generation.”

⁴ Business Monitor (2011). *China Power Report*. Business Monitor International, London.

⁵ US Energy Information Administration (EIA). (2011). *International Energy Outlook 2011*. EIA, Washington DC.

⁶ Business Monitor (2011). *China Power Report*. Business Monitor International, London.

⁷ Alagh, Yoginder. *Transmission and Distribution of Electricity in India Regulation, Investment and Efficiency*. OECD, Paris, 2011

⁸ Asia Pacific Energy Research Center (2008). *Energy in China: Transportation, Electric Power and Fuel Markets*. Asia Pacific Energy Research Center. Tokyo

⁹ US Energy Information Administration (EIA). (2011). *International Energy Outlook 2011*. EIA, Washington DC.

¹⁰ World Economic Forum. (2009). *Thirst Energy: Water and Energy in the 21st Century*. World Economic Forum.

Figure 43: Thermoelectric power plant water usage

| Water use in Thermoelectric power plants per unit of net power produced | | |
|---|----------------|-----------------|
| | Liters per MWh | Gallons per MWh |
| Nuclear | 2700 | 720 |
| Subcritical pulverized coal | 2000 | 520 |
| Supercritical pulverized coal | 1700 | 450 |
| Integrated gasification combined-cycle, slurry-fed | 1200 | 310 |
| Natgas combined-cycle | 700 | 190 |

Source: National Energy Technology Laboratory (NETL). (2008). Water requirements for Existing and Emerging Thermoelectric Plant Technologies, Revised 2009, part of Table ES-1 is reproduced with the permission of NETL. <http://www.netl.doe.gov/>

the Three Gorges Dam.¹¹ Concerns over the environmental impacts of such freshwater reliance may hinder construction of new dams for the foreseeable future.

Resolving freshwater issues must be dealt with at a local level. Utilities in high water stress areas must look for low water usage generation.

Urbanization will increase access to electricity and increase the overall load on grids. Urbanization may also precipitate a shift in the types of fuels people use. In rural areas, biofuels are generally used to power basic necessities such as a cooking and lighting. In urban areas, where the electricity demand is significantly greater, more conventional energy sources, such as nuclear and fossil fuel, are used.

When combined, Electricity generation's five high-risk trends present a systemic risk. Increases in population growth, wealth growth and urbanization would

drive additional demand for energy. That in turn would drive additional energy and fuel consumption, resulting in increased carbon dioxide emissions. Climate change may limit population growth, as more areas become uninhabitable and/or may drive a flow of climate refugees to cities thus increasing urbanization and urban energy demand. With less freshwater availability, more energy could be needed to treat existing water or desalinate salt water. Population growth will increase the demand for material resources, as people consume more electronics and other high-end goods. Rising costs of critical rare earth elements will make building renewable energy more costly.

These rising sustainability risks also present opportunities. Public and regulatory pressure on utilities has produced a strong shift towards renewable energy sources in recent years and has resulted in a sector that is moving towards large-scale sourcing of renewable energy for its

“ Droughts in developed nations have already shown a propensity to hamper electricity production. ”

¹¹ Qui, J. (2011, May 25). *China admits problems with Three Gorges Dam*. Retrieved from <http://www.nature.com/news/2011/110525/full/news.2011.315.html>

power generation needs. Furthermore, techniques like carbon capture are being leveraged to help deal with the short-term implications of the emissions from fossil-fueled power plants. Electricity suppliers operating in countries or regions with stringent emissions regulation frameworks in place may find it easier to prepare strategy. In Europe, the creation of an emissions trading scheme (ETS) has provided the framework necessary to incentivize utilities to plan out their future power plant types.

In the US, the uncertainty around potential carbon or air pollution legislation makes it more difficult for utilities to commit to new power plant construction. As a result, utilities are driven towards retrofit projects of older plants, for example by fitting carbon scrubbers or switching to cleaner-burning coal or gas. Nonetheless, the majority of electricity at present is still generated through fossil fuels and utilities with strong fuel mix and supply security are the most prepared for fluctuations.

Disclosure and reporting: Rigorous approach to governance and assurance

The Electricity sector's response to sustainability issues is reflected in a reporting rate of 71 percent, based on research conducted for the KPMG International Survey of Corporate Responsibility Reporting 2011. Like the other two extractive industries, mining and oil & gas, the Electricity sector performs well in terms of the professionalism of reporting, maturity of its information systems and its rigorous approach to governance and assurance. Utilities in Western Europe generally do better with an 86 percent reporting rate, but those in the fast growing BRIC countries are not far behind with an 80 percent reporting rate (after discounting India, where sustainability disclosure levels are low – making it difficult to

benchmark against its peers). The reporting rate varies according to the size of the company: the rate drops down to 52 percent for companies with revenues below US\$1bn. However, type of ownership does not seem to affect reporting patterns as state-owned utilities have similar level of disclosure as listed companies.

An overwhelming majority of reporters cite strengthening of their customer relationships as the biggest driver behind sustainability reporting. Only the utilities in the BRIC countries explicitly state their relationship with regulators as an equally important driver to reputational considerations. In Western Europe, where the EU climate policy is clear, utilities have made better use of the market opportunities as more than half (55 percent) of the reporters specify green or sustainable product offerings.

Elsewhere in the world, where the regulatory landscape is not as clear, for example in the BRIC countries, a significantly lower number of reports (21 percent) specify green products. Although there is a strong focus on hydroelectric energy in Brazil and India, the lower number of electric utilities citing green product offerings reflects the stubborn reliance of the sector on fossil fuels, especially coal, despite ambitious policies from some governments such as China to increase renewables in the fuel mix.

Over 40 percent of the Western European electric utilities demonstrate financial benefits from sustainability in their reports, three-quarters of which cite top-line growth, signifying growing consumer demand for green energy. In contrast, only 15 percent of the BRIC utilities demonstrate financial benefits from sustainability, mainly from cost savings.

Despite the heavy reliance on water for cooling, only 69 percent of reports discuss water: a low rate compared

“Nonetheless, the majority of electricity at present is still generated through fossil fuels and utilities with strong fuel mix and supply security are the most prepared for fluctuations.”

“ In 2009 leaders of the G20 committed to rationalize and phase out over the medium term inefficient fossil fuel subsidies but to date subsidies have continued to rise. ”

to other sectors with high exposure to water (the survey found a rate of 88 percent among chemicals companies and 94 percent for mining). Although the number of electric utilities reporting on water usage is slightly higher than oil & gas producers (64 percent), only a quarter of the electric utility reports discuss adapting to changes in water availability or mitigating the impacts of reduced water availability on the company or its stakeholders. Increasing water stress may stimulate electric utilities to look for options to further reduce their water consumption and improve their level of disclosure on this issue.

Summary: New technologies and rational pricing are key issues

The move towards cleaner energy solutions appears to have gained momentum and progress has been made in increasing the viability of renewable energy sources. However, further mandates, direction and policy instruments will be required from governments and regulators.

Given the rapidly growing affluence and industrialization of emerging markets, the demand for electricity is unlikely to diminish in the foreseeable future. In emerging markets it will become crucial for governments and utilities alike to collaborate in producing and distributing the electricity essential for sustained economic growth in a responsible, efficient and sustainable manner.

Investment in renewable energy topped US\$200 billion worldwide in 2010¹² and all indications are that this will continue as public support builds for sustainable power solutions. Moreover, as the technology matures and rollout expands, the prices for renewable technology and energy should continue to decline.

There remains ambiguity about the financing of renewable energy projects.

The need for financing is clearly evident; it is estimated that the total required investment for the coming 25 years is over US\$30 trillion.¹³ Banks are mindful of the implications that Basel III's liquidity requirements will have on their energy lending business given the long-term (15-20 years) loans common in energy project financing. Common ground will have to be sought to bridge this gap and allow for the funding that is needed.

The developed world must continue the path to large-scale renewable adoption. Although renewables are unlikely to completely supplant fossil fuels as the main source of electricity generation, the increased adoption of renewables implies that overall costs associated with these new technologies should come down. While renewables are certainly an important part of a sustainable solution, more conventional solutions like carbon capturing installations and carbon offsetting initiatives are likely to grow in importance as utilities look for “quick-wins” with regards to their emissions. Perhaps the most important element to a holistic emissions reduction initiative may be the curtailing of demand through the true pricing of electricity, so as to reflect its true production costs. A component of this might be reducing global subsidies for fossil fuels, currently estimated at approximately \$409 billion,¹⁴ that have kept prices artificially low. In 2009 leaders of the G20 committed to rationalize and phase out over the medium term inefficient fossil fuel subsidies but to date subsidies have continued to rise.

While the challenge of curtailing the environmental impact of utilities is great, an increasing number of mitigating technologies and solutions are emerging that should allow this crucial sector to grow more sustainably.

¹² Renewables 2011 (REN21). *Global Status Report 2011*, Paris

¹³ KPMG Global Power & Utilities Conference – Europe, 2011, Paris

¹⁴ IEA, *World Energy Outlook* (2011)



Food Producers

Sustainability is key to food sector license to operate

The Food and Beverage sectors had sales of US\$12.8 trillion in 2011, and sales are expected to grow beyond US\$15 trillion by 2014.¹ Projected growth is fastest in the Asia Pacific region, with a compound annual growth rate (CAGR) of 7 percent, followed by Latin America (6 percent) and Middle East and North Africa (5.8 percent). By 2050, total food production is projected to increase by about 70 percent globally and nearly 100 percent in developing countries. This demand for food, together with demand from other competing uses, would place unprecedented pressure on many agricultural production systems across the world.²

The Food Producers sector would be highly sensitive to potential supply disruptions from extreme weather conditions related to climate change and to scarcity of critical resources, especially water. The sector is already responding through sustainability approaches in the global supply chain such as improved water management:

those companies taking steps to address these issues will have a marked advantage in the near future.

Exposure to Global Sustainability Megaforges

Highly exposed to: Climate Change; Water Scarcity; Ecosystem Decline; Population Growth; Wealth; Energy & Fuel

Potentially exposed to: Urbanization

Food Producers' environmental impact

There is likely to be increasing pressure over the next 20 years for the price of resources, products and services to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

“The Food Producers sector would be highly sensitive to potential supply disruptions from extreme weather conditions.”

¹ Frost & Sullivan. (2011). *Financial Assessment of Food Processing Market*.

² FAO. (2011). *The State of the World's Land and Water resources for food and agriculture (SOLAW) – Managing systems at risk*. Food and Agricultural Organization of the United Nations, Rome and Earthscan, London.

“The majority of this is attributed to livestock but land use change is also a major contributor.”

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake. In the case of the Food Producers sector, their data suggests that the environmental impact in 2010 amounted to approximately US\$200 billion (the highest of the 11 sectors studied in this report) and would account for 224 percent of sector earnings.³

These figures are hypothetical in that they assume business may in the future be required to bear the full environmental costs of their operations, but by making this assumption they provide an indication of the potential value at stake. In reality it is likely that such costs would be passed on – at least in part – to end users rather than being borne by the producers alone.

Trends, risks and opportunities: Wealth growth could revolutionize the sector

Food producers are impacted both by the effects of climate change, and by

legislation to limit climate change effects. Regulatory and reputational risks are high for this sector as it is a significant high emitter of CO₂, whereas climate change brings physical risks which could directly impact raw materials and supply chains.

Food and agricultural production have been estimated to generate between 30 percent⁴ and 50 percent⁵ of all manmade greenhouse gas emissions. The majority of this is attributed to livestock but land use change is also a major contributor. Meat and dairy production represent a large net contribution to greenhouse gas (GHG) emissions due in part to the food chain required to support farming. Additionally, industrial livestock feeding operations create methane emissions, a more potent GHG than carbon dioxide (though shorter lived in the atmosphere).

The supply chains of food industries are directly impacted by climate change. Expected climate change effects include global temperature change, altered

Figure 44: Projected climate change impacts on agriculture, forestry and fisheries

| Phenomenon and direction of trend in weather and climate events | Possible impacts on agriculture, forestry, fisheries and ecosystems |
|--|---|
| Warmer and fewer cold days and nights; warmer and more frequent hot days and nights over most land areas (virtually certain) | Increased yields in colder environments; decreased yields in warmer environments; increased insect pest outbreaks |
| Warm spells and heat waves increasing in frequency over most land areas (very likely) | Reduced yields in warmer regions due to heat stress; increased danger of wildfire |
| Heavy precipitation events increasing in frequency over most areas (very likely) | Damage to crops; soil erosion; inability to cultivate land due to waterlogging of soils |
| Drought-affected area increases (likely) | Land degradation and soil erosion; lower yields from crop damage and failure; increased livestock deaths; increased risk of wildfire; loss of arable land |
| Intense tropical cyclone activity increases (likely) | Damage to crops; uprooting of trees; damage to coral reefs |
| Extremely high sea levels increase in incidence (excludes tsunamis) (likely) | Salinization of irrigation water, estuaries and freshwater systems; loss of arable land and increase in migration |

Source: Food and Agriculture Organization of the United Nations. (FAO). (2008). Climate Change Adaptation and Mitigation in the Food and Agriculture Sector. Technical background document from the expert consultation held in Rome.

³ See Appendix 1 for methodology

⁴ FAO. (2010). *Organic agriculture and climate change*.

⁵ Goodland & Anhang. (2009). *Livestock and Climate Change*.

weather patterns (drier arid areas and wetter tropical areas), extreme weather events increasing in intensity and frequency, increased atmospheric CO₂, droughts, rising sea levels, saltwater intrusion, coral bleaching, increased pestilence and changing migration patterns.⁶ According to the International Food Policy Research Institute (IFPRI):

‘In more than 40 developing countries – mainly in Sub-Saharan Africa – cereal yields are expected to decline, with mean losses of about 15 percent by 2080. Other estimates suggest that although the aggregate impact on cereal production between 1990 and 2080 might be small – a decrease in production of less than 1 percent – large reductions of up to 22 percent are likely in South Asia. In contrast, developed countries and Latin America are expected to experience absolute gains.’⁷

The magnitude of these effects could differ on a regional and local level, making global solutions difficult. Yet the potential for disruption is considerable: supply chain disruptions and failures, crop destruction, altered consumer demand, threats to physical assets and interrupted distribution networks.⁸ Low-income countries with limited adaptive capacities to climate variability and change may face significant threats to food security.⁹

The sector is exposed to Water Scarcity risks.

Estimates of additional water requirements to meet future demand for agricultural production under climate change scenarios vary from 40–100 percent of the extra water that would be needed in the absence global

warming.¹⁰ Water demand increases not only due to population growth, but also due to the rise of the middle class in developing countries. Food consumption patterns are changing accordingly, as people eat less staple carbohydrates, and demand more luxury food products such as milk, meat, fruit and vegetables. This change will increase demand for water, as these products require more water in the production process. The livestock sector is a key driver in increasing water use: in 2006 the FAO reported that the livestock sector accounted for 8 percent¹¹ of global human water use, mostly for the irrigation of feedcrops (the production of a kilo of beef requires 15,500 liters of water compared to a kilo of wheat which consumes 3,400 liters of water).¹²

In addition, Food Producers directly affect the quality of freshwater in the regions in which they operate. Nitrogen and phosphorus fertilizers leach into waterways, causing “dead zones” – low-oxygen areas incapable of supporting aquatic life.

Disruptions in water supply would have an impact on farmers, suppliers, operations, and customers. Poor water management and increased competition could pose financial, regulatory and reputational risks to firms and would have an impact on population health, political stability and economic growth in countries. For these reasons, companies should start looking into possibilities of using more reclaimed water in their production processes.

Water scarcity and **Ecosystem Decline** could lead to shortages in food supply in regions such as Africa within 10-15 years. According to the FAO, by 2025,

“ Poor water management and increased competition could pose financial, regulatory and reputational risks. ”

⁶ IPCC. (2007). Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

⁷ von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions*.

⁸ Wong & Schuchard. (2011). *Adapting to Climate Change: Guide for the Food, Beverage and Agriculture Industry*.

⁹ von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions*.

¹⁰ FAO. (2008). *Climate change, water and food security*

¹¹ Food and Agriculture Organization of the United Nations. (2006). *Livestock's Long Shadow*.

¹² Oxfam. (2011). *Growing a better future, Food justice in a resource-constrained world*.

“ Globally, an estimated 25 percent of agricultural soil has been substantially degraded in quality. Soil productivity in developing countries has declined by approximately 16 percent. ”

1.8 billion people could be living in countries or regions with absolute water scarcity, and two thirds of the world population could be under water stress conditions. Furthermore, the World Bank indicates that China may have a supply shortfall of 201 billion cubic meters by 2030 and 1.2 billion people in India, where farmers use 80 percent of available water, are predicted to exhaust their fresh-water supplies by 2050 at the current rate.

Degradation of agricultural soil

Globally, an estimated 25 percent of agricultural soil has been substantially degraded in quality. Soil productivity in developing countries has declined by approximately 16 percent.¹³ Soil degradation is caused by a number of factors: overgrazing (35 percent), agricultural activities (28 percent), deforestation (30 percent), overexploitation of land to produce fuel (7 percent), and industrialization (4 percent).

Population growth will generate the sector’s most significant risks and opportunities.

The UN expects the world’s population to reach approximately 8.4 billion by 2032.¹⁴ This growth presents multifaceted pressure on and opportunity for the food sector to meet global nutritional needs. The bulk of growth is expected to occur in developing nations, many of which currently lack food security. For example, according to IFPRI, 22 of the world’s 34 most food-insecure countries experienced average annual population

growth rates of 5–16 percent between 2004 and 2006.¹⁵

The use of genetically-modified (GM) agricultural technology could significantly increase and stabilize yields, improve resistance to pests and diseases and protect against extreme weather. In 2010, 15.4 million farmers were growing these products. Developing countries grew 48 percent of global biotech crops in 2010 and are predicted to exceed industrial countries’ hectareage before 2015.¹⁶ Despite controversy over the use of GM crops and GM organisms in food production, especially in Europe and Japan, where concerns are raised about safety, health, environmental risks and food security, biotechnology could be a major tool in the fight against hunger and poverty, especially in developing countries.¹⁷

Wealth growth and **Urbanization** in OECD countries as well as developing countries fuels demand for high value products which are in most cases more ecologically intensive. In South Asia, for example, per capita rice consumption is declining, while dairy and vegetable consumption is projected to increase by 70 percent and meat consumption is expected to increase by 100 percent by 2025.¹⁸ According to IFPRI, “the composition of food budgets is shifting from the consumption of grains and other staple crops to vegetables, fruits, meat, dairy, and fish. The demand for ready-to-cook and ready-to-eat foods is also rising, particularly in urban areas.”¹⁹

As consumers become wealthier, they are also demanding products that are believed to enhance physical and mental health and well-being. Companies have

¹³ Coxhead & Oygard. (2007). *Land Degradation*.

¹⁴ United Nations Department of Economic and Social Affairs. (2004). *World Population to 2300*.

¹⁵ von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions*.

¹⁶ ISAAA. (2010). *Global status of commercialized biotech*.

¹⁷ FAO. (2002). *World Agriculture towards 2015/2030*.

¹⁸ von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions*.

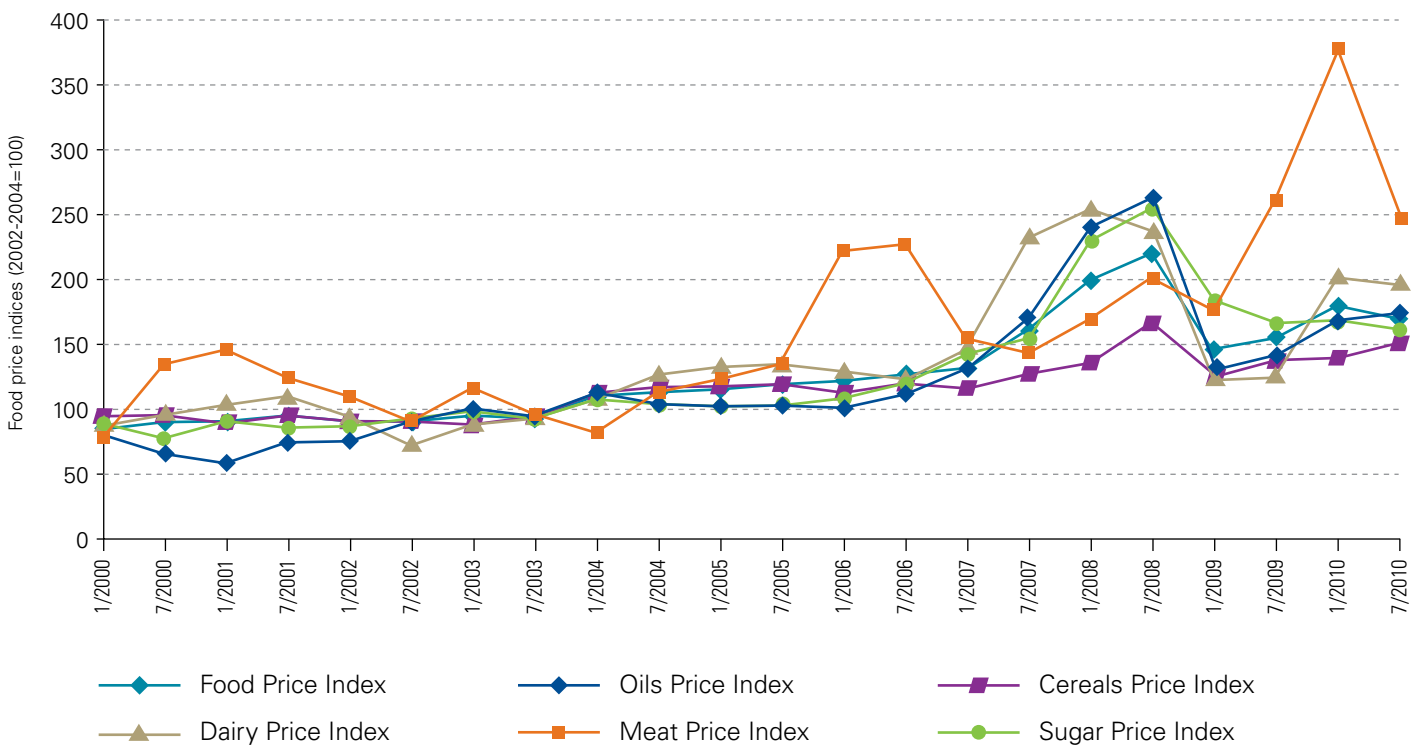
¹⁹ von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions*.

responded by introducing products with less fat and sugar. Food-related diseases such as diabetes and obesity are spotlight issues for the industry. Increased demand for health and wellness products, coupled with raised awareness of environmental and social issues, represents an opportunity to develop substantial new markets. The technological challenge will be to meet this demand without increasing livestock emissions and manage food security mainly in developing countries.

Agri-commodity prices are expected to rise and become more volatile as a result of **Material Resource Scarcity**, economic growth, shifting dietary requirements and changing biofuels policies. Companies and governments are minimizing the risks by securing their current and future agri-commodity supplies, while at the same time dealing with higher price volatility levels.²⁰

The Food sector is also exposed to **Energy & Fuel** volatility risks. Fossil fuel prices play a large part in determining

Figure 45: Commodity prices are becoming increasingly volatile



Source: KPMG. (2012). Based on Food and Agriculture Organization of the United Nations's Global Information and Early Warning System (FAO/GIEWS) database. Available at <http://www.fao.org/giews/>

²⁰ Rabobank (2011). *Rethinking the F&A supply chain, impact of agricultural price volatility on sourcing strategies*

“Companies are demanding higher environmental standards and certified products from their suppliers.”

transportation and processing costs, while modern industrial agriculture requires large inputs of fertilizers and pesticides derived from fossil fuels. Nitrogen fertilizers are typically manufactured from natural gas or coal and are thus subject to energy price fluctuations.

Many agricultural and food products companies have recognized environmental threats and implemented measures to lessen impacts.

- Food companies have started to incorporate water management into their production processes. For example, to protect water supplies in India, Unilever harvests rainwater at a quarter of its factories and has plans in place to spread this program to all sites.²¹ Nestlé has reduced water consumption over the past decade by 33 percent, while increasing its food and beverage production volume by 63 percent.²²
- Companies are demanding higher environmental standards and certified products from their suppliers. Food companies are often supporting programs that help farmers to earn a sustainability certificate. For example, Mars Inc. has set a goal of using only certified, sustainable cocoa in all its products by 2020 and is investing in programs that foster innovation in agricultural science, transfer key technologies to farmers and enable effective collaboration between farmers, manufacturers, governments and NGOs.²³
- Research from the Food and Agriculture Organization shows the importance and effectiveness of dealing with climate change problems on a local level, where

farmers are taught and supported to incorporate sustainable methods in farming. In 2010, Walmart launched a global commitment to sustainable agriculture, aiming to support farmers and their families produce more food with fewer resources and less waste, and sustainably source key agricultural products.²⁴

Disclosure and reporting: Water scarcity needs more attention

According to research undertaken for the KPMG International Corporate Responsibility Reporting Survey 2011, the Food sector has an overall reporting rate of 65 percent. In Western Europe and North America the reporting rate is at 84 percent, but drops down to 56 percent in South America and 30 percent in Asia Pacific (only 15 percent in Asia alone). Smaller companies with revenues below US \$1bn have low reporting levels (49 percent), rising to 75 percent for companies above US\$1bn.

Based on the survey analysis, the sector scores below average on reporting quality in terms of the maturity of communication and reporting process. To bring the reporting quality on par with the leading sectors the sector needs to better demonstrate how sustainability integrates with its core business and also to improve reliability and accountability in reporting.

For a majority of food companies (60 percent) the business imperative of sustainability programs is in differentiating their brand. Further, a modest 43 percent of the reporters have identified sustainable or green products. However, only a minority (18 percent) report the business value of their sustainability initiatives, whether through cost savings or actual financial gains

²¹ Wong & Schuchard. (2011). *Adapting to Climate Change: Guide for the Food, Beverage and Agriculture Industry*.

²² Toops. (2011). *Top Food and Beverage Companies: Leaders in Sustainability*.

²³ Mars, Inc. <http://www.mars.com/global/brands/cocoa-sustainability-home.aspx>

²⁴ Walmart. (2010). *Walmart Unveils Global Sustainable Agriculture Goals*.

in revenues or market opportunities. As current consumer demand broadens from functional health products and convenience packaging to more socially and environmentally driven organic, eco-products or ethically-sourced products, the pace of market-oriented innovation is likely to accelerate. Compared to other sectors, food sector has a surprisingly low number of reporters (18 percent) that consider sustainability to drive innovation.

As discussed above, water scarcity is a major issue for the Food sector, but only 70 percent of corporate responsibility reports address water, substantially lower than in the Automotive (80 percent) or Chemical (88 percent) sectors. Three quarters of these companies report on initiatives related to treatment or reducing consumption of water. However, less than one third discuss adapting to changes in water availability and mitigating the impact of water scarcity on the company and its stakeholders.

Food companies often operate within a long and complex chain of growers, producers, processors and marketers. Yet supply chain issues are discussed in only 61 percent of reports. Around half of these report the active management of suppliers by using sustainability codes in auditing suppliers to monitor their adherence to sustainability practices.

Summary: Broader research and development and policy readiness is needed

The Food sector needs to continue to invest in new technologies to improve agricultural systems. This means that

food producers should not only focus on increasing yields through the use of GM products, but also to widen the scope of R&D investment to improve resource use and security.

An important area for development is waste avoidance. A study from the Swedish Institute for Food and Biotechnology (SIK) for the FAO showed that roughly one-third of food produced for human consumption is lost or wasted globally. In more developed countries food is mostly wasted in consumption stages while in lower income countries food is lost in mainly the early and middle stages of the food supply chain.²⁵ This means that solutions in the middle and higher income countries lie in consumer education and information, while in the developing countries the solution may lie in informing farmers and producers on new techniques to prevent food loss.

Companies should increase the level of commodity certification: certified products attract a premium price, allowing primary producers to invest in new technologies and increase productivity.

The role of governments and international organizations in addressing sustainability in the food sector will become more important as food insecurity increases and the impact of climate change becomes more apparent. Policymakers will focus on farmers, food processors and on consumers: the competitive opportunity for food companies lies in preparing for and supporting the process of finding these solutions.

“An important area for development is waste avoidance. Roughly one-third of food produced for human consumption is lost or wasted globally.”

²⁵ FAO. (2011). *Global food losses and food waste*.



Marine Transportation

Sustainability is a competitive response to industry crisis

Survival in the Marine Transportation industry is dependent on designing, building, and operating ships cost-effectively which in recent years has translated into increasingly larger vessels. These offer efficiency gains which improve sustainability performance. The industry as a whole also faces increased risks from secondary impacts of sustainability megaforges.

Exposure to Global Sustainability Megaforges

Highly exposed to: Climate Change; Energy & Fuel and Population Growth

Potentially exposed to: Ecosystem Decline; Food Security and Urbanization

Marine transportation environmental impact

There is likely to be increasing pressure over the next 20 years for the price of resources, products and services to

reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake. In the case of the Marine Transportation sector, their data suggests that the environmental impact in 2010 amounted to approximately US\$15.7 billion and would account for 59 percent of sector earnings.¹

“Survival in the Marine Transportation industry is dependent on designing, building and operating ships cost-effectively.”

¹ See Appendix 1 for methodology

These figures are hypothetical in that they assume business may in the future be required to bear the full environmental costs of their operations – but by making this assumption they provide an indication of the potential value at stake. In reality, it is likely that such costs would be passed on – at least in part – to end users rather than being borne by the shipping companies alone.

Trends, risks and opportunities: Climate change and growth stress are key

Extreme weather or changing sea levels due to **Climate Change** could cause delays, cancellations, accidents and route closures as well as causing damage to port infrastructure. A recent study by WWF estimated that, assuming a sea level rise of 0.5 meters by 2050, the value of exposed assets in 136 port mega-cities will be as high as US\$28 trillion.² This strengthens the case for the use of sophisticated weather routing which both reduces the risk of damage from storms and saves fuel.

Additionally, the impact of global sustainability megafactors on food production could in turn affect demand for marine transportation in the future. For example, in 2007 a decline in wheat production brought about by poor weather conditions led to a 10 percent fall in the volume of dry goods transported by sea.³

Marine Transportation is vulnerable to greenhouse gas regulatory risk as total emissions from the industry are increasing over time. Relative carbon emissions per ton of fuel or per mile are improving as larger, more efficient ships come into service and slow-speed steaming becomes more widely adopted but this is offset by the increase

in demand for shipping being driven by globalization. Gains from slow steaming are likely to be lost as freight rates pick up from their current lows, which will likely result in shipping lines increasing vessel speeds again to meet demand.

The sector is estimated to have emitted 1,046 million tons of CO₂ in 2007, approximately 3.3 percent of global emissions. However, mid-range scenarios show that, in the absence of mitigating policies, expected growth in demand for marine transportation may increase emissions by between 150 percent and 250 percent from 2007 levels.⁴

The International Maritime Organization (IMO) is taking steps to control greenhouse gas emissions from international shipping and encourage cleaner, more fuel-efficient maritime transport by enacting emissions standards like low sulfur directives.⁵ There has been some progress in reducing emissions of greenhouse gases and other pollutants, although this has been primarily through reduced trade levels as a result of the economic downturn rather than the implementation of the IMO's regulations.

The evolution of emissions legislation and continued competitive pressure is likely to force shipping lines to look even more critically at their operations in order to maximize efficiency but it is still unclear how and when broad-ranging emissions legislation for the maritime sector will be implemented. Legislation at present remains a patchwork of local and national standards and regulations. A global approach via the IMO is generally regarded as the better option but in the absence of significant progress regional initiatives may fill the gap. Most notably, the European Commission is considering carbon

“ Climate Change could cause delays, cancellations, accidents and route closures. ”

² WWF. (2009). *Major Tipping Points in the Earth's Climate System and Consequences for the Insurance Sector*

³ United Nations Conference on Trade and Development (UNCTAD). (2011). *Review of Maritime Transport*.

⁴ International Maritime Organization (IMO). (2009). *Prevention of Air Pollution from Ships*. IMO, London.

⁵ Ibid

“Skillful carbon management combined with fuel efficiency could lead to increases in profitability.”

pricing options for shipping such as inclusion of shipping in the EU ETS. It is also important to note that significant progress has been made by the IMO on regulating the emissions of new ships through the recently agreed Energy Efficiency Design Index (EEDI).

The EEDI is intended to stimulate continued development of all components influencing the fuel efficiency of a ship; and by separating the technical and design-based measures from the operational and commercial ones to improve the design efficiency of all new cargo vessels. The EEDI uses a vessel's CO₂ emissions and its transport characteristics (deadweight tonnage, speed, installed power) to assess its energy efficiency. However, its current environmental impact is limited given it only applies to new ships; it only incentivizes design

improvements and not improvements in ongoing operations.⁶

As the regulatory framework develops, shipping companies could be exposed to either a market-based mechanism or a price levy on carbon emissions. In both cases, the sector will need to bolster its capabilities in carbon pricing and trading, and in understanding and operating within a carbon-legislated market. Skillful carbon management combined with fuel efficiency could lead to increases in profitability within a carbon constrained legislative environment. The continued tightening of permissible sulfur levels in marine diesel fuel in the EU (North Sea and Baltic), Canada and the US (Eastern Seaboard and Caribbean) is one example of how regulation continues to become more stringent.⁷ There are calls for similar legislation to be enacted in other parts of the world.

Figure 46: Global GHG mitigation potential from marine transportation

| Sector | Category | Measure | Reduction under BAU conditions (% in 2050) | Additional reductions from BAU emissions (% in 2050) | Combined reduction potential (% in 2050) |
|--------|--|--|--|--|--|
| Marine | Operations | Speed reduction, Optimized routing, Reduced port time | 20 | 27 | 47 |
| | Ship design and propulsion | Novel hull coatings, propellers, Fuel efficiency optimization, Combined cycle operation and multiple engines | 20 | 17 | 37 |
| | Alternative fuels and power | Marine diesel oil (MDO), Liquefied natural gas (LNG), Wind power (sails) | 2 | 38 | 40 |
| | Total reduction from BAU emissions in 2050 | | | 62 | |

Source: The Center for Climate and Energy Solutions, formerly the Pew Center on Global Climate Change. (2009). Greenhouse Gas Emissions from Aviation and Marine Transportation: Mitigation Potential and Policies. Available at www.c2es.org.

Notes on chart:

*Business-As-Usual (BAU) reductions are the expected efficiency improvements and corresponding GHG reductions under a business-as-usual scenario. Additional reductions are those emission reductions that can be achieved under more aggressive technology penetration and alternative fuel use scenarios; they are shown as percentage reduction in 2050 emissions from the BAU baseline.

* Technological and operational mitigation potentials are based on McCollum, Gould, & Greene's calculations. Marine estimates are from MARINTEK (2000), and BAU projections from IMO (2008).

⁶ Ibid

⁷ European Union Fuel Directive (2010)

Figure 46 depicts the sector's potential to reduce its emissions. Some of the industry's major players and suppliers have invested heavily in increasing competitiveness through the construction of larger ships which reduce operating costs, the development of more efficient power plants and the adoption of slower speeds. These measures have reduced costs and carbon emissions; however as exposure to regulatory and physical risks continues to rise, concrete steps are needed to raise the improvement level from 'business-as-usual' levels to the higher level of mitigation associated with more aggressive technological and organizational innovation. Rising cost of fuels will add strength to the commercial business case for energy efficiency investments.

Exposure to energy and fuel price volatility

Shipping, which handles over 80 percent of world trade by volume, is almost wholly reliant on oil and has to date not adopted alternative types of fuels.⁸ The majority of cargo vessels continue to burn relatively low-grade bunker oil, which is more polluting than higher grade oils.⁹ Rapid growth in global trade over recent decades was powered by easily available and affordable oil supplies but the Marine Transportation industry, along with others, must now deal with volatile fossil fuel prices as oil becomes more costly and difficult to extract and supplies become more vulnerable to disruptions. The cost of fuel combined with the likelihood of further emission regulations for sulfur, carbon and soot ('black carbon') could push the industry to implement further efficiency measures and increase

the use of cleaner-burning fuels such as distillates and liquefied natural gas (LNG).

Within the Marine Transportation sector, there is significant potential for energy efficiency gains and emissions reductions. Major shipping lines, in consultation with naval architects, academia and power plant manufacturers are developing new energy efficient technologies from improved electronic engine management systems to streamlined hull designs and friction-reducing paints. The more novel technologies being developed include a towing kite to harness wind power for merchant vessels, which is currently being extensively trialed by Cargill.¹⁰ Hybrid propulsors, ballast water-free ship design and advanced air bubble lubrication systems for hull designs are also being developed (potential 10 percent reduction in fuel burn).¹¹

Larger vessels are also part of the solution. A family of the largest container vessels in the world featuring the latest in marine diesel engine technology and hull improvements has recently been commissioned.¹² They will be followed in 2014 by an even larger and more fuel-efficient class of ships.¹³ The trend in bulk carriers has also been towards larger vessels: the higher payload coupled with fuel burn comparable to smaller vessels allows for significant efficiency improvements.¹⁴

Population Growth and Wealth

growth in developing nations – primarily in Asia – are likely to strain existing ports and harbors. China's unprecedented demand for raw materials has driven a boom for iron ore from Australia and

“Rising cost of fuels could add strength to the commercial business case for energy efficiency investments.”

⁸ United Nations Conference on Trade and Development (UNCTAD). (2011). *Review of Maritime Transport*.

⁹ Basdani, E. L. (2011). *LNG Use as a Maritime fuel: Environmental Challenges and Perspectives*. Piraeus, Greece: Department of Shipping & Transport.

¹⁰ www.cargill.com

¹¹ *Technology Outlook 2020*. Oslo, Norway: Det Norske Veritas. (2010).

¹² *Ship-technology.com* (2010, May 23).

¹³ *Dispatchcontrol.com* (2011, February 21).

¹⁴ IBIS World. (2010). *Industry Report: Global Logistics – Shipping*.

“ Less than 20 percent of the reporting companies discussed sustainability products or disclosed financial benefits of sustainability. ”

Brazil and its export-oriented economy has driven East-West container traffic to record levels.¹⁵ Moreover, as the middle class in China grows, the nation's role may shift from being a mass exporter of finished goods to a net importer, sourcing its goods from other lower-cost Asian countries and Africa.¹⁶ These trends, while good news for the sector in a commercial sense, will present challenges through associated increases in emissions and other environmental impacts as well as increasing marine overcrowding.

Shipping and related marine infrastructure can contribute to marine disturbances, erosion, oil spills and **Ecosystem Decline**. Other environmental and health risks of the shipping industry include transportation of contaminated dry goods and delivery of aquatic nuisance species (ANS) from ballast water. This may cause increased species competition along with changes in habitats, species interactions, and community structure. The sector is therefore potentially exposed to any future regulation focused on the protection of ecosystems.

Reporting & disclosure: Room for improvement

Based on research conducted for the KPMG International Survey of Corporate Responsibility Reporting 2011, the reporting rate of the Marine Transportation sector is 60 percent: one of the lowest reporting levels among the 11 sectors studied for this report. Although the largest companies with revenues above US\$10 billion have a near-perfect reporting rate, the rate drops significantly to 38 percent for

smaller companies below revenues of US\$1 billion. Companies in Asia, where the largest proportion of Marine Transportation companies are located, have a reporting rate of 69 percent. Less than 20 percent of the reporting companies discussed sustainability products or disclosed financial benefits of sustainability.

KPMG's analysis shows that Marine and Airlines, score below average among the 11 sectors under review in their quality of disclosure and reporting. These below-average scores were due to low quality of communication and absence of sustainability information systems and controls. To improve these scores the Marine Transportation sector would need to develop a communications strategy, integrate sustainability with core business, use GRI-type reporting guidelines, and implement reliable information systems with improved governance and assurance to bring the reports on par with other sectors.

Summary: Sustainability is a solution, not a cost

Despite the aftermath of the 2008 financial crisis which had far-ranging implications for the Marine Transportation sector, ship-borne trade should maintain its dominant position as a lynchpin of the global economy as it remains the only cost-effective way of shipping many goods across oceans.

In terms of its sustainability impact, the industry has historically been loosely regulated but legislation in the areas of fuel quality and emissions standards are likely to become more stringent and

¹⁵ Various. (2011, December 9). *Mining: Ore*. Retrieved January 11, 2012, from News: <http://www.mining.com/2011/12/09/chinas-iron-ore-demand-to-reach-1-13-billion-tons-by-2015/>

¹⁶ Various. (20 May 2011). *Marine Solutions*. Retrieved 16 Jan 2012, from Wartsila Corporate: http://www.wartsila.com/en_CN/marine-solutions/segments/merchant.

globally coordinated. To be successful in meeting these standards, companies will need to adopt proactive and innovative strategies on issues such as long-term fuel sourcing and energy security, emissions standards and overall sector environmental impact.¹⁷ Environmentally responsible maritime operations often benefit from lower operational costs, most notably from fuel savings.¹⁸

The trend towards larger and more efficient container vessels is likely to continue until the constraints of port infrastructure and congestion in shipping channels preclude any further growth. Bulk carriers however seem to have reached their viable size limits for the foreseeable future; draft limitations already prevent the largest bulkers from mooring in all but a few ports. The recent introduction of the largest bulkers ever built, has placed tremendous pressure on bulk freight rates, with competitors predicting rates will drop so low¹⁹ that sector recovery from the 2008 financial crisis will take longer than initially expected.

Regulators, certification bodies, naval architects, shipyards, power plant manufacturers, owners and operators alike all have a part to play in positioning the industry for sustainable growth. The process would be helped by clear and consistent emissions standards, market-based or otherwise. Sustainable

shipbuilding processes incorporating fuel-efficient engines burning clean fuels and heat-recovery systems would enable cleaner operations. Optimized speeds and routings while vessels are in revenue service coupled with responsible handling of ballast waste and sewage would also help sustainable operation.

When a vessel has reached the end of its economic life, scrapping must be done in an environmentally friendly manner to minimize damage to surrounding ecosystems but also to ensure that there is a minimum of wastage (and maximum recycling) in components and shipbuilding materials.²⁰ Container shippers in particular, which are frequently integrated in their customer's supply chains, need to continue to work with both supply chain partners and end-users in reducing environmental impacts across the value chain. While sustainability in and of itself is not a cost, the potential upside of burning less fuel and adopting other sustainable business practices may represent an attractive proposition against a background of an unusually high level of overcapacity and competitive pressures. Going forward, a shipping line that is actively monitoring both its costs and by extension, its environmental impact, may be able to derive competitive advantage from this.

“Environmentally responsible maritime operations often benefit from lower operational costs, most notably from fuel savings.”

¹⁷ *Technology Outlook 2020*. Oslo, Norway: Det Norske Veritas. (2010).

¹⁸ Various. (20 May 2011). *Marine Solutions*. Retrieved 16 Jan 2012, from Wartsila Corporate: http://www.wartsila.com/en_CN/marine-solutions/segments/merchant.

¹⁹ (BusinessWeek, April 2011)

²⁰ *Sustainable Shipping Initiative: Vision 2040*. (2011).



Mining and Industrial Metals

Sustainability a challenge in frontier regions

Meeting the increasing demand for mining and metals products presents companies in the sector with unique risks and opportunities arising from issues related to sustainability. Meeting demand is a critical issue due to risk pressures including dwindling global reserves, increasing project complexity and government intervention and changing stakeholder needs around environmental and social issues.

Mining exploration and production activity is increasingly expanding into virgin or under-exploited territories, which are often remote and politically unstable and with high levels of unemployment and skills shortages. In these unstable environments, access to input resources such as water, energy and land can be unreliable and where available, costly to procure and retain. Success for mining companies requires respect for local social, economic and cultural practices.

For Mining & Industrial Metals (Mining & Metals) companies to win and

retain their licenses to operate, it is increasingly important for them to be seen not only as levers for national economic growth but also as making a meaningful contribution to social-economic wellbeing of local economies.

Exposure to Global Sustainability Megaforges

Highly Exposed to: Climate Change; Material Resource Scarcity; Energy & Fuel; Water Scarcity and Wealth

Potentially Exposed to: Ecosystem Decline; Urbanization and Deforestation

Mining & Metals environmental impact

There is likely to be increasing pressure over the next 20 years for the price of resources, products and services to reflect the full cost of their production – including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource and water scarcity. Possible

“ Meeting demand is a critical issue due to risk pressures including dwindling global reserves, increasing project complexity and government intervention. ”

futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake.

In the case of the Mining sector, their data suggests that the environmental impact in 2010 totalled US\$86 billion and would account for 64 percent of sector earnings. For Industrial Metals, the environmental impact for 2010 is estimated by Trucost at just over US\$69 billion and would account for 71 percent of sector earnings.¹

These figures are hypothetical in that they assume business may in the future be required to bear the full environmental costs of their operations, but by making this assumption they provide an indication of the potential value at stake. Mining companies that respond by reducing their environmental costs could carve out competitive advantage by doing so.

***Trends, risks and opportunities:
New operational curbs are a
near certainty***

The Mining sector is a substantial contributor to greenhouse gas (GHG) emissions, responsible for approximately 2 percent of global emissions.² The sector is highly exposed to climate change risks and is likely to be increasingly affected by changing and complex frameworks of carbon legislation around the world.

For example, mining companies in South Africa are important stakeholders in achieving the national goal of reducing emissions by 34 percent below business-as-usual by 2020.³ The key

instrument - a proposed carbon tax is expected to be implemented in 2012 – is expected to have a significant effect on the cost of mining production. There are concerns it could make South Africa's export coal industry unprofitable and adversely impact employment in the country.

In Brazil, varying carbon reduction targets at national, state and municipal levels mean that mining companies must already manage complex compliance and monitoring, reporting and verification (MRV) challenges.

Given that the next 20 years are likely to see a plethora of new national, regional and possibly international carbon regimes, companies in the Mining & Metals sector have to prepare early. Industry leading practice dictates that companies should initiate a carbon management process by developing an inventory of GHG emissions and developing strategies for mitigation that is aligned with their business strategy, including the use of carbon markets. A structured carbon management process can function as a hedge against future regulations, while companies that adopt a wait-and-see policy – delaying until external stakeholders start to ask for carbon data – run the risk of having to develop GHG accounting systems almost overnight to comply with increasing demands for non-financial information.

Some leading Mining & Metals companies are already taking concrete actions to mitigate their exposure to climate change risks by investing in Clean Development Mechanism (CDM) carbon offset projects and the development of carbon abatement technologies such as carbon capture and storage (CCS).

The sector could face challenges from the physical impacts of climate change,

“ Given that the next 20 years are likely to see a plethora of new national, regional and possibly international carbon regimes, companies in the Mining & Metals sector have to prepare early. ”

¹ See Appendix 1 for methodology

² ICMM. (May 2011). *Preparing the global way forward for mining*.

³ National Reasury, Republic of South Africa. (December 2010). *Reducing Greenhouse Gas Emissions: The carbon tax option*.

“The transition to a lower-carbon electricity mix through increasing use of renewable energy can contribute to energy independence and lower emissions.”

particularly in areas sensitive to weather pattern changes. Temperature changes and extreme weather patterns have also been related to infrastructure issues such as tailings dam breakdowns and construction and operating problems in Chile, South Africa, China and Australia resulting in supply disruptions.⁴

Water Scarcity is a critical vulnerability

The Mining & Metals sector should consider planning for policy changes intended to encourage sustainable water use, such as water pricing that reflects the relative scarcity of the resource. This is already happening in Australia where regulators have required some mining operations to provide their own water supplies, for example from coastal desalination plants.

The process of mining requires large volumes of water which are usually sourced directly from local surface water and groundwater. Extracting one ton of ore can take up to 8000 liters of water.⁵ The viability of new and existing mining projects will increasingly be linked to how the management of a mine's water will impact the quantity and quality of supplies for local communities. Some companies are seeing projects rejected, closed or suspended on the grounds of the risk they pose to local water resources. Community protests against the Conga and Tia Maria mining projects in Peru are an example; the company involved in the Tia Maria project effectively lost its social and legal license to operate.

Water Scarcity threatens to be the 'Achilles heel' of mining companies operating in water-stressed regions. Variability in rainfall patterns may increase with the onset of climate change, leading to more competition for water supplies not only with local

communities but also with other industry sectors.

With **Population Growth, Wealth** and **Urbanization** all combining to put even more stress on water supplies, a lack of water could directly affect the capacity of the Mining & Metals sector to maintain or increase its current rates of production.

Energy & Fuel: Critical to competitive edge

Energy & Fuel price volatility is a key issue for the profitability of the sector. Energy and fuel accounts for up to 30 percent of total operating costs in the Mining & Metals sector making companies highly susceptible to volatility in prices.⁶ Energy cost and availability depends on location. Companies in South Africa, for example, have already experienced power supply challenges as the country has struggled to generate sufficient supply to meet both domestic and export energy demand through the conventional energy infrastructure. Multi-year electricity price hikes have put significant pressure on the operating costs of mining companies. The transition to a lower-carbon electricity mix through increasing use of renewable energy can contribute to energy independence and lower emissions.

Energy efficiency is a key consideration for firms. Companies in the Mining & Metals sector saw an improvement of around 25 percent in energy efficiency in the 2007-2008 period.

Wealth and inequality: Opportunity or threat?

There are increasing calls from governments and communities for the equitable distribution of wealth resulting from mining operations. This has translated into regulatory measures such

⁴ RiskMetrics Group. (2009). *Industry Overview: Non-Precious Metals & Mining*. New York, NY: RiskMetrics Group.

⁵ J.P. Morgan. (2008). *Watching water A guide to evaluating corporate risks in a thirsty world*

⁶ RiskMetrics Group. (2009). *Industry Overview: Non-Precious Metals & Mining*. New York, NY: RiskMetrics Group.

as royalty taxes in Australia, concerns around nationalization of the sector in South Africa and tax revisions in Peru. While the final form of regulation will vary across countries, it is clear that mining companies will face greater pressure to spread the positive externalities from mining. This presents risks to companies that fail to recognize that these issues have a material influence on their continued license to operate. Concurrently, it presents opportunities for progressive companies that aim to align their financial goals with the needs of the societies within which they operate.

Ecosystem Decline: A growing issue

Ecosystem Decline is an issue that mining companies may increasingly confront. Mayflies in the Appalachian Mountains, Harpy Eagles in Brazil, the birds of New Caledonia, and spawning salmon in Alaska are examples of

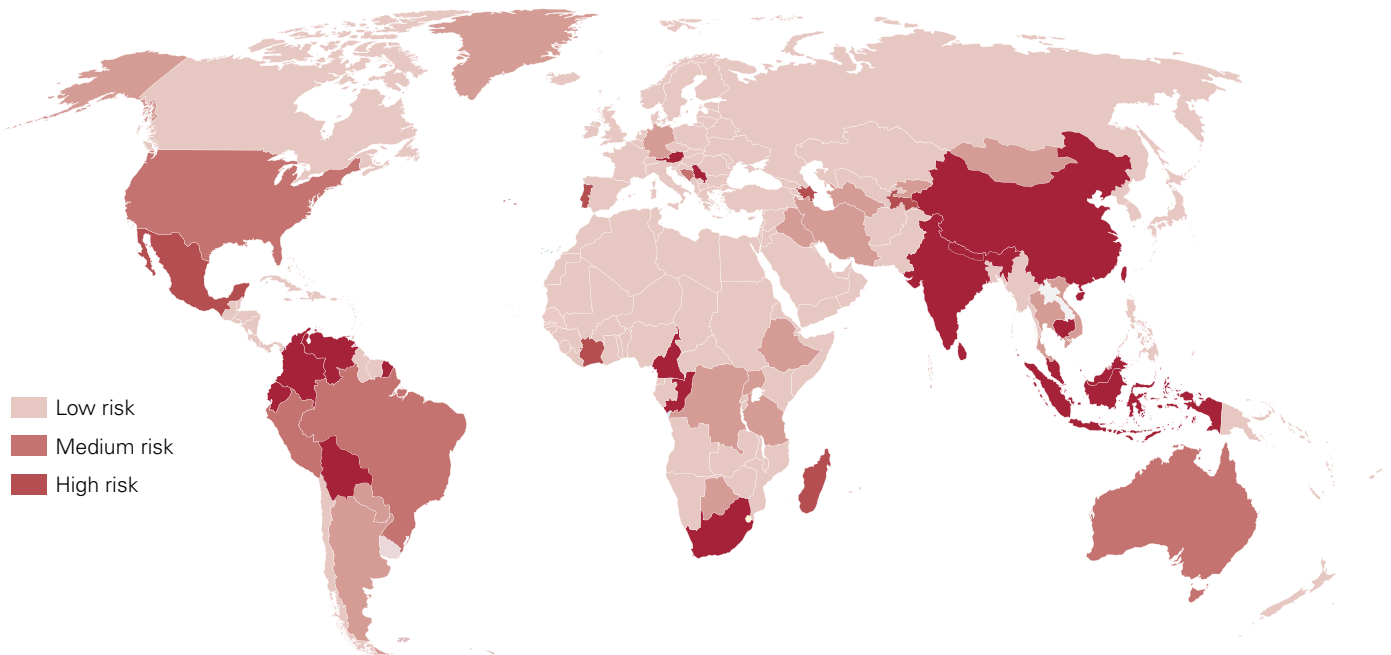
biodiversity issues being used by campaigners to restrict or stop mining and processing operations.⁷

As natural habitats deteriorate, resistance to mining operations that have an impact on vulnerable ecosystems is expected to grow. Companies that fail to adopt best practice in relation to ecosystems and biodiversity are expected to face challenges in their growth, performance and compliance. This issue could become increasingly challenging for the sector as many of the world’s remaining high-grade deposits are to be found in remote locations which, by their very nature, tend to be areas of high conservation value.

The map below shows where Mining & Metals companies incur the greatest risks and challenges linked to ecosystems and biodiversity.

“ Concurrently, it presents opportunities for progressive companies that aim to align their financial goals with the needs of the societies within which they operate. ”

Figure 47: Biodiversity risk for mining: MSCI 2010



Source: MSCI ESG Research. (2010). Industry Report: Metals and Mining, Non-Precious.

⁷ MSCI. (2010). *Industry Report: Metals and Mining, Non-Precious*. New York, NY: MSCI.

“These sustainability megaforges are likely to continue to grow in intensity exerting upward pressure on supplies and prices.”

Risk exposure is calculated on the basis of abundance and economic value of biodiversity, the fragility of the ecosystems and the amount of land in nature reserves.

Population Growth, Urbanization and Material Resource Scarcity: An engine driving demand

Population Growth, Urbanization and **Wealth** growth are together driving up demand for mining and metals commodities. China currently consumes as much as 35 percent of the world’s supply of base metals and is expected to play an even greater role in both supply and demand in the coming years as well as being able to dictate pricing more forcefully.⁸ These sustainability megaforges are likely to continue to grow in intensity exerting upward pressure on supplies and prices.

Mining companies are expected to face increasing challenges in meeting the growing demand for commodities. Commercially viable recoverable reserves are declining, while supplies of rare earth metals used in consumer electronics and other products are limited. China has placed export restrictions on its reserves. In order to find new reserves, companies must operate in locations that are more and more challenging: physically, technologically, culturally and politically. The long-term picture of Material Resource Scarcity suggests that as the availability of materials reduces, operational efficiency and effectiveness become ever-important to preserving

the profitability of operations. This prospect has been usefully explored by the World Economic Forum (WEF).⁹

Reporting and disclosure: Divergent results between sectors

Data collected for KPMG’s Corporate Responsibility Reporting Surveys 2011 and 2002 has been analyzed for the purposes of this report and revealed divergent results between the Mining and Metals sectors. Mining has increased its reporting rate from 31 percent in 2002¹⁰ to 84 percent in 2011; it ranks the highest among the 11 sectors included in the study.

Although the reporting rates benefit from having a strong base of businesses in the UK, Australia and South Africa (which have a strong tradition of sustainability reporting) the sector does well in all geographies barring a few exceptions such as India (40 percent) and Chile (60 percent). An overwhelming majority (94 percent) of the reporting companies address the issue of water in their sustainability reports, with most reporting on water treatment and reduction of water consumption. However only one third of these disclose their preparedness to deal with changes in water availability and a similar minority address the impact of water scarcity on their stakeholders.

The Metals sector does not perform so well in its sustainability reporting. In the KPMG survey 61 percent of metals companies issue a sustainability report.

⁸ RiskMetrics Group. (2009). *Industry Overview: Non-Precious Metals & Mining*. New York, NY: RiskMetrics Group.

⁹ World Economic Forum, *Mining & Metals: Scenarios to 2030* (2010)

¹⁰ KPMG. (2002). *International Survey of Corporate Responsibility Reporting 2002*. KPMG. (2011). *International Survey of Corporate Responsibility Reporting 2011*.

The reporting rate improves slightly with size of company: just over two thirds (67 percent) of companies with revenues above US\$5bn report. The rates are markedly lower in the Asia Pacific region (45 percent) where close to 40 percent of the Metals survey sample is located. Although water scarcity is one of the biggest challenges facing the metals sector, less than half (37 percent) of companies disclose a clear strategy to address this issue.

As the quality of reporting is increasingly a key determinant of the license to operate in both mining and metals, fuller reporting on key sustainability issues is likely to become a key issue for many companies in the sector.

Summary: More environmental controls could spell challenge and opportunity

Increasing economic, social and environmental challenges have made sustainability a defining feature of the Mining industry in the 21st century. Today's market conditions, characterized by increased regulation, shifting competitive landscapes, resource constraints and enhanced stakeholder expectations present unprecedented challenges, and opportunities for resource-intensive companies. Seen from this perspective, sustainability is aimed at creating value for mining organizations by aligning a company's financial interests with positive economic, social and environmental

outcomes in the context within which it operates. It implies that shareholders are no longer the only custodian of a company's fortunes. Rather, success and failure are determined by a company's ability to continuously meet the expectations of all its stakeholders, among whom are the national and local governments and the communities within which it operates, and its employees and customers.

The Mining industry has an opportunity to be a powerful enabler of development in regions that face increasing sustainability challenges. Changing patterns of competitive advantage in this resource constrained world will be determined by those industry players that take the lead in making proactive strategic decisions in this area. This places sustainability at the heart of a company's business model. Far from being a line function devolved to CSR departments, sustainability today defines a company's license to operate and warrants attention at the highest organizational levels. Companies that pursue short-term profits at any costs may find it difficult to compete with those that embed sustainability within the business model and recognise the substantial benefits of meeting today's key developmental challenges. Seen in this light, sustainability becomes a key driving force for growth, performance and compliance.

“Increasing economic, social and environmental challenges have made sustainability a defining feature of the Mining industry in the 21st century.”



Oil & Gas

Sustainability set to become key to competitive advantage

As the world population grows and emerging markets develop, Oil & Gas producers will experience rising demand for their products and services. However, depletion of easy reserves and growing competition with national oil companies (NOCs: which control roughly 80 percent of global proven oil and gas reserves)¹ have resulted in a gradual shift by private companies towards technically challenging environments such as the deep sea and unconventional resources such as shale gas and shale oil. The perceived risk profile within the industry is changing accordingly. According to the KPMG Energy Survey 2011, regulatory concerns are increasing: cited by 55 percent of Oil & Gas experts in 2011, compared to 33 percent in 2010. Moreover, perceived commodity price risk changed from 33 percent in 2010 to 41 percent in 2011.

Exposure to Global Sustainability Megaforces

Highly exposed to: Material Resource Scarcity; Ecosystem Decline

Oil & Gas environmental impact

There is likely to be increasing pressure over the next 20 years for the price of resources such as energy and water to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon pricing systems to more markets and higher carbon prices.

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant

“ Depletion of easy reserves and growing competition ... have resulted in a gradual shift by private companies towards technically challenging environments. ”

¹ "Deep water ahead? The outlook for the oil and gas industry in 2011", Economist Intelligence Unit, 2011

value potentially at stake. In the case of the Oil & Gas sector, their data suggests that the environmental impact in 2010 amounted to US\$152 billion and would account for 23 percent of sector earnings.²

These figures are hypothetical in that they assume business may in the future be required to bear the full environmental costs of their operations, but by making this assumption they provide an indication of the potential value at stake. In reality it is likely that such costs would be passed on, at least in part, to end users rather than being borne by the producers alone.

Trends, risks and opportunities: Growth and GHG regulation are critical megaforce risks

Population Growth and rising living standards in China, India, Brazil and other key emerging markets have driven competition for resources with the US, Europe and other developed regions. For Oil & Gas companies, competition usually means resource competition against a background of **Material Resource Scarcity**. As a result unconventional sources of fossil fuels are increasingly at a premium.

KPMG's Energy Survey 2011 reveals growing interest in shale gas and oil: 44 percent of respondents believe these to be the energy sources that will see the most future investment (the corresponding figure was less than 1 percent in 2010). Shale gas will represent 65 percent of US gas production by the 2030s, up from an estimated 43 percent by 2015.³ A secondary resource challenge is the shortage of vital materials needed for retrieving unconventional fossil fuels. Guar gum, for example, is an important input in hydraulic fracturing work. Although oil and gas producers have

long been consumers of guar gum, the recent boom in shale gas and shale oil drilling has dramatically increased demand for guar and led to significant price increases.

However, Oil & Gas companies have been active in mitigating the threats of resource depletion, mainly through acquisition of smaller firms and increased investments in exploration and production (E&P). According to estimates from Barclays Capital, global E&P spending in 2012 will reach US\$598 billion, a 10 percent increase from the previous record of US\$544 billion in 2011.⁴ These estimates suggest E&P spending will continue to escalate, especially as the production from existing wells declines, as demand continues to grow and as projects become increasingly complex and risky.

Recent discoveries of new deepwater offshore oil and gas fields, for example off Brazil and in the Gulf of Mexico, have created new growth opportunities for the industry. The industry has longstanding experience in deepwater exploration and production but in the wake of the Macondo Prospect disaster in 2010, many oil companies are reevaluating their risk profiles and disaster control processes. The industry is taking steps to mitigate the risk of these "high-impact, low probability" events from occurring.

Uncertainty about the future of climate change regulation

Although there is uncertainty about the future of climate change regulation, numerous countries already have specific regulations or proposals in place. One such example is China: as part of its 12th five year plan, China is planning to launch an experimental cap-and-trade system, to reduce energy intensity by 40-45 percent by 2020.⁵

“A secondary resource challenge is the shortage of vital materials needed for retrieving unconventional fossil fuels.”

² See Appendix 1 for methodology

³ "The Economic and Employment Contributions of Shale Gas in the United States", IHS Global Insight, December 2011

⁴ Bowman, "Global 2012 E&P Spending Outlook", Barclays Capital, 2011

⁵ "China's Policies and Actions for Addressing Climate Change", Information Office of the State Council, The People's Republic of China, November 2011, Beijing, http://www.gov.cn/english/official/2011-11/22/content_2000272.htm

“ KPMG’s International Survey of Corporate Responsibility Reporting 2011 indicates that the Oil & Gas sector has an overall reporting level of 69 percent. ”

and invest more than US\$ 5.3 trillion RMB – about US\$842 billion at current exchange rates – to stimulate clean energy deployment and improve energy efficiency. China also plans to generate 15 percent of its electricity from non-fossil fuel sources by 2020.⁶ The cap-and-trade approach has not met with the same level of success in the industrialized countries. The EU ETS has been implemented, but has, to date, not yet succeeded in driving down emissions. A clear and consistent approach as to how emissions are regulated needs to be established in order for such a system to be effective.

The emergence of an effective system may present opportunities for the oil & gas sector. Companies with trading capabilities can generate significant profits in CO₂ markets, and arbitrage opportunities are available to companies that abate emissions.⁷ Commercialization of second and third-generation biofuels has proved more difficult than first expected, but they have proven to be competitive with oil in some instances. Royal Dutch Shell has recently initiated a joint-venture with Cosan, one of Brazil’s major sugar cane producers, that will create a substantial ethanol-based biofuel player.⁸ For example, in the United States, the production of ethanol using widely available cellulosic materials could more than double the yield per acre of biofuel production compared to first generation fuels (such as corn ethanol).⁹ This method of biofuel generation could mitigate the land and water intensity problems commonly associated with earlier biofuels, and reduce the volatility of biofuel costs by using non-food alternatives as feedstock.¹⁰

In a growing unconventional fossil fuel market, **Water Scarcity** is another risk factor. Hydraulic fracturing, or fracking,

is an extraction technique which involves the use of large volumes of water mixed with sand and chemicals, has the potential to contaminate groundwater resources and damage fragile ecosystems by releasing sulfur oxides, nitrogen oxides, hydrocarbons and fine particulate matter into the atmosphere. In addition, large tailings ponds, where water and minerals are stored after oil is separated, contain toxins that can leak into groundwater sources. Oil & Gas producers face risks of their license to operate being jeopardized or revoked in ecologically sensitive and water-stressed areas.

Reporting and disclosure: A near perfect reporting rate, but lacking in some details

Research conducted for KPMG’s International Corporate Responsibility Reporting Survey 2011 indicates that the Oil & Gas sector has an overall reporting level of 69 percent. The largest oil companies with revenues over US\$50bn have a near perfect reporting rate of 95 percent and provide an example for smaller private firms and for large state and family-owned NOCs (which were outside the scope of the study) to improve on their sustainability performance.

The sector achieves a high quality of reporting, based on the quality of communication and the maturity of the reporting process and information systems. It ranks among the leading cluster of sectors, including Mining, Oil & Gas, and Electricity, which outperform in terms of professional quality and accountability.

Disclosure quality, however, is not an indication of sector readiness to face the sustainability challenges outlined in this report. The sector has significant opportunity to improve further in

⁶ Fung, Peter and Terry Chu, “China’s 12th Five-Year Plan: Energy”, KPMG, April 2011 <http://www.kpmg.com/cn/en/IssuesAndInsights/ArticlesPublications/Documents/China-12th-Five-Year-Plan-Energy-201104.pdf>

⁷ Ibid.

⁸ Baretto & Riveras, “Shells bets on ethanol in \$21 billion deal with Brazil’s Cosan”. Reuters. February 2010

⁹ Coyle, William, “The Future of Biofuels: A Global Perspective”, Amber Waves, USDA Economic Research Service, November 2007, <http://www.ers.usda.gov/AmberWaves/November07/Features/Biofuels.htm>

¹⁰ Ibid.

disclosure of its response to global sustainability megaforges.

For example, strains on vital material resources, especially water scarcity, are becoming a priority concern for the sector, especially in arid areas of production. Water is a critical component of production, being used to maintain reservoir pressures and in fracking processes, yet over 35 percent of the reports do not discuss the issue of water at all, and none includes information on their suppliers' water use. Just over 10 percent discuss action to mitigate the impact of water scarcity on local stakeholders. This is a key area for improvement.

The sector has always been highly reliant on, and therefore susceptible to, the performance of its partners and contractors, whose operations are beyond the company's direct control. However, less than half of the reporting oil and gas companies discuss supply chain issues in their corporate responsibility reports and less than a third of these are actively using supplier sustainability codes to select, contract or audit suppliers. In the light of recent, high profile spill disasters that have imposed significant reputational damage to big oil companies, we expect these numbers to improve over the coming years.

Summary: Sustainability as a means of competitive advantage

Growing global demand for energy, especially from emerging markets, could present Oil & Gas producers with lucrative growth opportunities in the near term. However, as depletion of easily recoverable oil and gas continues, the sector will depend on renewable and unconventional resources to replace conventional reserves and will be forced to operate in more challenging environments where new discoveries are being made.

As global sustainability megaforges such as climate change, energy security and resource pressure create unpredictable outcomes, the industry may find it increasingly difficult to retain its license to operate. The prospect of stricter environmental regulations presents significant downside risks.

Oil & gas companies must recognize sustainability as a means of competitive advantage. The sector can play an important role in developing and implementing renewable energy technology and bringing next-generation biofuels to commercial viability (as they have done and continue to do), and may be able to reap the benefits of GHG trading. The industry has responded to the increased demand for cleaner-burning natural gas by steadily increasing investment in the exploration and production of this fossil fuel.¹¹ Annual clean energy investment has risen nearly five-fold, from US\$52bn in 2004 to US\$243bn last year, a compound annual growth rate of 29 percent. Total new investment in clean energy increased 5 percent to \$260bn in 2011, despite the sluggish global economy and a squeeze on manufacturers.¹²

The impetus for a significant shift towards sustainable energy is expected to come from government legislation and the utilities sector rather than the oil & gas industry and it is unrealistic to expect the industry to completely forego its fossil fuel legacy. However it may find new ways to leverage its unique position and help shape the agenda for sustainable energy. The sector has the capital resources, operational and engineering expertise and scale to adapt its business model and enable it to profit from sustainability. Oil & Gas producers can either rise to this challenge, or be exposed to heightened levels of risk and forego significant opportunities for sustainable growth.

“The sector has always been highly reliant on, and therefore susceptible to, the performance of its partners and contractors, whose operations are beyond the company's direct control.”

¹¹ " US EIA (2011)

¹² Bloomberg New Energy Finance (2012)



Telecommunications & Internet

A solution-provider for sustainability challenges

The rapidly expanding Telecommunications & Internet (T&I) sector has the potential to help other industry sectors address sustainability challenges by providing technologies to reduce carbon footprints and increase energy efficiency.

At the same time T&I companies should not disregard their own vulnerability to sustainability megaforges, nor their own impacts. The sector shows varying degrees of readiness to seize opportunities and mitigate risks. Some companies have programs, products or services that serve as examples of better practice, but overall there remains a lack of industry consensus that would enable the sector to fully prepare for current and future impacts of megaforges. The challenge for the T&I sector is to remain innovative and proactive in offering other industries sustainable solutions while improving its own preparedness for the effects of sustainability megaforges.

For the purposes of this report the Telecommunications & Internet sector is defined according to Industry

Classification Benchmark sectors and includes providers of both fixed-line and mobile networks; providers of internet services and of telecommunications equipment (including mobile phones and high technology communication products).

Exposure to Global Sustainability Megaforges

Highly exposed to: Climate Change; Population Growth; Urbanization; Wealth

Potentially exposed to: Water Scarcity; Material Resource Scarcity

Telecommunications & Internet environmental impact: Best protected sector

There is likely to be increasing pressure over the next 20 years for the price of resources, products and services to reflect the full cost of their production including the cost of environmental impacts. Such pressure is likely to grow as governments address climate change and other sustainability challenges such as resource scarcity. Possible futures include the removal of fossil fuel and water subsidies, the spread of carbon

“The challenge for the T&I sector is to remain innovative and proactive in offering other industries sustainable solutions while improving its own preparedness for the effects of sustainability megaforges.”

pricing systems to more markets and higher carbon prices.

Data from Trucost indicates that the full environmental costs of production in 11 key industry sectors could account for a considerable proportion of earnings (EBITDA) and thus represent significant value potentially at stake. In the case of the Telecommunications & Internet sector, their data suggests that the environmental impact in 2010 amounted to approximately US\$12 billion and would account for only 2.5 percent of sector earnings.¹

These figures are hypothetical in that they assume business may in the future be required to bear the full environmental costs of their operations, but by making this assumption they provide an indication of the potential value at stake. In reality it is likely that such costs would be passed on – at least in part – to end users rather than being borne by the producers alone.

Trends, risks and opportunities: Rapidly growing demand

The entire ICT sector accounts for approximately 2–3 percent² of global CO₂ emissions. While the current impact may seem low compared with other sectors, the anticipated growth of global demand for telecom services will require huge amounts of energy in the years to come, more than doubling the sector's global GHG emissions in 2002 by 2020.³

Datacenters are the fastest growing part of the sector's carbon footprint.⁴ If growth continues in line with demand, the world will be using 122 million

servers in 2020, up from 18 million in 2008.⁵

The sustainability megaforges of **Population Growth, Wealth** and **Urbanization** will play a key part in creating this demand for telecoms services by driving a market in which billions more young people seek connectivity, consumers in emerging economies have more money to spend and more people live in cities where telecommunications infrastructure is most easily available. The highest annualized revenue growth for internet service providers is predicted in the Indian and Central Asian markets, which currently have only 2 percent internet penetration and are estimated to grow 22.7 percent annually between 2011 and 2016.⁶

Demand for telecom services will also grow outside cities, however. Although high-speed internet is not yet accessible for most consumers in low income countries, mobile telephones are becoming a basic global service.⁷ Mobile networks are now available to over 90 percent of the global population, with future growth in the mobile market expected mainly from increasing usage of mobile broadband.⁸

Rapid technological change (such as VOIP and Wimax) is shifting the telecommunications landscape and driving competition between internet service providers and cable, wired and wireless companies, as well as outside entrants. This competition is changing the traditional role of telecoms, and creating expanding product and service opportunities that have the potential not only to be profitable but also to mitigate

“The anticipated growth of global demand for telecom services will require huge amounts of energy.”

¹ Trucost, 2012. See Appendix 1 for methodology

² OECD. (2010). *Greener and smarter: ICT's, The Environment and Climate Change*.

³ The Climate Group. (2008). *SMART 2020: Enabling the low carbon economy in the information age*. Global eSustainability Initiative (GeSI).

⁴ Pike Research (2010). *Green Data Centers*.

⁵ The Climate Group on behalf of GeSI. (2008) *SMART 2020*.

⁶ IBIS World. (2011). *Global Internet Service Providers. Global Internet Report*.

⁷ ITU-GeSI. (2010). *Using ICTs to tackle climate change*.

⁸ Ibid.

“An important area where the T&I sector has potential as an enabler is in the substitution of traditional goods and services with lower-carbon electronic alternatives – or “dematerialization.” ”

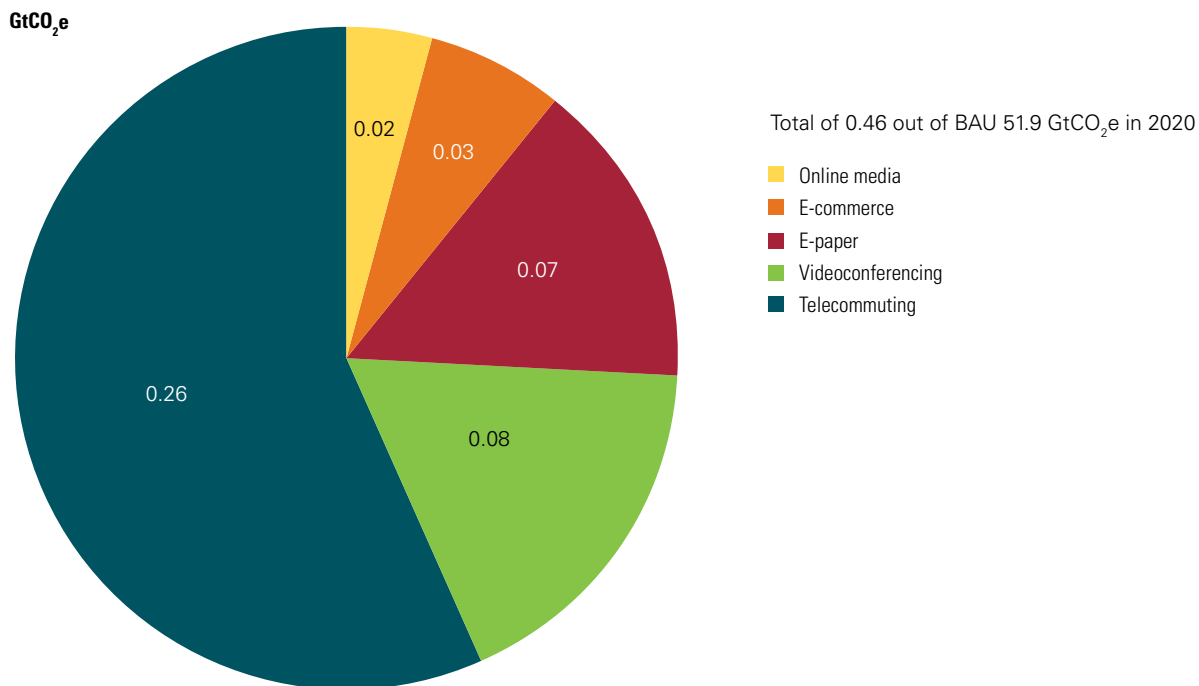
climate change and reduce fossil fuel use. The opportunity arises for the T&I sector to become the key enabler for “green growth” in all sectors of the economy.⁹

Dematerializing traditional goods and services

An important area where the T&I sector has potential as an enabler is in the substitution of traditional goods and services with lower-carbon electronic alternatives – or “dematerialization” as it is known. Examples include remote

networking instead of travelling, and replacing paper-based products such as books, newspapers, bills and documents with electronic versions. Mobile and internet applications for services such as shopping, finance and health can reduce the emissions associated with constructing, operating and travelling to buildings such as shops, banks and hospitals. Some estimates suggest that the dematerialization of products and services in the private and public sectors could reduce global emissions by as much as 500m metric tons.¹⁰

Figure 48: The impact of dematerialization



Source: Global e-Sustainability Initiative (GeSI). (2008). SMART2020: Enabling the Low-Carbon Economy in the Information Age, a report by GeSI.

⁹ OECD. (2010). *Greener and smarter: ICTs, environment and climate change*.

¹⁰ The Climate Group on behalf of GeSI. *SMART 2020*. (2008)

Climate Change and Energy: Exposure from soaring energy use

The **Climate Change** megaforce brings significant risks for the sector. Its growing use of energy means companies are likely to be more exposed to volatility in energy prices and to carbon-reduction legislation or taxes.

Climate Change also brings a growing reputational risk to the telecommunications sector: several major internet brands have come under consumer and campaigner pressure not only to become more energy efficient but also to choose cleaner energy. Such pressure is yielding results and some companies are locating datacenters close to green energy sources. For example, Facebook recently announced plans to build a new data center in Sweden, using hydroelectric power for the servers and relying on the local climate for cooling.¹¹

Pressure for the T&I sector to reduce its energy and carbon intensity is not only coming from consumers, but also from corporate clients under pressure to reduce their own carbon footprints and become more energy efficient. Although T&I regulators have yet to put mandates in place relating to climate change, individual companies and industry associations have started to address the issue. Investment in greener datacenters is expected to experience rapid growth over the five years to 2015, increasing from US\$7.5 billion in global revenue to US\$41.4 billion, representing 28 percent of the total data center market.¹²

The global ICT consortium Green Touch, comprising of leading telecommunications companies, governments and universities, has set a goal of making networks 1000 times more energy efficient. The Climate Group, a non-profit organization working with business and governments, estimates that ICT industries, largely telecoms, can deliver up to a 15 percent reduction (7.8 GtCO₂e) of “business as usual” GHG emissions across sectors by 2020.¹³

Wealth brings opportunity

Urbanization and **Wealth** are potentially beneficial to the T&I sector in promoting economies of scale and opportunities to expand next-generation networks (NGNs) which carry all types of services, including voice, video and e-mail, on a common platform.

NGN infrastructure is viewed by many governments as essential to economic competitiveness, improving productivity and encouraging growth. Studies suggest that in addition to benefits in social inclusion and reduced income inequality, NGNs can realize savings in the energy, transport, healthcare and education sectors.¹⁴

In many countries NGNs may help to reduce GHG emissions by allowing improved equipment management and sharing of infrastructure. For example, high tech networks play an important role in smart technologies such as smart motors, smart building control systems, smart electricity grids and smart logistics. These four technologies alone have the potential to deliver

“Climate change brings a growing reputational risk to the telecommunications sector.”

¹¹ CIO. http://www.cio.com/article/696970/Facebook_Recruits_Google_Green_Energy_Czar_for_Sustainability_Push

¹² Pike Research (2010). *Green Data Centers*.

¹³ The Climate Group on behalf of GeSI. *SMART 2020*. (2008)

¹⁴ KPMG. (2010). *The roll-out of Next-Generation-Networks*.

“KPMG’s International Survey of Corporate Responsibility Reporting 2011 indicates that 74 percent of T&I companies report on sustainability, an increase of over 50 percent since 2008.”

US\$946 billion of energy-efficiency cost savings in the year 2020, according to the Global e-Sustainability Initiative (GeSI).¹⁵

Urbanization also brings the opportunity for T&I companies to play an integral role in the designed ‘smart’ cities of the future by providing bandwidth and operational know-how to run a reliable and secure intelligent ecosystem of services. Challenges may include integrating legacy network systems, but benefits could be a 20 percent reduction in carbon emissions, 50 percent in energy savings and a 20 percent reduction in crime rates and traffic jams, according to International Data Corporation.¹⁶

Water Scarcity is another risk for the sector. Water is used for cooling datacenters and other T&I infrastructure construction and maintenance requirements. Although the T&I sector is exposed to a relatively low water risk compared to other sectors such as Food Producers and Electricity,¹⁷ water availability and cost could become a future operational and financial risk.

Material Resource Scarcity and toxic hazards associated with key T&I inputs are also significant risks. PVC, lead, and cadmium found in cell phones and other hardware pose environmental and health threats that are leading to new regulations with regard to manufacture and end use: the European Union, Japan, China, South Korea, New Zealand and several states in the United States have all passed electronics toxics legislation. Leading companies like BCE Inc,

France Telecom and NTT DoCoMo Inc., directly address this risk by working with suppliers to facilitate recycling, and some companies generate revenue from extraction of metals through such programs.¹⁸

T&I companies can anticipate such risks by recycling hardware and thus avoid or reduce the need to extract raw materials, especially highly energy intensive materials such as rare earths. Strong partnerships within the sector between suppliers such as handset manufacturers, network specialists and software companies will be essential for adapting to new conditions and expanding offerings in a competitive environment.

**Reporting and disclosure:
The communication challenge
is yet to be met**

Data compiled for KPMG’s International Survey of Corporate Responsibility Reporting 2011¹⁹ indicates that 74 percent of T&I companies report on sustainability. The reporting rate shows little variation by geography but drops significantly for companies with revenues of less than US\$1 billion.

A majority of T&I companies cite sustainability in their corporate responsibility reports as an effective brand differentiator to strengthen customer relations and an important driver for innovation. However, less than half (44 percent) of the companies report on sustainable products or services and only about a third (34 percent) disclose financial benefits of their sustainability

¹⁵ The Climate Group on behalf of GeSI. *SMART 2020*. (2008)

¹⁶ IDC. (2011). *Delivering next generation citizen services*.

¹⁷ Ceres. (2011). *The Ceres Aqua Gauge: A Framework for 21st Century Water Risk Management*. Ceres, in collaboration with the World Business Council for Sustainable Development, Ibaris consultancy and the IRRC Institute, Water Department.

¹⁸ Meade, C. (2009). *Key ESG Issues: Telecommunications*. Risks Metrics Group, Sustainability Solutions.

¹⁹ KPMG (2011). KPMG International Survey of Corporate Responsibility Reporting 2011

efforts. The KPMG survey suggests that the sector takes a somewhat conservative approach to sustainability reporting, with more companies focused on building effective sustainability reporting systems and processes than on effectively communicating their achievements. The effectiveness of disclosure could be improved through more common integration of sustainability and business strategies and the use of structured frameworks such as the GRI guidelines.

Summary: Alliances can mitigate risk and improve competitiveness

Global sustainability megaforges pose risks, but also generate great opportunities for the T&I sector. Population growth combined with climate change concerns and water and resource scarcity should drive an increased demand for telecommunications services, especially those that improve resource efficiency. Likewise, growing inequality is likely to drive demand for ‘dematerialized’ services that provide a lower-cost option by avoiding intensive fuel or resource use. Urbanization should enable economies of scale that help telecommunications providers to maintain margins in a capital-intensive industry.

The sector shows varying degrees of readiness to seize opportunity and mitigate risks. Opportunity lies in diverse, adaptive products and services that

facilitate low-carbon lifestyle changes, cost reduction and efficiency. Energy and emissions monitoring and management are two product areas where the sector stands to gain as a result of the Climate Change and Energy megaforges.

The sector’s efforts to reduce its own global carbon footprint are important to respond credibly to emerging customer demands and to prepare for the possibility of having to comply with more stringent carbon legislation and costs.

Partnerships and alliances could become increasingly important in every part of the value chain: these include partnerships with suppliers to develop sustainable products and services, and with peers to set industry standards, reduce costs and address challenges collectively. Capital intensive infrastructure and technological innovation, competition with adjacent industries and an evolving regulatory environment point to smart strategic partnerships as the most effective way to reduce costs, manage risks and drive growth.

Such alliances might also include closer working relationships with policymakers and industry groups: the aim should be to ensure that regulations related to energy and fossil fuels, carbon emissions and toxic materials provide opportunities and incentives for T&I companies to realize their role as solution providers for climate change and other challenges.

“The effectiveness of disclosure could be improved through more common integration of sustainability and business strategies and the use of structured frameworks such as the GRI guidelines.”

Call to action for **businesses and policy makers**

Introduction

With potentially devastating impacts on the horizon – including a rapidly changing climate, natural resource scarcity, food shortages, and population growth – businesses and policymakers together must make strategic decisions now and promote changes in long-term thinking. Without action and planning for the complex future that lies ahead, risks will continue to multiply and opportunities will be lost.

Sustainability requires a push from both economic sides – supply and demand. The supply side must make more with less; the demand side must make less do more. For the supply and production side, increasing resource efficiency and minimizing the environmental footprint of processes and operation must become standard practice for business. For the demand side, minimizing the impact of growing urban populations, rising middle classes and their growing demand for goods and services, while addressing the ensuing pressure on dwindling natural resources, must become a top priority.

In simplest terms, businesses and governments around the world must fundamentally change the way the world produces and consumes. There is no silver bullet. Instead, a wide range of actions – the global sum of individual company and government efforts – will lead towards a more sustainable future and breathe life into the concepts and solutions offered by this report.

This chapter examines the key business implications of global trends, both the risks and opportunities, and considers three key types of actions:

- actions by businesses to manage risks and opportunities
- potential actions by governments to help businesses respond more effectively (what business requires in terms of policy interventions)
- actions by businesses and governments together through public-private cooperation and partnerships to deliver a sustainable future.



Actions by business

In an increasingly complex world of population growth, urbanization, scarcity and environmental change, success will depend on how well a company can analyze problems, identify effective ways to address them, and implement appropriate action. This approach can turn daunting complexity into solid opportunities for growth. Such opportunities range from developing and maintaining low-carbon, zero-waste

cities and infrastructure to improving and managing biodiversity, ecosystems, lifestyles and livelihoods. Enabling these changes can also create opportunities for finance, information and communication technology and partnerships. With new opportunities to be explored, external priorities to assess, partners to engage and risks to navigate, businesses that plan now for coming decades are likely not only to withstand the changes, but also to prosper.

“Businesses will face a more volatile and unpredictable market for fossil fuels and other resources.”

Sustainability megaforges: core challenges for business

- Understanding and assessing risks
- Analyzing opportunities for efficiency, substitution and adaptation or adjustment
- Using integrated strategic planning and strategy development
- Managing risks and capitalizing on opportunities

The Future is Now: Companies are already experiencing impacts of sustainability megaforges

Multinational food companies are already facing price pressures that were unimaginable years ago. The IMF calculates that between 1974 and 2005 real food prices, adjusted for inflation, fell by nearly 75 percent as improved technologies lowered costs. Then, in 2007 the UN food prices index rose by 40 percent in a single year. The wheat price now can routinely rise or fall by 15 percent in two days. Over the 12 months to May 2011, corn prices rose 80 percent in the futures market, oats was up 70 percent, wheat 54 percent and soy beans 37 percent. This increased volatility illustrates major difficulties in pricing, which may only grow worse in coming years.¹ A recent survey of consumer market executives found that approximately 50 percent of respondents have already seen a rise in the cost of compliance with health, food and safety, health care and environmental and sustainability regulations in the past year.²

Key emerging business risks related to global sustainability megaforges

Sustainability megaforges threaten to bring increasingly complex risks and interrelated challenges that demand a new approach to business planning. Businesses are likely to face a more volatile and unpredictable market for fossil fuels and other resources. New levels of scarcity for essentials such as water, energy, forest products and minerals could result in increased and more volatile prices and reduced availability of inputs. Water-intensive industries – including apparel, automobile, food and beverage, biotech and pharmaceutical, chemical, forest products, electronics, mining, refining and electric utilities – will be vulnerable to water shortages, declines in water quality, and water price volatility. Further degradation of global biodiversity and ecosystem services could also affect many industries, including forest products, pulp and paper, agriculture, fisheries and tourism. Industries dependent on biodiversity for innovation, such as pharmaceuticals, would be impacted by continued primary forest loss. These risks could jeopardize the

long-term profitability – or even the survival – of some of the most-impacted sectors.

Emerging business opportunities

Sustainability megaforges could also open the door to unprecedented opportunities for business. Companies can find ways to save resources and reduce business risks, while also cutting costs. By planning for future resource shortages, they can improve the material efficiency of production, develop alternate materials, or find new ways to use freshwater or energy more efficiently. Focusing on sustainability could also lead to access to new markets for greener products, improved brand credibility, price premiums for green products and new finance sources. Companies can also become providers of new resource-efficient technologies and products. Global efforts to combat climate change, for example, will create demand for low carbon technologies, such as industrial and commercial energy efficiency. According to KPMG's International Corporate Responsibility Reporting Survey 2011, almost half of the Global Fortune 250 (G250)

Making the most of green opportunities

Royal Philips Electronics has allocated EUR 2 billion for investments in Green Innovation by 2015 to accelerate sustainable business across its three sectors. As a result, Philips Green Products generated 38 percent of total 2010 sales, up from 31 percent in 2009. This was achieved through focusing on EcoDesign – a process aimed at developing products with a significantly lower environmental impact throughout their lifecycle.³

For Siemens, revenue from eco-friendly products and solutions showed strong growth over 2011. Its Environmental Portfolio – which comprises products and solutions that assist in the abatement of greenhouse gases, as well as environmental technologies for clean air and water – contributed around EUR 30 billion to the company total. Siemens aims at exceeding the EUR 40-billion revenue mark with green technologies by the end of fiscal 2014.⁴

¹ KPMG (2011) Consumer currents – Issues driving consumer organizations: *The trouble with food*.

² CFO Insights – A Global Survey of Consumer Markets Executives, KPMG International, 2011.

³ *Philips to invest EUR 2 billion in green innovation by 2015*, (February 18, 2011). http://www.newscenter.philips.com/main/standard/news/press/2011/20110217_sustainability_report.wpd

⁴ *Siemens ends fiscal 2011 with record operating results* (November 10, 2011) http://www.siemens.com/press/en/pressrelease/?press=/en/pressrelease/2011/corporate_communication/2011-q4/axx20111105.htm

companies report gaining financial value from their sustainability programs, while a third of the 100 largest companies in each of the 34 countries studied (N100) report the same.⁵

Population growth, and a growing middle class will mean significant increase in the number of potential consumers and producers driving the market for consumer goods, global connectivity and access to technology, as well as providing human resources for the workforce. Further opportunity is related to a variety of new financing mechanisms being developed for the transition to a sustainable economy. These range from product subsidies and tax breaks for R&D to pay-as-you-save loans. Companies can identify, quantify and capture tax credits and incentives specifically tailored to alternative energy, energy efficiency and other areas related to sustainability. Furthermore, sustainability is rapidly becoming a key differentiator in enhancing brand credibility.

Turning risk into opportunity: ensuring effective management of implications of global sustainability megaforges

Effective management of sustainability risks and opportunities requires their integration into strategic planning (*Figure 49*):

- identifying sustainability risks and potential opportunities through Enterprise Risk Management tools;
- integrating sustainability into core business functions and tapping into employee engagement – both internally and across business partners;
- measuring environmental inputs and productivity across the entire company and reporting on progress;
- and, finally, setting ambitious targets and leading by example. Leading global firms already are setting the pace with tough, long-term goals that define a vision, balanced with interim deadlines.

“The key for companies is to leverage current risk management processes to tackle future sustainability risks and to invest more leadership capital in sustainability risk management.”



⁵ KPMG (2011). *KPMG International Survey of Corporate Responsibility Reporting 2011*.

The Gulf oil spill: corporate responses and sustainability risk management

After the oil spill in the Gulf of Mexico in 2010, the oil and gas industry faced a host of challenges involving liability and insurance coverage, the optimal operating model, contractor relationships, existing risk management practices, and new regulations. Major oil operators therefore began to develop risk mitigation strategies that changed the traditional integrated model. BP has announced the creation of a new division, Safety & Operational Risk, to oversee and audit its global operations. Similarly, Shell in 2009 established a new Projects and Technology unit, which combines its major project delivery, technical services and technology capabilities, covering both upstream and downstream.⁶

Managing risks via Enterprise Risk Management

A sophisticated Enterprise Risk Management process will identify actions to mitigate risks as well as realizing opportunities. It can assist in identifying potential future events, assessing the related risks and defining responses to deal with the risks. These include accepting the risk, transferring it to other parties, treating it with controls, or terminating the activity related to the specific risk. Enterprise Risk Management already has a central role in strategic management and most companies have tools and talent at hand. However, full integration of the sustainability perspective is not yet common practice. The key for companies, therefore, is to leverage current risk management processes to tackle future sustainability risks and to invest more leadership capital in sustainability risk management.

Integrating sustainability into core business functions

To unlock the potential of a changing world, companies need to address the full range of organizational areas and functions. Strategic planning for sustainability, perhaps more than any other functional strategy, requires the involvement of the business management and strategic planners and subject matter expertise in the area of sustainability. Such planning should encompass a wide range of corporate functions and may include portfolio management, mergers and acquisitions, R&D and supply chain management and purchasing. It also includes departments such as communications, investor relations, government relations and public policy, human resources, risk and compliance, audit, financial reporting and tax. Tax, for example, could be a major sustainability

tool for companies using significant amounts of natural resources and energy in production or transportation.

Measuring and reporting sustainability

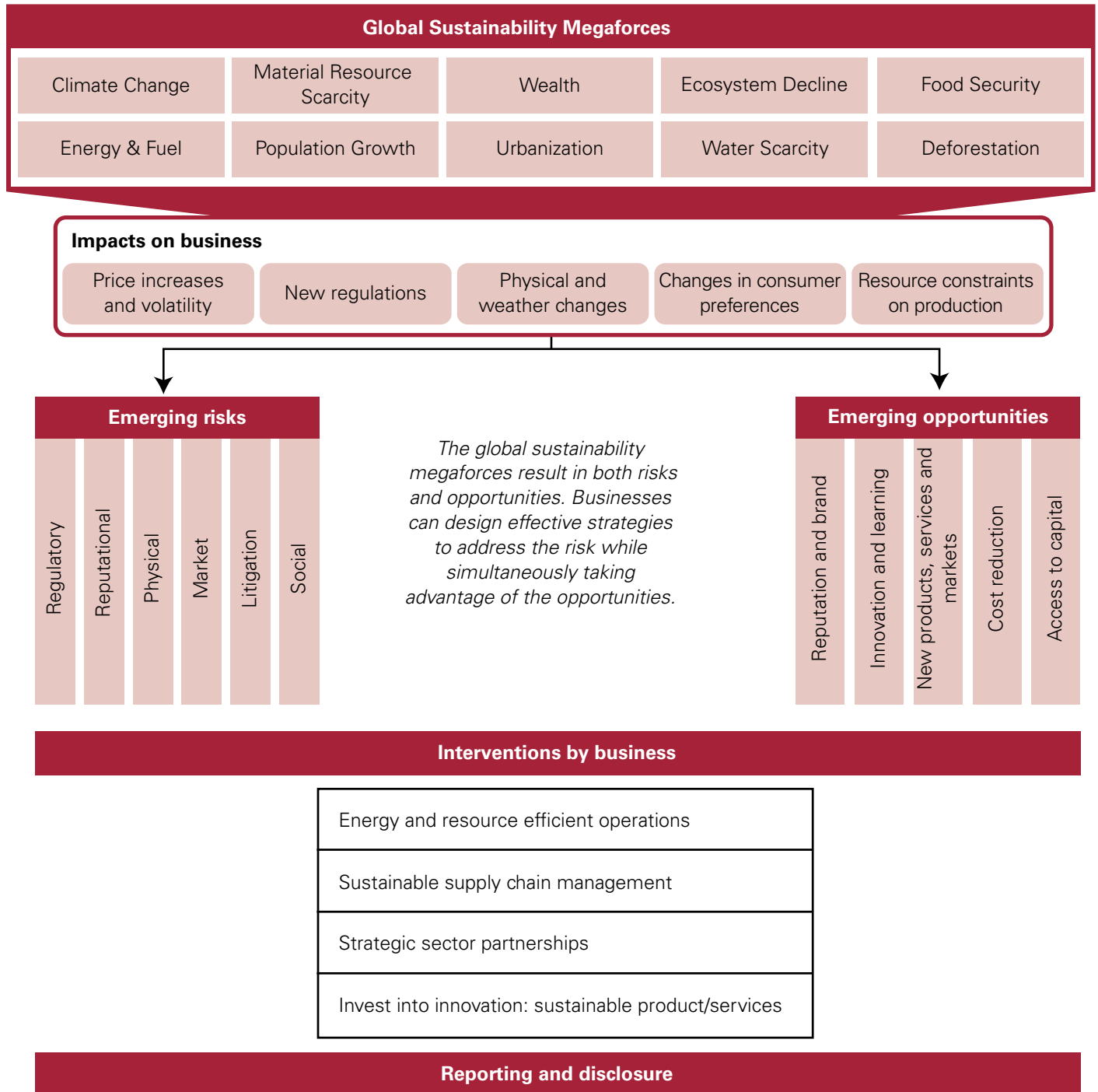
Measuring and reporting on sustainability performance is crucial for managing sustainability risks and opportunities. This is usually done through corporate responsibility (CR) reporting, a rapidly growing imperative for businesses worldwide. Of the 250 largest global companies, 95 percent now report on their behavior on key societal issues – a 14 percent increase since 2008.⁷ Companies increasingly recognize that sustainability reporting is about more than just being a good corporate citizen – it is also an important tool for driving innovation and promoting learning. Many companies in the above-mentioned survey reported discovering new opportunities for improvements by analyzing their CR reporting data and benchmarking their performance against industry peers.

Sustainability reporting, although largely still unregulated, will become increasingly important in the future. Recognizing this trend, some companies have recently undertaken “integrated” reporting, where sustainability related information is included in a full picture of the company’s comprehensive business performance and reported as part of the corporate financial reporting process. Many companies are already publishing CR or sustainability information throughout their directors’ report. The next step for integrated reporting should therefore be for companies to build a framework for their CR reporting processes, as well as stronger information systems and appropriate governance and control mechanisms – on par with those currently used in financial reporting.

⁶ *After the Gulf of Mexico Oil Spill: Recent Developments in the Oil and Gas Industry*, KPMG Global Energy Institute, 2011.

⁷ *KPMG International Survey of Corporate Responsibility Reporting 2011*.

Figure 49: Global sustainability megaforces – Addressing the risks while realizing the opportunities



Source: KPMG analysis.

The Global Reporting Initiative's sustainability reporting

The Global Reporting Initiative's (GRI) Sustainability Reporting Guidelines have gained widespread adoption as the de facto global standard for CR reporting. Today, 80 percent of G250 and 69 percent of N100 companies are aligning to GRI standards.⁸ The GRI, a network-based organization, draws participants from global business, civil society, labor, academic and professional institutions with the core goal of mainstreaming the disclosure on environmental, social and governance performance. The GRI is one of the initiators of the International Integrated Reporting Committee and firmly believes that integrated reporting should be the next step in corporate sustainability reporting.

“In the coming years, policymakers will be increasingly called upon to take the lead and adopt measures that promote sustainability while respecting consumer demand for goods and services as the primary driver of economic activity.”

Recommendations: the essentials of business action towards sustainability

Global sustainability megaforges could mean a world of unprecedented constraints, complexity and risks for business. But business leaders can do much more than simply survive these risks. Indeed, with foresight and planning, they can thrive by turning these risks into new opportunities and undertaking pioneering actions to prepare for an uncertain future.

- **Understand and assess risks and analyze opportunities for efficiency, substitution and adaptation or adjustment:** First and foremost, businesses need to fully assess and understand future sustainability risks and define their responses to deal with them.
- **Use integrated strategic planning and strategy development:** CEOs should make sustainability central to their corporate strategy and incorporate it at all levels. Companies will also need to appreciate the benefits of measuring performance and reporting on sustainability.

They should also seek collaboration between companies on sustainability issues, which will be critical to increase leverage and improve the cost-benefit ratio of action.

- **Manage risks and capitalize on opportunities:** Businesses need to turn strategic plans and strategies into ambitious targets and actions, such as energy and resource efficiency improvements, sustainable supply chain management, investment into innovation on sustainable products and services, and gaining access to new markets for greener products, services and technologies.
- **Build strategic partnerships:** Business leaders should seek opportunities for genuine dialogue with governments and demonstrate new and innovative approaches to public-private partnerships. Improved dialogue could focus on economic instruments and market barriers that could be reduced to make sustainable behavior easier.

⁸ KPMG International Survey of Corporate Responsibility Reporting 2011.

Actions by governments

Government policymakers must play an active part, in partnership with businesses and other stakeholders, to address global sustainability trends and help direct longstanding development patterns toward a more sustainable future. As demonstrated in Part 2, leading businesses around the world have already begun to take supply-side action ahead of current policies and regulations, such as the “quick wins” of efficiency measures, in pursuit of both a sustainability measure and a sound business opportunity.

Sustainability measures on the demand side, on the other hand, would require more government support. In the coming years, policymakers will be increasingly called upon to take the lead and adopt measures that promote sustainability while respecting consumer demand for goods and services among the key drivers of economic activity. Government regulations and incentives, such as tax credits for insulation improvement to residential housing, as well as measures to help direct consumer demand towards sustainable choices, such as new product standards for energy efficiency, pricing mechanisms and taxes must be thoughtfully and thoroughly directed toward the goal of global sustainability.

This section considers the potential actions that government, in cooperation with business, can take to achieve sustainable growth. It is based on an analysis of policy implications from recent publications by business associations, as well as key messages from KPMG publications. It also

Sustainability megaforges: core challenges for government

- Ensuring predictability and stability in government policies
- Removing barriers to investment
- Creating enabling conditions for business
- Incorporating price externalities

demonstrates that businesses and government can – and indeed must – work together to provide bold leadership, drive innovation and move the world towards a sustainable future.

The investment challenge: overcoming barriers to green growth

Sustainable growth will require massive investment from business. Climate change mitigation alone, according to the International Energy Agency, could require almost US\$10.5 trillion (US\$510 billion per year) over and above the business-as-usual scenario between 2010 and 2030.⁹ Yet this sum provides only a 50 percent chance of limiting greenhouse gas concentration to less than 450 parts per million and global temperature rise to less than 2 degrees centigrade. A large share of this investment needs to take place in developing countries¹⁰ and the bulk of funding – over 80 percent – must come from the private sector.¹¹ To confront this and other sustainability challenges, barriers to innovation and investment must be lowered or removed through appropriate government policies.

“Barriers to innovation and investment could be lowered or removed through appropriate government policies.”

⁹ International Energy Agency (2009). *World Energy Outlook 2009*. Paris.

¹⁰ International Energy Agency (2009). *World Energy Outlook 2009*. Paris.

¹¹ United Nations Framework Convention on Climate Change Secretariat (2007). *Investment and Financial Flows to Address Climate Change*. Bonn. Available from unfccc.int/files/cooperation.../financial.../background_paper.pdf.

“ Financial incentives may also include market-based mechanisms that create additional income from the sale of emission allowances or other rights to the use of resource. ”

Many green and low-carbon investments carry an unacceptable level of risk or offer an insufficient rate of return, particularly in developing countries, for a number of reasons. First, full environmental impacts and costs are often not priced in the market. Instead, current policies and market incentives allow businesses to run up significant social and environmental externalities, largely unaccounted for and unchecked. Limited availability and access to long-term finance for sustainability investments is another barrier, as banks often refuse long-term lending for less conventional and potentially risky technology, in addition to demanding high interest rates. Investors can also seek considerably higher returns, which are often incompatible with the payback periods of sustainability projects. Uncertainties around policy and fiscal regimes, and a lack of stable investment environment can also provide disincentives for green investment.

Call for government action

Transitioning to a sustainable economy will therefore require strategic government policies that encourage businesses to actively embrace sustainability. In addition to removing investment barriers, policymakers must establish enabling conditions in all areas: national-level regulations, policies, subsidies, incentives and legal frameworks, as well as international market, legal infrastructure, trade protocols and development aid measures. Governments, together with business, must make strategic decisions now and look to promote changes in behaviors and long-term thinking.

The complexity of addressing climate change provides a clear example of the strategic decisions needed now before the speed and severity of changes are fully known. Governments will need to take a close look at their existing policy and start thinking clearly about the long-term economic impact of energy choices ahead. If the goal is to avoid or minimize the negative impacts of global sustainability megafactors and in so doing leave a better world for future generations, it is critical to strive for a system that prioritizes effectiveness and long-term cost efficiency. Governments also need to think more aggressively about turning sustainability from a risk factor for business to an engine of economic growth.

Although climate change and other sustainability challenges seem formidable, an effective response can be achieved if governments – like business – apply a complex systems approach to policy making. Currently, most government interventions address trends in isolation without considering how distinct policy initiatives might interact, or even contradict, each other.

Therefore, a more comprehensive and coordinated systemic approach to managing resources that cuts across various nexuses will be essential for success. Government institutions with discrete responsibilities – such as water, agriculture, climate change, finance and urban development to name a few – need to work closely together to address sustainability. This allows for multiple co-benefits while minimizing required investment. For example, efforts to protect and sustainably manage forests are compatible with the goals of improving resilience to

climate change, addressing fresh water scarcity and protecting ecosystem services. Similarly, actions to mitigate climate change call for improving energy efficiency, which in turn reinforces responses to energy price volatility and reduced availability of energy resources.

Clear, well-planned and secure government policies are key to scaling-up private sector investment and facilitating the transition to green economy. Investors seek the security offered by clear policies with defined goals and consistent regulatory actions. They need coherent policy objectives accompanied by measurable targets and actions. Conflicting policy signals provide the opposite message and chill investor confidence in sustainability. An example is government policies that set the expansion of renewable energy as a primary policy goal while at the same time providing heavy subsidies for fossil fuel-based energy generation.

Incorporation of the full cost of externalities into the market price of resources is becoming increasingly important for scaling up investment in sustainable development. This is done through a range of economic and fiscal instruments, including environmental taxation (e.g. carbon tax), cap-and-trade systems and the removal of environmentally harmful subsidies. These instruments encourage emitters and resource users to find and implement the cheapest abatement options and to maximize efficiency in the use of resources, minimizing the overall cost to the economy. Environmental taxes and emission trading initiatives are already in place in several industrialized countries, while many developing countries are currently

considering implementing regional, sectoral or national carbon emission trading initiatives. Application of these instruments will create both winners and losers among the businesses. Consideration of these diverse economic impacts and gradual rather than abrupt transition to the new policy instruments will be key for ensuring the effectiveness of sustainability policies.

Measures to enhance access to finance by improving the risk-return ratio can play a key role, both in terms of lessening the environmental footprint of production and facilitating investment into innovative greener products and services. Instruments for improving the reward parameters of sustainability projects range from putting a price on environmental externalities (e.g. carbon) to financial incentives aimed at increasing direct returns (e.g. feed-in-tariffs for renewable energy, tax credits for green investment). Financial incentives may also include market-based mechanisms that create additional income from the sale of emission allowances or other rights to the use of resource. However, there must be certainty around continuation of financial incentives by the government, as sudden changes (e.g. abrupt discontinuation of feed-in-tariffs) may bear significant adverse impacts for investors. Many countries provide financial incentives for energy-efficient equipment and price supports for renewable energy, to stimulate the diffusion of technologies. In the US, the Energy Policy Act of 2005 contains several financial incentives for various advanced technologies. These financial incentives have been estimated at US\$11.4 billion over a 10-year period.¹²

“ Standards and regulations can promote sustainable practices on the production and supply side, such as standards for pollution control or energy standards ”

¹² Intergovernmental Panel on Climate Change (IPCC). (2007) *Fourth Assessment Report: Climate Change (AR4)*

“ Policymakers are urged to deliver the overarching policy goals that will be crucial for business to make a timely transition towards a sustainable society. ”

Policymakers can also help extend the period of lending or reduce the level of interest by, for example, providing blended public-private finance or guarantees. Government loan guarantees can allow private sector investors to borrow at a lower rate. Multilateral and bilateral financial institutions have long used such guarantees to mobilize private finance for infrastructure projects and restructuring programs.

Mixed equity funds are another means for lowering the risks for private equity investors. Such funds subordinate the public capital within the fund, giving private investors their returns first and protecting against the risk of project default or low financial performance. These mechanisms provide investors with the confidence to invest in less mature initiatives, where the financial model, technologies or skills bases might not yet be well established, but do not require governments to fund sustainability projects in full and up-front.

Taxation, if applied carefully and correctly, can provide an efficient tool for influencing behavior and promoting sustainability while raising revenue and providing a financial incentive to the marketplace. Approaches vary depending on jurisdiction. The US, for example, uses the “carrot” of tax incentives to promote the development of energy and sustainability projects. Some examples include programs for:

- alternative energy and energy efficiency;
- grants in lieu of tax credits;
- alternative fuel vehicles;

- energy efficient buildings deduction;
- energy efficient appliance credit;
- solar, geothermal and wind state incentives;
- green building related state incentive;
- sales tax exemptions;
- property tax exemptions and abatement;
- electricity related state tax incentives.¹³

Sweden applied the “stick” of carbon tax in 1991, which reduced greenhouse gas emissions during a period of overall economic growth while successfully assisting in raising revenue.

Standards and regulations can promote sustainable practices on the production and supply side, such as standards for pollution control or energy standards. On the demand side, they play a major role in directing markets towards more sustainable products in a number of sectors, such as home appliance standards for efficiency and fuel efficiency in automobiles. Furthermore, governments have a role in strengthening the metrics related to sustainability and productivity opportunities. Adoption of international reporting standards for business would significantly decrease complexity.

Capacity development and improving awareness efforts can be particularly important on the demand-side for influencing the preferences of consumers towards more sustainable lifestyles. Governments can play a major role in training local workforces and in building capacity for deployment of green technology, which in turn facilitates investors with a qualified local work force.

¹³ KPMG (2011) – *Making Green Greener – Tax Incentives for Energy Sustainability*

Government incentives for R&D are critical for facilitating innovation and helping business scale-up investment in newer, more sustainable products, technologies and resource substitutes. Government has a wide range of measures available, including tax incentives, direct government procurement or direct governmental R&D funding.

Recommendations: the essentials of government action towards sustainability

The global sustainability megaforges of the coming decades are likely to bring shocks and surprises. As governments in all regions could be called upon to take more steps to limit or reverse negative environmental and social impacts, businesses will be confronted with an ever more complex web of sustainability-related fiscal instruments and legislation. Policymakers are urged to deliver the overarching policy goals that will be crucial for business to make a timely transition towards a sustainable society.

- **Continuity and coherence in policy:** Clear, well planned and secure government policies are crucial for scaling-up investment and facilitating the transition to a green economy. Strong collaboration across governmental bodies and ministries on sustainability issues will be key.
- **Reducing complexity in policy:** Reducing regulatory complexity and improving transparency is another key area for action, as businesses frequently cite regulatory complexity as one of the main sources of risk and uncertainty surrounding sustainability.
- **Coordinated international collaboration:** Multilateral coordination across countries and regions, particularly for carbon markets and any future climate treaty, is needed to reduce regulatory complexity.

- **Creation of enabling “green” investment environment:** Policymakers need to remove barriers to green investment and establish the essential enabling conditions in all areas: national-level regulations, policies, subsidies, incentives and legal frameworks, as well as international market, legal infrastructure, trade protocols and development aid measures. In creating an enabling environment, governments must seek to use a variety of policy tools – including taxation.
- **Increased collaboration with private sector through Public-Private Partnerships (PPPs):** If properly designed, PPPs can provide an effective architecture for promoting sustainability in a way that mobilizes private sector finance, rather than relying on public funding alone.

Business and government working together: Public-Private Partnerships as a tool for green growth

In the transition to green growth, the success – or failure – of government policies may hinge on the ability of policymakers to build effective partnerships with the key actors. This will require a full understanding of their partners’ motivating factors, mutual interdependencies and long-term requirements, in addition to how they can best benefit through effective interaction. To achieve their strategies, governments need corporations to provide low-carbon and green technology, the skills to deploy and operate it, and the funds of financiers to invest in delivering it. Given that many national budgets remain stretched as a result of the global financial crisis, the conditions seem ripe for the wider introduction of PPP structures using private finance.

“Getting PPPs right will almost certainly be the key to unlocking affordable and sustainable infrastructure funding that ultimately will enable high-growth markets to maintain their current trajectory.”

In many emerging markets, such as India and Brazil, PPP has been successfully used for economic infrastructure that generates cash flows directly from the users (such as toll roads, electricity generation, and water supply). The success of PPP structures in high-growth markets often comes down to fully understanding the ramifications of these structures on governments, sponsors and users. Developing successful PPP

structures in emerging and high-growth markets requires both governments and sponsors to be realistic about the specific risk allocations for PPP projects, and to carefully assess the ability of projects to be freestanding economically. Getting this right will almost certainly be the key to unlocking affordable and sustainable infrastructure funding that ultimately could enable high-growth markets to maintain their current trajectory.¹⁴

Case Study: Mobilizing private sector investment for low-carbon technology through PPPs

International agreements under the United Nations Framework Convention on Climate Change (UNFCCC) now include a set of policies and actions, Nationally Appropriate Mitigation Actions (NAMAs), that developing countries can undertake as part of their commitment to reduce greenhouse gas emissions. The term NAMAs recognizes that different countries may undertake different actions and emission-reduction projects according to their specific national circumstances. It also emphasizes the need for financial assistance from developed countries to developing countries to help reduce their emissions. A key factor for ensuring the future success of NAMA projects therefore depends on the identification of an effective investment model that can successfully deploy low-carbon private capital at the scale required to secure a successful low-carbon transition for developing economies.

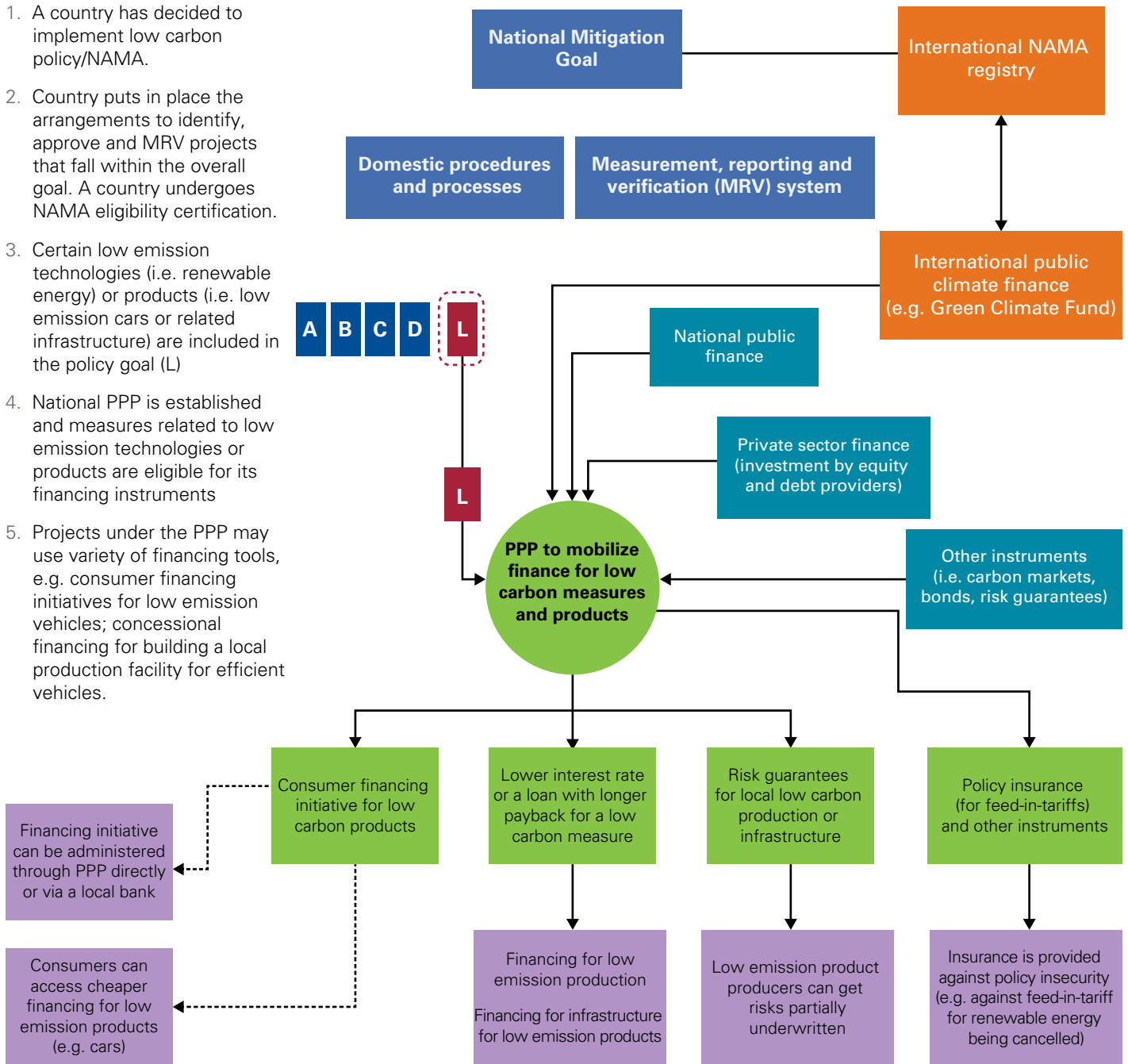
KPMG believes private sector investment through PPPs presents just such an effective model. Our proposed model employs a number of public finance instruments to remove barriers to private investment. Seed capital should come from the international financial pledges by developed nations through the Copenhagen Accord: US\$30 billion in 2010-2012 and up to US\$100 billion to be mobilized annually by 2020, i.e. through the Green Climate Fund or private sector facility. The model would give access to low-carbon finance in developing countries and leverage additional private finance by integrating the full toolbox of financial instruments to address the barriers related to the risk and reward profiles of projects (see *Figure 50*). Furthermore, it ensures the continuity of finance, since it would operate on a revolving basis both at the national and international level.

For example, the PPP at the national level could underwrite project risks or provide insurance against policy changes such as subsidies being removed. This type of insurance would improve a NAMA project's chances of attracting commercial finance. To benefit from such mechanisms, the country would need to have determined its overall policy goal, identified and prioritized mitigation measures, and undertaken financial and technological analysis of barriers and enablers to finance. Furthermore the essential domestic elements of the NAMA infrastructure need to be in place, in particular mechanisms and processes for measurement, reporting and verification of emissions and their reductions.

¹⁴ KPMG (2011). *Insight – Urbanisation: The massive challenge facing cities and innovative ways it's being addressed*.

Figure 50: Options for mobilizing climate finance through PPPs

1. A country has decided to implement low carbon policy/NAMA.
2. Country puts in place the arrangements to identify, approve and MRV projects that fall within the overall goal. A country undergoes NAMA eligibility certification.
3. Certain low emission technologies (i.e. renewable energy) or products (i.e. low emission cars or related infrastructure) are included in the policy goal (L)
4. National PPP is established and measures related to low emission technologies or products are eligible for its financing instruments
5. Projects under the PPP may use variety of financing tools, e.g. consumer financing initiatives for low emission vehicles; concessional financing for building a local production facility for efficient vehicles.



Source: Embarking on the low carbon journey: National Mitigation Actions as green growth vehicles in developing nations, KPMG International 2011.

For example, scaling-up the use of low emission or electric vehicles, the above model could help address most of the challenges car manufacturers face in delivering such vehicles to the market at scale. Grant financing through the PPP could build the capacity of local suppliers and infrastructure providers and help reduce the barriers to the production and operation of low emission vehicles (e.g., develop a charging infrastructure for electric vehicles or improve quality of fuel). The affordability of low emission vehicles for consumers could be addressed through a financing initiative under the PPP, whereby customers would be eligible for lower interest rates or longer repayment periods on their loans. This would reduce the price differential between conventional and low emission vehicles.

Almost all investments in any economy's low-carbon transition will cost more than carbon-intensive alternatives as long as the environmental costs are not properly priced, and, as such, are likely to be policy dependent. If the central question is "how developing nations can use NAMAs to increase investment in green growth," the answer is clearly "be more innovative in the blending of public and private finance". More effective collaboration is required between banks, pension funds, the private sector and semi-public resources. Putting a price on carbon can change the investment equation dramatically. Although

challenging, it is nonetheless possible to design NAMAs that put the private sector center stage and blend public and private finance intelligently to achieve green growth goals. KPMG believes in the possibility of designing an international architecture for supporting climate change mitigation in a way that mobilizes private sector finance, rather than relying on public funding alone.

Recommendations for PPPs

KPMG has engaged in many PPPs over the past 15 years. Based on this experience the key points for developing successful PPPs are:¹⁵

1. The PPP process cannot be rushed – it takes time to develop properly;
2. PPPs sometimes require significant upfront costs, but meeting these costs would make it much more attractive, particularly if investors can see that the right resources have been applied;
3. Governments must play an active role in monitoring and regulating the project;
4. PPP structures must be designed to include clear and formal methodologies for reviewing contracts over the term of the project (particularly those that last 10 to 30 years or more);
5. A single-minded focus is essential for developing transparent and competitive procurement procedures.

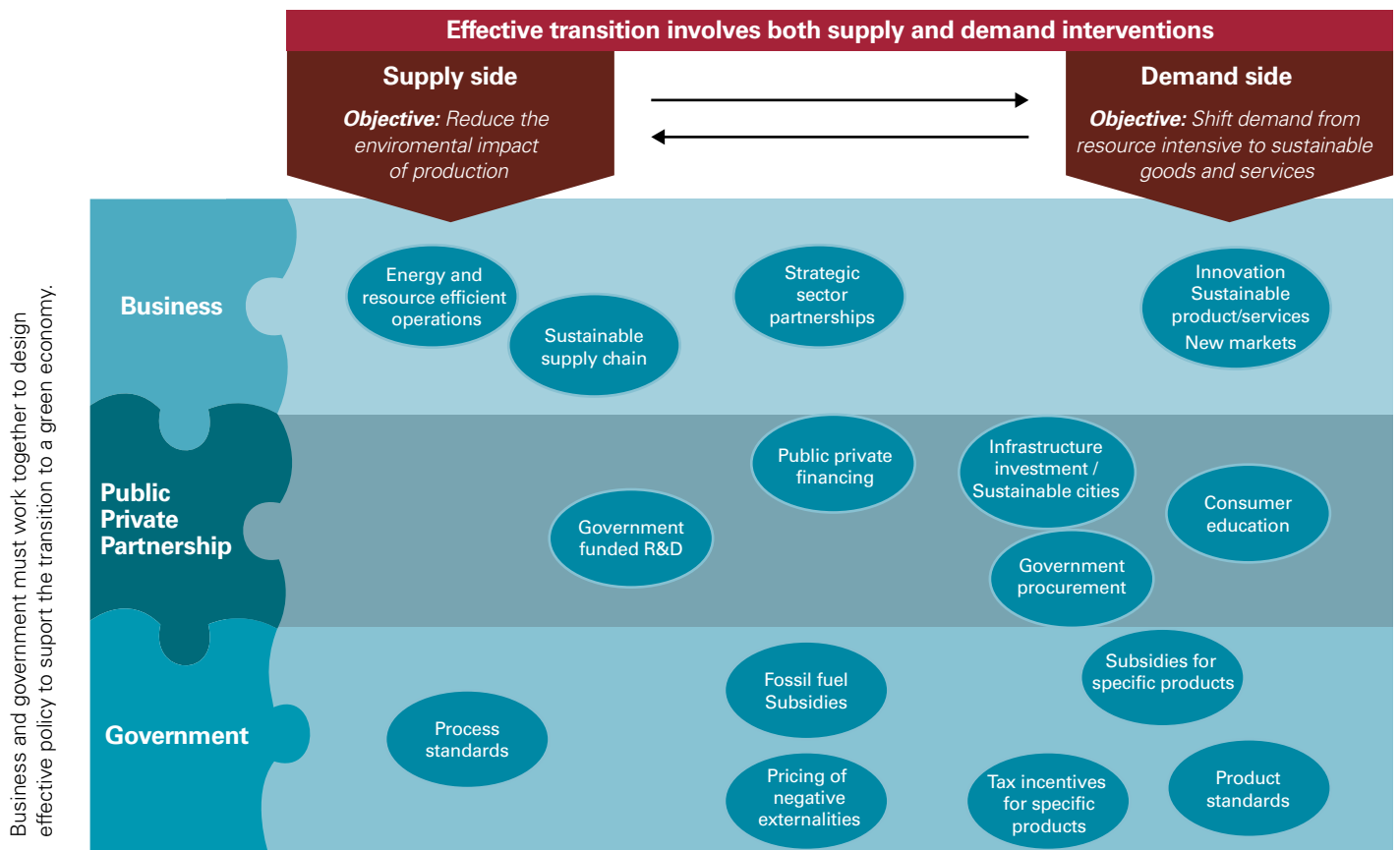
¹⁵ KPMG (2011). *Insight – Urbanisation: The massive challenge facing cities and innovative ways it's being addressed*

Imperatives for achieving sustainable growth

The global sustainability megaforges that will reshape the planet in the next 20 years clearly demonstrate that the current resource-intensive structure of the economy is no longer viable. Current production techniques and the ever-growing quantities they demand are pushing many of the planet's resources

to the brink. While the transition to a sustainable economy is technically possible, it requires widespread global support from businesses, governments and civil society. This transition requires solutions that address both how and which goods and services are produced (Figure 51). Clearly both the public and private sectors have a vital role to play and a coordinated approach holds the key to success.

Figure 51: Imperatives for concerted action on sustainability



Source: KPMG analysis.

Appendix 1: Methodology

Global Sustainability Megaforges

The global sustainability 'megaforges' identified as key drivers of future change in Part 1 of this report are: Climate Change; Energy & Fuel; Material Resource Scarcity; Water Scarcity; Population Growth; Urbanization; Wealth; Food Security; Ecosystem Decline; Deforestation.

The megaforges were identified through a review of over 30 external future trend projections a list of which can be found in Appendix 2.

Scenarios Interpretation

The scenarios interpretation in Part 1 of this report is based on a review of over 20 external future scenario research documents a list of which can be found in the bibliography included in Appendix 3.

Sector Definitions

The analysis in Part 2 of this report covers industry sectors defined according to the Industry Classification Benchmark (ICB) structure: a definitive system categorizing over 70,000 companies and 75,000 securities worldwide and maintained by FTSE International Limited. The ICB system recognizes four levels of industry aggregation: industry, supersector, sector, and subsector.

Most of the analysis was conducted at the sector level, but in a few cases data was analyzed at the industry level to capture an important industry fully, or at the subsector level in order to capture detail. This report covers:

Airlines (subsector): Companies providing primarily passenger air transport. Excludes airports.

Automobiles & Parts (sector): Makers of motorcycles and passenger vehicles, including cars, sport utility vehicles (SUVs) and light trucks. Manufacturers and distributors of new and replacement parts for motorcycles and automobiles, such as engines, carburetors and batteries. Manufacturers, distributors and retailers of automobile, truck and motorcycle tires. Excludes makers of heavy trucks and makers of recreational vehicles (RVs and ATVs).

Beverages (sector): Manufacturers and shippers of cider or malt products such as beer, ale and stout. Producers, distillers, vintners, blenders and shippers of wine and spirits such as whisky, brandy, rum, gin or liqueurs. Manufacturers, bottlers and distributors of non-alcoholic beverages, such as soda, fruit juices, tea, coffee and bottled water.

Chemicals (sector): Producers and distributors of simple chemical products that are primarily used to formulate more complex chemicals or products, including plastics and rubber in their raw form, fibreglass and synthetic fibres. Producers and distributors of finished chemicals for industries or end users, including dyes, cellular polymers, coatings, special plastics and other chemicals for specialized applications. Includes makers of colourings, flavours and fragrances, fertilizers, pesticides, chemicals used to make drugs, paint in its pigment form and glass in its unfinished form. Excludes producers of paint and glass products used for construction.

Electricity (sector): Companies generating and distributing electricity through the burning of fossil fuels such as coal, petroleum and natural gas, and through nuclear energy. Companies generating and distributing electricity from a renewable source. Includes companies that produce solar, water, wind and geothermal electricity.

Food Producers (sector): Companies that grow crops or raise livestock, operate fisheries or own nontobacco plantations. Food producers, including meatpacking, snacks, fruits, vegetables, dairy products and frozen seafood. Includes producers of pet food and manufacturers of dietary supplements, vitamins and related items. Includes manufacturers of livestock feeds and seeds and other agricultural products. Excludes producers of fruit juices, tea, coffee, bottled water and other non-alcoholic beverages, which are classified under Beverages. Excludes manufacturers of fertilizers or pesticides, which are classified under Chemicals.

Industrial Metals & Mining (sector): Companies that mine or process bauxite or manufacture and distribute aluminium bars, rods and other products for use by other industries. Producers and traders of metals and primary metal products other than iron, aluminium and steel. Manufacturers and stockholders of primary iron and steel products such as pipes, wires, sheets and bars, encompassing all processes from smelting in blast furnaces to rolling mills and foundries. Includes companies that primarily mine iron ores. Excludes manufacturers of finished aluminium products, such as siding, which are categorized according to the type of end product. Excludes companies that make finished products, which are categorized according to the type of end product.

Mining (sector): Companies engaged in the exploration for or mining of coal. Companies engaged in the exploration for and production of diamonds and other gemstones. Companies engaged in the exploration, extraction or refining of minerals not defined elsewhere within the Mining sector. Prospectors for and extractors or refiners of gold-bearing ores. Companies engaged in the exploration for and production of platinum, silver and other precious metals not defined elsewhere.

Marine Transportation (subsector): Providers of on-water transportation for commercial markets, such as container shipping. Excludes ports and shipbuilders.

Oil & Gas (industry): Companies engaged in the exploration for and drilling, production, refining and supply of oil and gas products. Integrated oil and gas companies engaged in the exploration for and drilling, production, refining, distribution and retail sales of oil and gas products. Suppliers of equipment and services to oil fields and offshore platforms, such as drilling, exploration, seismic-information services and platform construction. Operators of pipelines carrying oil, gas or other forms of fuel. Excludes pipeline operators that derive the majority of their revenues from direct sales to end users, which are classified under Gas Distribution. Companies that develop or manufacture renewable energy equipment utilizing sources such as solar, wind, tidal, geothermal, hydro and waves. Companies that produce alternative fuels such as ethanol, methanol, hydrogen and bio-fuels that are mainly used to power vehicles, and companies that are involved in the production of vehicle fuel cells and/or the development of alternative fuelling infrastructure.

Telecommunications (industry), Telecommunications Equipment (sector) and Internet (subsector): Providers of fixed-line telephone services, including regional and long-distance. Includes companies that primarily provides telephone services through the internet. Providers of mobile telephone services, including cellular, satellite and paging services. Includes wireless tower companies that own, operate and lease mobile site towers to multiple wireless service providers. Makers and distributors of high-technology communication products, including satellites, mobile telephones, fibres optics, switching devices, local and wide-area networks, teleconferencing equipment and connectivity devices for computers, including hubs and routers. Companies providing Internet-related services, such as Internet access providers and search engines and providers of Web site design, Web hosting, domain-name registration and e-mail services.

Further information on the ICB structure can be found at www.icbenchmark.com

Quantitative Analysis: Value at stake and environmental intensity

The quantitative data in Part 2 of this report is generated by Trucost, an independent environmental research agency. The data use a pricing methodology that calculates the cost to global society of environmentally-sensitive corporate activities. These include inputs such as resource use and outputs such as greenhouse gas and pollutant emissions. The data set is based on the operations of over 800 companies between 2002 and 2010 (2010 being the most recent available data) and representing the 11 key business sectors. The selection of companies is representative, as an exact comparison of companies between the two census dates is not possible due to alterations in the corporate landscape between 2002 and 2010.

The Trucost data price the damage that is done to society and human capital by pollutants and natural resource use. This external costs-based system draws on a library of prices for over 700 different natural inputs and outputs. The prices

are based on cost principles derived from a review of environmental economics literature, and the library is overseen by an independent international advisory panel of leading academics. A total of 22 key environmental impacts were evaluated for this report, including: greenhouse gases (carbon dioxide, HFCs, nitrous oxide, methane, perfluorocarbons, sulphur hexafluoride), water abstraction, pollutants including acid rain precursors, ozone depleting substances, and waste generation. The physical totals of these inputs and outputs incurred both directly and indirectly¹ were converted into financial values and aggregated to achieve a total environmental cost value. These costs which for the most part do not appear on corporate financial statements are known as external environmental costs.

In the quantitative analysis the external costs of these 22 environmental impacts have been compared with sector EBITDA. EBITDA data come from independent financial data providers, and are checked by Trucost analysts against company financial statements.

The conversion of environmental impacts into dollar sums of external environment cost is a relatively new practice. For this reason, the analyses and summary should be taken as indicative rather than absolute.

Qualitative: Risk and readiness

The perceived risk and readiness interpretation is based on KPMG's meta-review of over 60 external industry reports, which aggregates citations of sustainability risks and indicators of risk preparedness for all 11 sectors. Reports from sources including investment banks, business associations, insurance companies, consultancies, rating agencies and intergovernmental organizations were analysed in terms of risk types and sector preparedness. The risk categories used were physical risks; competitive risks, regulatory risks, reputational risks, litigation risks, and social risks. Expanded definitions of these categories of risk can be found in the Introduction to Part 2 of this report. The incidence and level of references to the six risks outlined were aggregated to provide an overall score of sectoral risk and readiness. In addition, the level of sector readiness has also been assessed using the results of the KPMG International Corporate Responsibility Reporting Survey 2011.

The qualitative findings of this review should be taken as indicative not absolute; risk exposure and readiness levels are perceived values, providing both a relative indicator across sectors, and a risk reading that is supplementary to the quantitative assessment.

¹ The external environmental cost data relate to both direct and indirect inputs and outputs – that is costs incurred by a surveyed company, plus costs incurred in the company's upstream supply chain. Trucost uses a global input-output model based on detailed government census and survey data on resource use and pollutant releases, industry data and statistics, and national economic accounts. The model can distinguish inputs and outputs at any level of the supply chain from the first-tier of suppliers through to total upstream supply chain requirements. The input-output methodology models the purchases a company makes and the resultant environmental impacts. This provides a means to differentiate between low impact supplied goods, such as renewable energy, and high impact supplied environmental goods, such as fossil fuel energy.

Appendix 2: Global sustainability megaforges bibliography

The identification of ten global sustainability megaforges was based on a review of over 30 external future trend projections:

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Glossary: Terms & abbreviations

ADB: Asian Development Bank.

APERC: Asia Pacific Energy Research Center.

ATC: Air Traffic Control.

Basel III: A set of banking regulations agreed in response to the financial crises that occurred at the end of the first decade of the 2000s. The regulations greatly increase the amount of capital banks must hold against their losses.

BAU: Business as usual.

BGS: British Geological Society.

Biomass: Biological material from living or recently-living organisms (usually in the context of a capability of being thermally, chemically or bio-chemically converted to energy). Examples include wood, grasses and crops.

BLS: US Bureau for Labor Statistics

BRIC: Brazil, Russia, India & China.

Carbon Trading: A system for pricing carbon emissions and trading the rights to emit carbon. Examples include the EU Emissions Trading System and the UN's Clean Development Mechanism.

CBD: Convention on Biological Diversity

CCS: Carbon Capture and Storage.

CDM: Clean Development Mechanism – a 'flexibility mechanism' defined in the Kyoto Protocol (2007) that allows industrialized countries to invest in emissions reductions in developing economies and thus gain carbon credits.

CDP: Carbon Disclosure Project.

Cefic: The European Chemical Industry Council.

Ceres: A coalition of more than 120 investors and public interest groups working towards global sustainability solutions.

CLD: Causal Loop Diagramming, a method of depicting the interaction of trends.

CO₂: Carbon dioxide.

CR: Corporate responsibility.

Crack Spread: The cost difference between a barrel of crude oil and a barrel of the petroleum products made from it, eg. jet fuel.

Cubic Meter: 1 cubic meter = 264.17 US gallons.

DEFRA: UK Department for Environment, Food, and Rural Affairs.

EBITDA: Earnings before interest, tax, depreciation and amortization.

EEDI: Energy Efficiency Design Index – a minimum standard of maritime energy efficiency established by the International Maritime Organization.

EIA: US Energy Information Administration.

EIU: Economist Intelligence Unit.

EPA: US Environmental Protection Agency.

EPHC: Environment Protection & Heritage Council.

ETS: EU Emissions Trading System.

EVs: Electric vehicles, including battery powered vehicles, full and plug-in hybrids, and fuel cell vehicles.

External Environmental Costs: A calculation of the total non-balance sheet value of environmentally-sensitive inputs and outputs in corporate operations, using the Trucost input/output price library.

FAA: US Federal Aviation Administration.

FAO: Food and Agriculture Organization.

FFF: Forum for the Future.

FSC: Forest Stewardship Council.

FWA: Fixed Wireless Access.

G20: A forum for 19 countries representing the world's leading economies, plus a representative of the European Union, meeting annually.

G250: Global Fortune 250 ranking of companies.

G8: A forum for eight countries, Canada, France, Germany, Italy, Japan, UK, US, and Russia, meeting annually.

GAO: US General Accounting Office.

GCF: Green Climate Fund.

GDP: Gross Domestic Product.

GeSI: Global e-Sustainability Initiative, an ICT industry membership organization.

GFN: Global Footprint Network, an international sustainability think-tank.

GHG: Greenhouse gas.

GM: Genetically modified.

GRI: Global Reporting Initiative. GRI's Sustainability Reporting Guidelines have gained widespread adoption as the *de facto* global standard for CR reporting.

GtCO₂e: Gigatonne of CO₂ equivalent.

IATA: The International Air Transport Association.

IBA: Indian Beverages Association.

ICT: Information & Communications Technology.

IEA: International Energy Agency.

IFPRI: International Food Policy Research Institute.

ITF: Institute for the Future.

IMF: International Monetary Fund.

IMO: International Maritime Organization.

IOC: International oil company.

IPPC: Intergovernmental Panel on Climate Change.

ITU: International Telecommunication Union.

JLG: Joint Liaison Group of the Rio Conventions.

Living Planet Index: An indicator of the state of global biodiversity, developed by the WWF.

LNG: Liquefied natural gas.

MARINTEK: Norwegian Marine Technology Research Institute.

MDO: Marine diesel oil.

Metric Ton: 1 metric ton (or tone) = 1.1 US (short) tons.

Millennium Ecosystem Assessment: A United Nations-sponsored research project undertaken 2001-2004 designed to identify the implications of global ecosystem change.

MRV: Monitoring, reporting and verification.

MSA: Mean Species Abundance, a biodiversity indicator.

MWh: Megawatt hour.

N100: The largest 100 companies by country.

NAMA: Nationally Appropriate Mitigation Action.

NGN: Next Generation Network.

NGO: Non-Governmental Organization.

NOC: National oil company.

OECD: Organization for Economic Cooperation and Development.

PEFC: Program for the Endorsement of Forest Certification.

PES: Payments for Ecosystem Services, incentives for ecological management of agricultural resources.

PPP: Private Public Partnership.

RED: EU Renewable Energy Directive, a 2009 directive designed to ensure that the EU produces 20% of overall energy and 10% of transport energy from renewable sources by 2020.

REDD: Reducing Emissions from Deforestation and Degradation.

REM: Rare Earth Mineral.

SEI: Stockholm Environment Institute.

SERI :Sustainable Europe Research Institute.

SFI: Sustainable Forestry Initiative.

SIK: Swedish Institute for Food and Biotechnology.

SITM: Symbiosis Institute of Telecom Management.

Smart building: A building that embodies a group of embodied ICT systems that maximize energy efficiency.

Smart grid: An electric power grid that integrates ICT applications throughout the grid to enable efficiency and optimization solutions.

SOX: The Sarbanes–Oxley Act (also known as the Public Company Accounting Reform and Investor Protection Act), a 2002 US federal law.

TEEB: The Economics of Ecosystems and Biodiversity, a United Nations Environment Program research initiative designed to explore the economic benefits of biological diversity.

UCSUSA: US Union of Concerned Scientists.

UII: Urban Infrastructure Initiative.

UN DESA: United Nations, Department of Economic and Social Affairs.

UNCTAD: United Nations Conference on Trade and Development.

UNDP: United Nations Development Program.

UNEP: United Nations Environment Program.

UNFCCC: United Nations Framework Convention on Climate Change.

UNFPA: United Nations Population Fund.

UN-Habitat: The United Nations agency for human settlements.

USDA: US Department of Agriculture.

USGS: US Geological Survey.

VOIP: Voice Over Internet Protocol.

WBCSD: World Business Council for Sustainable Development.

WEF: World Economic Forum.

Wimax: Worldwide Interoperability for Microwave Access, a wide-area high-speed internet delivery technology.

WRG: Water Resources Group.

WRI: World Resources Institute.

WWF: The World Wildlife Fund (known outside the US and Canada as the World Wide Fund for Nature).

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Colophon

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KPMG's Climate Change and Sustainability Services (CC&S) professionals provide sustainability and climate change Assurance, Tax and Advisory services to organizations to help them apply sustainability as a strategic lens to their business operations. We have more than 25 years experience working with leading businesses and public sector organizations which has enabled us to develop extensive relationships with the world's leading companies and to contribute to shaping the sustainability agenda.

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