KPMG
cutting through complexity

Expect the Unexpected:

Building business value in a changing world

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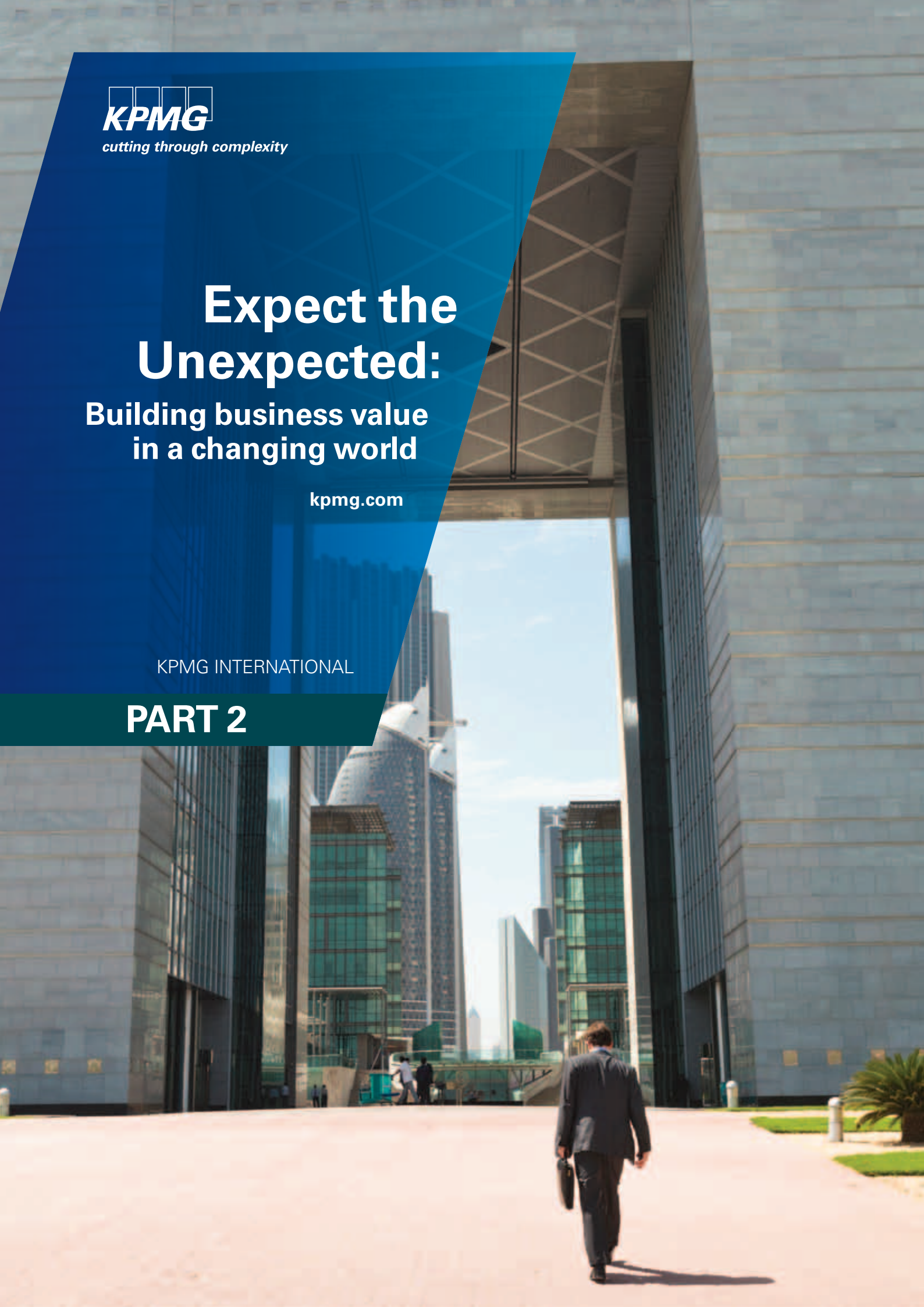
KPMG INTERNATIONAL

PART 2



In this report we offer a starting point for discussion. We present a system of ten sustainability megaforces 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.

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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 megaforces 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 megaforces 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.

Michael Andrew
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PART 2

01 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

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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 megaforces. 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

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“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 megaforces 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$195billion and Oil & Gas at US$152billion.[6]

[3] Trucost, 2012
[4] Trucost, 2012
[5] Trucost, 2012
[6] Trucost, 2012

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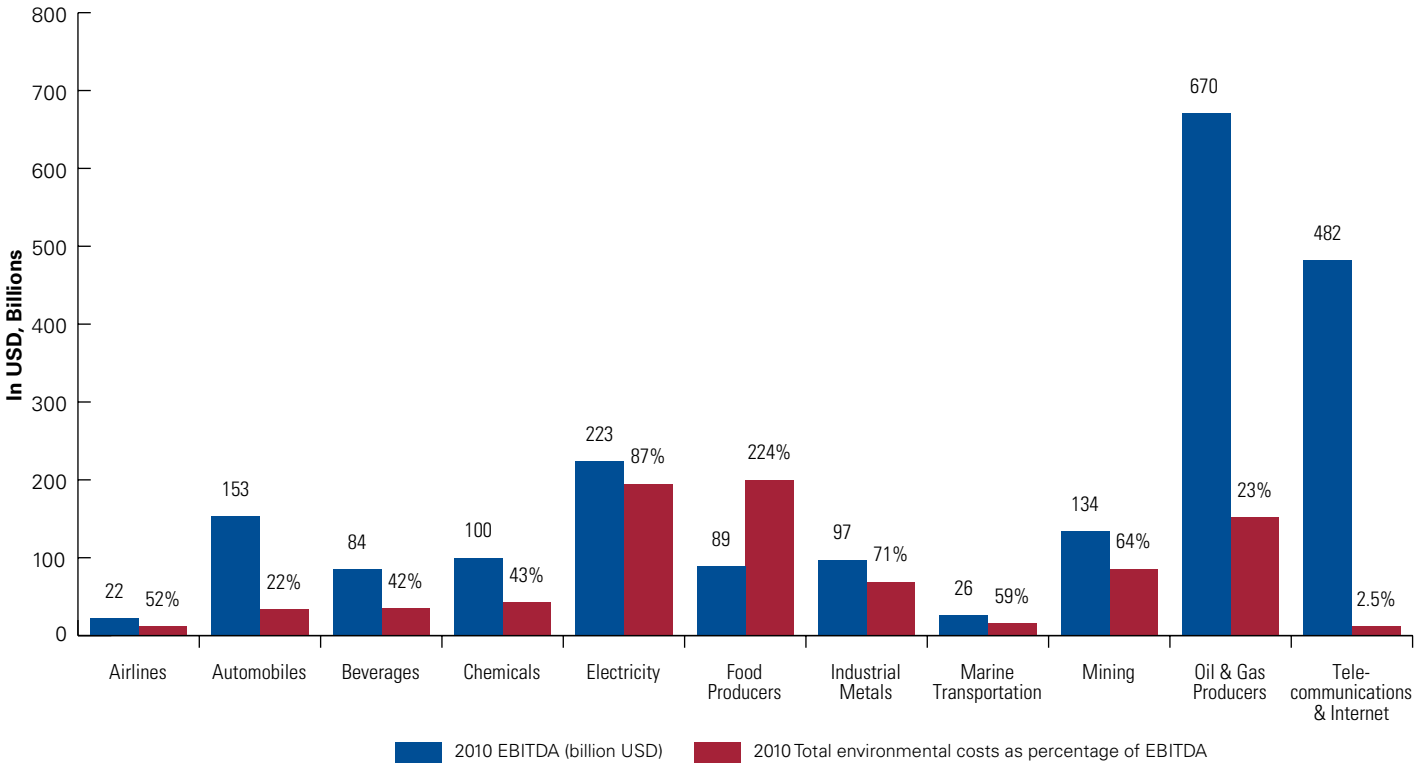
Figure 27: 2010 EBITDA vs external environmental costs



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 EBIDTA 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

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"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."

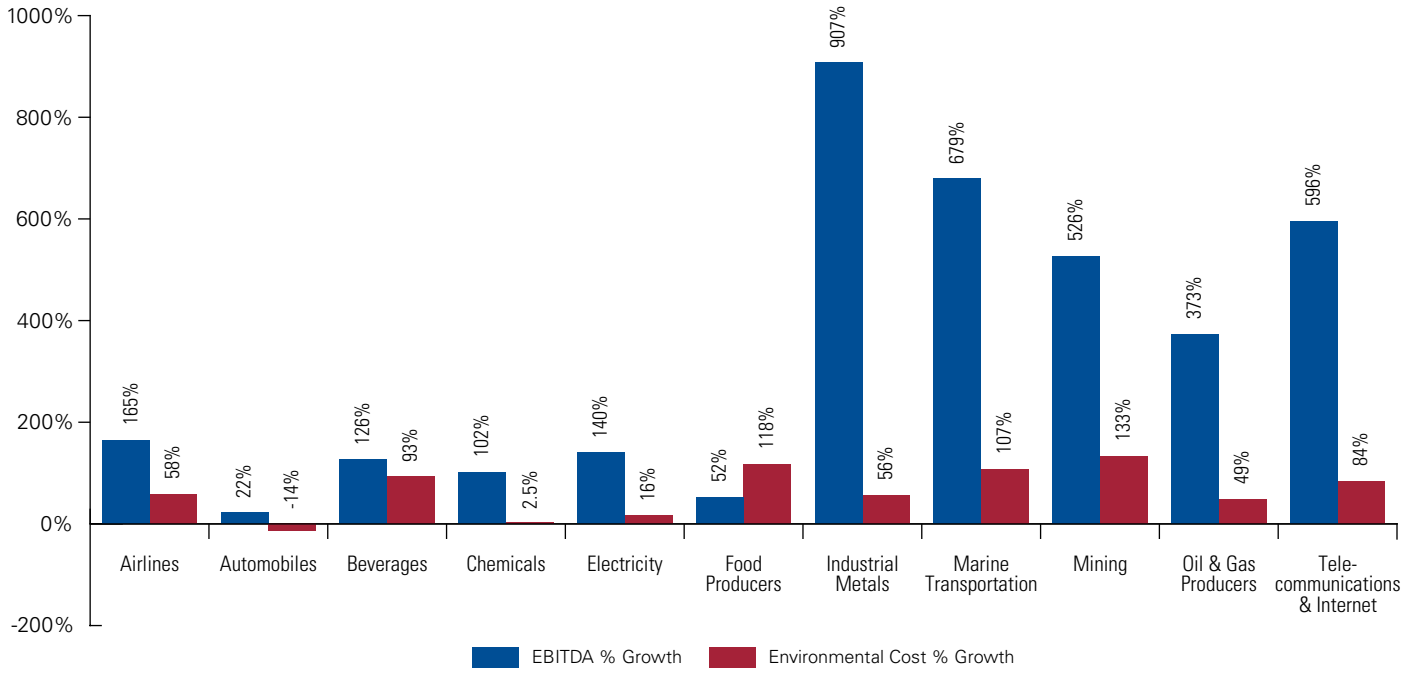
The greatest reductions in earnings exposure to environmental cost were seen in the Industrial Metals sector, followed by Marine Transportation, Mining and Electricity. This reduction in exposure is for the most part driven by rapid growth in earnings rather than a reduction in or slowing of growth in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

Environmental costs grew the most in the Food Producers, Mining and Marine Transportation sectors, 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] Trucost, 2012
[9] Trucost, 2012

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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).

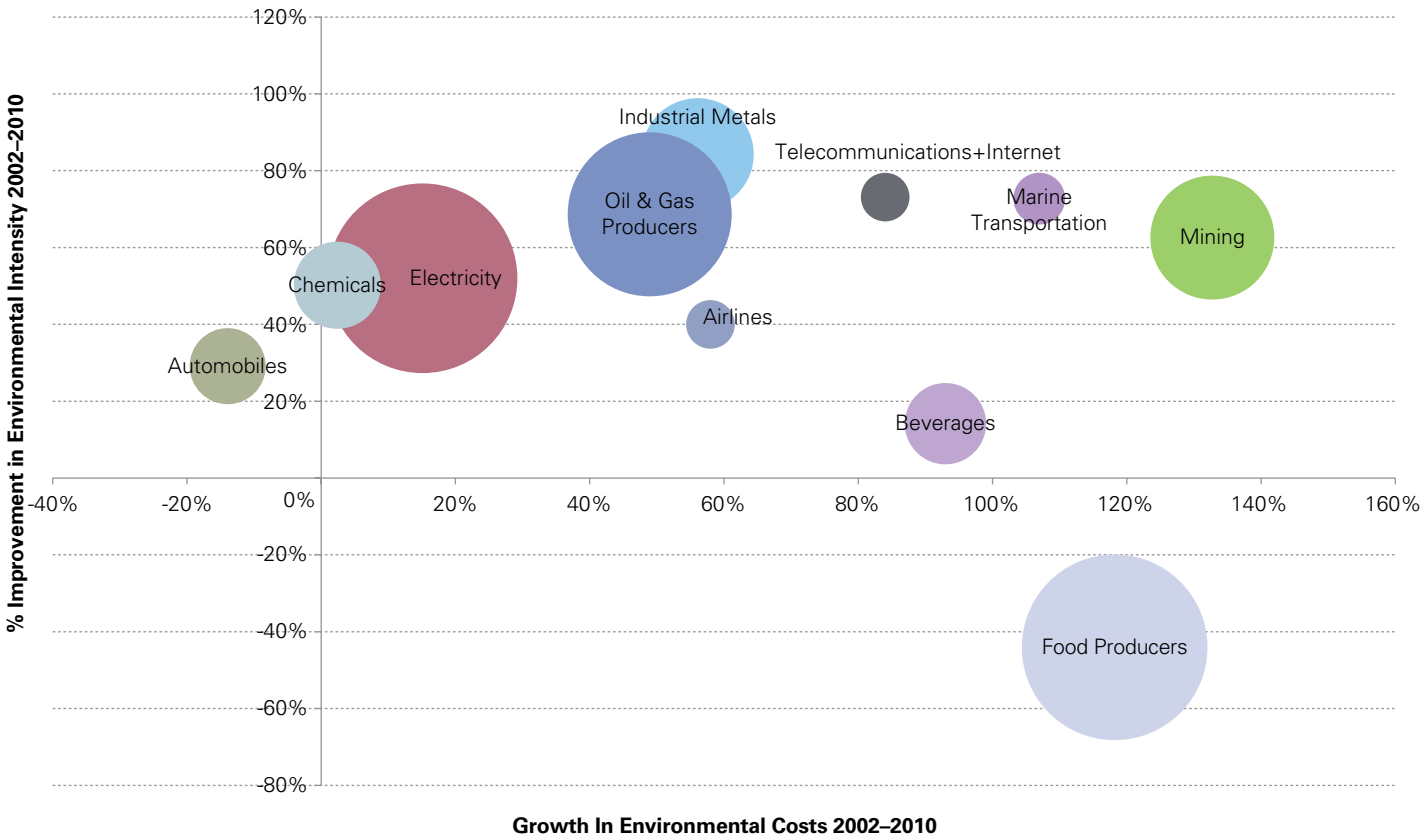
As indicated in *Figure 29*, the size of the bubbles indicates the current (2010) external environmental cost incurred by each sector, according to the Trucost data. The position on the chart indicates how much the environmental costs have grown over the eight years to 2010, as well as the change in 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 enviromental intensity improvement

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



Source: Trucost 2012

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“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 megaforces 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 megaforces 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,

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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 megaforces 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 megaforces on shareholder value.

Social Risks: the risk of serious disruption to business operations and supply chains due to the societal effects of sustainability megaforces. 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 megaforces and ask how prepared sectors 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] *KMPG International Survey of Corporate Responsibility Reporting*, 2011

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"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*

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levels were underestimated or under-reported. The risk/readiness review in this new report suggests growing market awareness of the sectors' vulnerability to sustainability megaforces 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 megaforces 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 it is still vulnerable to regulations limiting GHG emissions and water use."

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“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 megaforces.

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 megaforces affect the sector, the risks and opportunities ahead and the sector’s readiness to respond to them.

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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

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"The sector has reduced its carbon intensity over the last decade through technological advances and operational efficiencies."

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 CO_2 in 2010 – representing approximately 2 percent of global emissions[2] – 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 dramatically reduced its carbon intensity through technological advances and operational efficiencies that are estimated to have saved 3.3 billion metric tons of emissions since 1990, compared with a business-as-usual trajectory.[4] According to aviation trade body IATA, air transport has reduced its CO_2 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 despite a 1.7 percent annual reduction in emissions attributed to efficiency.[5]

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.[6]

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.[7]

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2 International Air Transport Association (IATA) (2011). Fact Sheet: *Environment*. http://www.iata.org/pressroom/facts_figures/ fact_sheets/pages/environment.aspx

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

4 International Air Transport Association (IATA). P. Steel. *Aviation and Environment*. Singapore 2011.

5 International Air Transport Association (IATA) (2011). *Facts and Figures – Fact Sheet: Environment*. http://www.iata.org/pressroom/facts_figures/fact_sheets/Pages/environment.aspx

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

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

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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 gallon of jet fuel adds approximately US$175 million to US airline fuel bills.[8] 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 is expected to account for 25 percent of revenues according to Standard & Poors estimates.[9]

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.[10]

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 or other renewable fuels 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 CO_2 emissions a year.[11] Europe's proposed new Single European Sky (SESAR) system could reduce CO_2 emissions from aviation in the EU by 10 percent by 2020.[12]

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."

[8] Airlines for America. *The Price of Jet Fuel and Its Impact on American Airlines.* http://www.airlines.org/Pages/The-Price-of-Jet-Fuel-and-Its-Impact-on-U.S.-Airlines.aspx

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

[10] Boeing Commercial Airplanes. (2011). *Current Market Outlook 2011–2030.*

[11] Airbus. (2011). *Delivering the Future.* Airbus, Toulouse. http://www.airbus.com/company/market/forecast/passenger-aircraft-market-forecast/, accessed on April 30, 2012.

[12] SESAR Joint Undertaking. (2010). *SESAR and the Environment.* http://www.sesarju.eu/sites/default/files/documents/reports/SESAR_environment_June_2010_web.pdf

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“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.[13] 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 60 percent of the world’s population is predicted to be in Asia.[14] 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 76 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.[15]

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*).[16]

[13] Airbus. (2011). *Delivering the Future*. Airbus, Toulouse.
[14] Airbus. (2011). *Delivering the Future*. Airbus, Toulouse.
[15] Airbus. (2011). *Delivering the Future*. Airbus, Toulouse.
[16] Airbus. (2011). *Delivering the Future*. Airbus, Toulouse.

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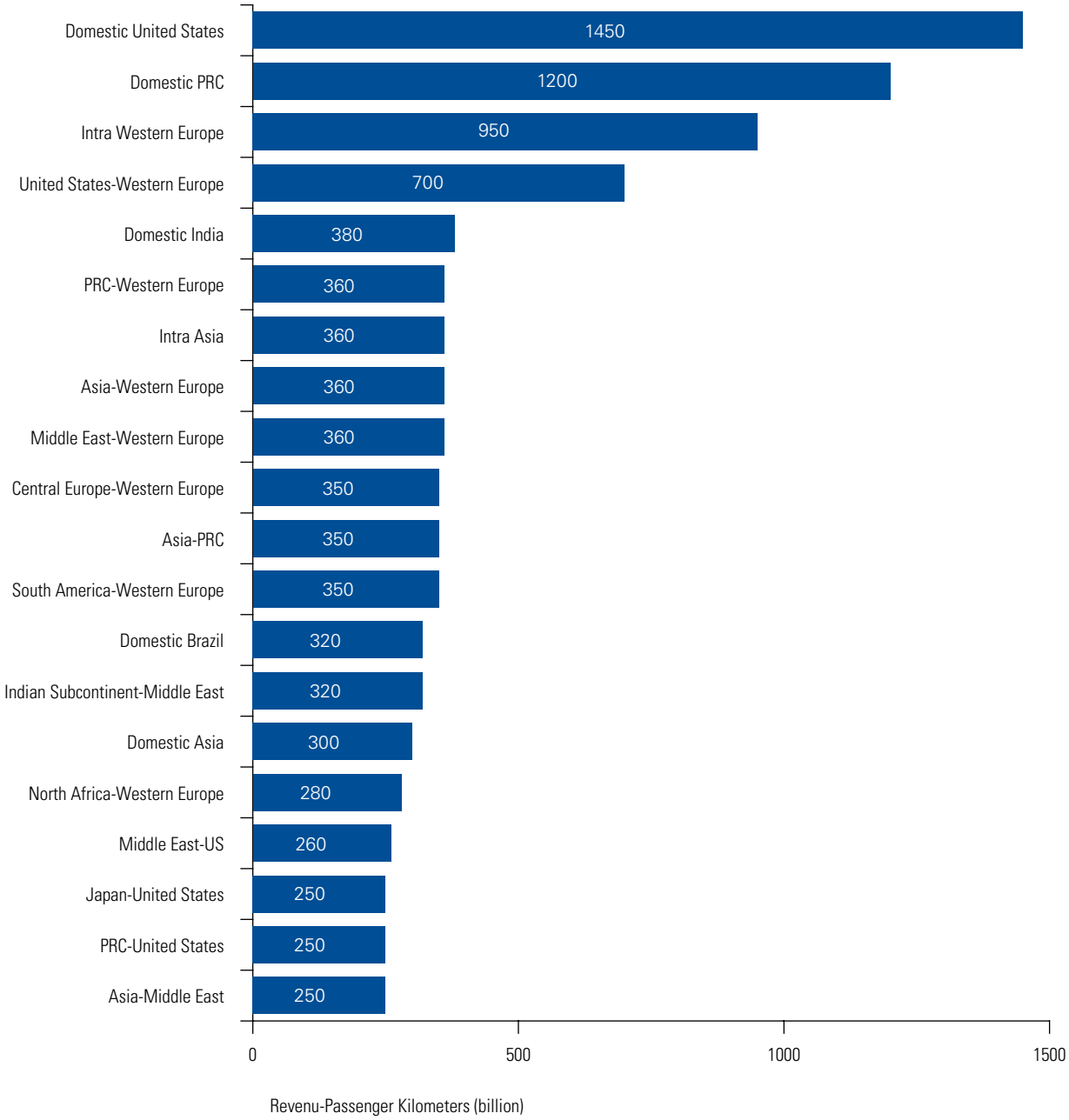
Figure 31: Airline traffic flows in 2030



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

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“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 megaforces 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.

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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 is it 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.”

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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.”**

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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. CO_2 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 CO_2 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[6] and Germany has pledged 1 million by 2020.[7]

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 34*). 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 US Department of Energy. (2011). *One Million Electric Vehicles By 2015.* February 2011 Status Report. Retrieved on May 1, 2011 from: http://www1.eere.energy.gov/vehiclesandfuels/pdfs/1_million_electric_vehicles_rpt.pdf
7 Economist Intelligence Unit. (2011). *World Automotive Outlook.* The Economist Group, London.

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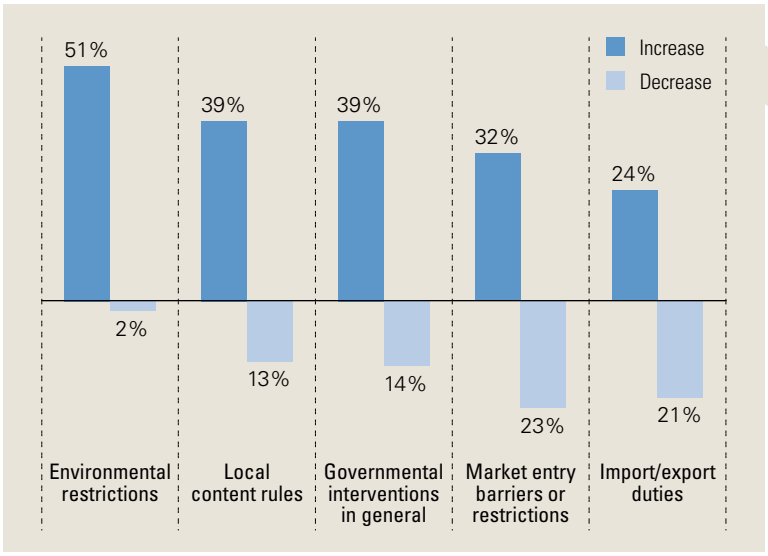
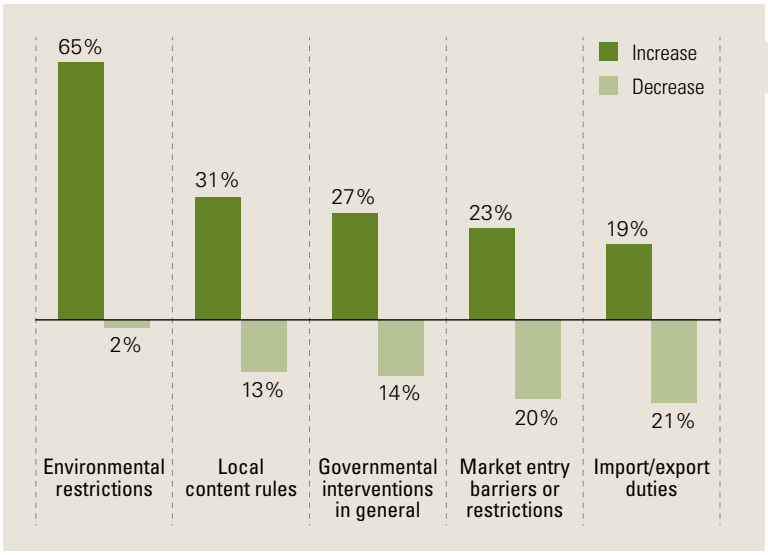
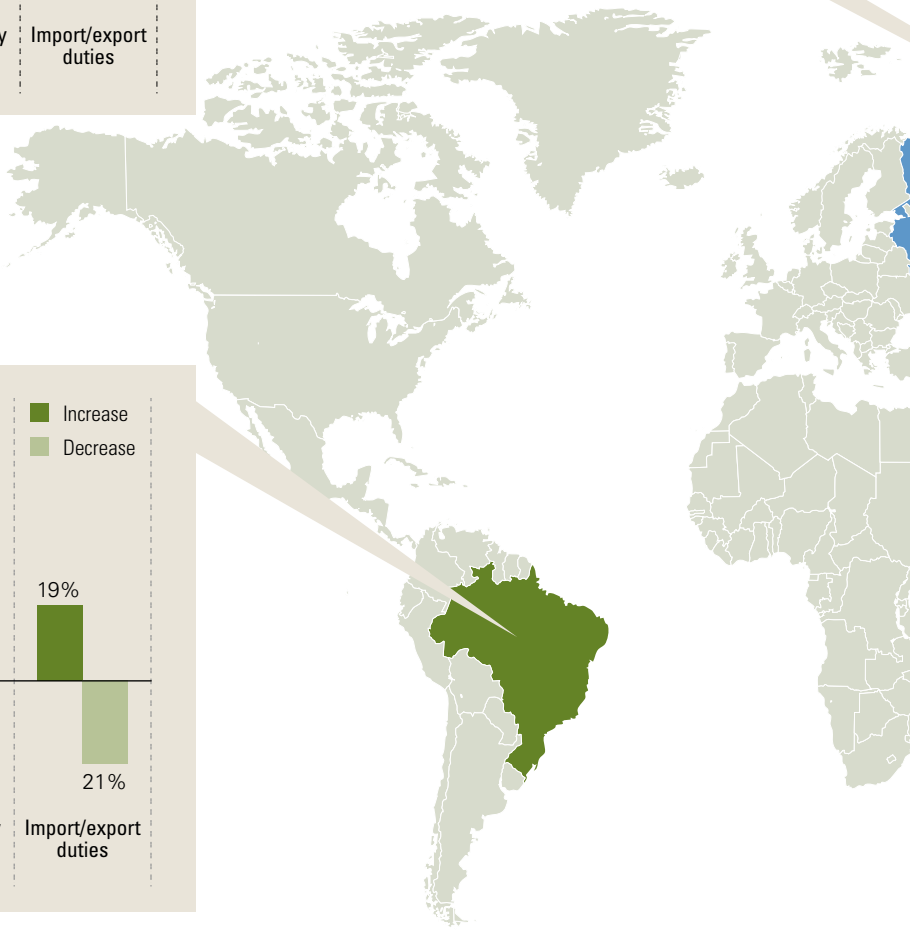
Figure 32: Development of market conditions and barriers in the BRICs







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

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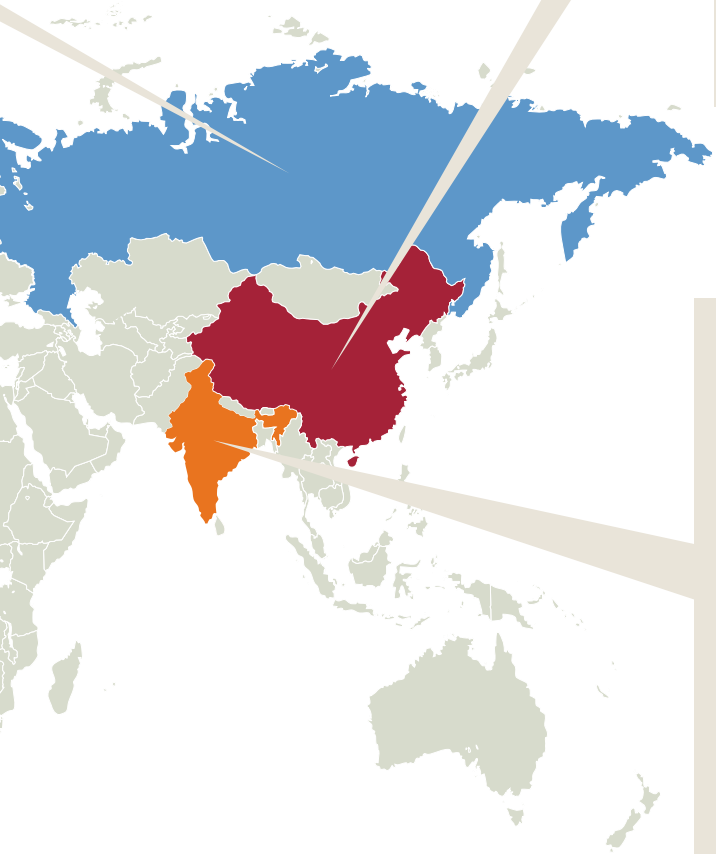

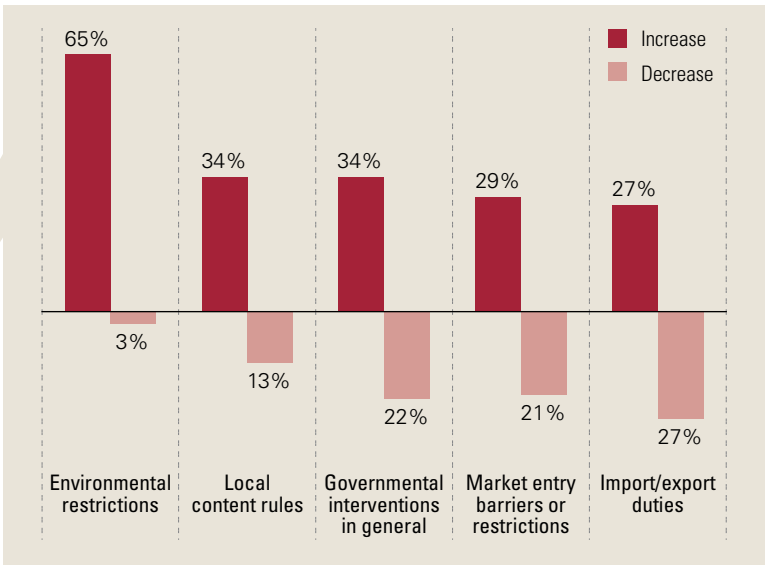

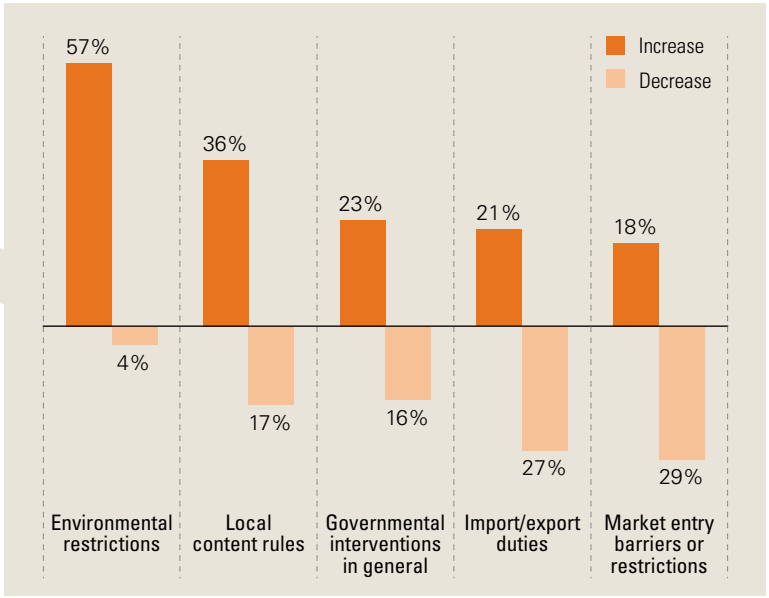

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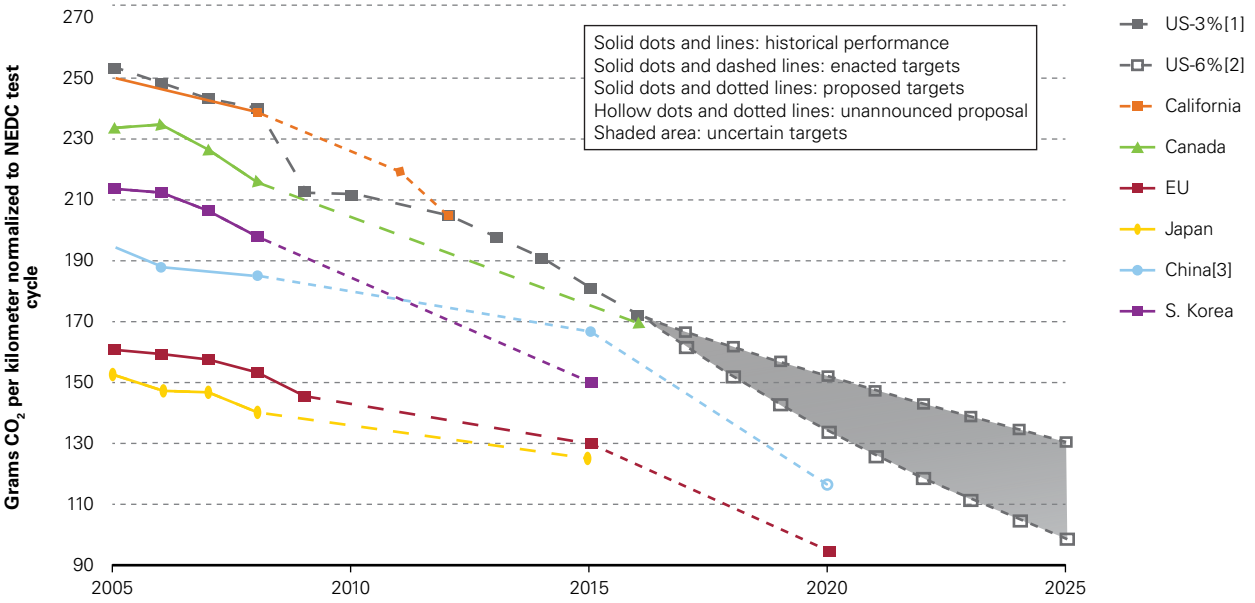
Figure 33: Summary of regional GHG emission targets

A comparison of the historical fleet performance and the stringency of forthcoming regulations



[1] Based on 3% annual fleet GHG emissions reduction between 2017 and 2025 in the September 30th NOI.
[2] Based on 6% annual fleet GHG emissions reduction between 2017 and 2025 in the September 30th NOI.
[3] China's target reflects gasoline fleet scenario. If including other fuel types, the target will be lower.

Source: http://www.theicct.org/info/documents/PVstds_update_apr2011.pdf, accessed on May 16, 2012.

"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 35*).

Asian growth to fuel sustainability megaforces

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 is expected to grow to 78 percent by 2050.[8]

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

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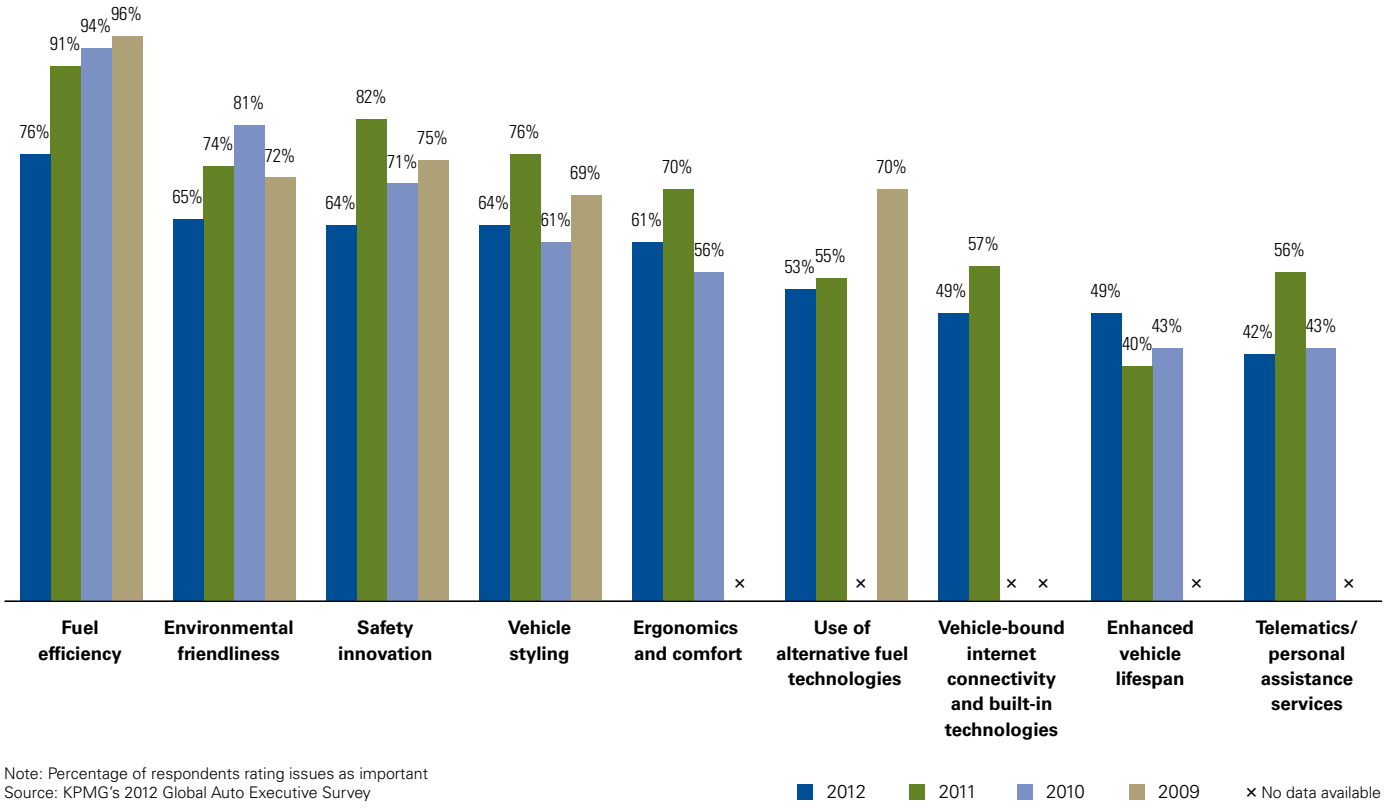
Figure 34: Product issues influencing consumer purchase decisions



Note: Percentage of respondents rating issues as important
Source: KPMG's 2012 Global Auto Executive Survey

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.[9] 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."

[9] OECD. (2010). *The emerging middle class in developing countries.*

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“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.[10]

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 a automobile paint shop which uses a waterless separation process for topcoat application.[11]

According a report by Hart Energy, demand for biofuels will increase from 80 billion liters in 2010 to roughly 180 billion liters in 2020.[12]

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 CO_2 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.[13]

These CO_2 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

[10] Toyota. (2011). *Sustainability Report 2011.*

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

[12] M. Pinto, *Global Biofuels Outlook 2010-2020,* Hart Energy, Rotterdam, 2011, http://www.sari-energy.org/PageFiles/What_We_Do/activities/worldbiofuelsmarkets/Presentations/DownstreamBiofuels/Maelle_Soares_Pinto.pdf.

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

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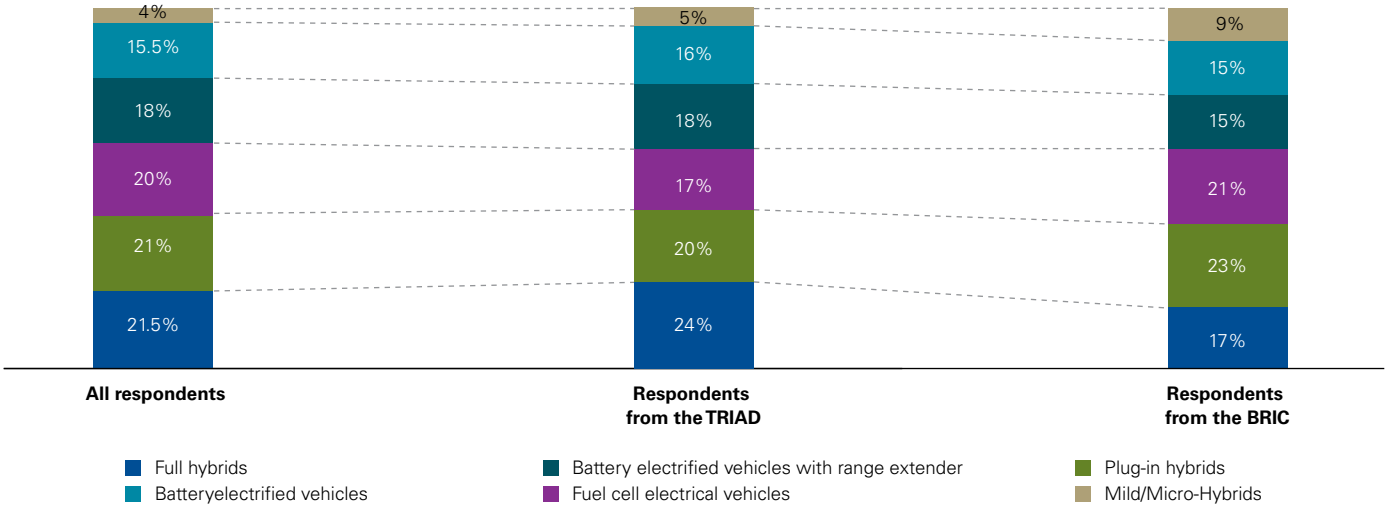
Figure 35: Electric vehicle technology attracting the most customer demand by 2025



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

2011,[14] 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."

[14] KPMG (2011). *KPMG International Survey of Corporate Responsibility Reporting 2011*

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"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 CO_2 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.

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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 megaforces. Responding to these effectively will require a high level of preparedness.

Exposure to Global Sustainability Megaforces

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

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“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, a major soft drink bottling plant in India lost its social license to operate amid accusations that it was depleting the water table.[4]

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.[5]

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.[6]

[3] The Economist. (2008). *A water warning*
[4] J. Singh, *India Coca-Cola compensation law is passed in Kerala,* BBC, 24 February 2011; M. Geller, *Water risks ripple through the beverage industry,* Reuters, June 16, 2009.
[5] Indian Beverages Association. http://www.in-beverage.org/
[6] IBISWorld. (2011). *Global Soft Drink and Bottled Water Manufacturing.*

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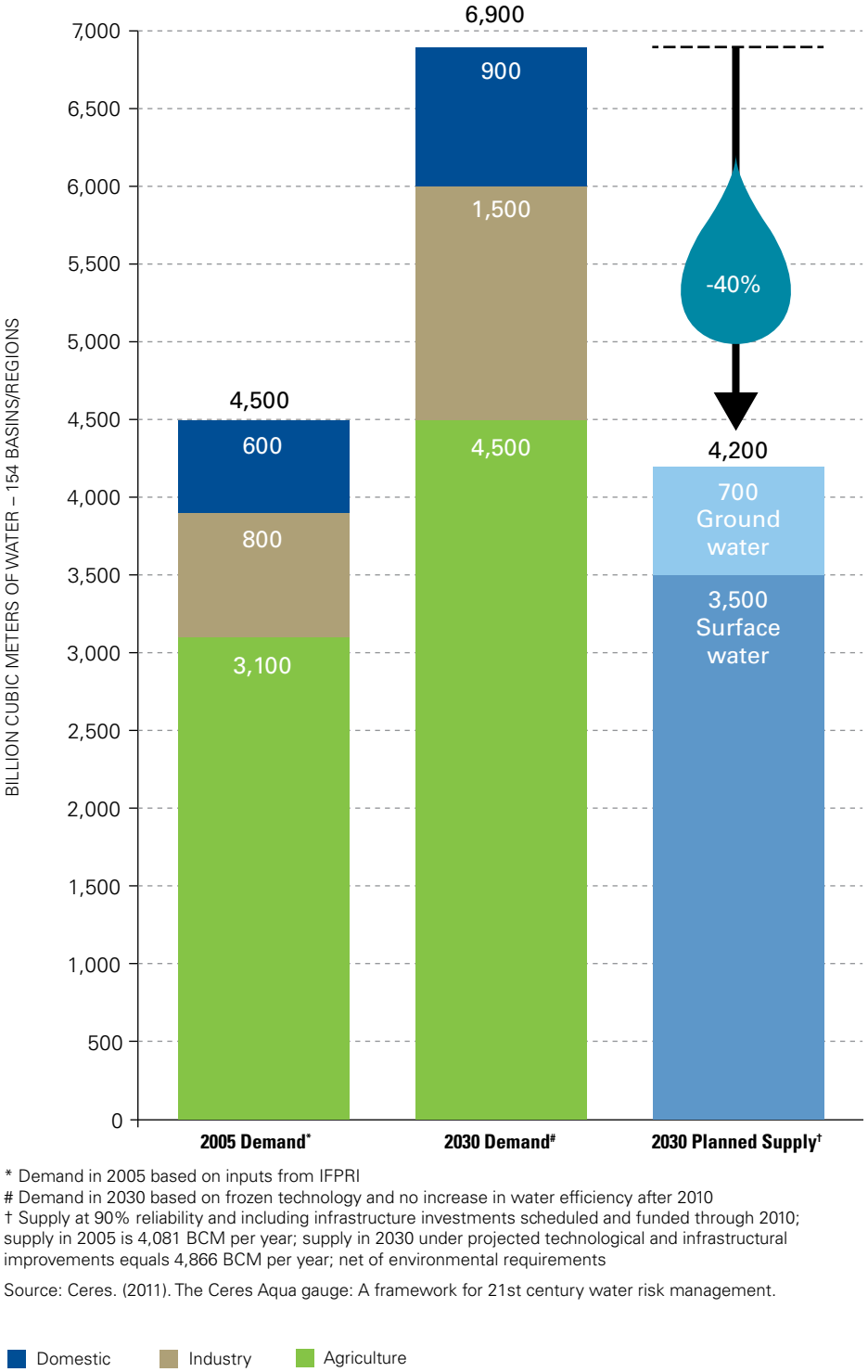
Figure 36: Global fresh water demand gap projected by 2030



* 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.

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

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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 futrue)
Operating efficiency	Processing costs	Cost ↑	The beverages subsector is critically dependent on water for both procesing 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 of 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.[7]

However, the **Climate Change, Food Security** and **Water Scarcity** megaforces 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 aluminum, resins, sugar, barley, corn and hops. Raw materials like these are the largest cost category for Beverage companies, accounting for more than 50 percent of revenue for soft drink and water producers and around 35 percent of revenue for beer producers[8, 9].

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

[7] 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
[8] IBISWorld. (2011). *Global soft drink and bottled water manufacturing.*
[9] IBISWorld. (2011). *Global beer manufacturing.*
[10] Starbucks. (2012). *Tackling Climate Change.*

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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 2032[12] 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, Population Division. (2011). *World Population Prospects: The 2010 Revision.*
[13] who.int/mediacentre/factsheets
[14] Responsible Research. (2010). Key risks facing the beverages industry.

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“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 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: “Beverage containers are an important sub-set of all packaging waste and include mainly glass, plastics, aluminium 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 megaforces, 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.*

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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 7 percent of global man-made emissions. 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.[3]

> **"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 American Chemistry Council. *Global Business of Chemistry.* www.americanchemistry.com/Jobs/EconomicStatistics/Industry-Profile/Global-Business-of-Chemistry.
3 International Council of Chemical Associations, ICCA. (2009). *Innovations for Greenhouse Gas Reductions.*

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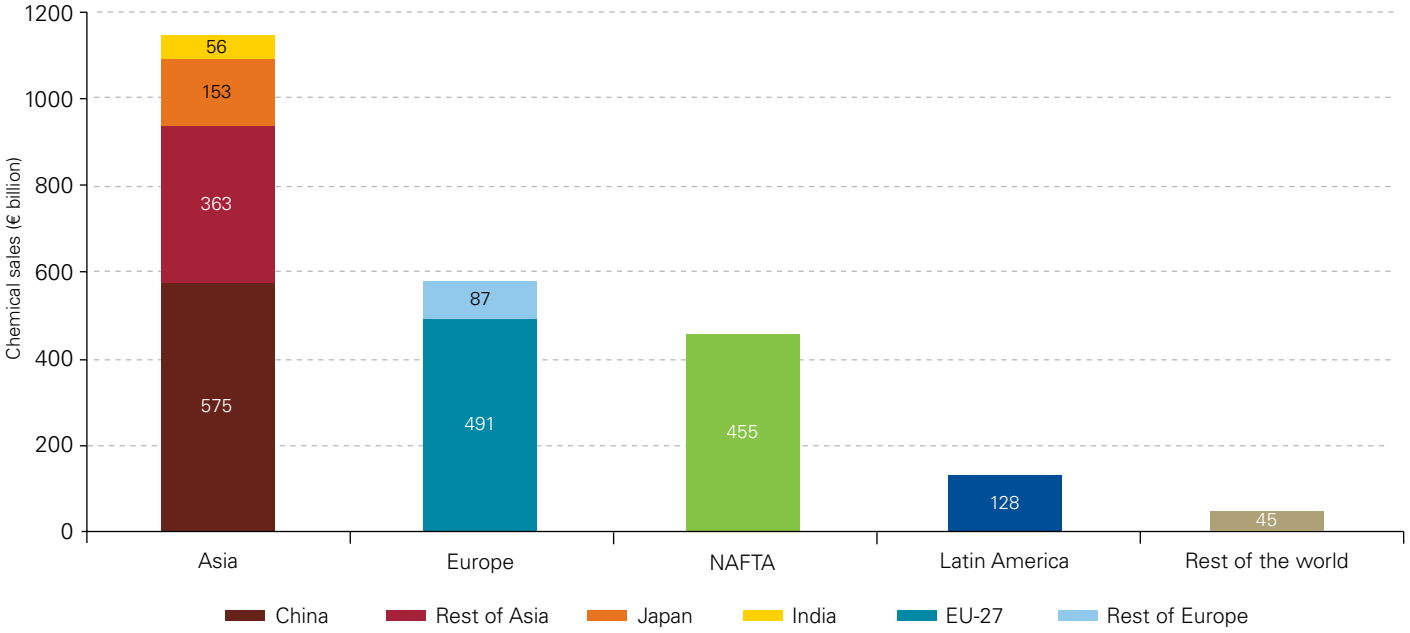
Figure 38: Global chemical sales by region



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 2030[4] 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 Megaforces

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.[5]

[4] International Council of Chemical Associations, ICCA. (2009). *Innovations for Greenhouse Gas Reductions.*
[5] See Appendix 1 for methodology

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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.[6] By 2025, developing nations are expected to increase water withdrawal rates by 50 percent, compared to an 18 percent increase in developed nations.[7] 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 CO_2 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.

"Between 1990 and 2009, production in the EU chemicals industry, including pharmaceuticals, rose by 60 percent, while total energy consumption and greenhouse gas (GHG) emissions fell by 27 percent and 49 percent respectively during the past years 1990 to 2009."[8]

However, despite the industry's progress in reducing GHGs, it remains one of the most energy intensive industries,[9] 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."

6 Tillson, Tim "*Water Scarcity: What chemical companies need to know*", KPMG 2010.
7 Tillson, Tim "*Water Scarcity: What chemical companies need to know*", KPMG 2010.
8 Hadri, Moncef, "*Facts and Figures 2010, The European Chemical Industry in a Worldwide Perspective*", Cefic European Chemical Industry Council
9 Hadri, Moncef, "*Facts and Figures 2010, The European Chemical Industry in a Worldwide Perspective*", Cefic European Chemical Industry Council

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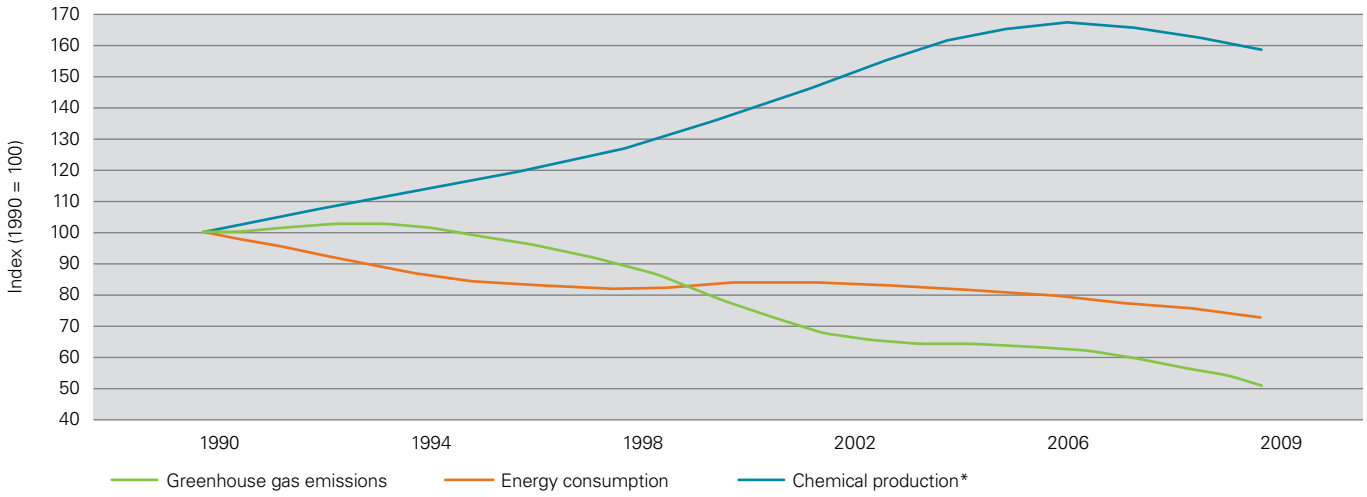
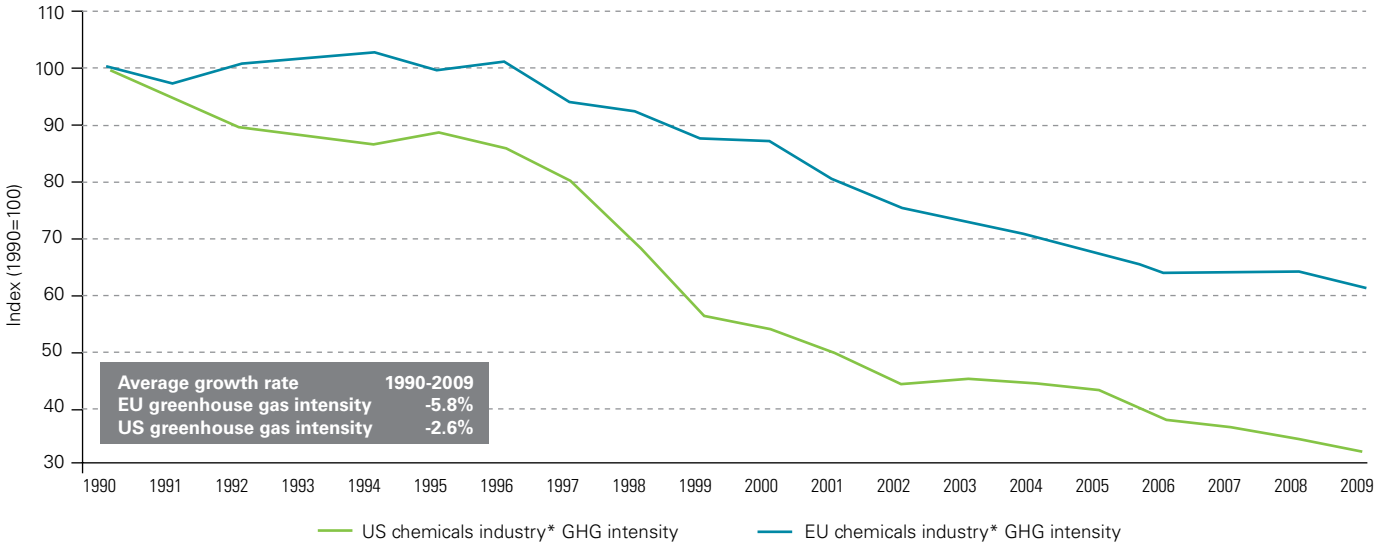
Figure 39: Chemicals production decoupled from energy use



* 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



* Including pharmaceuticals

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

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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.

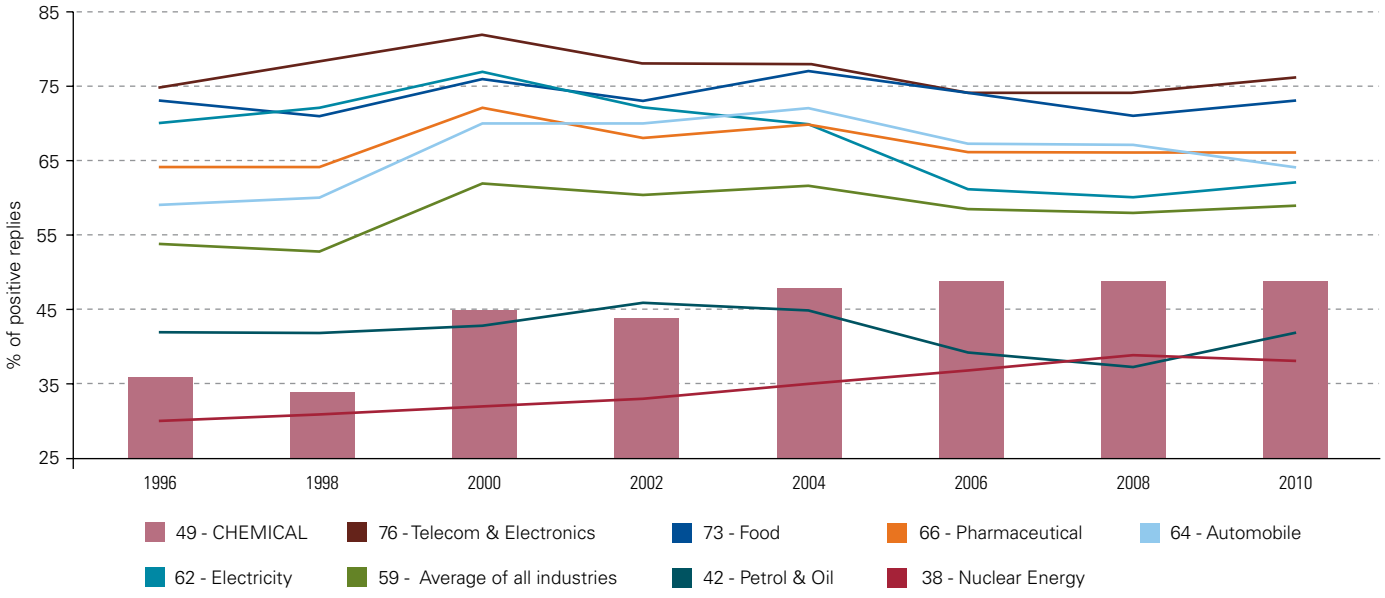
Population Growth could increase community resistance to chemical plants

By 2050, the global population is predicted to increase to over nine billion, and to as much as 10 billion by the 2080s.[10] 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 70 percent by 2050.[11] 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 teraphalic 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.

[10] "*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

[11] OECD, *Tackling Climate Change and Growing the Economy,* www.oecd.org/dataoecd/28/18/44287948.pdf

[12] OECD, *Tackling Climate Change and Growing the Economy,* www.oecd.org/dataoecd/28/18/44287948.pdf

[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

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

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 an 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.

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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

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“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.”

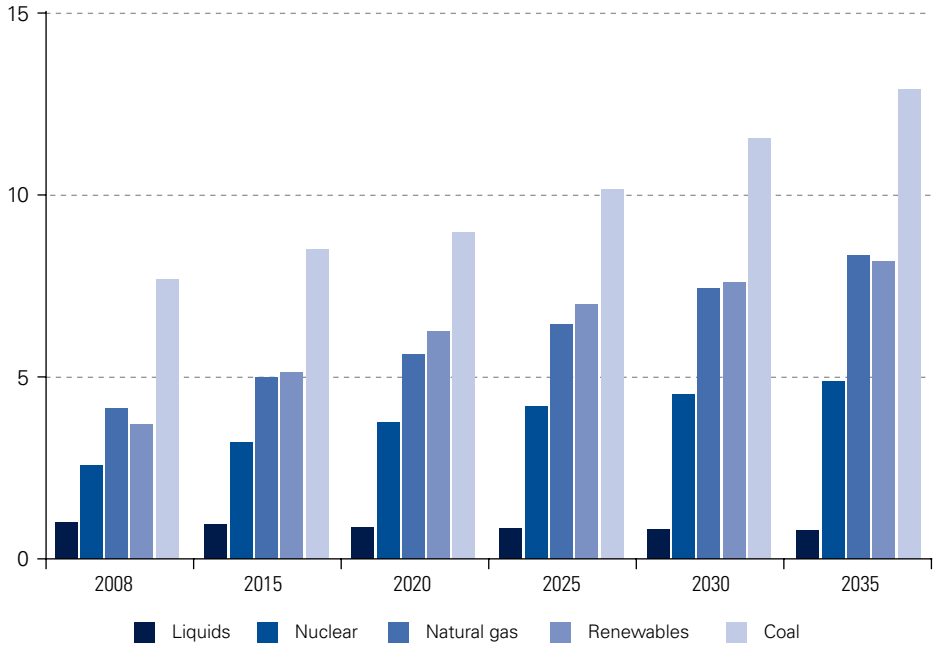
Trends, risks and opportunities: Regulatory pressures are building and shifting

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 37 percent of all generation by 2035,[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.

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 were put on halt after Fukushima, and

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



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

[2] Center for Climate & Energy Solutions, 2010

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

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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.

Non-hydro renewable energy sources are therefore likely to see strong growth; their share is expected to grow from 3 percent of electricity generation in 2009 to 15 percent by 2035.[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. In the US, the Environmental Protection Agency recently announced emissions standards that are expected to discourage the building of new coal plants.[8]

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. According to IEA projections, China's share of global electricity consumption may reach almost 30 percent by 2035, fueled by a rising population, urbanization and economic activity.[9] Global net electricity generation is projected to rise by 84 percent between 2008 and 2030, with non-OECD countries, led by China and India, fueling the bulk of that growth.[10]

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. Electric utilities are highly dependent on freshwater and any systemic increases in water demand or drought-like conditions could severely impede electricity production.[11]

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 International Energy Agency. 2011, World Energy Outlook 2011.
6 Reuters, May 6, 2011, http://www.reuters.com/article/2011/05/06/china-solar-idUSL3E7G554620110506
7 Alagh, Yoginder. *Transmission and Distribution of Electricity in India Regulation, Investment and Efficiency*. OECD, Paris, 2011
8 Trefis Team, *EPA's New Regulations Hit King Coal & Railroad Companies,* Forbes, April 3, 2012; F. Barringer, *For New Generation of Power Plants, a New Emission Rule From the E.P.A.,* New York Times, March 27, 2012.
9 International Energy Agency. 2011, World Energy Outlook 2011.
10 US Energy Information Administration (EIA). *International Energy Outlook 2011*. EIA, Washington DC.
11 World Economic Forum. (2009). *Thirst Energy: Water and Energy in the 21st Century*. World Economic Forum.

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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	2730	720
Subcritical pulverized coal	1970	520
Supercritical pulverized coal	1700	450
Integrated gasification combined-cycle, slurry-fed	1170	310
Natgas combined-cycle	720	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.[12] 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."

[12] 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

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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.”

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"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 2010[13] 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 energy infrastructure investment for the coming 25 years is over US$30 trillion, of which US$6 trillion will be needed to fund currently planned renewable electricity and biofuels projects. 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.[14]

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 US$409 billion,[15] 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.

[13] Renewables 2011 (REN21). *Global Status Report 2011*, Paris
[14] KPMG Global Power & Utilities Conference – Europe, 2011, Paris
[15] International Energy Agency. 2011, World Energy Outlook 2011.

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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).[2] 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.[3]

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 Megaforces

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 Frost & Sullivan. (2011). *Financial Assessment of Food Processing Market.*
3 FAO. (2011). *The State of the World's Land and Water resources for food and agriculture (SOLAW) – Managing systems at risk.* Summary Report. Food and Agricultural Organization of the United Nations, Rome and Earthscan, London.

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"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.[4]

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 CO_2 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 percent[5] and 50 percent[6] 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.

[4] See Appendix 1 for methodology
[5] FAO. (2010). *Organic agriculture and climate change.*
[6] Goodland & Anhang. (2009). *Livestock and Climate Change.*

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weather patterns (drier arid areas and wetter tropical areas), extreme weather events increasing in intensity and frequency, increased atmospheric CO_2, droughts, rising sea levels, saltwater intrusion, coral bleaching, increased pestilence and changing migration patterns.[7] 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'.[8]

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.[9] Low-income countries with limited adaptive capacities to climate variability and change may face significant threats to food security.[10]

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.[11] 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.[12] The livestock sector is a key driver in increasing water use: in 2006 the FAO reported that the livestock sector accounted for 8 percent[13] 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 rice which consumes 3,400 liters of water).[14]

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."

7 IPCC. (2007). Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

8 von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions.* International Food Policy Research Institute.

9 Wong & Schuchard. (2011). *Adapting to Climate Change: Guide for the Food, Beverage and Agriculture Industry.*

10 von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions.* International Food Policy Research Institute.

11 FAO. (2008). *Climate change, water and food security.*

12 FAO. (2008). *Climate change, water and food security.*

13 Food and Agriculture Organization of the United Nations. (2006). *Livestock's Long Shadow.*

14 Oxfam. (2011). *Growing a better future, Food justice in a resource-constrained world.*

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“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.[15] Furthermore, the World Bank indicates that by 2030 China may have a water supply shortfall of 201 billion cubic meters, and in India, where 80 percent of available water is used for agriculture, the supply shortfall may be close to 756 billion cubic meters.[16]

Degradation of agricultural soil

Globally, an estimated 25 percent of agricultural soil has been substantially degraded in quality.[17] Soil productivity in developing countries has declined by approximately 16 percent.[18] Soil degradation is caused by a number of factors: overgrazing, agricultural activities, deforestation, overexploitation of land to produce fuel, and industrialization.

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.[19] 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 the USDA, Sub-Saharan Africa’s high population growth rate of 2.4 percent per year will further strain the already food-insecure region as it struggles to feed an additional 213 million people by 2020.[20]

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’ hectarage before 2015.[21] 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.[22]

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.[23] 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.”[24]

As consumers become wealthier, they are also demanding products that are believed to enhance physical and mental health and well-being. Companies have responded by introducing products with less fat and sugar. Food-related

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15 FAO, 2007 World Water Day, *Coping with water scarcity, Challenge of the twenty-first century.*

16 2030 Water Resources Group (WRG). (2009). *Charting Our Water Future.* WRG, New York.

17 FAO, “Scarcity and degradation of land and water: growing threat to food security,” FAO press release, 28 November 2011, Rome, http://www.fao.org/news/story/en/item/95178/icode/

18 World Meteorological Organization. (2005). *Climate and Land Degradation.* http://www.wmo.int/pages/themes/wmoprod/documents/WMO989E.pdf

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

20 USDA. *Food Security Assessment,* 2010-20 / GFA-21. Economic Research Service/USDA

21 ISAAA. (2010). *Global status of commercialized biotech.*

22 FAO. (2002). *World Agriculture towards 2015/2030.*

23 von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions.*

24 von Braun. (2007). *The World Food Situation: New Driving Forces and Required Actions.*

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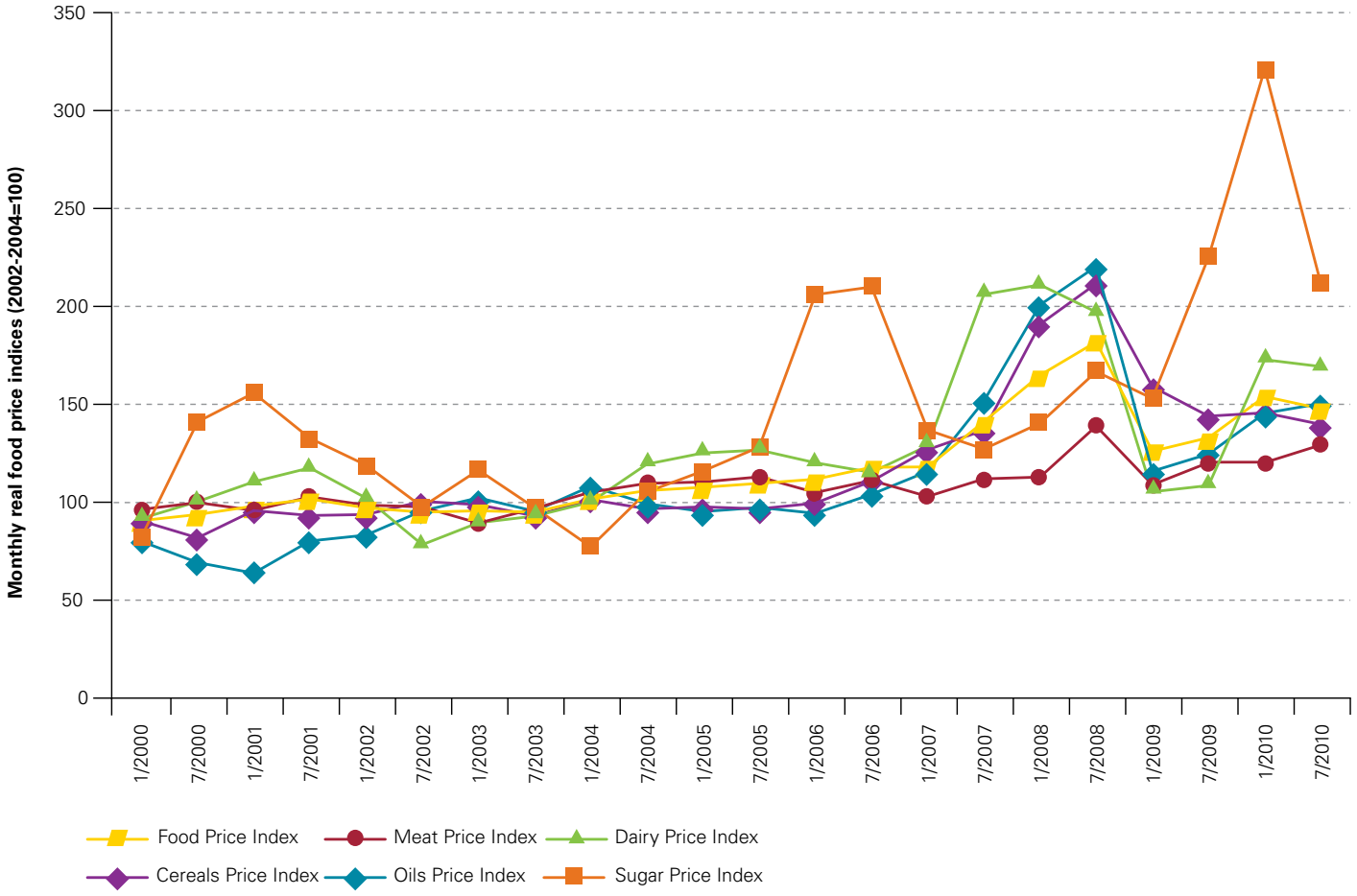
diseases such as diabetes and obesity are spotlight issues for the industry. Increased demand for health and wellness products, coupled with raised awareness of environmental and social issues, represents an opportunity to develop substantial new markets. The technological challenge will be to meet this 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.[25]

The Food sector is also exposed to **Energy & Fuel** volatility risks. Fossil fuel prices play a large part in determining transportation and processing costs, while modern industrial agriculture

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/

[25] Rabobank (2011). *Rethinking the F&A supply chain, impact of agricultural price volatility on sourcing strategies*

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“Companies are demanding higher environmental standards and certified products from their suppliers.”

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.[26] Nestlé has reduced water consumption over the past decade by 33 percent, while increasing its food and beverage production volume by 63 percent.[27]
- 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.[28]
- 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.[29]

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 in revenues or market opportunities. As current consumer demand broadens

[26] Wong & Schuchard. (2011). *Adapting to Climate Change: Guide for the Food, Beverage and Agriculture Industry.*
[27] Toops. (2011). *Top Food and Beverage Companies: Leaders in Sustainability.*
[28] Mars. Inc. http://www.mars.com/global/brands/cocoa-sustainability-home.aspx
[29] Walmart. (2010). *Walmart Unveils Global Sustainable Agriculture Goals.*

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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.

A 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.[30] 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.”

[30] FAO. (2011). *Global food losses and food waste.*

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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 megaforces.

Exposure to Global Sustainability Megaforces

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

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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 megaforces on other sectors will in turn affect demand for marine transportation in the future. The close linkage between marine transportation demand and state of the world economy means that the sector is exposed to the same shocks as the global macoeconomy.[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 CO_2 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 certain greenhouse gases and other pollutants through implementation of IMO regulations, but reduced trade volumes due to the global recession may have had a larger impact on the sector's overall emissions trajectory.

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] International Maritime Organization (IMO). (2009). *Prevention of Air Pollution from Ships.* IMO, London.

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"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 CO_2 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] International Maritime Organization (IMO). (2009). *Prevention of Air Pollution from Ships*. IMO, London.

[7] European Union Fuel Directive (2010) Directive 2005/33/EC of the European Parliament and of the Council of 6 July 2005 amending Directive 1999/32/EC

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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. 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).[9]

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.[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] The higher payload of these new very large vessels coupled with fuel burn comparable to smaller vessels allows for significant efficiency improvements.

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] United Nations Conference on Trade and Development (UNCTAD). (2011). *Review of Maritime Transport.* http://unctad.org/en/docs/rmt2011_en.pd

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“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.[13] 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.[14] 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

[13] 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/; International Business Times. April 11, 2012. http://au.ibtimes.com/articles/326350/20120410/iron-ore-china-brazil-rio-tinto-vale.htm

[14] United Nations Conference on Trade and Development (UNCTAD). (2011). *Review of Maritime Transport.*

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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.[15] Environmentally responsible maritime operations often benefit from lower operational costs, most notably from fuel savings.[16]

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.

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 that there is a minimum of wastage (and maximum recycling) in components and shipbuilding materials.[17] 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.”

[15] *Technology Outlook 2020.* Oslo, Norway: Det Norske Veritas. (2010).
[16] Various. (20 May 2011). *Marine Solutions.* Retrieved 16 Jan 2012, from Wartsila Corporate: http://www.wartsila.com/en_CN/marine-solutions/segments/merchant.
[17] *Sustainable Shipping Initiative: Vision 2040.* (2011).

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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 Megaforces

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.”

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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 expected to play a key role 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] KPMG. January 2011. *Capitalizing on sustainable development in mining.*

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"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.[7]

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.
[7] RiskMetrics Group. (2009). *Industry Overview: Non-Precious Metals & Mining.* New York, NY: RiskMetrics Group.

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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

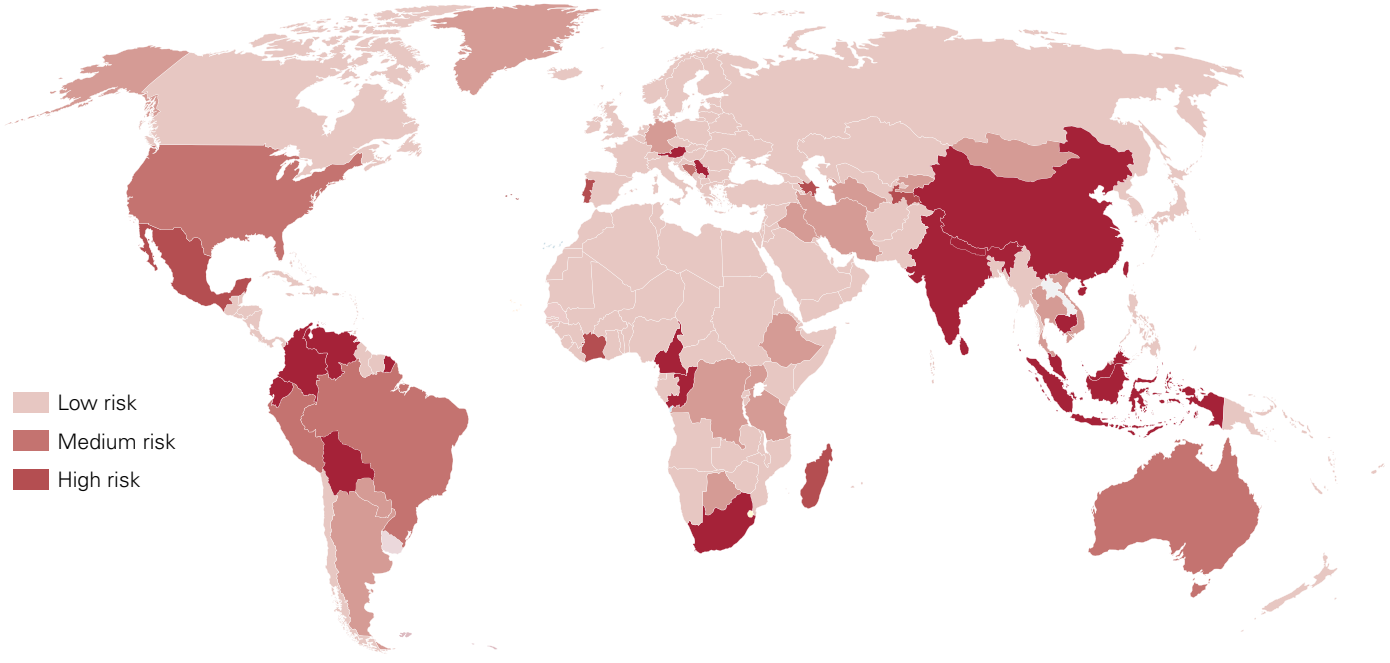
Ecosystem Decline is an issue that mining companies may increasingly confront. Mayflies in the Appalachian Mountains, Harpy Eagles in Brazil, the birds of New Caledonia, and spawning salmon in Alaska are examples of biodiversity issues being used by campaigners to restrict or stop mining and processing operations.[8]

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.

[8] MSCI. (2010). *Industry Report: Metals and Mining, Non-Precious*. New York, NY: MSCI.

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"These sustainability megaforces 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.[9] These sustainability megaforces 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).[10]

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 2002[11] 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.

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9 RiskMetrics Group. (2009). *Industry Overview: Non-Precious Metals & Mining.* New York, NY: RiskMetrics Group.

10 World Economic Forum, *Mining & Metals: Scenarios to 2030* (2010)

11 KPMG. (2002). *International Survey of Corporate Responsibility Reporting 2002. KPMG. (2011). International Survey of Corporate Responsibility Reporting 2011.*

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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.”

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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 31 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

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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 60 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] and invest more

"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

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"KPMG's International Survey of Corporate Responsibility Reporting 2011 indicates that the Oil & Gas sector has an overall reporting level of 69 percent."

than 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 CO_2 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

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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 Scott Nyquist and Jurriaan Ruys, "CO2 abatement: Exploring options for oil and natural gas companies," McKinsey on Oil & Gas, Number 2 Winter 2009, http://mkqpreview1.qdweb.net/PDFDownload.aspx?ar=2517.

8 Baretto & Riveras, "*Shell 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.

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disclosure of its response to global sustainability megaforces.

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 megaforces 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.[12] Total new investment in clean energy increased 5 percent to $260bn in 2011, despite the sluggish global economy and a squeeze on manufacturers.[13]

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 Energy Information Administration (EIA). (2011). *Annual Energy Outlook 2011*. EIA, Washington DC.
[12] Bloomberg New Engergy Finance (2011). "Clean Energy Attracts Its Trillionth Dollar," http://bnef.com/PressReleases/view/176
[13] Bloomberg New Energy Finance. (2012). "Solar Surge Drives Record Clean Energy Investment in 2011." http://bnef.com/PressReleases/view/180.

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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 megaforces, 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 megaforces. 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 megaforces.

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 Megaforces

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 megaforces."**

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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 percent[2] of global CO_2 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 megaforces 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 ITU-GeSI. (2010). *Using ICTs to tackle climate change.*

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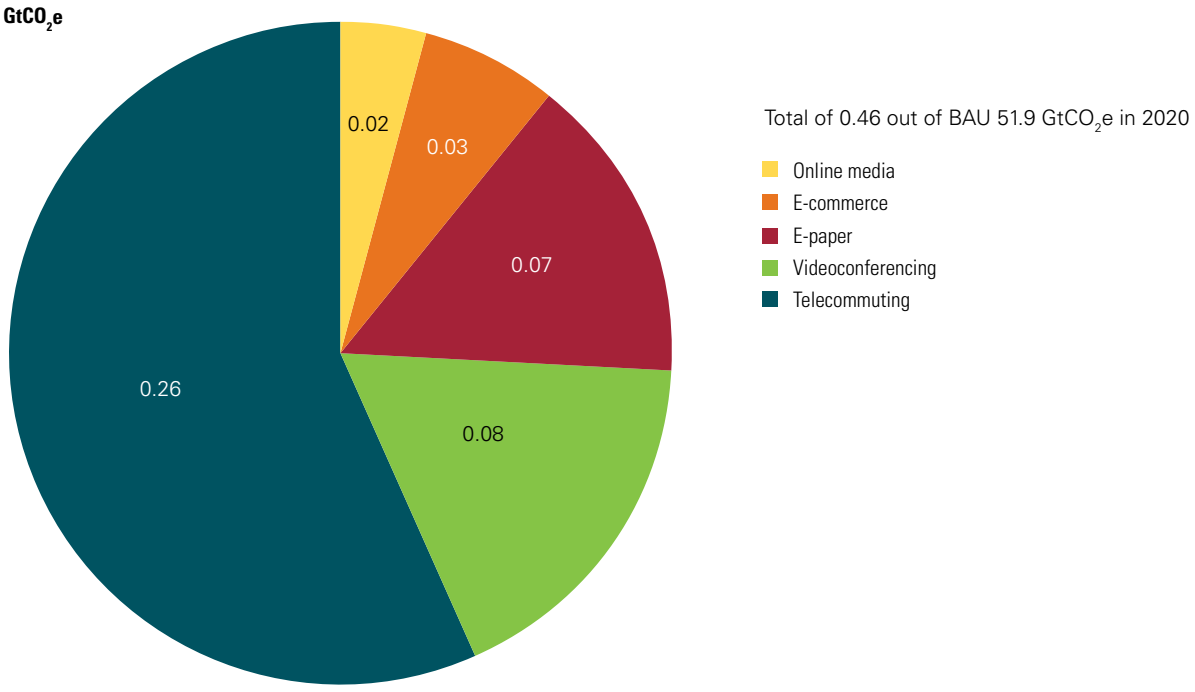
"An important area where the T&I sector has potential as an enabler is in the substitution of traditional goods and services with lower-carbon electronic alternatives – or "dematerialization."

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)

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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 $GtCO_2e$) 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, "Green Data Center Market to Reach $41 Billion Annually by 2015," Pike Research press release, August 5, 2010, http://www.pikeresearch.com/newsroom/green-data-center-market-to-reach-41-billion-annually-by-2015.
[13] The Climate Group on behalf of GeSI. *SMART* 2020. (2008)
[14] KPMG. (2010). *The roll-out of Next-Generation-Networks.*

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"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 25 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 for telecom equipment manufacturers.

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 2011[19] 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

[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 Guage: 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*

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financial benefits of their sustainability 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 megaforces 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 megaforces.

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."

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Appendix 1: Methodology

Global Sustainability Megaforces

The global sustainability 'megaforces' 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 megaforces 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, carburettors and batteries. Manufacturers, distributors and retreaders 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.

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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.

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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

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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), waterabstraction, pollutants including acid rain precursors, ozone depleting substances, and waste generation. The physical totals of these inputs and outputs incurred both directly and indirectly[1] 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.

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Appendix 2: Global sustainability megaforces bibliography

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Appendix 4: Qualitative meta-review bibliography

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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.

CO_2: 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.

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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: 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 Government Accountability 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.

$GtCO_2e$: Gigatonne of CO_2 equivalent.

IATA: The International Air Transport Association.

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IBA: Indian Beverages Association.

ICT: Information & Communications Technology.

IEA: International Energy Agency.

IFPRI: International Food Policy Research Institute.

IFTF: Institute for the Future.

IMF: International Monetary Fund.

IMO: International Maritime Organization.

IOC: International oil company.

IPCC: 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.

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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 Programme.

UNEP: United Nations Environment Programme.

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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Figure 1: Accelerating human footprint on natural systems and resources
(*Percent change statistics ranging from 1990 through 2011 on a global basis*)

1. *Air freight transport*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012).
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18. *Urban population*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012).
19. *Food production*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012).
20. *Energy consumption*: Energy Information Administration (EIA), International Energy Outlook 2011.
21. *Total materials extraction*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012).
22. *Global CO_2 emissions*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012) (1990 global CO_2 emissions); International Energy Agency (IEA), World Energy Outlook 2011 (2010 global CO_2 emissions).
23. *Fish and seafood consumption*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012).
24. *Petroleum consumption*: Energy Information Administration (EIA), International Energy Outlook 2011.
25. *Global ecological footprint*: World Wildlife Fund, Living Planet Report 2010.
26. *Per capita natural resource consumption*: Sustainable Europe Research Institute (SERI), Global Materials Flow Database (www.materialflows.net).
27. *World population*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012).
28. *Meat consumption*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012).
29. *Resource intensity*: Sustainable Europe Research Institute, Under Pressure (Nov. 2011).
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Figure 2: Human social and economic progress
(*Percent change statistics ranging from 1990 through 2011 on a global basis*)

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2. *Female parliamentarians*: United Nations Environment Programme (UNEP), *Keeping Track of Our Changing Environment, From Rio to Rio +20* (1992-2012).
3. *Mean years of schooling*: United Nations Development Programme, Human Development Reports (various years).

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9. *Access to improved water service*: World Health Organization (WHO) Fact Sheet 290 (May 2011).
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11. *Primary education completion rate*: World Bank, World Development Indicators 2011.
12. *Adult literacy rate*: World Bank, World Development Indicators 2011.
13. *Girl-boy ratio, education enrollment*: World Bank, World Development Indicators 2011.
14. *Life expectancy at birth*: World Bank, World Development Indicators 2011.
15. *Male youth literacy rate*: World Bank, World Development Indicators 2011.
16. *Female labor force participation*: World Bank, World Development Indicators 2011.
17. *Population living <$US 2.00 per day*: World Bank, World Development Indicators 2011.
18. *Dependency ratio on working population*: World Bank, World Development Indicators 2011.
19. *Undernourishment prevalence*: World Bank, World Development Indicators 2011.
20. *Underweight children <5 years old in the developing world*: United Nations, Millennium Development Goals Report 2011.
21. *Total fertility rate*: World Bank, World Development Indicators 2011.
22. *Population living <$US 1.25 per day*: World Bank, World Development Indicators 2011.
23. *Population average annual growth rate*: World Bank, World Development Indicators 2011.
24. *Infant mortality rate*: World Bank, World Development Indicators 2011.
25. *Maternal mortality rate*: World Bank, World Development Indicators 2011.
26. *Under 5 child mortality rate*: World Bank, World Development Indicators 2011.

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Figure 3: Persistent human deprivation
(*Percent change statistics ranging from 1990 through 2011 on a global basis*)

1. *People without access to adequate sanitation*: United Nations Environment Programme (UNEP), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*, 2011.
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Figure 18: Summary of business-as-usual global projections
(*Variously from 2008/2010 to 2035*)

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2. *Mean temperature rise*: IPPC/UNEP/GRID-Arendal, Graph: *Projected Changes in Global Temperature (global average 1856-1999 and projection estimates to 2100)*.
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Colophon

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The expanding CC&S network, across more than 50 countries, enables us to apply a consistent, global approach to service delivery and respond to multinational organizations' complex business challenges with services that span industry sectors and national boundaries. Our experienced teams assist organizations in the following areas:

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- Corporate responsibility strategy assistance
- Corporate Social Responsibility/Sustainability/GHG information systems design and implementation
- Regulatory framework assessment and optimization, including tax and carbon emission regimes
- Tax incentives and credits
- Sustainable supply chain enhancements
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