



PwC Briefing: IPCC Fifth Assessment Report (AR5)

Working Group III – Mitigation of Climate Change

April 2014

The **IPCC Working Group 3 (WGIII)** released the third section of the Fifth Assessment Report on the mitigation of climate change. As with the first two reports, the PwC Sustainability & Climate Change team considers the implications of the WGIII for government and business in the UK.

The group comprises over 200 authors and subject matter experts from nearly 60 countries and received up to 20,000 in its early drafts and culminated in a week-long meeting with governments and other observers to finalise its 16 chapters, covering topics from outputs from integrated macro-models and sectoral implications to the international negotiation context and the need for climate finance. In short, it summarises the core challenge of our century.

KEY HIGHLIGHTS FROM IPCC WG3

If the **Working Group 2 report** on impacts describes a potential train wreck and Working Group 1 identifies the driver, the Working Group 3 report on mitigation explains how to avoid the crash. But it also suggests that the brakes are not working.

Reality check since 2007

In a significant shift from the last Assessment Report, the AR5 places more emphasis on behavioural economics. In 2007 the economically rational, public good argument of climate change mitigation, typified by the 2006 Stern Review, frames the decision making context and the rationale to act on climate change. But in this latest report there is distinctive coverage on how decisions are made under uncertainty, and the implications of risk perceptions, short-termism and intuitive decision making in the face of a global systemic long term issue such as climate change. This is the challenge politicians and business leaders all face, and an important reason behind the inertia today.

The WG3 concluded that economic and population growth continue to be the two main drivers for increases in global fossil fuel CO₂ emissions in the last decade, and that without concerted mitigation efforts, global mean surface temperature rise could increase to 3.7 to 4.8 degrees Celsius by the end of the century. The WG2 report released three weeks ago suggests this could have catastrophic impacts.

Avoiding significant climate change will depend on the world's collective choices and actions. But the IPCC's collation of estimates suggested that driving emissions down to meet with a 2-degree carbon budget (or concentration levels between 450 and 500 ppm CO₂e) by 2100 would require 2030 emissions to be between 30 – 50 GtCO₂e.

Delayed action would tend to involve a substantially more difficult pathway from 2030 onwards, or have a larger reliance on carbon dioxide removal (CDR) technologies which are today in their infancy (i.e. bioenergy with CCS or even geoengineering). **PwC's Low Carbon Economy Index (LCEI)**, which started tracking global energy-related carbon intensity since 2009, estimated that we could limit emissions to around 30 GtCO₂e by 2030 through reducing carbon intensity by 6% a year, every year. This has never been achieved globally and in 2012 we questioned the viability of the 2 degree target without a radical economic and policy transformation.

The economics of climate action

Consultants, politicians, business leaders all like to use cost benefit analysis when considering how to act; and climate change is no different. The IPCC reports on climate impacts (WG2) and on climate

mitigation (WG3) provide numbers that appear to do this calculation. WG2 suggested that (based on imperfect estimates and models) global losses in GDP could be around 0.2% - 2% under a 2 degrees Celsius of warming. We noted in our last commentary that these were serious underestimates. The current publication WG3 estimates that the costs of mitigation to limit warming to 2 degrees Celsius could amount to global consumption levels – which could grow anywhere between three- and nine-fold by the end of the century - falling by 1% to 4% (median 1.7%) in 2030, 2% to 6% (median 3.4%) in 2050, and 3% to 11% (median 4.8%) in 2100.

These are small losses compared to the growth projections and suggest that mitigating climate change today is affordable. The IPCC calculated that these numbers correspond to an annual reduction of consumption growth by 0.04 to 0.14 (median: 0.06) percentage points over the century. Thus for example, if we assume a 3% consumption growth rate per year (the range in IPCC is 1.6 – 3%), paying to avoid dangerous climate change will mean global consumption grows by 2.94% per year instead. But a strong message from IPCC is that the longer we wait, the more we need to do over a shorter amount of time and the more expensive it therefore becomes. Delaying action could increase these costs by 28 - 44% in 2030 - 2050, and 15 - 37% in 2050 - 2100.

There are caveats to the cost estimates. Caveats that suggest the economic case to act (the mitigation costs versus the benefits of responding) is likely to be even more convincing:

- **What they don't include:** The WG2 estimates of costs of potential damages do not include the costs from extreme events, or the economic impacts of catastrophic outcomes through potential tipping points, mass migration and serious conflict. The costs of mitigation on the other hand have not included the economic costs of avoided climate change and the costs of additional benefits such as improved productivity, health, energy security, and reduced local air pollution. In other words, the cost of impacts is probably underestimated and the cost of mitigation possibly overestimated.
- **2 degrees and beyond:** The costs described in WG3 report relate to the difference between business as usual (around 4 degrees of warming) and a 2 degrees scenario (450ppm CO₂e by 2100). The WG2 report estimates are only for 2 degrees of warming, so they are comparing different baselines. WG2 suggests the cost of impacts beyond 2 degrees could rise exponentially.
- **Timing, certainty and the accumulation effects:** Trying to estimate the costs of mitigation is harder for the long term, since we would be making assumptions about carbon prices, technologies and their costs that will change over time. We also have the accumulation effects of assumptions, where even small variations in assumptions of GDP growth can translate to large differences when compounded over 80 years. So there is more confidence in the estimates for the shorter term, while the long term 2100 costs are more speculative.

WG3 suggests that mitigation is affordable and possible as long as we don't delay. But reading the reports individually may lead to confusion around which costs are comparable. The AR5 Synthesis report will draw together the findings from the three working group reports into a coherent conclusion. But this is not due for publication until October. In the meantime, misinterpretations on the economics of climate change could spur unhelpful debates about the types and costs of action on climate change. Not least during a period when governments are preparing for the Climate Leaders' Summit in New York and the climate negotiations that follow in Lima, Peru.

Dr Celine Herweijer, partner, Sustainability and Climate Change, PwC

“The IPCC has provided some estimates on the global scale of the costs, both for reducing emissions (WG3) and for the impacts of climate change (WG2). There are many caveats, but uncertainties due to a handful of nascent economic models are not excuses for inaction. What is certain is that the costs to act only become more expensive the longer we wait. Complacency in responding will see us head to a world of 4 degrees or more of warming by the end of this century, where business, economic and ecosystems survival cannot be assumed. Fundamentally, the latest IPCC reports show that not only are the costs to act affordable if we do so early, but that we all lose if we fail to respond adequately. Policymakers and business leaders have the mandate to act under the weight of the evidence at hand. This evidence suggests urgent and bold action is a must at the national and international level.”

IMPLICATIONS FOR BUSINESS

The IPCC WG3 chapters drill down into sectoral mitigation potential and implications. Two core themes appear to run across all sectors: firstly the role of governments in driving through appropriate, effective policies which enable private investment; and secondly the importance of cooperative, cross-sectoral collaboration at different levels, for example through sharing of infrastructure and information. For each sector the IPCC considers their mitigation potential, barriers and uptake.

Energy

Currently, the energy supply sector accounts for around one-third of total anthropogenic GHG emissions at around 30GtCO₂, but emissions have been growing more quickly in recent decades. Emissions grew by 1.7% per year from 1991-2000, but this rose to 3.1% per year from 2001-2010. Without mitigation policies, fossil fuel and industrial emissions could reach 55-70 GtCO₂ by 2050 and around 90 GtCO₂ by 2100. This is in stark contrast with a low carbon future, where the energy system needs to be virtually zero carbon by 2100.

The IPCC reiterates the major options for emissions reduction: energy efficiency improvements and fugitive emission reduction; fossil fuel switching; and low carbon technologies such as renewable energy, nuclear power, and carbon dioxide capture and storage (CCS).

A key message from the IPCC is that energy efficiency improvements and the switch from coal to gas would not be sufficient to deliver the scale of changes required. Indeed, our LCEI analysis shows that globally, almost all of the recent changes in carbon intensity can be attributed to improvements in energy efficiency, suggesting that other measures are yet to be adopted more widely. Nevertheless progress is still visible particularly for renewable energy, and more technologies are approaching technical and economic maturity to be deployed at scale. The challenge is about the rate of that deployment. We observed that three G20 countries achieved more than 25% growth in renewable energy consumption in 2012, another 10 countries achieved between 10% and 25% growth. But shale gas proponents will be pleased to see that the IPCC acknowledges the role of gas replacing coal as a short term measure to limit emissions growth.

The main longer term challenges are considered to be from the lack of deployment in CCS technologies, despite the fact that all of the separate components of integrated CCS systems exist and are in use in various parts of the fossil energy chain. Short and long term economic incentives and well-defined regulations are deemed essential for a large-scale future deployment of CCS.

But global challenges may mask fundamental issues for certain regions and countries. Energy infrastructure in many developing and least developed countries is still relatively undeveloped and heavily reliant on fossil fuels.

Sam Bickersteth, director, PwC and CEO of CDKN

"The IPCC has recognised that for developing countries, there are often co-benefits and positive spill-overs from implementing low carbon technologies, both at centralized and distributed levels. These include creating new jobs and income, improving energy access that can help alleviate poverty, and empowering local rural communities. There are risks of course, that these low carbon transformations could be costly for low income households, so this is where development aid could come in to help manage and reduce these risks. There are already examples of how this has worked well, in Indonesian provinces such as West Nusa Tenggara, where a CDKN project is helping to increase the energy supplies from small- and medium-scale renewable energy, such as mini hydro, and where these projects can improve access to electricity for the local people."

Transport

The conclusions on transport emissions echoed those of energy emissions. Accounting for nearly a quarter of total energy-related CO₂ emissions, growth in passenger and freight activities, particularly from emerging and developing countries, means that aggressive GHG mitigation can only be sustained if transport emissions is decoupled from GDP growth. This would involve behavioural changes and modal shifts, greater uptake of improved vehicle and engine performance technologies (particularly electric vehicles), the use of low-carbon fuels and investments in related infrastructure, and changes in the built environment.

Buildings and infrastructure

Existing buildings already account for a third of global final energy use, while **urbanisation** and development means there will continue to be massive build-up of new urban infrastructure in the coming decades. Due to the very long lifecycles of buildings and infrastructure there is a very significant lock-in on technology. An urgent and ambitious move towards low-carbon buildings and infrastructure could help determine future emissions pathway and provide security against future regulatory standards. But strong barriers currently hinder the market uptake of cost-effective opportunities, including behaviour, lifestyle and culture, such that current energy use could be up to 3-5 times higher than required in some regions or applications.

Leo Johnson, PwC partner

“As a species we are switching habitat, from 2% urban back in 1800, to over 70% projected to be urban by 2050. The challenge of urbanisation, a defining challenge of the 21st century, is not just about building ‘smart cities’ to create eco-efficient oases of silicon for the privileged few. The challenge is to deploy technology to fix both the urban and rural problems that confront us.”

Industry

Energy efficiency has always been a focus for energy intensive industries, and often industry commentators remark that best-in-class technologies are already being employed because energy costs comprise such a significant share of their cost base. But the IPCC noted that across industry, and particularly for less energy intensive industries, there are still many energy efficiency options yet to be undertaken. Their analyses found that industrial energy intensity could be reduced by up to 25% compared to current levels through the wide-scale deployment of best available technologies, and innovation could increase this potential by another 20%.

Over the long term, step-changes such as low carbon electricity, radical product innovations, and CCS for cement, steel and refining remain important pillars for industrial decarbonisation. WG3 noted that these can be associated with other co-benefits such as enhanced competitiveness, cost reductions, new business opportunities, better environmental compliance, better health and work conditions, and reduced waste.

Lit Ping Low, Climate policy economist, PwC

“There is a pre-conception that carbon regulations impose undue costs on industry. But across all sectors, businesses are often faced with all sorts of regulations so carbon regulation is not exceptional. Indeed, for some companies and industries, particularly those with medium energy intensities, carbon costs are considered relatively immaterial compared to other costs, but a price signal can still drive tangible carbon reduction actions. The important thing for businesses is to have transparency, clarity and fairness in the costs they face.”

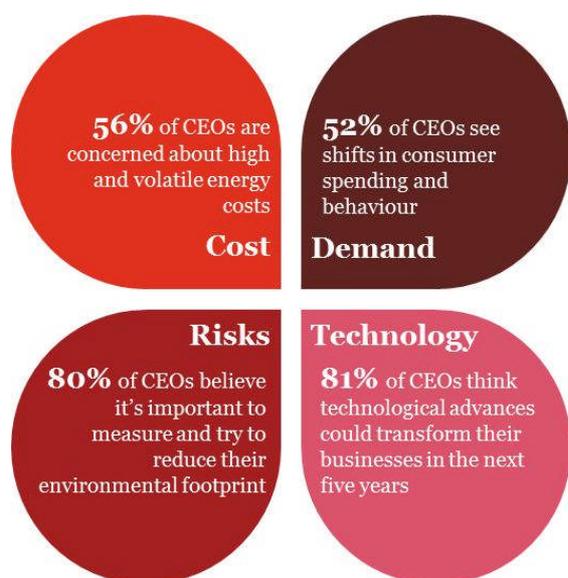
Agriculture, Forestry and Other Land Use (AFOLU)

AFOLU emissions are expected to remain an important source of carbon abatement, as it continues to represent just less than one quarter of anthropogenic emissions. But it could contribute between 20 and 60% of total cumulative abatement to 2030. The WG3 report recognises many of the challenges associated with the sector including land governance, corruption, conflict, and leakage of emissions. Importantly, discussions on demand-side drivers focusing on food waste, dietary change and changes in wood consumption provide a signal to businesses that there may be where policymakers' attention is increasingly shifting towards.

Jim Stephenson, Forestry and carbon specialist, PwC

“The IPCC suggests that AFOLU abatement could be cost-effectively deployed despite the many challenges raised. However many project developers, investors and donors suggest that AFOLU abatement costs are often higher than predicted, and vary widely programme to programme.”

The focus of CEOs



Source: PwC 17th Global CEO survey

In PwC's 17th Global Annual CEO Survey, we found that the pressure on CEOs to act on reducing carbon emissions from their businesses remain strong. Demand pull, cost, risk and the emergence of new technology all drive action.

Many of the largest companies operate globally, and their actions can drive the transformative changes that a low carbon revolution needs. For example through our work with the CDP, we found that almost 70% of the FTSE350 companies have operations abroad, and that this group collectively operate in 145 countries. This means that much of their emissions would also originate from overseas, at 77% of Scope 1 and 83% of Scope 2 emissions.

Targets set by companies and actions undertaken by them therefore have a significant impact on achieving the global ambitions of limiting warming to 2 degrees Celsius. But there is great difficulty is reconciling business targets with what the IPCC said is required.

Only 20% of the 500 largest companies globally have adopted emissions targets to 2020, and the average target is only around 1% per year. Within the UK, while 84% of the FTSE100 companies have emissions targets, with an average horizon of three- to four-years, only 58% of the FTSE250 companies have targets, and these tend to be shorter one- to two-year targets.

Jonathan Grant, Climate and carbon specialist, PwC

“It is important that targets that companies set match up to the ambitions of politicians. Our analysis shows that on average, utilities and consumer staples companies tend to have longer-term carbon targets but only out to 2020. Despite these targets, the majority of utilities companies remain on an upward emissions trajectory.”

IMPLICATIONS FOR GOVERNMENTS AND POLICY MAKERS

National, sub-national and regional policies

The number of national and sub-national policies to address climate change has increased significantly since the previous IPCC report, but these have not yet delivered the scale of emissions reductions necessary to limit temperatures to within 2 degrees Celsius.

A range of policy instruments have been used to deliver emissions reductions from regulatory and information approaches (e.g. energy efficiency standards and labelling programs) to economic (market) instruments such as taxes, subsidies, and cap and trade schemes. Market mechanisms are growing in number at the city (e.g. Tokyo), provincial (e.g. 7 emissions trading schemes in China), national (e.g. South Korea) and regional (e.g. EU) levels, but experience has shown that if not designed correctly, they can have little abatement impact but increase business costs.

On the whole, sectors specific policies such as building standards have been more widely employed than economy-wide measures. At the regional level, climate-specific regional cooperation policies have had mixed success in terms of reducing emissions. For example the EU-ETS was not as successful as anticipated due a persistently low carbon price, whilst EU directives on energy efficiency, renewable energy and biofuels have had delivered some progress on achieving mitigation objectives. Non-climate specific modes of regional cooperation, such as the agreements on trade and technology, have implications for delivering mitigation objective, but again have had a modest to negligible impact. This illustrates the considerable heterogeneity across and within regions in terms of the level and sources of emissions, and opportunities, capacity and financing for climate action, which has implications for the potential of different regions to pursue low carbon growth and development.

The report also emphasised the need for complementarity of policies. This includes policies within sectors (for example, policies that discourage carbon-intensive vehicles and those that increase investment in public transport), and across sectors, such as innovation and R&D policies.

Sam Bickersteth, International climate policy specialist, PwC

“There are an increasing number of mitigation policies and mechanisms at the local and national levels, and with mixed success. But because it doesn’t matter where the carbon abatement comes from, more co-operation and linkages between countries and regions would, generally speaking, lower the overall cost of mitigation. Finding mutually beneficial opportunities for collaboration at the regional or international levels to deliver low carbon development could make it cheaper to mitigate climate change. Politically it could also help negotiating parties under the UNFCCC identify common ground to deliver an ambitious climate agreement.”

International cooperation

National and local action will underpin the nature of international cooperation. Currently, the sum of national pledges to reduce carbon emissions remains insufficient to keep the world to the 2 degrees Celsius target. International cooperation is a necessity to addressing climate change. The UNFCCC is identified as the only current ‘legitimate’ venue for international cooperation, but the WG3 authors observe that the institutions for climate cooperation have been diversifying to other fora, such as those addressing human rights and trade.

2014 is a pivotal year for international climate cooperation. A global climate treaty is expected to be signed at the 2015 UN Climate Conference in Paris. For this deal to stand any chance of success, negotiators would need a strong draft global agreement in place by the end of this year in Lima. This September, heads of state, business and civil society leaders will meet in New York with a hope to kick-start the final stretch of negotiations that follow.

The IPCC analysis will be of interest to policy makers, at all levels of governments, looking to learn from the failures of the past, and to inform the development of their next steps towards effective international cooperation. Each will make its own interpretation on how to play their cards in New York, Lima and Paris. But if there's one thing to learn from the past, it is that without concerted and consistent commitments on the table we are unlikely to see a global deal.

Dr Celine Herweijer, Sustainability and Climate Change partner, PwC

“2014 is the year that climate change must regain its political salience. At the international level, with Paris 2015 slated to be the year that leaders will need to reach a global climate deal, we will need to see plans that up the ante on ambition and cooperation. The UN Secretary General is calling world leaders to his summit in New York this September and urging them to bring strong and positive action. The Lima UN climate talks this November need to see a strong draft agreement in place. But we must remember that the UN is not the only game in town. Ultimately the success or not of national, sub-national and regional policies, investment and action, and that of business action at large, will determine whether we can implement the economic transformation needed to avoid dangerous climate change.”

Financing carbon mitigation

It is probably apt that the final chapter in the report covers finance, as striking a global deal may all come down to how much money gets put on the table. WG3 covers the need for finance to support innovation, demonstration and deployment of technologies, as well as to mobilise regional and international cooperation. But it is very difficult to quantify the amount of finance required for climate change mitigation, since it also funds other objectives such as poverty alleviation, economic development, and energy access and security. The IPCC attempted this nevertheless, suggesting that in recent years total climate finance for mitigation and adaptation amounts to around US \$343 – 385 billion per year, of which around 95% is on mitigation projects. Public climate finance is estimated at \$35 – 49 billion per year, and that which flows into developing countries is largely channelled through bilateral and multilateral institutions as concessional loans and grants.

Financing climate change mitigation will require a substantial scale up from current levels. Estimates suggest that annual investment in the period to 2030 would need to increase by \$336 billion/year in energy efficiency, \$147 billion/year in renewables, nuclear and CCS and \$21 – 35 billion/year in REDD+. At the same time, investments need to fall by \$30 billion/year in fossil fuel power plants without CCS and by USD 116 billion/year into fossil fuel extractions. In other words a carbon divestment needs to occur.

The role of the private sector is recognised, with its contribution estimated at over \$200 billion/year in recent years. But private sector investment, particularly in developing markets, tends to be underpinned by low-interest, long-term loans or risk guarantees provided by the public sector, as well as a country's broader institutional, political and legal context.

Dr Celine Herweijer, Sustainability and Climate Change partner, PwC

“Climate finance is not only often the bargaining chip at the climate negotiations, but more fundamentally it is a necessity to enable the scale of the global energy and technology revolution required to avoid dangerous climate change. Pinched purse-strings as the world recovers from the worst recession in recent history has not helped matters, particularly with respect finance for developing country responses. This makes it even more important that every dollar of public mitigation finance is efficiently mobilizing private capital. This includes for example grant finance for R&D, feed-in tariffs for renewable generation, concessional debt arrangements for clean technologies and infrastructure, and guarantees to reduce political or technology risks. Developing countries and their expanding populations must be helped to leapfrog the dirty development of the West. A greener growth pathway will also offer additional benefits of energy security, human security, cleaner air and health and wellbeing“

About PwC Sustainability & Climate Change

PwC's sustainability and climate change advisory team was established in 2007, and combines 700 experts globally, with over 100 in the UK. Specialists work with public and private sector clients on emerging issues of climate change science, policy, economics and development, sustainability/CSR strategy, supply chain, responsible investment, measurement, reporting and assurance. For more information see www.pwc.co.uk/sustainability.

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