Shell Energy Scenarios to 2050

SIGNALS & SIGNPOSTS

Shell Energy Scenarios to 2050

An era of volatile transitions

Acknowledgements

Our thanks go to Shell colleagues and the many external experts who have contributed to the development of *Signals and Signposts* and the previously published Shell energy scenarios.

Other Shell scenario material can be found at www.shell.com/scenarios

Contents

Foreword

For almost half a century, Shell scenarios have helped us to gain a deeper understanding of global developments and the world's energy supply, use and needs. They help us to make crucial choices in uncertain times as we grapple with tough energy and environmental issues.

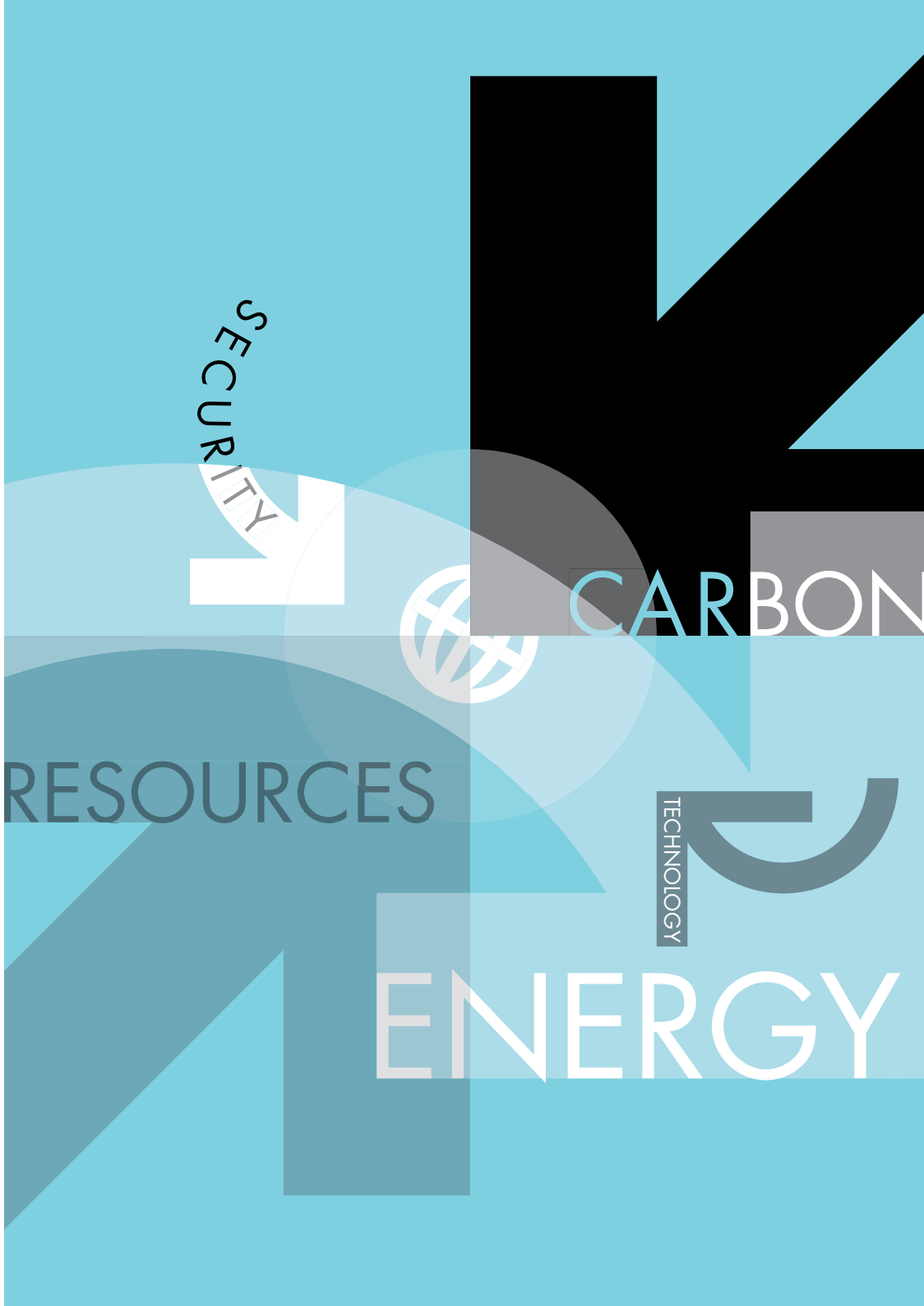
Three years ago, we made public our *Shell Energy Scenarios to 2050*. These scenarios addressed the challenges facing the world and influenced our own strategic direction. To ensure we continue playing a constructive and responsible role in the global energy and environmental debate, we must listen to others. We must also continue to share our best understanding of what we believe the future holds.

Our energy scenarios – *Scramble* and *Blueprints* – remain a credible vision of what may lie ahead. This new booklet – *Signals & Signposts* – updates our thinking by taking into account the impact of the global economic and financial crisis. Over the next four decades, the world's energy system will see profound developments. Heightened collaboration between civil society and the public and private sectors is vital if we want to address economic, energy and environmental challenges.

Partnerships must be grounded in commercial reality, but energy and environmental developments have to accelerate in the right direction. We must widen and deepen the debate across industry and geographical boundaries. With policy drift and increasing challenges to market-based solutions, we must focus on policies that deliver affordable solutions now and technological advances for the future. Some preferred energy solutions will only be affordable and available at scale tomorrow. Others are available now and will remain attractive. For example, I firmly believe that natural gas must make a growing contribution. The global supply picture for this low-carbon fuel has improved considerably over the past few years.

I trust you will find *Signals & Signposts* stimulating, thought-provoking and useful. I hope it will help you seek collaborative opportunities. I hope it will also help you embrace, rather than shy away from, the challenges which lie ahead.

Peter Voser, CEO
February 2011



Introduction

For 40 years, Shell has drawn on its scenarios to enhance business decisions and its ability to respond to change. Our most recent scenarios also contributed positively to the global public debate on energy and the environment.

But the financial crash, the deepest economic slump in 70 years, and a patchy and fragile recovery have changed the world dramatically. We must consider how these events may or may not have altered our energy outlooks. *Signals & Signposts* offers our best understanding about the changes brought by the global financial and economic crisis.

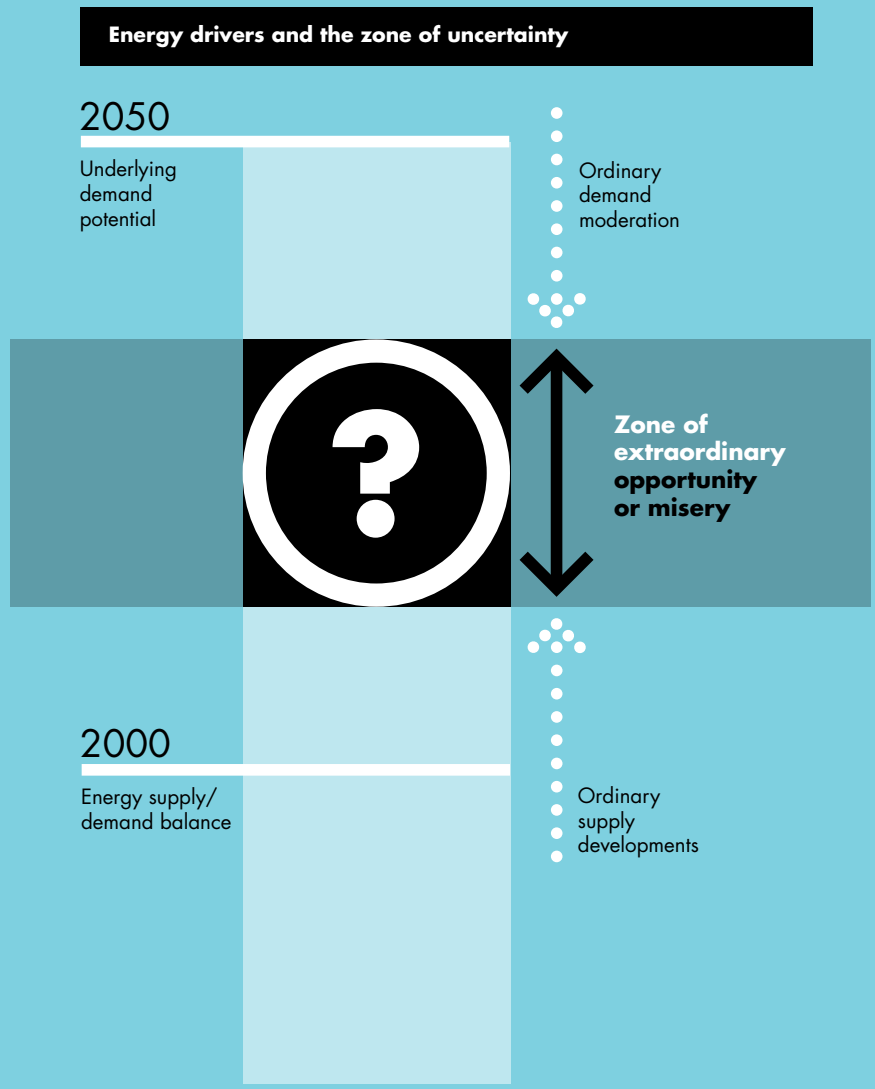
Internally, we have been using *Recession & Recovery* scenarios since September 2008. The two outlooks – *Severe-yet-Sharp and Deeper-and-Longer* – have, so far, bracketed actual developments. We have also drawn on a supplementary but unlikely scenario, *Depression 2.0*. These scenarios continue to provide useful insights and we draw on them in this booklet.

Despite the economic turbulence, the fundamental drivers and uncertainties explored in our *Shell Energy Scenarios to 2050* remain fully relevant.

Signals & Signposts highlights significant additional factors and should be read as a companion to our *Scramble* and *Blueprints* energy scenarios, which can be downloaded from *www.shell.com/scenarios*. An overview is in the Appendix.

POPULATION AND PROSPERITY

The key driver in our scenarios outlook remains growth in global population and prosperity as emerging nations enter their most energy-intensive phase of economic development. Millions are escaping poverty. They are gaining access to commercial energy in the home and benefitting from the industrialised production of household goods and infrastructure.



The energy system will struggle to match this surging demand for easily accessible energy. Supply, demand and environmental tensions will swell and spread. Political, industrial and individual choices will determine whether these tensions can be resolved and whether the solutions will be benign or harmful to us.

ZONE OF UNCERTAINTY

Underlying global demand for energy by 2050 could triple from its 2000 level if emerging economies follow historical patterns of development.

In broad-brush terms, natural innovation and competition could spur improvements in energy efficiency to moderate underlying demand by about 20% over this time. Ordinary rates of supply growth – taking into account technological, geological, competitive, financial and political realities – could naturally boost energy production by about 50%. But this still leaves a gap between business-as-usual supply and business-as-usual demand of around 400 EJ/a – the size of the whole industry in 2000.

This gap – this *Zone of Uncertainty* – will have to be bridged by some combination of extraordinary demand moderation and extraordinary production acceleration. So, we must ask: Is this a *Zone of Extraordinary Opportunity* or *Extraordinary Misery?*

Smart urban development, sustained policy encouragement and commercial and technological innovation can all result in some demand moderation. But so can price-shocks, knee-jerk policies and frustrated aspirations.

Timescales are a key factor. Buildings, infrastructure and power stations last several decades. The stock of vehicles can last twenty years. New energy technologies must be demonstrated at commercial scale and require thirty years of sustained double-digit growth to build industrial capacity and grow sufficiently to feature at even 1-2% of the energy system.

The policies in place in the next five years shape investment for the next ten years, which largely shape the global energy picture out to 2050. Speed and direction are significant. How fast will tensions rise? How fast can we make the right choices? And how quickly can positive developments happen?

KEY NEW FACTORS SINCE THE FINANCIAL CRASH:

- **Greater economic volatility and cyclicality**. Balance sheets, risk appetites and credit flows are adjusting. We will see global trend growth somewhat less than pre-recession. The good policy, good practices and good luck that underpinned the last two decades of the *Great Moderation* period are unlikely to continue as before. We will see greater economic volatility and cyclicality, driving political volatility and perceived investment risk. All this could limit developments needed to bridge the vast *Zone of Uncertainty*.

- **More uncertainty and risk**. Regulatory uncertainty around greenhouse gas emissions have grown since the Copenhagen climate summit. Developing a regionally differentiated and politically feasible patchwork of measures seems the most likely path forward. Tensions are increasing as the majority scientific view becomes increasingly pessimistic and yet public opinion weakens. This divergence is not sustainable indefinitely.

  Similarly, the Macondo well disaster in the Gulf of Mexico has increased regulatory uncertainty and investment risk. The broader, longer-term and international ramifications of this tragic event remain to be seen.

- **Natural gas developments**. The supply picture for natural gas has improved spectacularly in the past few years, driven by the boom in tight and shale gas in North America and coalbed methane in Australia. The unconventional gas boom's echoes are heard far beyond North American shores: it has freed up supplies of liquefied natural gas (LNG) – destined for the US – for other parts of the world and it has inspired other nations to search for new gas resources themselves. But it is still uncertain how confident other regions will be to accelerate building or extend gas infrastructure and power-generation capacity.

- **Iraqi energy industry**. The opening up of investment into the Iraqi energy industry brings significant resources into play, alongside uncertainty on how OPEC will accommodate this and how the obvious security challenges will be addressed.

SCRAMBLE OR *BLUEPRINTS*?

Taking these new *Signals & Signposts* into account, do we see the world heading on a pathway that looks more like *Scramble* or *Blueprints*?

Like *Scramble*, bilateral state-sponsored energy deals continue to pepper the headlines and the use of cheap coal continues to surge. But, like *Blueprints*, recognition of new mutual interests is driving new cross-border collaborations, as demonstrated by central banks during the financial crisis. Public-private coalitions – like that of Chinese businesses targeted at developing electric vehicles, markets and infrastructure – are also emerging.

The Copenhagen and Cancun summits can be interpreted through both a *Scramble* and a *Blueprints* lens: nation-states scrambling to protect narrow interests or the emergence of a new coalition of the most critical players for politically feasible progress.

The signals are mixed. *Blueprints* sees the emergence of a patchwork of incentives over the next five years to moderate the energy and carbon dioxide intensity of economic development. While it is clear that extending the scope of internationally transparent emissions pricing remains a distant prospect, more limited schemes and less transparent regulatory means are developing. China, for example, may supplement its strong focus on energy efficiency targets with a limited domestic emissions cap-and-trade system within its next policy planning cycle. Many businesses worldwide are already factoring additional regulatory action into decisions on long-term investments.

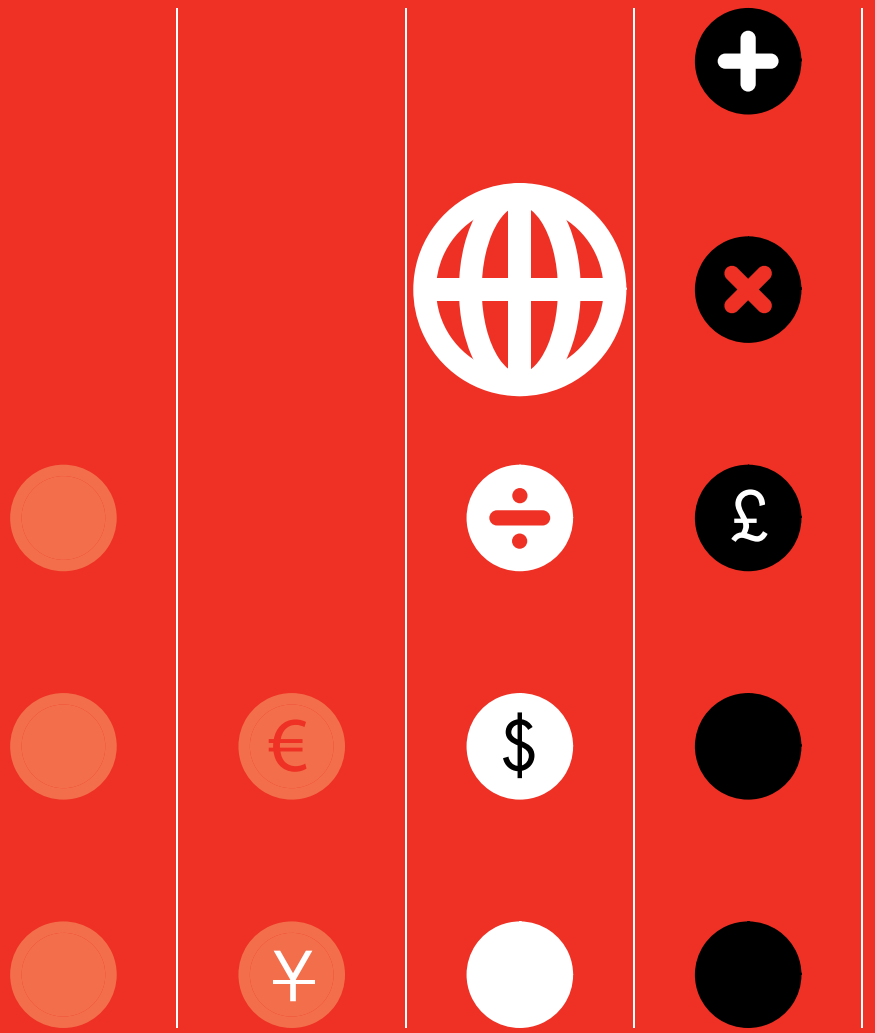
Still, even the enormous transformations highlighted in *Blueprints* result in an atmospheric concentration of greenhouse gases that remains greater than the level the majority of climate scientists would consider responsible. And we are currently changing more slowly than the *Blueprints* scenario. Is it possible to move even faster than *Blueprints*? Or are we more likely to move as slowly as *Scramble*?

In publishing *Shell Energy Scenarios to 2050* we broke a long tradition of neutrality. We declared that, while we aim to be responsible and commercially successful regardless of the future, the accelerated pace of change described in *Blueprints* promises the best hope for a sustainable future for all of us.

We now offer *Signals & Signposts* for your consideration. There is great opportunity to be realised through effective combinations of policy, technology, and commitment. With our partners, and those who will partner with us in the future, we aim to realise a share of that opportunity. We hope this material can help you do likewise.

Jeremy Bentham
VP Business Environment
February 2011

1 ECONOMIC ENVIRONMENT



1 Economic Environment

The fall in consumer and business demand triggered by the 2008 financial crisis and its spread through trade and financial systems was far greater than many economists expected. This downturn may have been accelerated in part by media and information technology rapidly spreading the collapse in confidence and accelerating output cuts by producers.

But the global recovery has been stronger than expected – lacklustre in many advanced economies, but robust in most emerging and developing countries. Monetary policy has been highly accommodative and supported by unconventional asset purchases by central banks. Fiscal policy also provided a major stimulus in response to the deep downturn, but at the expense of fiscal sustainability in some countries.

Financial conditions have stabilised but remain much more difficult than before the crisis. Credit growth will be constrained as banks rebuild their balance sheets and some sectors still struggle to access credit. Consumers and small and medium-size enterprises face tight borrowing conditions. In advanced economies, high public deficits and debt have pushed some sovereign risk premiums sharply higher, raising concerns of a new round of financial sector losses.

Financial flows from advanced to emerging economies have recovered. This is largely due to their relatively rapid growth, large yield differentials in their favour and returning appetite for risk. But this is putting upward pressure on some emerging market currencies and creating new stress in the global economy.

The policy responses by governments and central banks have achieved significant success. But the high financial cost and policy risks associated with these responses continue to loom large on the horizon, with those related to high public debts in advanced economies having become sharply more evident over the course of 2010.

Room for policy manoeuvre in many advanced economies is now much more limited, leaving the fragile recoveries vulnerable to any new shocks. The impact of the crisis on underlying global trend growth rates remains very uncertain.

DEBT, POLICY, BANKS AND POLITICS

The economic recovery remains in the grip of substantial uncertainty. We focus on four key drivers of the short to medium-term economic outlook:

- **Debt and balance sheet adjustments.** The substantial deterioration in government deficits and debt in the euro area, Japan and the US will have to be followed by a sustained period of fiscal restraint if public debt crises are to be avoided. Overstretched household balance sheets, especially in the US and UK, must be rebuilt through higher savings rates, holding back consumer spending. At the same time, financial sectors in Europe and the US must repair and strengthen their balance sheets in order to put these sectors on a much more stable footing but this process will restrict credit growth.

- **Inflation versus deflation.** The combination of very high government deficits and debt, and the reaction of monetary policy to accommodate it, raises concerns of impending inflation in Europe and the United States. At the same time, the rapid pace of fiscal cuts in the euro area and the UK, high unemployment rates and low inflation rates make some central banks very concerned about deflation. Steering a course between inflation and deflation will require very skilful management of monetary policy, both of interest rates and the extraordinary assets purchased by central banks.

- **Financial sector weaknesses.** While US and European financial institutions have made substantial progress in dealing with the sub-prime mortgage fiasco, other financial sector vulnerabilities remain. These include exposure to European sovereign risk and US commercial real estate. Reforms to deal with some of the underlying causes of these vulnerabilities have so far been modest in the face of strong financial industry pressure to maintain the status quo.

- **Geopolitical developments.** When faced with an extraordinary collapse in the global economy, the G20 showed a remarkable degree of cooperation in stabilising the situation and achieved considerable success. But this cooperation was short-lived and attempts to manage the wide global imbalances that have re-emerged with the global recovery have so far failed. A return to competitive exchange rate practices and trade protection is possible.

GREATER VOLATILITY AHEAD..?

The recession has significantly increased macroeconomic volatility, making markets less efficient and business planning more difficult. This is holding back investment and growth of individual firms. But will this volatility be fleeting or enduring?

Prior to the financial crash and recession, a combination of good policy, good practices and good luck enabled most advanced economies to enjoy about 20 years of historically low volatility - a *Great Moderation*. Since the mid-1980s, central bank independence and policies of inflation targeting have enabled monetary policy to stabilise output and inflation more effectively. Emerging and developing economies also made substantial progress in reducing their government deficits and debt.

At the same time, better inventory management – thanks to information technology – helped firms to manage demand volatility with less overshooting. Financial innovations expanded access to credit and improved risk allocation. In theory, this helped smooth consumption and investment in the face of shocks to income and earnings – but in practice also led to a build up of systemic risks.

Through the mid-2000s there were strong gains in productivity with advances in information and computing technology, helping economies to grow without inflation. The relatively fewer and smaller oil price shocks in this period also helped reduce volatility, along with the fall in oil expenditure relative to GDP.

Some analysts say the *Great Moderation* trends are permanent and will re-emerge with the eventual recovery from the global recession. But this view is too simple. While some factors will remain (central bank independence and gains in information technology) others were either less beneficial than previously thought (aspects of financial innovation) or are likely to fade (low oil price volatility).

MORE SHOCKS LOOM

The recession interrupted the oil and commodity price boom, but it may return. Emerging nations like China and India are going through materially intensive development and a tighter market will continue to support prices. We can also expect more shocks from policies aimed at mitigating climate change and other environmental stresses.

Market-based approaches to curb emissions – either cap-and-trade systems or taxes – are unlikely to deliver abrupt price shocks because of their cost transparency and political sensitivity. But command-and-control regulations - like the mandates contemplated in recent US Senate and Environment Protection Agency proposals - could have a negative impact on costs and prices. The longer the delay in climate policy action, the more likely shocks become.

This will increase the chance of knee-jerk policy steps which are not cost transparent – very *Scramble*-like behaviour.

The dramatic deterioration in fiscal policy in most advanced economies will render monetary policy improvements insufficient to safeguard macroeconomic stability. Fiscal consolidation is happening too slowly or too late in some countries to maintain investor confidence in the sustainability of budget deficits and public debt. Within the euro area, the Greek and Irish governments have already faced precipitous falls in investor confidence, and concerns remain about the public finances of Portugal and Spain.

Investor expectations swing between fear of inflation and fear of deflation. Given the serious risks to growth and employment from deflation, central banks are likely to err on the side of inflation. But any de-anchoring of inflation expectations would increase the volatility of output growth.

The financial crash showed us that innovations can also contribute to bouts of financial instability, particularly when financial markets are prone to speculative price bubbles and private incentives are distorted by inadequate financial regulation.

This greater uncertainty and volatility may amplify the behavioural trends behind both the *Scramble* and *Blueprints* scenarios, intensifying rather than re-directing possibilities. While increased risk perceptions may spur investment in transformation in regions with room to manoeuvre, overall we expect a delay which would tend towards *Scramble*.

TRENDS IN GDP GROWTH MAY ALSO BE RESET

There are several other potentially enduring impacts of the financial crisis and global recession that could lower underlying economic trend growth rates. Tighter financial regulation and less appetite for risk are likely to lower investment and slow innovation. A second possibility is the recourse to competitive exchange rate practices and trade protection in the face of persistent global imbalances and high unemployment in Europe and the US. A third is a shift in consumer values away from material consumption in response to a more challenging and volatile economic environment, making virtue from some of the necessary adjustments to past excesses.

Chart 1. Post-recession trend GDP Growth Rates

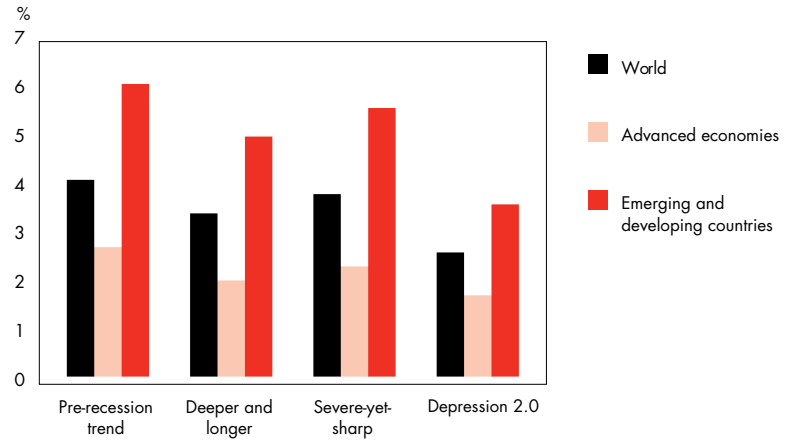
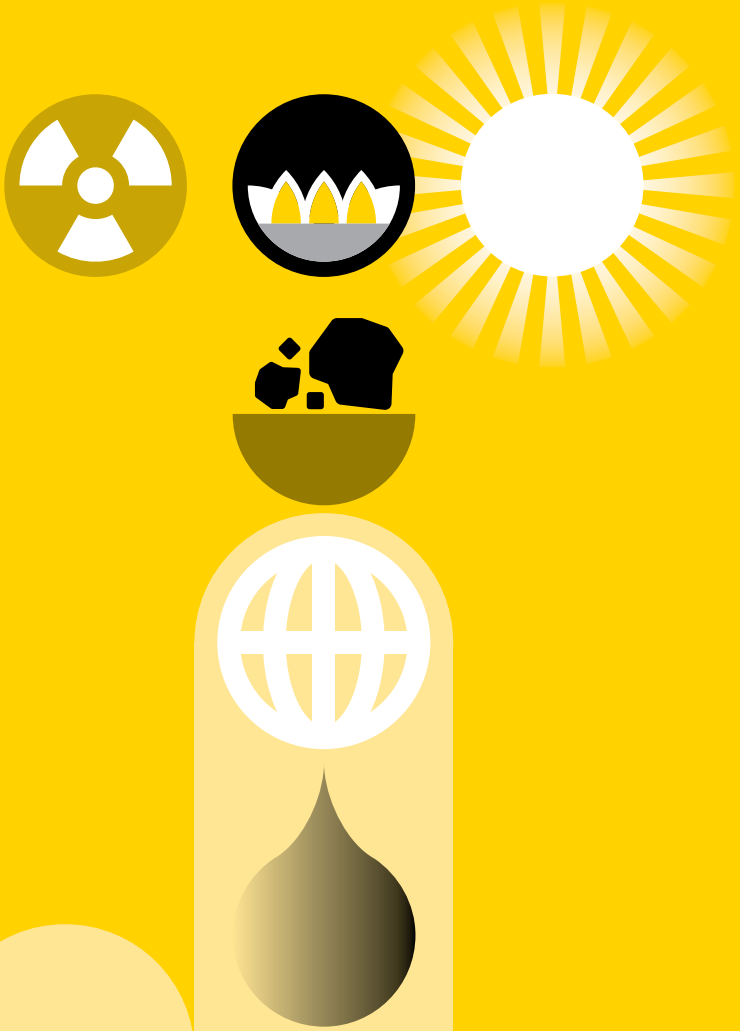


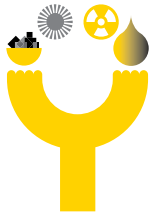
Chart 1 shows alternative scenario outlooks for post-recession trend growth rates in the global economy that reflect the three factors in varying combinations and intensity. The *Depression 2.0* scenario, which has all three coming forcefully into play, has a low probability but potentially high impact on the global economy and energy system.

DEPRESSION DRIVERS

A potential driver of the *Depression 2.0* scenario is a breakdown in the global economic order structured around free trade and capital flows. The re-emergence of global macroeconomic imbalances with the recovery has again brought to the fore concerns about competitive exchange rate practices and trade protection. This shows how difficult it is to coordinate policies across countries to address fundamental problems. But the G20 response to the crisis in March 2009 showed a strong willingness to sustain the global economy when necessary.

2 ENERGY DEVELOPMENTS





2 Energy Developments

The financial crisis changed the parameters of the world's energy system by triggering a significant drop in global oil demand. In fact, the economic downturn has set global energy demand back by about 2-3 years and 2008 demand levels are only expected to be reached again during 2011. The lengthy lead time needed for new projects means that energy supply cannot adjust rapidly enough to weaker demand. This increases market volatility.

The recession has also provided governments, anxious to weather the downturn, with opportunities to take regulatory measures. Concerns about employment, debt, economic competitiveness, energy security and climate change are now being used to justify this. These measures are accelerating or delaying energy system change, depending on the political or economic circumstances. For example, investment in higher-cost renewable energy has slowed in countries severely hit by the financial crisis. However, energy efficiency measures, made before the recession and stimulated as part of economic recovery plans, will reduce the energy or carbon intensity of many advanced and developing economies.

The rapid emergence of abundant and affordable gas creates new possibilities. But are the frameworks in place to realise its full potential?

In a *Blueprints* world, natural gas will give the world an early opportunity to reduce overall CO_2 emissions from energy by displacing coal with gas. At the same time, a continued strong focus on energy efficiency and market based CO_2 pricing will keep demand growth in check.

In *Scramble*, the world fails to realise this because of the absence of necessary policy frameworks. The availability of abundant and affordable gas would depress the need for accelerating energy efficiency, particularly in industry and buildings. Coal would remain strong in the electricity mix. Capital-intensive renewable energy developments would slow to relieve pressures on government budgets, especially in countries severely affected by the financial crisis. More gas production would boost the liquid supply profile, reducing the need for early efficiency measures in transport.

GLOBAL DEMAND

Oil demand is swinging from west to east. The recession-driven drop in oil demand occurred mainly in the OECD countries while developing economies continued their strong growth. In the medium term, demand will continue to fall in OECD countries as efficiency measures take effect. But how quickly will this happen?

Post-recession and post-Copenhagen policy developments in major energy consuming countries will determine investment in alternative energies and reward consumer behaviour towards higher efficiency solutions. But it will take time for the new Corporate Average Fuel Economy (CAFÉ) standards in the US to take effect by moving consumers away from SUVs to (plug-in) hybrid vehicles. Likewise, it will take time for the EU and Japan to move towards passenger transport electrification.

China's aggressive motorway building programme and rising prosperity are key to strong demand growth. Demand will also remain strong in the Middle East and in other developing countries.

The net effect is that global oil demand will increase. Meeting this expected growth will rely more and more on alternative sources of energy supply, like natural gas liquids, biofuels and unconventional oil.

Natural gas demand will grow strongly, driven by economic growth and the thrust towards lower carbon fuels. In the electricity sector, lower-cost gas fired generation will replace coal-fired generation where possible.

Growth in renewable energy also means more gas-fired power plants are required to provide flexibility. The success in unconventional gas production in the US, which may be replicated elsewhere in the world, will underpin this demand growth.

Chart 2. World-Total Primary Energy Demand - By Region

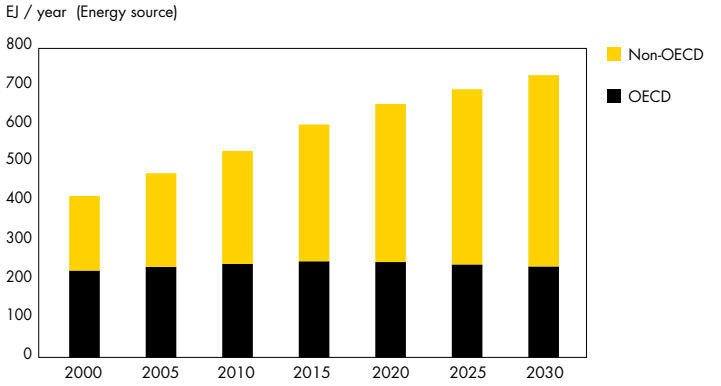
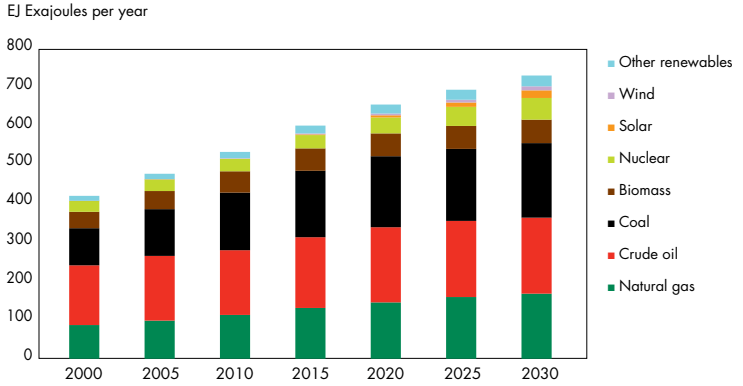


Chart 3. World-Total Primary Energy Supply



GLOBAL SUPPLY

Two arguments can be made for recent oil supply trends. One says non-OPEC production is in inevitable decline with underlying decline rates in conventional oil supply accelerating. Another says that normal cyclical behaviour will occur with new supply sources exploited as costs fall or prices go up.

Non-OPEC conventional crude supply has been falling over the past five years and this is likely to continue. But the fall could be slowed by new discoveries like that in deep water off Brazil and reserves in existing fields being upwardly revised with the application of new technologies, viable in higher oil price environments. This decline could also be mitigated by supplementary sources like unconventional oil and biofuels, as well as strong growth in OPEC Natural Gas Liquids (NGLs).

Meeting the expected growth in global demand will rely heavily upon alternative sources of energy supply, which are, in general, more costly than conventional sources. This will put upward pressure on oil prices in the longer term. However, the pace of new investments and of learning curves could lower the cost of alternative energy sources.

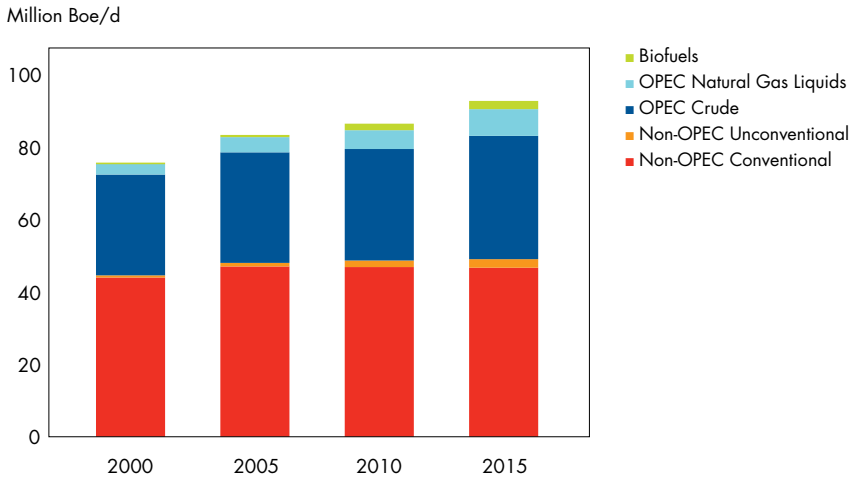
Iraq is a key uncertainty in the oil supply picture. If reasonable stability and security can be achieved, production will increase quickly under the new partnerships between national and international oil and gas companies. The deals could double Iraq's output to 5-6 mln b/d over the next decade. The Iraqi government is even more ambitious putting the country's future output at as much as 10-12 mln b/d. This would mean annual growth rates of 10-15% would have to be sustained for at least 10 years – a feat unseen in recent history.

In the medium-term, however, a balance must be struck between ramping-up production quickly for Iraq to generate income, and avoiding over-supply so that OPEC can manage its spare capacity buffer adequately. Iraqi production uptake therefore has the potential both to increase or to decrease price volatility.

Key to price volatility will be OPEC's spare capacity levels, its adherence to agreed quotas to limit production during periods of weak demand and continued market perception of medium to longer term supply-demand tightness.

Saudi Arabia has recreated its spare production capacity by bringing new facilities on-stream. This enables it to retain its OPEC leadership and consolidate its international influence. This leadership will be tested if the present OPEC spare

Chart 4. Global Oil Supply Growth



capacity buffer lasts well into this decade. It will depend on the pace of uptake of Iraqi oil production and the 'competitive' response of other OPEC members in maintaining market share.

The breakthrough in natural gas supply in North America is one of the most important changes since we published the *Shell Energy Scenarios to 2050*. Oil and gas companies have more than doubled the discovered shale gas resource base in North America in the past three years and they have scaled-up production dramatically. Total potential resources are now thought large enough to meet current consumption levels for about a century.

This boom reaches far beyond North American shores. Many other countries are now inspired to search for new gas resources themselves. Unconventional gas covers a wide range of sources like tight gas, shale gas and coalbed methane.

The global unconventional gas resource base must still be proven, but with the IEA estimating a potential recovery of around 13,400 trillion cubic feet (tcf), it will clearly be a game-changer. The largest addition comes from the US, with the Energy Information Administration (EIA) estimating some 2,000 tcf. Its success will give governments, investors and consumers the confidence to commit to natural gas for the long term.

FUTURE ENERGY EMISSIONS

Future energy emissions hinge on a patchwork of policy frameworks developing; the uptake and success of Carbon Dioxide Capture and Sequestration (CCS) projects; and the nuclear renaissance we see emerging.

We must also consider any likely acceleration or delay in renewable energy investment, in particular in China, which is rapidly catching up in deploying renewable energies like wind and solar, thereby reducing costs and developing manufacturing capacity for export.

How quickly the world can make the most of available natural gas and its contribution to lower emissions will be key, especially if it can be used to displace coal.

Chart 5. CO_2 Emissions from Energy

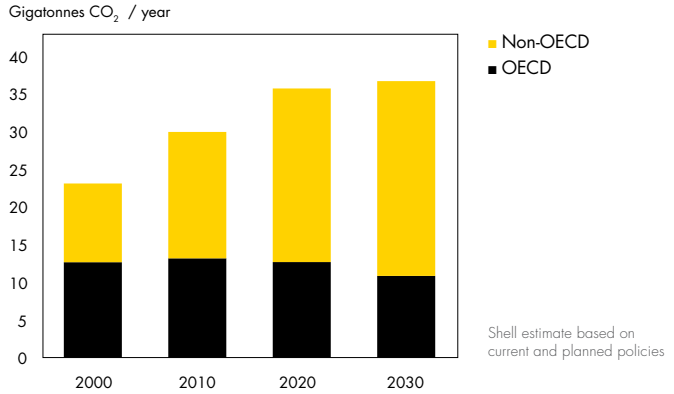
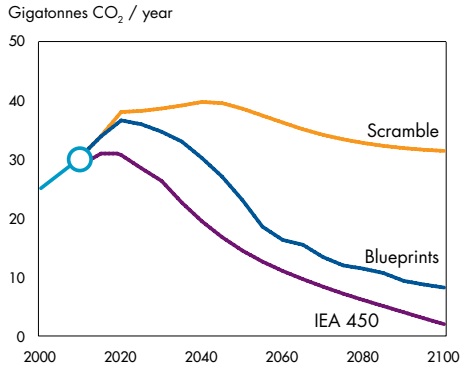


Chart 6. CO_2 Pathways



There is growing discussion around the 450 ppm target (whether CO_2-only or CO_2e, covering all greenhouse gases). Some experts, like James Hansen, even advocate 350 ppm, a level below today's figure. Different groups have proposed different pathways to keep within this carbon budget, but for 450 ppm, the broad conclusion is that global emissions need to fall by at least half by 2050. For further discussion see page 53.

3 CHOICES

The emissions levels we can expect over the coming decade are largely determined by investment choices made in the past 10 years and will continue to grow at around 2% pa. Most growth will come from the non-OECD countries – especially China and India - as coal-fired power generation surges. However, some countries in the OECD, facing the imminent phase-out of older, inefficient and air-polluting, coal fired power generation, will have the opportunity to move faster and reduce emissions already this decade.

CO_2 policies adopted in the OECD over the next 10 years will start to impact after 2020 and emissions could begin falling by about 1.5% pa. This will slow overall emissions growth but much more needs to be done in developing economies before an overall emissions reduction is achieved.

Based on current and planned policies, the overall CO_2 future is likely to be closer to the *Scramble* scenario than to *Blueprints*. The chief question the world must ask itself is: What more can be done now to achieve the faster than *Blueprints* profile that is so vital to a sustainable energy future.

3 Choices

GEOPOLITICAL DEVELOPMENTS

The global economic crisis has coincided with a shift in geopolitical and economic power from west to east. This decisive shift is transforming the global economic and political system. The change is gradual, but its potential consequences are profound. The economic crisis in the west may accelerate this trend. Future generations may see 2008 as the turning point.

The world faces a period of uncertain global politics. Strategic fault lines are emerging. Rising powers are increasingly and confidently asserting what they see as their national interests. This is undermining global mechanisms for ensuring collective security.

Uncertain global governance

There is growing recognition that the pace of globalisation has not been matched by change in the institutions of global governance. At the same time, the authority and legitimacy of established powers and multilateral institutions charged with managing the global economy have been damaged by the financial crisis.

The prominent role played by the G20, rather than the G8, in tackling the global economic crisis is evidence of this shift in geopolitical and economic power, and highlights concerns over the legitimacy of efforts to forge global multilateral policies.

The G20 is more representative than the G8, but its size makes it harder for leaders to achieve sustained progress on tough issues, to agree the rules of the game and act decisively. How global governance will develop remains to be seen. Despite the prominence of the G20 summits, the established major powers remain reluctant to share power with a wider circle of developing countries, preferring to treat the G20 as a broad consultative forum.

We can expect a period of disorderly globalisation. Uncertainty will grow and it will become harder for world leaders to reach global consensus on the tough challenges that face us.

The US – China relationship

The relationship between the US and China is pivotal to the shift in geopolitical and economic power. There has been talk of both countries forming a G2 to coordinate global policy. This would be unchartered waters given neither is familiar with cooperating with other world powers as equals. China is also reluctant to assume global responsibilities. As a developing country it does not believe it has the resources to do so.

A slow drawn-out economic recovery could also damage US confidence. This, together with China not stepping forward, could lead to a leadership vacuum at the global level.

Scramble or Blueprints?

In a *Blueprints* scenario, the US may well remain the world's pre-eminent political power, but it faces a serious loss of structural influence and cannot act unilaterally. The economic imbalances at the heart of the financial crisis helped fund the political imbalances that underpinned US geopolitical dominance. Unwinding these economic imbalances requires the US to accept a lesser role in a more plural world. It will have to share power with old allies, as well as with new ones like China and India.

The crisis has changed the way emerging powers view the West. Although they do not challenge globalisation itself, *Blueprints* could see more of an Asian growth driver emerge with the burgeoning of an Asian regional economy.

A *Scramble* scenario brings more dramatic political implications. Here every state will look to protect its own interests. Willingness to cooperate for the greater good and for long term interests will diminish. This will increasingly call into question the tenets of the Anglo-US liberal co-operative global framework that has hitherto underpinned the international system.

Scramble in the west could also result in increasing anti-globalisation, more protectionism and political radicalism. China has emerged in US domestic politics as a popular scapegoat to account for its economic problems. As global order fragments, governments in developed countries will be pressured to protect the living standards of their populations. In the extreme, the US could retreat to become more isolationist and protectionist.

Scramble also troubles a China dependent on global economic cooperation. The *Scramble* world is one of antagonistic relationships, nationalistic state-driven policies and growing geopolitical tensions. It sees an increasingly confrontational US – China relationship as both take a harder line internationally. Bold leadership is vital to steer China through these turbulent waters. Chinese leadership will need to act decisively, which may require significant political change to strengthen its legitimacy to act. Weak leadership could resort to repressive measures which could deteriorating growth.

Whatever the scenario, the world will become more interdependent and more competitive. Globalisation will continue to generate winners and losers, especially among workers. Inequality is likely to increase despite an overall increase in wealth. The Middle East and sub-Saharan Africa – where populations are getting younger - will feel the impact of inequality the most.

The politics of recession and recovery

The world's established powers will remain politically wary until a sustained recovery emerges. Global imbalances - symptomatic of the problems that sparked the crisis – are still with us. In domestic politics there is a "phoney war" – an awareness of the cost of the crisis but as yet no significant casualties. Most governments have weathered the recession, but at the price of huge fiscal imbalances. This has delayed the social and political impact of the crisis, but has also made a return to growth significantly more challenging. When governments begin to re-adjust their spending, the political consequences will hit home hard.

An extended phase of below-average growth restricts governments' freedom to manoeuvre. The key political issue will be who shoulders the burden when governments tighten spending and raise taxes. Adjustments will be difficult; all countries, not just China, need economic growth to underpin political stability.

The economic crisis has challenged prevailing orthodoxies and has sparked a search for policy alternatives. But we have yet to see a paradigm shift.

The state has returned to play a more active role in response to the crisis. Large developing countries have become vocal advocates of industrial policy. Free market orthodoxy remains deep-rooted but that orthodoxy gained ground only in the last 30 years. What we consider to be business as usual may be more transient than we assume. It is difficult, however, to envisage the emergence of an alternative to capitalism. All approaches that we have exist within a broad capitalist framework, with variants that are either more market-centric or more state-focused.

Societal trust in organisations is low. People demand increased transparency in how they are governed. *Mercurial* individuals with unpredictable, unstable or extreme positions may become prominent. Greater international connectivity and copy-cat responses could amplify such behaviour.

The more confrontational international environment of *Scramble* in particular, leads to an antagonistic domestic political environment. A sudden increase in insecurity creates social resentment and a search for scapegoats. People turn on one another and target minority groups. There may be a resurgence of far-right politics, ethnic nationalism or new fundamentalist ideologies. Already signals of change in some countries see politicians advocating populist solutions and feeding off dissatisfaction and disappointment. Political change is likely to be turbulent. Knee-jerk reactions will be magnified by distrust and volatile behaviour could trigger extreme responses.

KEY DRIVERS GOING FORWARD

- **G20 governance –** Can the G20 take on a meaningful role? Can it evolve into the hub of a networked system of global governance, bringing in other global issues such as climate change?
- **The China-US relationship –** Can China and the US work cooperatively over a range of issues from global economic recovery to energy and climate change? This will be crucial to achieve successful outcomes in all these areas. The evolution of the China-US relationship also acts as a marker of the evolving longer term geopolitical adjustment between established and emerging powers.
- **Sharing the burdens of adjustment –** How will the costs of adjustment be allocated? This will be hotly debated. In seeking to reduce their deficits, government choices on taxation, inflation and growth stimulation will determine, to a significant degree, who bears the costs.
- **New policy paradigm –** How can we reshape the capitalist model and drive new political energies to move economies onto a firm recovery path? The return of the state and of industrial policy, already evident in response to the crisis, could become entrenched as key elements of government policy.

BEHAVIOURAL PERSPECTIVES

Behavioural economics has enhanced our ability to understand how consumers make choices. It has helped governments find ways to reduce energy demand without losing votes. It has helped businesses develop more innovative and profitable ways to serve consumers. At its heart is the notion that the 'architecture' around customer choices can nudge consumers towards making particular choices. In the US, the approach has been successfully applied to services including employee participation in workplace health and benefits schemes.
It has also been used to target childhood obesity by changing the layout of cafeterias and shops to encourage children to eat healthier food.

Persuading consumers

When it comes to energy use, these behavioural principles are gradually emerging to shape consumer behaviour. But a majority of consumers still need to be persuaded that cutting energy consumption is worth the bother.

The recession and a rise in energy prices in 2007-08 turned a brighter spotlight on energy efficiency as consumers tightened their belts. But the environment and climate change were overshadowed by concerns about economic security as the financial crisis deepened. Even the Gulf of Mexico oil spill, while hardening public attitude towards energy providers, did little to change the energy consumption habits of consumers.

A new communications boom is also creating marked shifts in consumer behaviour. Communications technology is part of daily life, increasing our ability to connect with others and allowing us to access multiple information sources. We live at the heart of a complex and ever-expanding network of 'smart' technologies and devices, but while connectivity accelerates the spread of information, it can also deepen uncertainty. Research shows that the structure of the network connections people use can strengthen or weaken the spread of behavioral trends in unpredictable ways.

This may explain another paradox, one which presents energy efficiency opportunities:

Despite the belief that greater connectivity increases uncertainty in a more complicated world, US trials on energy use in homes and transport paint a different picture. In fact, more access to data creates gamesmanship inviting the citizen to compete.

Studies on motorists' fuel economy reveal a so-called *Prius Effect* among drivers of hybrid vehicles. These drivers measure their fuel economy through instant dashboard updates on vehicle performance. Toyota Prius owners are even known to compete against one another in virtual leagues for supremacy in the fuel efficiency stakes.

This competitiveness is also evident in US utility billing trials where households receive monthly bills comparing their energy use with that of their nearest neighbours. This has driven down energy use as households compete to be the lowest consumer on their street, or risk being publically labelled the neighbourhood energy glutton.

Demands for transparency

The recession had a major impact on behaviour. Trust in government and business – notably banks – has dropped to an unprecedented low. This in turn has prompted widespread calls for greater transparency and checks on the market.
Collectively, people are still holding their breath. Major developed economies are emerging from a period of fiscal stimulus and now face significant pressures. Severe public spending cuts are straining ties between voters and politicians. This has been accompanied by rising industrial action by trade unions in many countries, reflecting the underlying trend towards economic and political volatility outlined earlier in this book.

Urban development – risk or opportunity?

By 2050, three-quarters of the world's 9 billion people will live in cities. According to the United Nations' Habitat group this population rise would require development equivalent to a new city of one million people every week for the next 30 years. Some estimates predict that as many as half of those could be in city 'slums', with limited access to power for heat and light.

Recent research puts the costs of development and operation of urban infrastructure at $350 trillion to 2040 – seven times current annual global GDP [1]. But how will that investment be deployed? If development is chaotic, we can expect cities with sprawling mobility needs, highly inefficient energy consumption and large slums. If smarter development is achieved, there will be more compact cities with high population density, mass-transit infrastructure and energy-efficient combined heat and power (CHP) developments. Integrating the transportation, energy, water and waste systems which contribute to the physical infrastructure of modern cities is important. From a climate perspective, scientists predict that the management of energy use in cities – from which almost 80% of CO_2 emissions emanate – will be a decisive factor in the coming years.

1] Booz & Co/WWF, *Reinventing the City: Three Prerequisites for Greening Urban Infrastructures*, March 2010

Dramatic urban growth is being most keenly observed in the rapidly expanding economies of the East and particularly evident in two categories of city:

- **Rapidly growing smaller cities –** population <1 million – with fewer existing resources but so called 'upstart' advantage. Their carbon footprints are lower by virtue of their relative size and their infrastructure is yet to be developed.
- **Second-tier or midi-cities –** whilst having little global name recognition currently, their rapid economic growth and burgeoning populations – 1-5 million people – means that their need for effective urban infrastructure planning is real and urgent.

Based on historic patterns of urban development – typically evolutionary and driven by the demands of unmanaged economic migration – failure to plan and manage city growth will render cities powerful forces for environmental destruction through their emissions and waste.

As a recent study from the WWF and Booz&Company concludes, cities are immensely diverse but the case for sustainable planning processes are common to all major urban environments. *'Whether Sweden, Nigeria or China, urban leaders need to focus infrastructure spending on three kinds of activities… aggressive energy reduction plans; investment in cutting edge technological advances; [and]…innovative financing….'*

Energy, resources and infrastructure companies face a significant opportunity to innovate in new supply chains for an increasingly urban world. But they also face major up-front investment costs. Already multinational companies like IBM and Siemens have reshaped their organisations for the urban world in an effort to capture market demands for urban mass-transit systems, electric mobility, energy-efficient heating and power schemes, and high-speed information technologies.

We must ask: To what extent will policies enable better management of future city development to ensure a more stable transition? If this can be achieved – and it is a bold assumption on the evidence of history – then the challenge to business will be whether rewards for innovation offset the risks of diversifying early.

URBAN SPRAWL – LIMITS AND LONG-TERM DRIVERS

Large disparities in energy consumption patterns exist for passenger road transport globally. For example data shows that the average American motorist uses three times as much energy as the average European.

Markets with historically lower energy prices have typically evolved with a less efficient fleet of larger, heavier vehicles. This trend has been exacerbated by differing approaches to vehicle and fuel taxation from market to market and has led to greatly varied costs for consumers. In costlier markets these factors are manifested in lower average personal mobility and proportionately more mass transit. Latterly, policies like the CAFE standards in the US are intended to close the gap in vehicle energy efficiency over a prolonged period as the stock of vehicles turns over.

When considering distances travelled, the US again shows an average of double the distance travelled by European drivers annually. This is often assumed to be due to lower average population density, but some commentators point to urban sprawl and low levels of public mass transit in the US. These factors have been heavily influenced by assumptions on the long-term costs of mobility in the period of the post-war mid-20th century when most urban infrastructure was being developed.

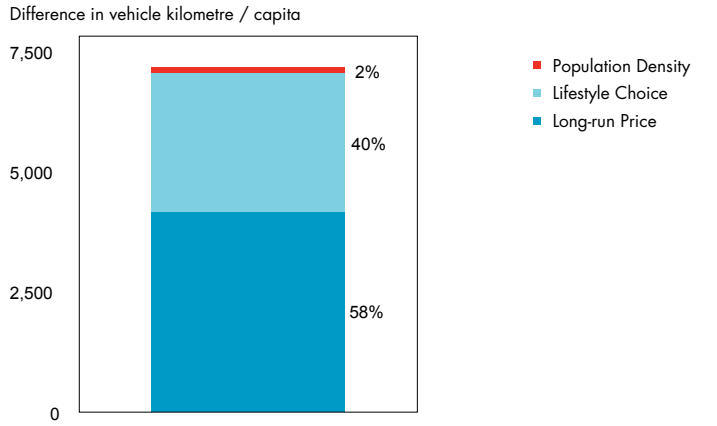
Shell's analysis of 20 developed economies found that the difference in average travel distance could be explained by two key factors:

1. The decisions which lead to the development of highly dispersed urban infrastructure - or city sprawl - are (in part) motivated by low long-run energy prices. This accounts for 60% of miles travelled
2. Lifestyle choices that tend to increase the propensity to drive, explain some 40% of all miles travelled.

The difference in population density contributes only very little directly and is in fact not significant according to our analysis.

This result indicates that the quality of urban mobility infrastructure development can hard-wire either energy profligacy or energy efficiency into the system for decades. It also highlights the pernicious impact on long-term demand of low energy prices such as those driven by subsidies, particularly in emerging markets.

Chart 7. Contributions to difference in driving distance between US and EU motorists*



* EU15 excluding Luxembourg and Portugal

4 CLIMATE & ENVIRONMENT

4 Climate & Environment

The outlooks for global environmental and sustainable development issues have shifted radically since *Scramble* and *Blueprints* were published. The majority scientific view is becoming increasingly pessimistic about the potentially devastating effects of climate change from greenhouse gases. Paradoxically, the global recession's impact on public sentiment has diverted policy attention further away from the environment as a vote-winning issue.

Disillusionment at the pace of progress in the UN policy negotiating sphere culminated in the perceived failure of the 2009 Copenhagen summit to reach new globally binding emissions targets. This has led some experts to question the very legitimacy and relevance of the process. Meanwhile, the worst offshore oil spill in history in the deep waters of the Gulf of Mexico has again raised concerns over the safety of producing oil and gas in frontier environments and led to renewed calls for tough regulation and more investment in renewable energy.

THE UNEVEN ROAD FROM COPENHAGEN

The climate change crisis is far from over. The decade 2000-2010 is the hottest ever recorded and data reveals each decade over the last 50 years to be hotter than the previous one. The planet is enduring more and more heat waves and rain levels – high and low - that test the outer bounds of meteorological study.

The failure of the USA, Australia and Japan to implement relevant legislation after the Copenhagen Accord, as well as general global inaction, might lead people to shrug off the climate issue. Many are quick to doubt the science. Amid such ambiguity a discontinuity is building as expert and public opinion diverge.

This divergence is not sustainable!

Society continues to face a dilemma posed in *Shell Energy Scenarios to 2050*: a failure to reduce emissions now will mean considerably greater cost in the future. But concerted global action is still too far off given the extreme urgency required.

CO_2 price transparency needed

Some countries forge ahead with national and local measures but many are moving away from market-based solutions and are punishing traditional energy sources. Cap-and-trade systems risk being discredited. The EU-Emissions Trading System (EU-ETS) has failed to deliver an adequate CO_2 price. Industry lobbying for free allowance allocations is driving demands for CO_2 taxes to eliminate perceived industry windfalls. In some cases this has led to political stalemate.

The transparency of a CO_2 price is central to delivering least-cost emission reductions, but it also contributes to growing political resistance to cap-and-trade systems. Policy makers are looking to instruments – like mandates – where emissions value is opaque. This includes emission performance standards (EPSs) for electricity plants and other large fixed sources. Unfortunately, policies aimed at building renewable energy capacity are also displacing more natural gas than coal where the CO_2 price is low or absent. This is counter-productive when it comes to reducing emissions. Sometimes the scale of renewables capacity also imposes very high system costs. At other times, policy support for specific renewables is maintained even after the technology reaches its efficient scale, as is the case in the US.

The recession has raised a significant issue for the EU-ETS: how to design cap-and-trade systems in the face of economic and technological uncertainty? Phase III of the ETS risks delivering a structurally low CO_2 price due to the impact of the recession on EU emissions. A balanced resetting of the cap should be considered. It is more credible to introduce a CO_2 price floor ahead of such shocks than engage in the ad hoc recalibration of the cap in response to them. This would signal to investors that unexpected shortfalls in emissions would be used in part to step-up reductions and reduce uncertainty in investments associated with the CO_2 price. This is an important issue for the design of Phase IV of the ETS.

Climate too low a priority

Structural climate policy problems aside, the global recession has moved climate concerns far down the hierarchy of government objectives. The financial crisis and Gulf of Mexico oil spill have also hurt trust in the private sector, spawning tighter regulation and leading to increased risk aversion. This hits funding and political support for new technologies, in particular Carbon Capture and Sequestration (CCS) where industry needs indemnification from some risk. Recent moves by the EU and the US regarding long-term liabilities show this support is far from secured. Government support for technology development may also be hit as they work to cut deficits.

In this environment of policy drift and increasing challenge to market-based solutions, it is important to remain strongly focused on least-cost solutions today and advances in new technologies for the future. Even if more pragmatic policy choices prevail, it is important that they are consistent with, and facilitate the eventual implementation of market-based solutions.

Interdependent ecosystems approach

Global policy around environmental sustainability focuses almost exclusively on climate change and CO_2 emissions reduction. But since 2008, an approach which considers interdependent ecosystems has emerged and gradually gained influence.

This approach argues that targeting climate change and CO_2 alone is insufficient. The planet is a system of inextricably inter-related environmental processes and each must be managed in balance with the others to sustain stability.

Research published by the Stockholm Resilience Centre in early 2009 consolidates this thinking and proposes a framework based on 'biophysical environmental [2] subsystems'. The *Nine Planetary Boundaries* collectively define a safe operating space for humanity where social and economic development does not create lasting and catastrophic environmental change.

According to the framework, planetary boundaries collectively determine ecological stability. So far, limits have been quantified for seven boundaries which, if surpassed, could result in more ecological volatility and potentially disastrous consequences. As Table 1 shows, three boundaries have already been exceeded. Based on current trends, the limits of others are fast approaching.

Table 1. Planetary Boundaries	Status
Climate Change (atmospheric CO_2 concentration and change in radiative forcing)	Boundary Exceeded
Rate of Biodiversity Loss	Boundary Exceeded
Nitrogen Cycle - part of a boundary with the Phosphorus Cycle	Boundary Exceeded
Phosphorus Cycle - part of a boundary with the Nitrogen Cycle	Approaching Limit
Ocean acidification	Approaching Limit
Global freshwater use	Approaching Limit
Change in land use	Approaching Limit
Stratospheric ozone depletion	Not exceeded
Atmospheric aerosol loading	Not yet quantified
Chemical pollution	Not yet quantified

2) Rockstrom, J et al. *A Safe Operating Space for Humanity*, Nature 461, 472-475 (24 September 2009)

For the energy industry, CO_2 management and reduction is the chief concern and the focus of much research and investment. But the interdependence of the other systems means that if one limit is reached, others come under intense pressure. The climate-change boundary relies on careful management of freshwater, land use, atmospheric aerosol concentration, nitrogen–phosphorus, ocean and stratospheric boundaries. Continuing to pursue an environmental policy centered on climate change will fail to preserve the planet's environmental stability unless the other defined boundaries are addressed with equal vigour.

IS FRESHWATER THE NEW CRISIS?

Many consider the availability of freshwater a challenge as critical as CO_2 and climate change. In the coming decades, population growth and social and economic development could cause a demand, supply and environmental crisis when it comes to water. If current water consumption trends continue, the world could face a 40% shortfall between global freshwater demand and supply by 2030*[1].

Energy producers are amongst the largest industrial consumers of freshwater. The link between energy production and water will intensify as portfolio choices move increasingly towards more water-intensive production methods such as biofuels and enhanced hydrocarbon recovery methods (EOR). In the US alone, where energy currently accounts for 40% of all freshwater consumption, projected growth in energy production will require an increase of 165% in freshwater withdrawal by 2025*[2].

In the energy sector, freshwater access is likely to emerge as a particularly prominent issue. The environmental significance of operating in water-poor countries will inevitably create deep operational and commercial challenges as water regulations grow and the costs of using it escalate.

*(1)(2) World Economic Forum

Gulf of Mexico Spill

The fallout from the oil spill in BP's deepwater Macondo exploration well in the Gulf of Mexico in April 2010 dominated news headlines for several months. It damaged industry reputation and prompted a deep review of deepwater operations and regulation in the US and other oil producing nations.

The prominence of the incident, at the time, suggested a cognitive threshold had been crossed and that the disaster would become an enduring reference point in public and political dialogue about the industry.

As the crisis response gradually shifted from immediate environmental remedies towards long-term planning and management of oil and gas permits, demands for change and reform of the regulatory system in the US concentrated opinion around a number of key issues. An intense debate developed about what a post-*Deepwater Horizon* world meant for energy security, the industry and public trust in a system that had allowed such a disaster to happen.

Close observers of the disaster are cautious about the long-term impact. The clouds which gathered in the initial aftermath are clearing and some clarity over the policy and regulatory framework for the industry is emerging. The environmental impact on the Gulf coast; costly and delayed permitting processes under a partially restructured regulator for the industry; and the impact of industry reputation, are seen by many as the main long-term impacts.

To consider the potential impact of the crisis over the longer-term, we have formulated two scenarios to help explore the boundaries of a broad range of plausible outlooks. These are *High Wire* and *Safety Net*:

HIGH WIRE

A low trust/high compliance world with little incentive for industry collaboration.

- Rigid and escalating regulatory responses and executive order
- Knee-jerk and politicised responses
- Stiff penalties for accidents and incidents impacting all industry players
- Stringent financial risk and liability requirements impact number of operators able to participate in frontier environments
- Low trust environment perpetuated with little motivation for operators to strive for above industry standards

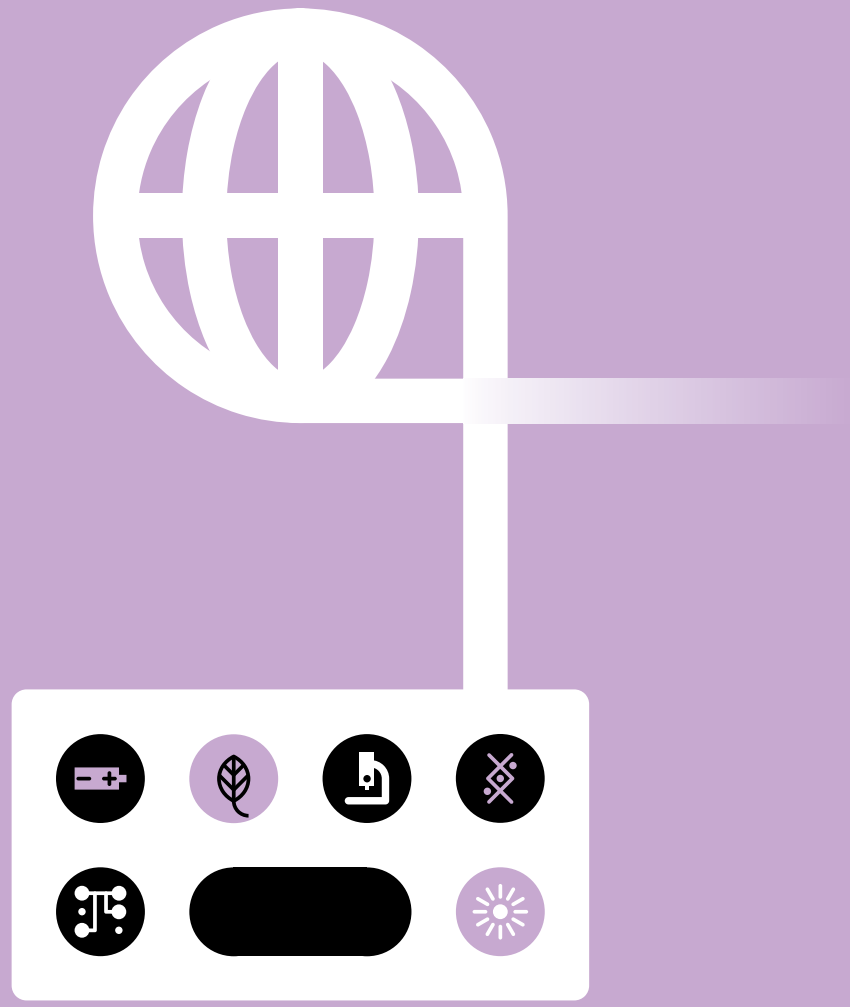
High Wire broadly represents the default position for an entire industry judged according to the standards of the worst operators. Safety Net meanwhile, can be perceived as a better industry operating model if collaboration can be achieved.

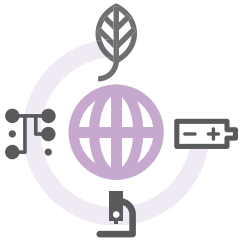
SAFETY NET

Trust is earned and sustained by adopting greater openness and transparency across operations and communications.

- Belief amongst early adopters in a better operating model
- Recognition that high standards can be leveraged to benefit wider industry and society
- Transparency principles underpin new approach and are rewarded with stronger relationships with government and regulators and increasing societal acceptance
- Collaboration on standards drives greater investment in joint industry R&D and innovation
- Gradually self-regulation and auditing of standards becomes the norm and a new form of compliance emerges that does not depend exclusively on government regulation

5 TECHNOLOGY & INNOVATION





5 Technology & Innovation

THE POTENTIAL FOR A GREENER SCENARIO THAN *BLUEPRINTS*

In September 2008, MIT published a paper comparing Shell's energy scenarios with those of others [3]. The paper said the *Blueprints* scenario's energy-related emissions would lead to atmospheric concentrations of 540 ppm for CO_2, 650 ppm for all greenhouse gases and to a temperature rise of more than 3°C [4].

MIT observed that *Blueprints* results in lower estimated levels of temperature change than nearly all of the other scenarios analysed by MIT. This seems reasonable given that we pushed the plausible boundaries for how the energy system could evolve in this scenario. However, many commentators, seeing the scientific consensus on the impacts from greenhouse gas emissions, now increasingly talk about targets of a maximum 2°C rise in temperature and 450 ppm of greenhouse gases. This led to the observation that the *Blueprints* scenario still "wasn't good enough" when it came to dealing with the energy and environmental challenges facing the world.

If anything, the scenarios emphasised the enormous scale of the challenge and the unprecedented transformation required. Such a conclusion highlights uncertainty in the future balance of energy supply and demand and points to the even wider uncertainty over the extent of climate change damage we might expect.

Technology vital to energy future

Many people advocate clear targets such as the 450 ppm or 2°C maximum temperature rise. But, in reality, the range and extent of damage for any level of concentration, as well as the emissions required to reach that level have significant uncertainty ranges in the climate models. Scientific forecasts are increasingly gloomy [5]. If the gloom mounts, we can expect growing tension over energy system management despite some positive supply developments. Technology will play a critical role in this future.

3) The Influence on Climate Change of Differing Scenarios for Future Development Analyzed Using the MIT Integrated Global System Model, MIT, September 2008

4) This represents the central estimate at 2100. The temperature rise is above pre-industrial levels.

5) Some scientists, such as James Hansen, argue that to avoid dangerous climate change we need to look for even deeper emissions cuts than this, and have target CO_2 levels (350 ppm) below today's level (390 ppm, in mid 2010 see http://www.esrl.noaa.gov/gmd/ccgg/trends/)

The table below shows a comparison of the latest data for growth rates since 2003 against *Scramble* and *Blueprints*. The divergence between the two scenarios becomes greater in the long term but these early projections show a great deal of similarity. However, Solar PV is an interesting exception. Here the early policy support measures have led to growth very much in line with *Blueprints* so far.

Table 2. Comparison of world annual growth rate by energy resource type.

2003 - 2009

	CAGR		
	SCRAMBLE	**BLUEPRINTS**	**ACTUAL**
1st generation biofuels	25%	25%	25%
Biomass electricity	5%	4%	7%
Geothermal electricity*	10%	9%	4%
Geothermal heat	12%	11%	4%
Solar PV	16%	47%	45%
Solar thermal electricity	54%	68%	15%
Wave & Tidal	3%	11%	-1%
Wind	32%	29%	28%
Oil	1%	1%	1%
Natural gas	2%	2%	2%
Coal	4%	4%	5%
Nuclear*	1%	1%	1%
Hydro-electricity*	4%	4%	4%

* based on 2003 - 2008 data

The impressive growth in photo-voltaic solar power (Solar PV) is almost exactly in line with *Blueprints*. However, concentrated solar power (CSP) and ocean energy technologies have performed more slowly than anticipated. Geothermal has also been slower to develop and we may have been too optimistic about access to good sites. Wind and 1st generation biofuels are among the larger new renewables and projected growth for both scenarios has fared well against the actual growth. Electricity from biomass has moved slightly faster in reality than the scenarios projected and is gaining greater prominence. This is largely due to coal power stations alleviating their CO_2 emissions by co-firing biomass with coal and also to the recognition that "negative emissions" may ultimately be required [6]. In this case biomass electricity with Carbon Capture and Sequestration (CCS) may be critically positioned. Even so, coal has continued to grow ahead of expectation – reminiscent of the surge envisaged in a *Scramble* scenario.

6) Biomass is capable of consuming more CO_2 than it emits. This means that it can be used to produce zero-carbon (or even negative carbon) energy.

In the longer-term, both scenarios draw heavily on 2nd generation biofuels, electric vehicles (battery and hydrogen fuel-cell) and CCS. The scenarios assumed that all could be available at widespread commercial scale from 2020. CCS and 2nd generation biofuels developments are currently developing too slowly to meet the scale at which *Blueprints* then takes them up. Hydrogen fuel cell vehicles (FCVs) may be in line with *Blueprints,* with several car manufacturers preparing to release their next generation of FCVs over the next few years. However, the development of the supporting infrastructure remains a big question. Battery electric vehicles look to be the one major technology that may be developing more quickly. Our analysis suggests that the deployment curve may be five years earlier than *Blueprints* envisaged if progress continues to go well and vehicles have customer appeal.

New technology deployment takes decades

How quickly can new energy technologies feasibly be deployed? An article in *Nature* in 2009 [7] identifies two common "laws" of energy technology success in the past:

1. Establishment Phase: It takes 30 years to span the 1000-fold growth needed to get from pilot-plant scale up to 1-2% of the world's total primary energy – a sustained growth rate of 26% pa.
2. Growth Phase: After this, the deployment rises more linearly to its ultimate share in the energy mix, which depends on direct economic competitiveness at scale.

Most energy technology is long-lived. *Blueprints* pushed the limits on replacement of end-user equipment – including steel mills, cars and home heating systems – and also within the energy industry itself, like power stations. The *Blueprints* scenario already aggressively projects the world beating the above "laws" and doing so with more simultaneous technological development than ever before.

The primary focus at the moment is on the establishment phase: demonstrating and deploying early-stage technologies, like solar PV. Policy is increasingly using incentives targeted at technology "families", acknowledging the need for several technologies. It increasingly recognises different constraints for different technologies and their differing stages of development. It is also widely acknowledged that policy support will probably be needed for decades.

7) Gert Jan Kramer and Martin Haigh, Nature 462, 568-569 (2009)

The continued deployment phase can by no means be taken for granted. Policy will have a key role here in limiting cost increases to end-users, handling collaboration and intellectual property rights, fears over picking winners and local acceptability.

We anticipate focus in the next few years moving to the second law: what must be done to ensure that low carbon technologies can achieve a substantial share of the energy mix?

So called electric renewables, like solar and wind, along with sustainable biomass, CCS and nuclear at large scale will be needed to meet growing needs while reducing greenhouse-gas emissions.

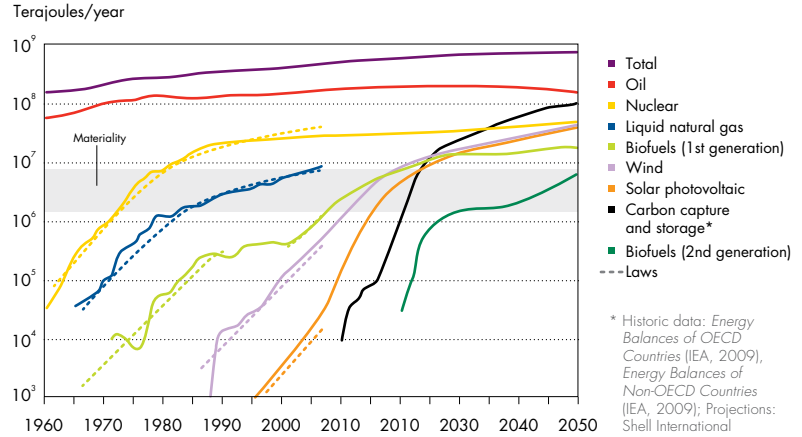
Yet the latter three are facing significant resistance from environmental lobbies. Their development will also occur at a time when burgeoning demand from the developing world will pull strongly on expanding established energy sources like coal. Priorities are therefore likely to be divided. These conventional energy sources will struggle to keep up with demand pressures once the hangover from the economic crisis has passed.

Focus on "known" new technology

There is a practical need to focus major attention on developing the new technologies that are already "known" and deployed at some scale. This is because of the time it takes for growth to deliver a material contribution to world energy production and also because of the speed of action required at scale to come even close to 450 ppm-type pathways.

Of course, the energy system will continue to evolve after 2050. Some early-stage technologies - such as engineered geothermal systems or nuclear fusion - may play a significant role in the second half of the century. But for now we know the major energy sources we have to work with for 2050 targets. We already know which sources governments, industry and society will need to focus on to facilitate the current transformation of the energy system.

Chart 8. Energy-Technology Deployment



* Historic data: *Energy Balances of OECD Countries* (IEA, 2009), *Energy Balances of Non-OECD Countries* (IEA, 2009); Projections: Shell International

SYSTEM INTEGRATION CRUCIAL

In 2009, President Obama lauded Denmark for producing 20% of its electricity from wind compared with America's 3% . This sparked vigorous debate with sceptics claiming that over half of Denmark's wind production was exported, whilst others said that only 1% ended up outside the country. Whatever the case, an important feature is that Denmark exports the variability in supply created by its wind farms - a variability balanced internationally by the large hydro-electric storage in Norway and Sweden. Germany widely deploys photo-voltaic solar - nearly 14 GW in total by late 2010 - encouraged by robust feed-in tariffs. This deployment has caused large volatility in electricity prices. The same occurs in Texas, which has a large wind power infrastructure.

Innovative solutions like smart grids; distributed storage; and continental-scale electricity grids are necessary if renewables like wind and solar are to achieve a large penetration in the energy mix. *Blueprints*-type approaches, which recognise new mixes of mutual interests and a longer-term outlook, are likely to foster them. Smart Grids and Super Grids will both be needed. But it is too early to tell whether these concepts can be rolled out at the scale and within the time required.

Other solutions will be necessary in the meantime to sustain the growth of renewables. Local generation and management may spread. But for centrally managed solutions, operators will draw on hydro-electricity where they can, or increasingly, natural gas.

Gas replacing coal

Breakthroughs in shale gas technology can offer part of the solution and are available now. The energy deployment curves and *Blueprints* suggest that other low carbon energy options only make a substantial difference to the emissions pathways after 2030. Of course, these options won't achieve aspired market shares by 2050 unless the groundwork is laid before 2030.

Going forwards, one of the largest impacts on cumulative CO_2 emissions will come from the degree to which the new gas can replace growth in coal. Many express a fear that, if left unmanaged, the new gas will simply be burned in addition to the existing fossil fuel supply, leading to increased emissions. However, if policymakers can sustain the deployment of the low CO_2 solutions at the same time as actively substituting coal with gas in electricity generation, then we have the chance to follow a lower CO_2 pathway at little extra cost.

Allowing natural gas rather than coal to grow to meet power demand is the surest, fastest and most comprehensive way there is to reduce CO_2 emissions over the crucial next 10 years. Strong development of CCS programmes should help support such a strategy as part of a long-term vision for low-carbon energy supply.

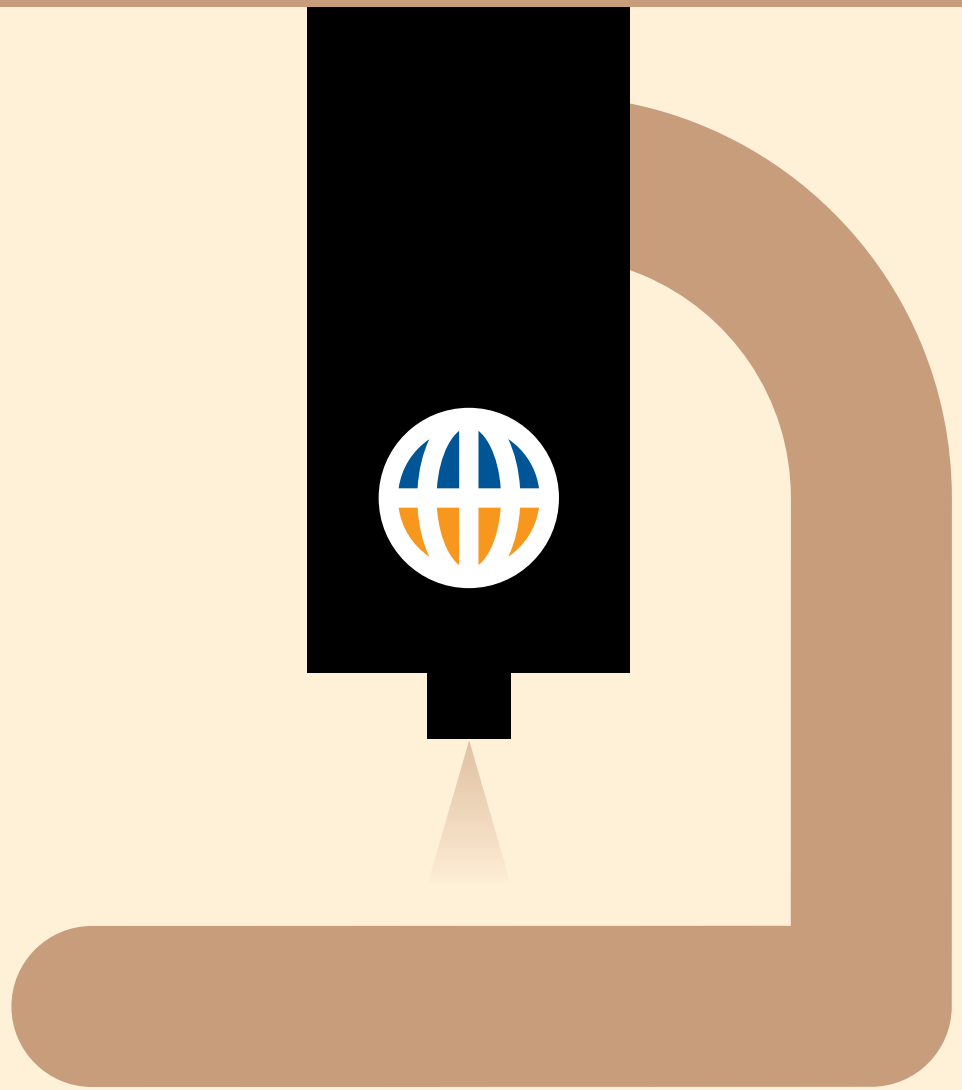
Sometime between 2020 and 2030, we can expect the constraining factor for renewables deployment to move from industrial capacity building to accommodation within the energy system. This would impact land-use and require new infrastructure, such as major upgrades to grids [8, 9]. These are essential for renewables to maximise their share of the energy mix.

In conclusion, there is a need to encourage continued strong uptake of lower carbon solutions climbing the deployment curve while establishing system-wide solutions that will be required for the long-run. Of course, being realistic about the cost of any accelerated transformation and accepting the importance of this cost within society's priorities are also vital to success.

8) See Sustainable Energy Without Hot Air, David MacKay. In this excellent book, MacKay has illustrated the spatial aspect, and shown what this means for land use in Britain

9) On the infrastructural accommodation, the European Climate Foundation in 2010 and the Desertec project have pointed to the sorts of scale necessary for an EU-wide electricity grid.

6 RECOGNISING SCRAMBLE & BLUEPRINTS



6 Recognising *Scramble & Blueprints*

The general picture of the energy landscape to 2050 described in the *Scramble* and *Blueprints* scenarios seems to us to remain valid. So, from the vantage point of today, do we see the world heading on a pathway that looks more like *Scramble* or *Blueprints*?

It is, of course, too early to tell conclusively. These scenarios represent strong patterns of behaviour, and examples of both abound. The scenarios provide lenses for interpreting contemporary events, as well as pointing to the possibilities of the future landscape. A number of developments are highlighted below to illustrate this.

SCRAMBLE SCENARIO

In the *Scramble* scenario, immediate pressures to achieve energy security trump demand management policies. National government attention falls to supply side levers resulting in a resource scramble waged by nations and between nations. Actions to address climate change become subordinated until major events – physical effects like floods and severe storms - drive responses.

Action to tackle energy demand and promote efficiency comes only when supplies become tight and continued economic growth can only be achieved with better management of constrained resources. The energy system in *Scramble* is characterised by discontinuities as a result.

Example:
***Scramble* Signal - Growing tensions over the South China Sea**

US Secretary of State, Hillary Clinton, stated in Hanoi in July 2010 that *"the United States supports a collaborative diplomatic process by all claimants for resolving the various territorial disputes [in the South China Sea] without coercion … [and that the US] opposes the use or threat of force by any claimant."*

This statement brought to a head already simmering tensions between China and the US over the South China Sea. It led the Chinese Ministry of Defence to state that *"China has indisputable sovereignty of the South Sea, and China has sufficient historical and legal backing [to support its claims]."*

These statements have fed concerns over a *Scramble*-type confrontation between the various regional powers to secure oil and gas reserves in the South China Sea.

Chinese concerns arise for different strategic reasons. The spectre of an increasingly powerful China asserting its influence in an area it has long regarded as within its traditional sphere of interest is among these. But more direct to China's concerns is US control over China's sea lanes for communications and supplies. This was expressed by President Hu Jintao in November 2003 as the *"Malacca Dilemma"*. Over 80% of China's energy imports pass through the Malacca Straits and waters patrolled by US and South-East Asian navy vessels.

Concern over the forward deployment of US forces also drives China's strategic incentive to develop its air and naval power, and it is moving to do so. The US, for its part, has long been accustomed to asserting its naval power through regional waters.

The dispute has triggered debate among South-East Asian states as to where their future geopolitical security lies. Looking into the future, they are concerned that the US may not be able to sustain its military and economic commitments to the region, given its efforts to reduce its government deficit, with a possible impact on future military spending. South-east Asian governments seek a balance between the great powers in their region, as they begin to realise that they can no longer take US hegemony for granted.

Even though the resources themselves appear marginal for China (and indeed Japan), they are potentially significant for the development of the Sea's littoral South-East Asian states, if they can be commercially exploited.

OTHER EXAMPLES OF *SCRAMBLE* SIGNALS:

- **US energy policy direction**

President Obama's initial decision to open more of the Outer Continental Shelf (OCS) for drilling (subsequently reversed with the moratorium on development following the Deepwater Horizon spill in the Gulf of Mexico) in order to increase energy supply security and reduce imports from foreign states.

- **China's push for energy security**

China has invested heavily in oil and gas outside of its own borders, particularly in areas where IOCs are deterred from investing (often for humanitarian, environmental or political reasons e.g. Sudan). The practice typically employs foreign policy concessions, to secure the deals, such as the $20 billion loans-for-oil agreement with Venezuela in April 2010.

- **Iraq oil licensing rounds**

International energy companies participated in successive bidding rounds in 2009/10 for contracts to redevelop existing producing oil fields in Iraq despite service contract terms rather than production sharing contracts preferred by energy companies. This was in spite of deemed high security and non-technical risks associated with developments.

- **US climate legislation**

Legislation to create an effective market for CO_2 management in the US has lost urgency after a period of intense economic slowdown, a difficult political environment for the Administration (following unpopular plans to reform US healthcare) and contradictory scientific evidence on climate change found a naturally skeptical constituency who sought to exploit it aggressively.

***BLUEPRINTS* SCENARIO**

In the *Blueprints* scenario, action to manage energy use better is driven by a combination of concerns both about the available supply of resources but also environmental interests and the commercial opportunities presented by a transforming energy system.

Alliances to drive better economic and lifestyle prospects are increasingly initiated by coalitions recognising new mutual interests, then adopted at a local level and increasingly mainstreamed across geographies where interests are shared.

A patchwork of policies drives businesses to lobby for regulatory clarity and drive early adoption of new technologies and innovation.

Example: *Blueprints* Signal - The global politics of climate change

The global process to negotiate a multilateral agreement on climate change to replace or extend the Kyoto Protocol has slowed considerably since the UN Climate Change Conference in Copenhagen in December 2009. While Copenhagen failed to make progress towards achieving an overarching global agreement to cut emissions, five key countries – Brazil, the US, South Africa, India and China – sketched out the Copenhagen Accord. The Accord sets no real effective targets for emissions reductions and is not legally binding but it marks a shift for the UN-brokered process and a potentially more politically feasible path forward.

As *Blueprints* notes, it is highly unlikely that agreement between 192 nations with a panoply of divisions in ideology and capacity would agree on policies sufficiently radical to contain the threat of climate change. Rather, progress is more likely to be achieved by a smaller group of countries, which must comprise the critical developed and developing countries that matter for climate change, working together to spearhead change.

The Copenhagen Accord may set voluntary targets rather than committing nations to a binding agreement but the international community has few effective sanctions to ensure compulsion in any case. What the Accord does is establish an anchor for other possible changes. It is an example of what has been termed *"minilateralism"* [10]. Like regional agreements, minilateralism is a response to a growing recognition that large scale multilateral agreements – whether over trade liberalisation, the Milennium Development Goals or climate change – have effectively stalled or failed; and that more targeted approaches at collective problem solving are necessary. In *minilateralism*, the correct number in any given problem area is *"the smallest possible number of countries needed to ensure the largest possible impact"*.

While the future of the Kyoto Protocol remains uncertain, global action on climate change is not dead. The Copenhagen Accord may be seen as a *Blueprints* attempt to construct a functional approach on a wider than regional but less than global basis, with most critical countries, including the key emitters, taking a leading role. What the *Blueprints* scenario still requires is a shift in the public mood to support the long-term solutions needed to deal with climate change.

OTHER EXAMPLES OF *BLUEPRINTS* SIGNALS:

- **Green city development**

Japan proposes to use its position as a world leader in sustainable habitats to build state-of-the-art, eco-friendly cities in India to help it industrialise and raise general standards for energy efficient urban planning. Firms involved in the project include Hitachi, Mitsubishi, JGC Corp and Toshiba. The cities will be built along the Dedicated Freight Corridor (DFC), passing through six Indian states. Pilot projects have already begun in Haryana, Maharashtra and Gujarat.

- **Technology-differentiated feed-in tariffs for green power**

A concept, first developed in Germany 10 years ago, since adopted by over 50 countries, including developing nations like China, India and South Africa. Example of a concept being mainstreamed globally.

- **Norway funds rainforest protection**

Unilateral action to fund Indonesian rain forest preservation pursuant with the spirit of the UN REDD+ programme. Norway offers to provide up to $1 billion to help reduce deforestation in Indonesia. In 2008, they committed $1 billion to Brazil to reduce Amazon deforestation. Funds have also been given to several other countries, including Guyana and Tanzania

10) "Minilateralism - the magic number to get real international action", in Foreign Policy July/August 2009.

- **Sub-national climate change action**

Actors ranging from established and emerging cities, regional states and provinces to trans-regional groups like Regional Greenhouse Gas Initiative (RGGI) and the Western Climate Initiative (WCI) in North America. Not waiting on senior government decision-making, they are entering the climate arena and waging social re-design campaigns aimed at significantly reducing carbon footprint.

- **Walmart and Conservation International**

Walmart has pledged to eliminate 20 million metric tons of greenhouse gas (GHG) emissions from its global supply chain by the end of 2015. This represents one and a half times the company's estimated global carbon footprint growth over the next five years and is the equivalent of taking more than 3.8 million cars off the road for a year.

- **High Voltage North Sea DC grid**

A project to link offshore renewable wind energy and Norwegian hydro-electric power (for back-up capacity) to serve large energy consumption centres (UK, Middle Europe, France/Benelux, Scandinavia).

- **Desertec and Transgreen**

A planned network of power cables under the Mediterranean to bring solar electricity to Europe and Africa. The project aligns a large number of companies, supported by governments of over 40 countries, rallying around a road map for a future power infrastructure over two continents.

Closing Comments

We hope we have helped form a richer picture of the future energy landscape – a landscape in which volatility and cyclicality will play an intrinsic role and where global society will struggle to develop in a truly sustainable manner. The *Scramble* scenario outlines the future consequences of pursuing the path of least resistance now. While addressing the same challenges, the *Blueprints* scenario indicates that significantly more positive outcomes can be built up from the distributed pursuit of individually modest opportunities and objectives.

To put it simply, we find it useful to benchmark the pace of regulatory and technological developments in the energy system against the scenarios. *Scramble* represents a sluggish pace of development, while *Blueprints* indicates the most accelerated pace we consider politically, socially, and technically plausible.

Many people hope development will be "faster than *Blueprints*". But, at this point, developments are generally proceeding "slower than *Blueprints*", despite some achievements. Looking ahead, economic volatility and cyclicality threaten to depress the pace of change still further.

In presenting this outlook, we hope we have brought some clarity to the pressures and uncertainties facing the world. It is vital that developments move in the right direction at a brisk pace, even if it involves only a limited number of players acting within a limited scope. Policy frameworks that release the power of the commercial engine in the appropriate direction can still accelerate the overall pace of positive transformation.

We hope you are as passionate about encouraging this as we are and that our work will help you pursue innovative opportunities and constructive partnerships.

The Shell Scenario Team,
February 2011

www.shell.com/scenarios

A APPENDICES

Appendix 1: Extract from Shell Energy Scenarios to 2050 (published 2007/8)

The world can no longer avoid three hard truths about energy supply and demand

Step change in energy use

Developing nations, including population giants China and India, are entering their most energy-intensive phase of economic growth as they industrialise, build infrastructure, and increase their use of transportation. Demand pressures will stimulate alternative supply and more efficiency in energy use — but these alone may not be enough to offset growing demand tensions completely. Disappointing the aspirations of millions by adopting policies that may slow economic growth is not an answer either — or not one that is politically feasible.

Supply will struggle to keep pace

By the end of the coming decade, growth in the production of easily accessible oil and gas will not match the projected rate of demand growth. While abundant coal exists in many parts of the world, transportation difficulties and environmental degradation ultimately pose limits to its growth. Meanwhile, alternative energy sources such as biofuels may become a much more significant part of the energy mix — but there is no "silver bullet" that will completely resolve supply-demand tensions.

Environmental stresses are increasing

Even if it were possible for fossil fuels to maintain their current share of the energy mix and respond to increased demand, CO_2 emissions would then be on a pathway that could severely threaten human well-being. Even with the moderation of fossil fuel use and effective CO_2 management, the path forward is still highly challenging. Remaining within desirable levels of CO_2 concentration in the atmosphere will become increasingly difficult.

Two possible worlds

Profound change is inevitable, but how will it happen? Will national governments simply *Scramble* to secure their own energy supplies? Or will new *Blueprints* emerge from coalitions between various levels of societies and government, ranging from the local to the international, that begin to add up to a new energy framework?

People are beginning to realise that energy use can both nourish and threaten what they value most — their health, their community and their environment, the future of their children, and the planet itself. These deeply personal hopes and fears can intensify and interact in ways that have different collective outcomes, and usher in the new energy era in very different ways.

Scramble

Scramble reflects a focus on national energy security. Immediate pressures drive decision makers, especially the need to secure energy supply in the near future for themselves and their allies. National government attention naturally falls on the supply-side levers readily to hand, including the negotiation of bilateral agreements and incentives for local resource development. Growth in coal and biofuels becomes particularly significant.

Despite increasing rhetoric, action to address climate change and encourage energy efficiency is pushed into the future, leading to largely sequential attention to supply, demand and climate stresses. Demand-side policy is not pursued meaningfully until supply limitations are acute. Likewise, environmental policy is not seriously addressed until major climate events stimulate political responses.

Events drive late, but severe, responses to emerging pressures that result in energy price spikes and volatility. This leads to a temporary slowdown within an overall story of strong economic growth. Although the rate of growth of atmospheric CO_2 has been moderated by the end of the period, the concentration is on a path to a long-term level well above 550 ppm. An increasing fraction of economic activity and innovation is ultimately directed towards preparing for the impact of climate change.

Blueprints

Blueprints describes the dynamics behind new coalitions of interests. These do not necessarily reflect uniform objectives, but build on a combination of supply concerns, environmental interests, and associated entrepreneurial opportunities. It is a world where broader fears about lifestyle and economic prospects forge new alliances that promote action in both developed and developing nations. This leads to the emergence of a critical mass of parallel responses to supply, demand, and climate stresses, and hence the relative promptness of some of those responses.

This is not driven by global altruism. Initiatives first take root locally as individual cities or regions take the lead. These become progressively linked as national governments are forced to harmonise resulting patchworks of measures and take advantage of the opportunities afforded by these emerging political initiatives. Indeed, even the prospect of a patchwork of different policies drives businesses to lobby for regulatory clarity.

As a result, effective market-driven demand-side efficiency measures emerge more quickly, CO_2 management practices spread. Carbon trading markets become more efficient, and CO_2 prices strengthen early. Energy efficiency improvements and the emergence of mass-market electric vehicles are accelerated. The rate of growth of atmospheric CO_2 is constrained leading to a more sustainable environmental pathway.

Appendix 2

Table 3. Current projected primary energy demand (exajoules per year) - 2000-2030				
EJ per Year	**2000**	**2010**	**2020**	**2030**
Crude oil	155	168	195	197
Natural gas	87	114	146	169
Coal	96	149	184	193
Nuclear fission	28	32	41	56
Biomass	42	55	59	61
Solar	0	1	6	20
Wind	0	1	4	10
Other renewables*	3	7	23	28
Total Primary Energy Demand	**422**	**536**	**659**	**734**

Source – Shell International, projections under current and expected policies.
*Other renewable include hydro-electric, geothermal, tidal, and waste

DATA SOURCES

The principal data sources used in the development of Shell's analyses and charts in this booklet are:

- Allen, M. R. et al. Nature 458, 1163–1166 (2009).
- Consensus Economics
- Energy Balances of Non-OECD Countries © OECD/IEA, various years up to and including 2010
- Energy Balances of OECD Countries © OECD/IEA, various years up to and including 2010
- Global Insight
- IEA Electricity Information (2010)
- IEA Oil Market Reports (2010)
- IMF
- Meinshausen, M. et al. Nature 458, 1158–1162 (2009)
- Oxford Economics
- Renewables 2010 Global Status Report, REN21
- UN Population Division
- World Bank WDI

www.shell.com/scenarios

CAUTIONARY NOTE

The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this publication "Shell", "Shell group" and "Royal Dutch Shell" are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to subsidiaries in general or to those who work for them. These expressions are also used where no useful purpose is served by identifying the particular company or companies. ''Subsidiaries'', "Shell subsidiaries" and "Shell companies" as used in this publication refer to companies in which Royal Dutch Shell either directly or indirectly has control, by having either a majority of the voting rights or the right to exercise a controlling influence. The companies in which Shell has significant influence but not control are referred to as "associated companies" or "associates" and companies in which Shell has joint control are referred to as "jointly controlled entities". In this publication, associates and jointly controlled entities are also referred to as "equity-accounted investments". The term "Shell interest" is used for convenience to indicate the direct and/or indirect (for example, through our 34% shareholding in Woodside Petroleum Ltd.) ownership interest held by Shell in a venture, partnership or company, after exclusion of all third-party interest.

This publication contains forward-looking statements concerning the financial condition, results of operations and/or businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as ''anticipate'', ''believe'', ''could'', ''estimate'', ''expect'', ''intend'', ''may'', ''plan'', ''objectives'', ''outlook'', ''probably'', ''project'', ''will'', ''seek'', ''target'', ''risks'', ''goals'', ''should'' and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this publication, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for the Group's products; (c) currency fluctuations; (d) drilling and production results; (e) reserve estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including potential litigation and regulatory effects arising from recategorisation of reserves; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; and (m) changes in trading conditions. All forward-looking statements contained in this publication are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional factors that may affect future results are contained in Royal Dutch Shell's 20-F for the year ended December 31, 2009 (available at www.shell.com/investor and www.sec.gov). These factors also should be considered by the reader. Each forward-looking statement speaks only as of the date of this publication, February 2011. Neither Royal Dutch Shell nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this publication.

Shell International BV
Carel van Bylandtlaan 16
2596 HR The Hague

P.O. Box 162
2501 AN The Hague
The Netherlands

CS The Hague 693476, 2011


2011