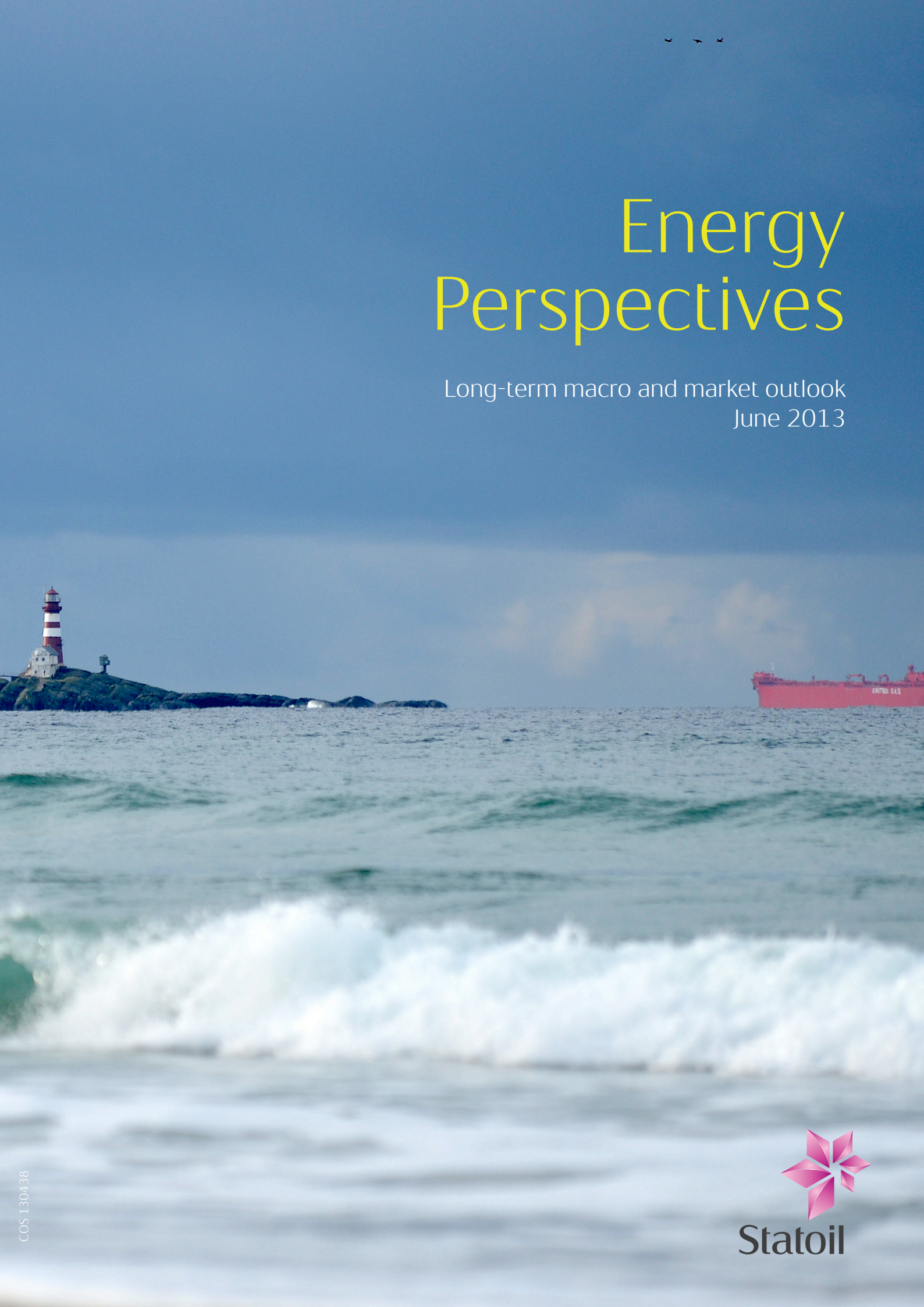

Energy Perspectives

Long-term macro and market outlook
June 2013

Statoil

COS 130438

Editorial process concluded 11 June 2013.

This report has been edited and coordinated by MPR Strategy and Business Development in Statoil, based on input from different parts of the Statoil organisation.

Frontpage photo: Jæren beaches near the Stavanger region. Photographer: Harald Pettersen, Statoil

Energy Perspectives 2013

After the global financial crisis, Western businesses and countries feel increasingly confronted with an environment that can be denoted by the military phrase "VUCA": volatility, uncertainty, complexity and ambiguity. We are struggling to understand the situation and find it difficult to act rationally and with impact. The old world powers are not able to solve crises in small and previously considered "negligible" hotspots around the globe. Former fault lines between "them" and "us" have been replaced by a complex network of political alliances and power plays. A stream of surprises with small probabilities and large impacts – "Black Swans" – is coming towards us, in financial markets and elsewhere. Rich countries are stuck in a quagmire of low growth, high unemployment and political paralysis. All countries are unable to address one of the Earth's most pressing problems: putting economic development on a more sustainable path in terms of climate change. Once confident in their ability to explain, comprehend and dominate the world, Westerners are now struggling with all this uncertainty and ambiguity. Conversely, many people in emerging economies are gradually and substantially improving their living conditions and becoming part of a global middle class. Economic growth fuelled by energy availability, globalisation of trade, improved institutional frameworks and democracy, is leading to higher incomes for people in Asia, Africa and Latin America. One consequence is that the economic centre of gravity is moving back towards the population centre of gravity. In this sense, economic development over the last decades is very democratic and entails a substantial shift in economic power from West to East. There are of course large uncertainties in the future development of emerging economies as well, in particular on the sustainability of and need to change their different growth models. However, the perception of increased uncertainty and complexity that makes it difficult, and even impossible, to predict our future is perhaps more of a Western phenomenon.

Irrespective of the above, energy companies still need to forecast the most likely trajectory for energy demand and developments for individual energy sources, as a framework for making educated investment decisions. Economic development will continue to drive energy demand, and energy is a prerequisite for economic growth. This outlook provides a global perspective on macroeconomics and energy markets until 2040, based on analysis of likely developments in key driving forces, and with emphasis on Statoil's key markets.

Annual growth in the world economy is projected to average 2.8% to 2040, the same as in last year's projections, but with a few adjustments for different regions. Emerging economies are expected to continue to lead the way, with non-OECD growing at 4.5% on average per year and OECD at 1.9%. It is important to highlight that this is our current expectation, and that there is, of course, significant uncertainty associated with future economic progress.

The long-term trend of improving energy efficiency, as measured by energy use per unit of GDP, is expected to continue, in contrast to the development over the last decade, when energy-fuelled growth in emerging economies has outweighed efficiency improvements. Energy demand growth is projected at an annual average of 1.3% until 2040, consistent with an overall improvement in energy efficiency of some 35% during the period. Demand is projected to increase for all energy sources, but with substantial variation, ranging from 0.5% (oil) to 8.9% (new renewables).

Oil demand will peak around 2030, and growth is limited by its relatively high price and fuel competition, technological change and efficiency improvements in the transport sector, in addition to environmental policies. Income growth and increased private transportation in emerging economies are the most important factors contributing to higher oil demand growth. Unconventional oil supply developments and decline rates in legacy fields are key uncertainties.

Natural gas demand is forecast to grow faster than total energy demand, by 1.6% per year on average until 2040, resulting in a moderate increase in gas' market share. The supply potential of shale gas continues to surprise, both in terms of volumes and marginal costs. Environmental policies are expected to help improving the competitiveness of gas compared to coal. LNG and new sources of gas exports will contribute to integration between regional gas markets.

In this outlook, new renewable energy is expected to grow substantially faster than total energy demand, increasing its market share from just above 1% to almost 8% in 2040. Climate and environmental policies and continued cost improvements are key factors behind this development.

Led by the emerging economies, the global economy continues to grow, and with no global climate policy agreement or rapid technology breakthrough in sight, CO_2 emissions are projected to increase until about 2030. During the last part of the forecast period emissions will start to decline as energy demand slows down, renewables take a bigger bite of the total, and CCS starts to have an impact on emissions.

Eirik Wærness
Chief Economist

Acknowledgements

The analytical basis for this outlook is long-term research on macroeconomics and energy markets undertaken in the Statoil organisation during the winter and spring 2012/2013.

The research process has been coordinated by MPR Strategy and Business Development in Statoil, with crucial analytical input, support and comments from various parts of the company, including but not limited to market and policy analysts in various business areas and staffs.

Joint efforts and close cooperation between the above units and other resources in the company have been critical for the preparation of an integrated and consistent outlook for total energy demand and for the projections of future energy mix.

This report has been drafted and edited by MPR Strategy and Business Development in Statoil. We hereby extend our gratitude to everybody involved.

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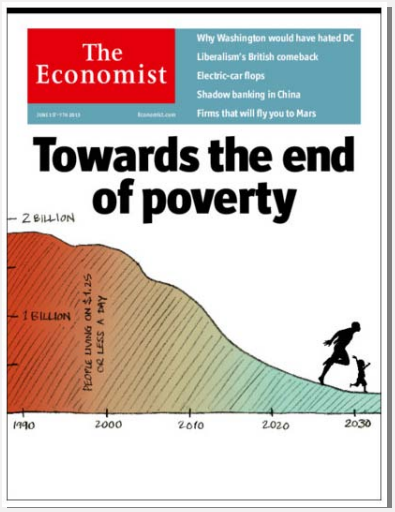
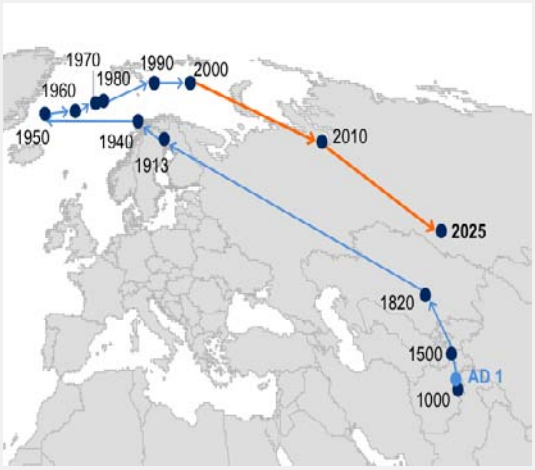
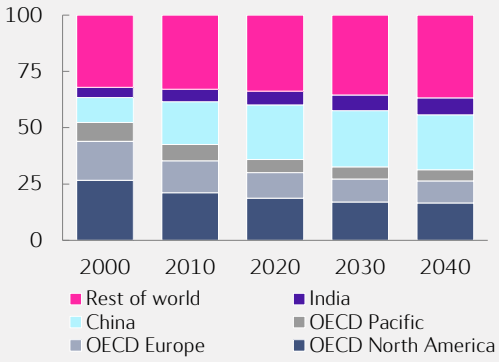


Global economic centre of gravity through history
Based on geographical weighting of GDP



Source: McKinsey & Company

Shifting energy demand
Shares in global energy demand, %



Source: IEA (history), Statoil (forecast)

Energy markets in an uncertain future

A world characterized by uncertainty – for how long?

In this report, we forecast economic growth and demand for different energy sources in 12 regions until 2040. Given the considerable uncertainty surrounding them, we hope to be vaguely right in the general trends that we describe, and to avoid being precisely wrong in our detailed forecasts. This fundamental assumption underlies our projections: growth in energy demand is above all linked to economic growth and development in energy efficiency, which in turn is driven by policies, prices and technology.

After the financial crisis and the subsequent sovereign debt crisis and fall in global economic growth, there is considerable uncertainty about how these drivers for energy demand will develop over the coming years and decades. Is the lacklustre growth after the crisis an indication of a long-term change towards lower growth globally, with potential for social unrest and frustrations? Or, will we look back upon the last five years as a shock that had substantial effects on global wealth, but where growth rates gradually returned to "normal", and where we see a massive redistribution of economic power from West to East?
On the one hand, the needs of growing populations in emerging economies are a strong long-term driver for both economic development and international trade, in general, and energy demand in particular. Higher per-capita incomes will change consumption patterns for millions of people in the large emerging economies, driving electrification and transport. Modernisation of economies will increase the need for energy in manufacturing and other industries.

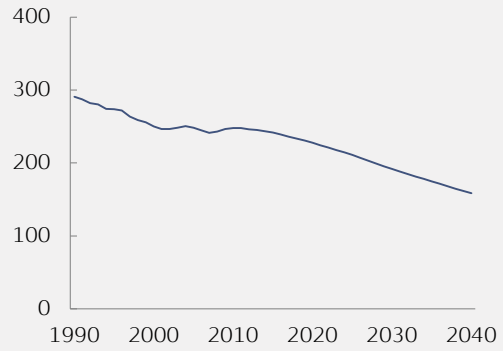
On the other hand, stagnating and aging populations and low economic growth in the OECD and some other economies signal reduced demand for energy from the current "gas guzzlers" of the world. High energy prices over the last years, on top of negative and low GDP growth, will contribute to lower energy demand growth and to ingenuity in finding smart solutions for improving efficiency further. Energy and climate policies seem to ebb and flow in sync with business cycles, need for jobs and varying perceptions of the danger represented by man-made carbon emissions, but could gain foothold on a larger scale and contribute further to energy efficiency and energy transformation.

This tug-of-war between the factors which increase and slow energy demand growth will determine the long-term relationship between economic activity and total primary energy demand (TPED). In this outlook it is assumed that TPED will continue to grow through the forecast period, by 1.3% on average per year from 2010 until 2040. Global GDP, on the other hand, will grow by 2.8% per year on average, split between 1.9% in OECD and 4.5% in non-OECD. Globally, this implies an improvement in energy efficiency of some 35% from today's level.

Too much, or too little, energy?

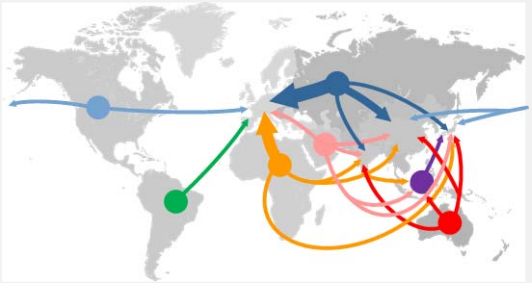
Over the last years, perceptions of the availability of affordable and reliable sources of energy have shifted considerably. The shale gas and tight oil revolutions in the US, together with their implications for coal markets, have helped move the world's concern about running out of oil and gas down the list of imminent challenges. Economic recession and

Energy intensity of the world economy
toe/million 2005-USD



Source: IEA/IHS Global Insight (history), Statoil (forecast)

Major global gas trade flows 2035



Source: IEA WEO 2012

increased use of renewable energy in parts of the world have modified the view on how dependent we are on non-renewable fossil energy. Commentators and analysts now seem to be more occupied with the possibility of "too much" fossil fuels, both in relation to the globe's capacity to absorb carbon emissions without disastrous consequences for the climate, and to prospects for future energy prices.

When judging the long-term implications for the energy markets of these short-term changes, a number of issues must be taken into account. First, the underlying growth in energy demand in emerging economies is strong, but improving energy efficiency is high on the agenda and will counteract demand growth. Second, the maturation of the world's largest oil and gas fields raises major challenges in terms of stemming decline and replacing production. Third, bringing energy sources to the consumers will require substantial investments in infrastructure even if the resource itself is readily available. Fourth, much of the new sources of hydrocarbon production is challenging to develop and therefore costly, in particular outside of North America, so that the conclusion on abundance could be "abundance, given high energy prices". Finally, the focus on sustainability and need to reduce carbon emissions is still strong in some regions, and energy and climate policies will contribute to limiting the overall consumption of fossil fuels to sustainable levels. In particular, the example of the United States serves as a reminder that increased availability of one fossil fuel, gas, could reduce demand for another fossil fuel, coal, with very positive effects on carbon emissions. To the extent that increased abundance of gas makes possible a real shift away from coal as the main source of electricity in emerging economies, there is hope that we could see some improvements in the relationship between overall energy use and carbon intensity.

Policy and technology

The future of energy and climate policies, and their impact on energy markets, is another key uncertainty. The current focus in Europe, where climate policies and political will to support renewable energy seemed to have the strongest foothold, is on reducing public expenditures, increasing jobs, and increasing growth. Carbon prices are record low, and coal is replacing gas in the power sector. The future of renewable energy and carbon emissions is uncertain. Will we see a return to a gradual movement towards regional climate policy regimes that will foster carbon free and low carbon energy?

Furthermore, with moderate economic growth, how quickly will the necessary technology to improve energy efficiency and lower carbon intensity be developed? It is probably possible to ensure energy access for all of the almost 9 billion people on Earth in 2040 and combine that with lower carbon emissions and much higher average energy efficiency than today. This would require technological progress in transportation, smart electricity grids, substantially improved housing technology etc., but it would also be extremely costly and capital intensive. Whether the world can, and will, afford such a development, remains an open question. In this outlook we assume improvements in overall energy efficiency and substantial improvements in average fuel consumption in transportation, as well as increased electrification in transportation and the residential sectors. However, these changes are far from sufficient to reduce carbon emissions sufficiently to reach a 2-degree target, because the underlying growth in energy demand outweighs these improvements.

Global macroeconomics

Short to medium term: a world in transition

The 2008 financial crisis and the subsequent shocks it helped trigger, such as the Eurozone debt crisis, have disrupted the global economic order of the past decade. The former system was financed by reducing savings and increasing debt in the advanced economies, thereby boosting domestic consumption and, by extension, import demand for emerging market goods. Rising OECD debt thus propelled growth in China's export industries, whose demand for raw materials in turn fuelled growth in Brazil and Indonesia. In general, surging imports in the US and Eurozone and high commodity prices were vital factors in strong emerging market growth during the first ten years of this century.

With the post-2008 crunch in consumer credit and public debt markets, as well as softer commodity prices, these and other mechanisms of the old global growth engine have ceased to function. For a few years, most countries believed that the old order could be restored and even now many are still struggling to come to terms with the new reality. In the OECD economies, the realization is slowly settling in that growth fuelled by public spending is not a sustainable long-term solution. However, much needed structural reforms are still outstanding, largely because they would be socially painful and unpopular with voters.

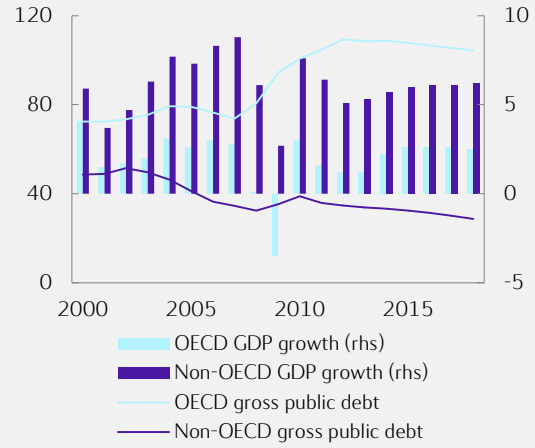
Meanwhile, major emerging countries, aware that they can no longer rely on double-digit export growth, seek to reconfigure their economies toward domestic consumption driven growth. For most of them this requires extensive market and political reforms, which, however, face strong headwinds from vested interest groups and infrastructure constraints. The remainder of this decade, therefore, will be shaped by slow but profound transition processes in both developed and emerging economies, naturally accompanied by high levels of uncertainty.

US medium term: on track for stronger growth

The path ahead is perhaps the clearest for the US, where – notwithstanding the dysfunctional politics in Washington DC – progress has been made in putting fiscal policy on a more sustainable path and deleveraging households. Owing to automatic spending cuts and tax raises, the US is well on track toward stabilizing its debt-GDP ratio over the next decade. However, pressures from an aging population and the consequent explosion in future costs of entitlement programs require continued fiscal and labour reforms in the medium term. Despite the current spending cuts, US economic growth is forecast to reach 2% in 2013 – largely due to robust private consumption – and to accelerate further in subsequent years. Average annual growth in the 2016-20 period is foreseen to log 2.6% on the back of positive labour immigration dynamics, an education boost (a higher share of young Americans than ever is now enrolled in universities), and a small industrial revival stimulated by the shale energy revolution.

The full impact of the shale revolution, especially its effect on the competitiveness of US industrial exports, is not yet well understood and there is plenty of upside risk to our forecast. On the downside, the US growth story is threatened by growing poverty amid weak employment and the resultant potential for social unrest. If Congress fails to move out of its gridlock and provide a predictable policy environment, badly needed job-creating business investments would be unduly delayed.

Public debt ratios and real GDP growth
% of GDP, annual % change at PPP (rhs)

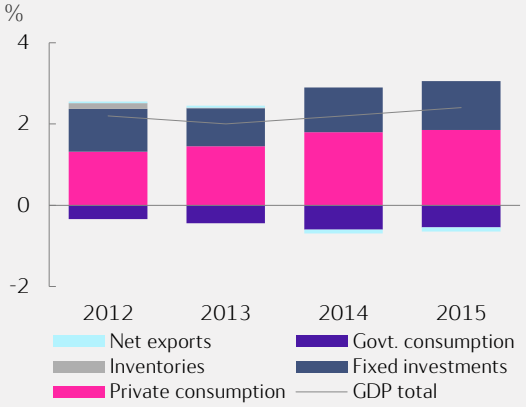


Source: The International Monetary Fund

Global economic growth fuelled by debt and public spending is not a sustainable long-term solution...

...hence profound transition processes in both OECD and non-OECD economies will shape the remainder of this decade

Contribution to change in annual US GDP
%

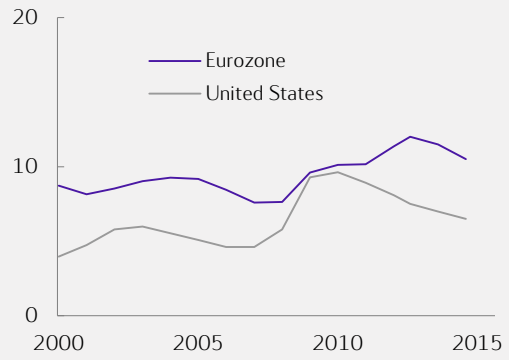


Source: Bureau of Economic Analysis, Statoil (projections)

The US is well on track to stabilizing its debt ratio helped by positive growth, but longer-term fiscal challenges loom

Unemployment

%

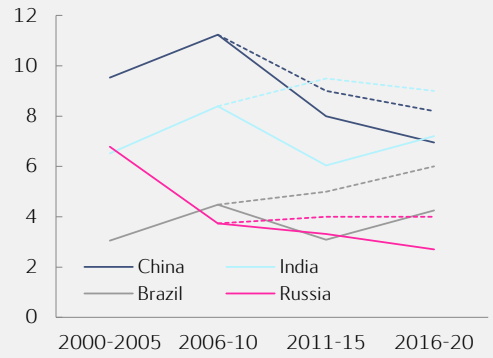


Source: Reuters Ecowin

Debt reduction and reform are big challenges in the Eurozone, with its low public patience and stagnant growth

BRICS forecast vs potential optimal growth

Annual % change at market exchange rates



Source: Statoil

Non-OECD economies seek to reconfigure toward domestic demand, but are held back by reform inertia

Eurozone medium term: preventing a lost decade

For all its challenges, the US outlook shines compared to the weakness in the Eurozone, which is still struggling with the double crisis of high sovereign debt and stagnant growth. Stabilizing the debt burden, while stimulating growth and employment is a tough balancing act. It calls for adjusting the old social welfare state model and deregulating labour markets; steps that initially will be socially disruptive before paying off later on. Given that voter patience already is worn thin, most politicians are now focusing on kick-starting growth, while fiscal consolidation is less important. With austerity measures thus somewhat moderated, financial markets calmed by massive liquidity injections, and resilient non-OECD demand for German exports, the Eurozone is expected to gradually climb out of recession and return to positive, albeit unimpressive, growth in 2014-15. However, should long-term commitment to reforms continue slacking, the Eurozone runs the danger of sliding into a prolonged Japan-style stagnation, which means that serious social unrest and a downsizing or dissolution of the monetary union remain real risks. France is crucial in this outlook, as it still is at the start of a painful but necessary reform process, and any French debt financing trouble would likely also push the periphery economies into fresh turmoil.

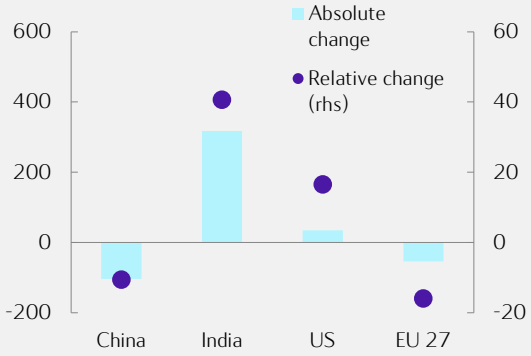
Emerging economies medium term: all about investment

Reform needs also set the agenda in emerging countries, where breaking up monopolies of state-owned enterprises (SOEs) and interest groups, spurring investment growth and building functional social safety nets are the prerequisites for sustainable domestic demand driven growth. China is the exception, since its growth has predominantly been fuelled by high investment levels. However, controlled by SOEs and local officials and financed by cheap state bank credit, investment allocation has become increasingly inefficient, creating excess capacity and diminishing returns. With rising nonperforming loans and simmering asset bubbles, the new leadership has stepped up market and financial reforms in order to slow investment and channel it toward more socially useful projects. China is definitely on the right track, but, judging by the slow reform speed of the past decade, entrenched corruption and powerful industrial elites, the transition will take well into the 2020s. So, investment growth will only gradually slow down, supporting 7% annual GDP growth in 2016-20.

In other major non-OECD economies too little rather than too much investment is the problem. Growth in Brazil, India and Russia has slowed recently for a variety of reasons, but reform inertia hindering private investment growth is the key concern for all. There is a general will for more business-friendly policies but also firm opposition from vested interests. In some countries, like Russia, the political system itself would be threatened by market reforms. Even as BRIC economic activity is likely to accelerate again, overall medium-term growth is forecast to trend below optimal levels and the rates seen in 2000-10. The biggest upside lies with India, where labour and land deregulation and resolving other supply side constraints could essentially double current growth rates.

With China at the helm, non-OECD energy demand will continue to surge, while faster and more industrial-oriented US GDP growth will also be reflected in stronger fossil fuel demand. Meanwhile, Europe's economic woes not only dampen overall energy demand, but also dilute efforts on the renewables build-up, potentially in favour of coal and gas.

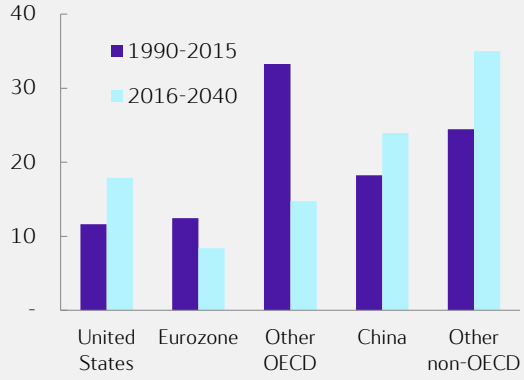
Working age population change 2012-2050
Million and %



Source: Stanford Center on Longevity

Long-term growth in large part depends on the speed of transition to more sustainable growth models

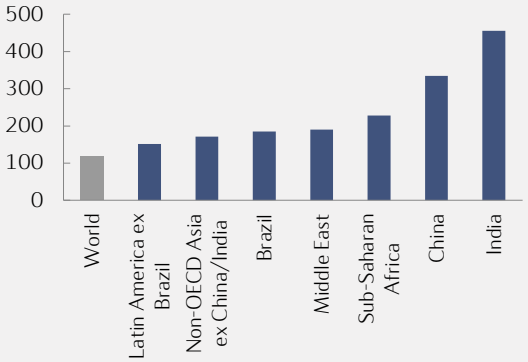
Contribution to global growth
% of total incremental GDP



Source: Statoil

In contrast with past decades, the largest share of growth will come from the non-OECD and emerging Asia

Fastest growing economies 2012-2040
Total growth in %



Source: Statoil

Long term: non-OECD becomes primary growth engine

Over the long term, economic performance is shaped by supply side factors, i.e., the availability and increasingly efficient use of labour, capital, and natural resources. Population growth is a crucial determinant of the labour component and is expected to halve from an average 1.2% over the past 10 years to 0.6% in the 2030s, with some countries (Japan, Russia) more severely affected than others. Together with a general aging trend, this implies that declining growth in the labour force must be offset by gains in the other factors and higher labour market participation.

Continued high capital contributions thus are expected to underpin nearly half of global growth (claiming larger shares in non-OECD economies), while the labour contribution declines and productivity gains remain fairly steady within their trend range (assuming that there will not be a major technological shock). The notable exception to the global trend is massive growth in India's working age population. However, whether the country can fully reap this demographic dividend will depend on how smoothly it can transform into a more investment-friendly market economy. In fact, for most major economies, the success chances for unleashing their full long-term supply side potential in large part depend on the speed of their medium-term transitions to more sustainable growth models.

We project annual global growth in 2020-40 to average 2.8%, which is close to the historic average of the previous 30 years. But, in contrast with past decades, a larger share of growth will come from the non-OECD: whereas 40% of global GDP gains in 1990-2015 will hail from the non-OECD, this share will rise to 60% for 2015-2040. This shift (which largely centers on emerging Asia) reflects a convergence trend in the global economy, where lower income countries are growing faster than mature economies and gradually catching up in per-capita terms. While non-OECD growth is expected to average 4.3% in 2020-2040, OECD growth is only going to log 1.8%. Within the OECD, the outlook is the best for the US which, fuelled by the same factors already benefitting the medium term, should grow faster than the OECD average, at 2.2% annually. Measured in market exchange rates, the US will still be the world's largest economy by 2040 and slightly ahead of China. The Eurozone also enjoys improved prospects, assuming that reforms and fiscal consolidation will be implemented and paid off by the 2020s. Other OECD economies (Japan in particular) will see growth sharply decelerate vis-à-vis 1990-2015, mainly due to shrinking populations and reduced competitiveness.

China's GDP is expected to more than double between 2020 and 2040, with investment remaining a strong driver even as the transition to a consumption-led economy continues. During the same period, India is expected to grow almost 1.5 percentage points faster than China (but below its full potential) as more structural reforms come under way. However, coming off a small base and facing strong population growth, India's per-capita GDP by 2040 will still only be one third of China's, unchanged from today. Other non-OECD economies will also see healthy growth and together will add to global GDP about as much as China's contribution. These trends imply that energy demand growth will by and large stem from the non-OECD economies, especially emerging Asia.

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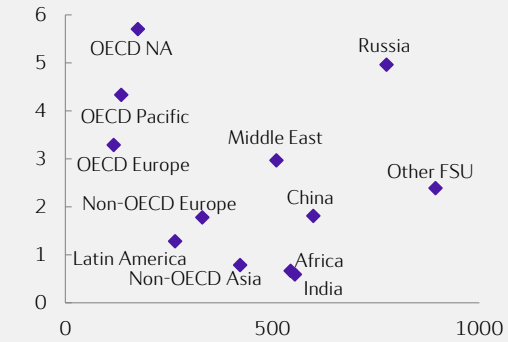
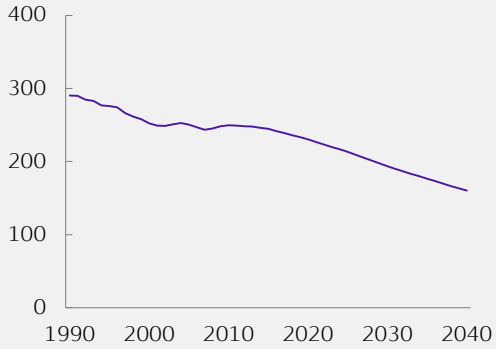
Primary energy demand per capita and per unit of GDP
toe/capita (v.a.), toe/million 2005 USD (h.a.)



Source: IEA

Major differences between regional energy intensities – but they are expected to narrow

Energy intensity of the world economy
toe/million 2005-USD



Source: IEA (historical data), Statoil (forecast)

The energy intensity of the global economy levelled out in the 2000s, but will soon be back on a declining trend

Overall energy market outlook

Energy demand and energy intensities

The future pace of energy demand growth is at the core of current climate policy and energy security debates. Key issues are whether general societal, technology and market developments will weaken the link between economic growth and energy demand growth, and how much policy may hasten the process.

World primary energy demand increased every year between 1971 and 2010, except in 1980-81 and 2009. In 1980-81 the world was trying to recover after the Iranian revolution and a doubling of oil prices. In 2009 the world was in the throes of the global financial crisis and economic growth was negative. On balance, primary energy demand increased by 2.2% annually, but growth fluctuated sharply from year to year in a 0% to 4-5% range around a gently downward sloping trend line.

Energy demand typically grows at different speeds in regions at different stages of their economic development. OECD annual energy demand growth averaged only 1.2% between 1971 and 2010, and the growth curve trended markedly downwards. At the other extreme, Chinese annual energy demand growth averaged 4.8% and more than doubled from the 1990s to the 2000s.

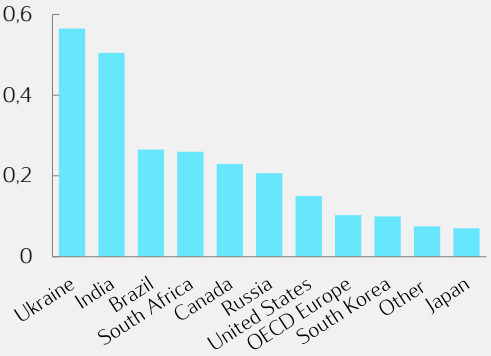
The energy intensity of the global economy – i.e., the amount of energy consumed per unit of GDP produced – declined by almost 1% annually between 1980 and 2010. However, the decline rate slowed towards the end of this period – from 1.2% annually in the 1980s and 1990s to 0.5% between 2000 and 2010. In 2010 there was apparently a small increase in the energy intensity of the global economy. In 2011 there was, judging by data from mixed sources, zero change. The global energy intensity decline curve has leveled out mainly because of rapid, heavy industry and infrastructure led growth in China and other emerging economies. Countries and regions differ considerably in their energy consumption per unit of GDP produced due to differences in climate, topography, demography, energy availability and level of development. The OECD countries require, on balance, only 25-30% of the energy the rest of the world needs to produce a given amount of goods and services, but use several times more energy per capita than the rest of the world.

Key questions relating to the future pace of energy demand growth are:

- How will structural change, technological progress, demographic forces and market forces affect the ratio of energy demand growth to economic growth?
- What policies to lower the ratio of energy demand growth to economic growth will be enacted?
- How much difference will these policies make?

Structural changes play a key role in countries in transition between agrarian and industrialized economies, but are also at work in more advanced countries with resources migrating from heavy, energy intensive industries to light, knowledge based industries. The importance of technological evolution is obvious. Demography is often an underestimated factor, but an aging population uses less energy than a young population, as witnessed by developments in Japan and many

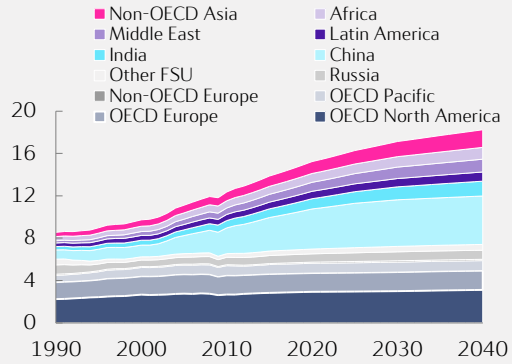
Energy savings potential in production of iron and steel by switching to best available technologies
GJ/ton



Source: IEA: Tracking Clean Energy Progress 2013

Major energy savings opportunities in switching from average to best available technologies

Global total primary energy demand
Bn toe



Source: IEA (historical data), Statoil (forecast)

European countries. Aging will also increasingly influence energy demand in China.

With market forces we mean basically the outlook for oil, gas, coal and electricity wholesale prices. Historically no events have boosted the pace of energy efficiency growth as much as the fuel price spikes experienced since the 1970s.

Perhaps the most decisive factor will be the pace of technological progress, and how long it will take to replace today's vehicle fleets, building masses and equipment parks. The scope for lowering a sector's energy intensity is often measured by the gap in energy efficiency terms between the best technologies available to the sector and the technologies embodied in the bulk of equipment in use. This gap varies in size from sector to sector and country to country, but it is nearly always significant.

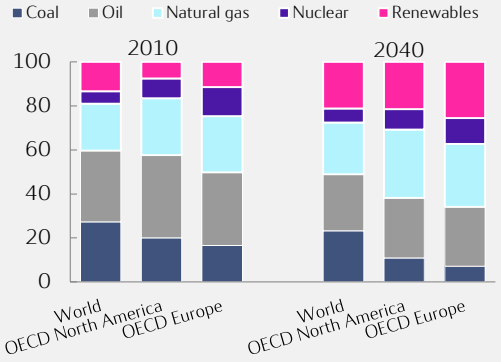
In IEA's New Policies scenario the energy intensity of the global economy declines by an average of 1.8% annually between 2010 and 2035. This scenario is thus not a conservative view of the future by historical standards. IEA's economic growth assumptions and this intensity forecast yield an average annual growth of 1.2% in world primary energy demand. IEA has also developed an "Efficient World" scenario, where tougher energy and climate policies accelerate the uptake of best available technologies and reduce primary energy demand growth to 0.6% annually. This scenario is IEA's stretch target for the world's governments.

IEA's "Efficient World" and similar scenarios assume that policies may indeed influence the pace of energy intensity decline. This may be undisputable as a general point, but studies of the impacts of earlier policy efforts are inconclusive. Consumers may not be aware of the possibilities that exist, may not see much merit in the incentives offered, or may not agree that large upfront investments in fuel saving equipment will pay back as quickly and smoothly as the energy efficiency community says they will. Other problems are the well-known rebound or backfire effects – measures to cut the consumption of, e.g. oil or electricity may lead to fuel price declines and eventually – if markets are allowed to function normally – to oil or electricity demand bouncing back. Some hurdles may be lowered through information; others may be eliminated the hard way, through standards rather than economic incentives. However, the flattening of the global energy intensity curve since the turn of the century, in a period characterized by unprecedented attention to the dark sides of fossil fuel use, is a reminder that energy intensity developments reflect a host of uncontrollable factors, as well as carefully laid political plans.

In this outlook, we assume an average annual growth in world energy demand between 2010 and 2040 of 1.3%. This is moderately higher than the rate in the IEA's New Policies scenario. Our estimate reflects an expectation of roughly the same economic growth than IEA, in combination with a marginally lower energy intensity decline rate than in IEA's base case scenario. Around this roughly similar global picture regional assumptions will differ somewhat more.

Energy mix

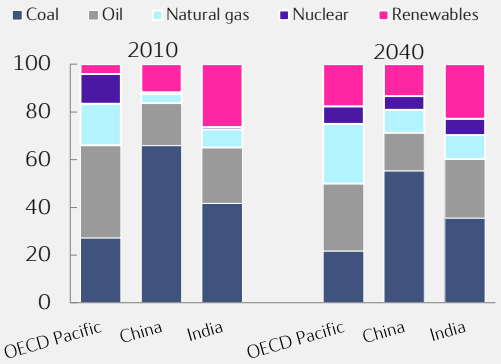
Share of total energy demand (TPED), %



Source: IEA (history), Statoil (forecast)

Energy mix

Share of total energy demand (TPED), %

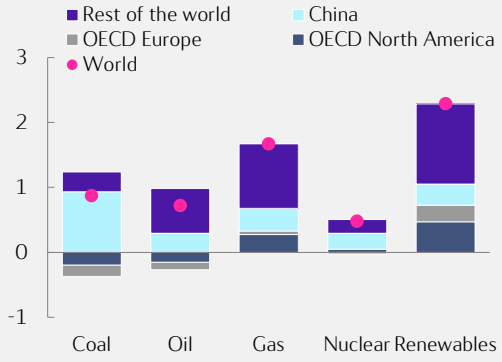


Source: IEA (history), Statoil (forecast)

Coal and oil losing market shares in all regions

Regional change in energy demand 2010-2040

Bn toe



Source: IEA (history), Statoil (forecast)

Global, regional and sectorial energy mix

The assumed 1.3% annual growth in world primary energy demand will add 40% to consumption by 2040. The OECD countries' energy use will not increase much, reflecting low population growth rates, aging, technological progress and energy saving practices. Non-OECD energy demand will however rise almost 70% by 2040 compared to 2010, reflecting population growth, industrialisation and growing prosperity. The use of different fuels will grow at very different speeds, ranging from 0.5% to 9.0% per year, with select renewables increasing most rapidly. In our projection, fossil fuels still supply 72.5% of TPED in 2040, down from 81.1% in 2010.

Considerable differences in regional energy mix

Differences in the availability of individual fuels will continue to play a large part in explaining interregional fuel mix differences.

In North America, we see natural gas overtaking oil as the largest source of energy around 2030. Furthermore, we expect that the market share of coal will be roughly halved during the forecast period, with coal consumption in 2040 being only 63% of the level in 2010. We anticipate roughly the same development in Europe, with gas overtaking oil towards the very end of the forecast period, with coal's market share declining considerably, and with new renewables supplying more than 10% of overall energy demand in 2040.

In China, coal will still by 2040 be the dominant fuel, but its market share is expected to go down from some 2/3 of total energy demand to around 55%. This reduction notwithstanding, overall coal demand in China is expected to be almost 60% higher in 2040 than today. However, other energy sources show substantially more impressive growth, with oil expected to increase by 67%, gas by close to 400%, hydro by more than 100%, and nuclear and new renewables increasing more than 10-fold during the forecast period.

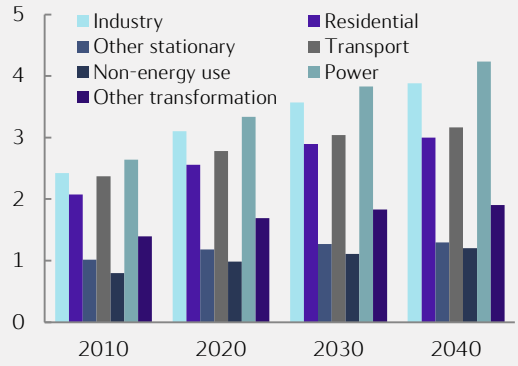
Oil to experience the slowest growth

Strong crude oil prices, less fuel subsidization in the non-OECD countries, technological advances and more stringent environmental regulations will dampen future oil consumption. Global liquids demand is seen to rise by some 15 mbd by 2040, The oil share of global energy consumption still drops from 32.3% in 2010 to 25.8% by 2040. In the developed countries oil use has peaked and will likely be significantly lower in 2040 than in 2010. The expected average annual growth of 0.5% in world oil and liquids demand reflects a growth of 1.4% annually in non-OECD demand, and above all a growth of 1.9% in China's, India's and the Middle East's combined demand. These three countries' additional demand in 2040 relative to 2010 is put at 13.8 mbd, which is almost 25% above Saudi Arabia's crude oil production in 2011.

From a sector point of view transportation and manufacturing output growth will play the key parts in driving oil and liquids demand growth. The petrochemical industry's need for feedstock will add to the other industries' need for oil as a fuel. We do however see gasoline and diesel becoming increasingly challenged as transportation fuels also outside the OECD area, as electric vehicles and plug-in hybrids become more widely accepted, as biofuels consumption increases, and as LNG and compressed natural gas start penetrating the road and marine transportation sub-sectors. See the special chapter on transportation below.

Total primary energy demand per sector

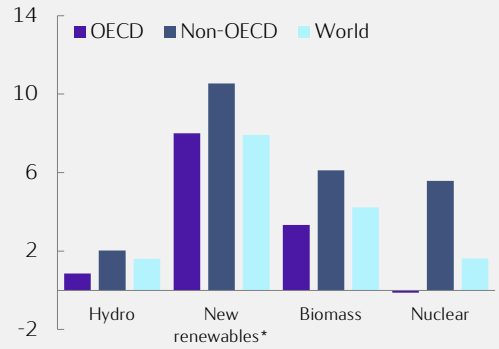
Bn toe



Source: IEA (history), Statoil (forecast)

Non-fossil fuels growth

2010-2040, CAGR



*Wind, solar and geothermal

Source: IEA (history), Statoil (forecast)

Increasing role of natural gas

Due to its availability, flexibility and environmentally friendly characteristics compared to coal, natural gas seems slated to become an increasingly important fuel. Gas demand is seen to grow particularly fast in China, with India, the Middle East and Africa in the next places. In sector terms, demand for gas for power generation is seen to grow by 2.1% p.a. while industrial gas use is forecast to increase by 1.2% p.a. These averages hide big interregional differences. Industrial gas use is seen to expand much faster outside than inside the OECD area.

Regulations will constrain coal demand

Coal displacement is expected to take place nearly everywhere, but at different speeds in different regions. Whereas in non-OECD Europe and in non-Russia FSU coal use is seen to make up nearly the same shares of total primary energy use in 2040 as in 2010, in OECD Europe the coal share of TPED is seen to drop from 16.5% to around 7%. We expect coal use to decline sharply also in OECD North America which like OECD Europe will implement tough environmental standards. China contributed 80% of the growth in world coal demand from 1990-2010. Chinese coal use is seen to increase by 1.5% per year going forward. This growth rate is only a fraction of that seen between 2000 and 2010, and below the rates expected for various other non-OECD regions, but since Chinese coal consumption is already so big it will boost the Chinese share of world coal use from 46% to 58%.

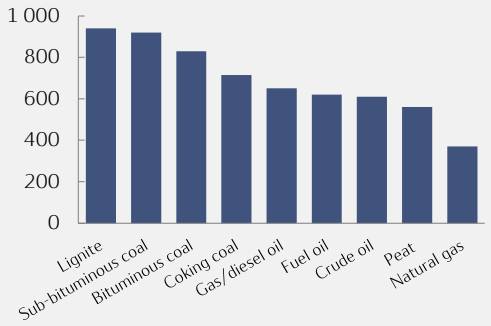
Non-fossil fuels will gain ground

Non-fossil fuels are expected to grow strongly in both the OECD (2.6% p.a.) and non-OECD (2.8% p.a.) parts of the world, driven by a universal desire to mitigate local pollution problems, combat climate change and secure energy supply. In some developing countries renewables are also used to bring electricity to the countryside. Growth patterns will be different, however, with the OECD countries prioritizing wind and solar, while many non-OECD countries due to their need to call upon all available energy sources will press ahead with hydro and nuclear as well. Solar, wind and geothermal energy will in any event continue to capture electricity market share. We see their combined contribution to world TPED increasing from 0.9% in 2010 to 7.8% in 2040, and their share of OECD European TPED going to 11%. By 2040 these energies account for almost 28% of OECD Europe's power generation, and together with hydro, biomass and nuclear they contribute 68% of regional power supply, leaving only 32% to fossil fuels. We assume that policy support will remain in place to drive the deployment of renewables and reduce costs.

Nuclear energy in limbo

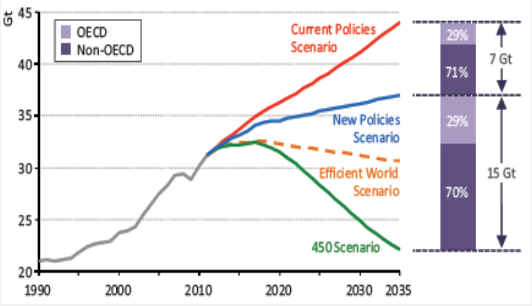
Nuclear energy seemed before Fukushima to be set for a comeback as a carbon free source of power generation. Fukushima altered this outlook. Germany, Belgium and Switzerland responded by committing to dismantle their nuclear industries, and Japan and France by declaring intentions to reduce their dependence on this technology. Yet, nations with high growth in electricity demand such as China and India continue building nuclear reactors. We believe that nuclear after an extended set-back will come back in the longer term and contribute almost 11% to global power generation by 2040, down from 13% in 2010. This expectation is however premised on an assumption of no more major nuclear accidents. Another Fukushima could undo our arguments and force massive declines in nuclear power generation irrespective of the CO_2 emission consequences.

CO_2 emissions from electricity and heat generation
g CO_2/kWh



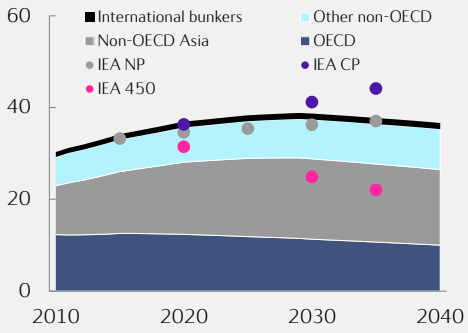
Figures are averages from the OECD member countries.
Source: IEA Emissions from fuel combustion 2011

IEA's scenarios and the changing roles and impacts of the different drivers of the 450 scenario



Source: IEA: World Energy Outlook 2012

World CO_2 emissions
2010-2040, bn toe



Source: IEA (history), Statoil (forecast)

CO_2 emissions

Global CO_2 emissions from fossil fuel use increased by an annual average of 1.9% between 1990 and 2010. Emissions grew by 0.6% per year in the OECD countries and by 3.0% per year in the rest of the world. 43% of emissions in 2010 came from burning coal, 36% from oil, and 21% from gas. 10 countries accounted for nearly two-thirds of global emissions, with China (24%) and the United States (18%) surpassing all others.

With few exceptions, scientists agree that CO_2 emissions must be reduced significantly. To achieve this goal, a tightening of policies to enable and incentivize energy savings, hasten energy efficiency growth, support renewables and develop carbon capture and storage technology is necessary. International cooperation as well as national initiatives have roles to play. Whether a global climate agreement will be in place by 2015 and enter into force in 2020 remains however an open question. The COP 18 conference in Doha in 2012 was only moderately successful, and later negotiation rounds have not resolved existing disagreements on how to share the burden of reducing emissions. Recently the US' key climate agreement negotiator dismissed the whole idea of trying to make everybody agree on one comprehensive set of targets for all countries. He suggested instead a bottom-up process with countries setting their own targets, arguing that such an approach would have as much bite as the current approach, since no country would like to be seen as a free-rider.

As noted elsewhere in this report, the EU ETS, which remains the world's leading carbon pricing system, is currently dysfunctional. Various other countries and regions have set up carbon markets. These are all at very early stages; hence how well they will work remains to be seen. Other countries have resorted to carbon taxes on top of trading systems. Carbon capture and storage technology is developing more slowly than expected. Some years ago EU believed it would have a string of pilot projects under execution by now, but not a single one has passed the threshold for receiving EU funding. CCS is not yet a commercial proposition, and it is unclear when it will become one.

We assume that climate policies together with moderating energy demand growth will reduce OECD emissions by 19% between 2010 and 2040. We also believe that more non-OECD countries will take steps to reduce the carbon intensity of their economies, and that the links between these countries' economic growth, energy demand growth and emissions growth will weaken. However, since these links will not be broken any time soon and since many countries will see high economic growth rates, non-OECD emissions are seen to increase by almost 50%. The Middle East and India will likely be the places with the highest emission growth rates. China scores comparatively well in growth rate terms thanks to tough energy efficiency and fuel diversification policies, but still accounts for well over half of incremental CO_2 emissions because of the size of its economy and its reliance on coal. The OECD countries, which in 2010 contributed a little over 40% of global CO_2 emissions, are in 2040 seen to account for around 27%. Global CO_2 emissions increase by an average of 1.3% annually until around 2030, when it peaks and subsequently declines, due to the gradual introduction of CCS, fuel changes in transportation and energy efficiency. The growth in CO_2 emissions between 2010 and 2035 is in line with IEA's New Policies scenario.

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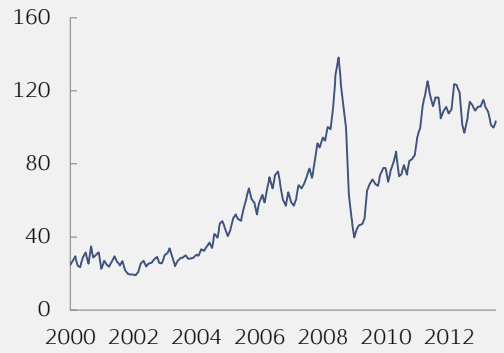
The global oil market

Oil prices

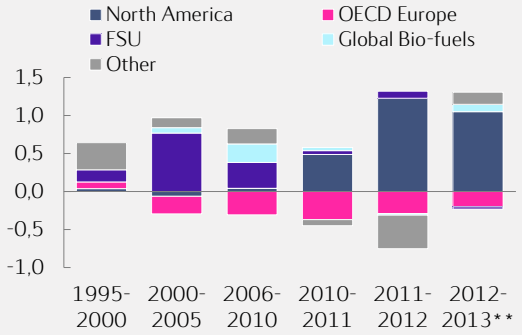
Brent, USD/bbl



Source: Reuters EcoWin

Non-Opec production*

Average annual change, mbd



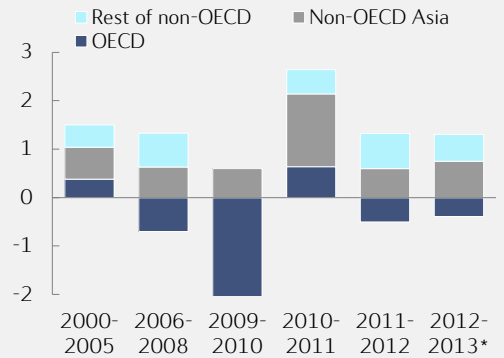
*Including processing gains

**Forecast

Source: IEA (historical), Statoil (forecast)

Global oil demand

Average annual change, mbd



* Forecast

Source: IEA (history), Statoil (forecast)

Recent trends – the impact of two revolutions

The aftermath of the Great Recession

The economic recovery following the Great Recession (2008-2009) and the exceptional strong oil demand growth in 2010 pushed oil prices upwards during the final quarter of the year. In December, just before the outbreak of the social and political unrest in Tunisia, prices reached almost 90 USD/bbl. This price level was consistent with widespread perceptions about the level of long-term marginal cost of new oil supplies, often seen as a medium-term price anchor, and the balanced position of short-term price determinants. Opec's spare capacity and commercial oil stocks were both at comfortable or neutral levels, and the risk premium was low in the fourth quarter of 2010.

Impacts of two revolutions

Since December 2010, the world and the oil market have increasingly been influenced by two revolutions – both with far-reaching and likely long-lasting political and market effects:

- The Arab Spring, which has led to regime changes in several countries and to political and social destabilization, and
- The US shale revolution, which has spread to oil, and holds a large resource potential both inside and outside the US.

Together with the escalation of the conflict over Iran's nuclear program and the stalemate between Sudan and South Sudan over oil exports, the spread of the Arab Spring to new countries in the Middle East and North Africa led to large supply losses in 2011 and 2012.The main losses in 2012 were from South Sudan, Syria, Libya and Iran. The development in Iranian export and production so far this year indicates that total output losses from this region alone may rise to 1.80 mbd in 2013.

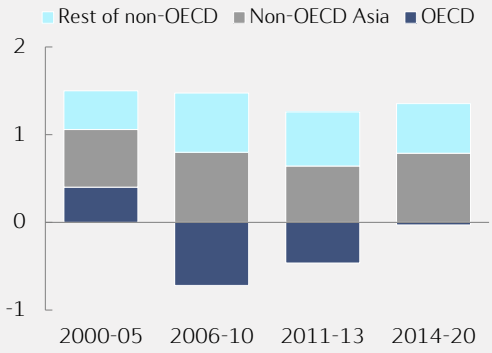
On top of the politically driven supply disruption in the Middle East and Africa, oil production in several other countries outside Opec also experienced losses due to operation problems. Despite these disruptions, non-Opec production has recently been growing. After stagnation in 2011 and a 0.6 mbd increase in 2012, non-Opec production is headed for a growth of more than 1.1 mbd in 2013. The largest contributions to the rise in production have come from the US and Canada, primarily driven by impressive growth in US tight oil production. From a level of 0.4 mbd in 2009, tight oil production will probably reach 2 mbd in 2013.

Oil prices have been lifted by spare capacity and high risk premium

After the extraordinarily strong increase in global oil demand in 2010, demand growth slowed sharply in 2011-2012. Large reductions in OECD demand have led to a modest 0.7-0.8 mbd increase in global oil demand. The 1 mbd loss of Libyan volumes in 2011 counteracted the slower demand growth and pushed prices temporarily to levels above 115 USD/bbl. To alleviate the tightness in the physical markets, Saudi Arabia raised its crude production to about 10 mbd, reducing its spare capacity to about 1.5-2.0 mbd. The combination of uncomfortably low levels of total spare capacity and a high risk premium, fuelled by the fear of further supply disruptions, have most of the time kept oil prices between 100 and 115 USD/bbl over the past 2½ years.

Global oil demand

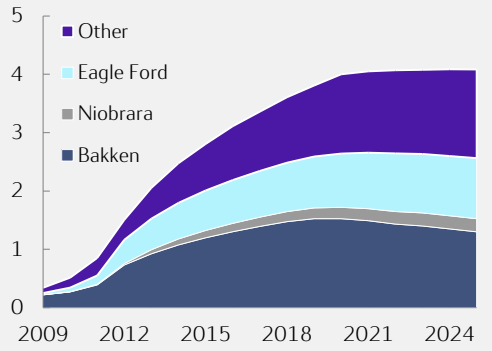
Average annual change, mbd



Source: IEA (history), Statoil (forecast)

US tight oil production

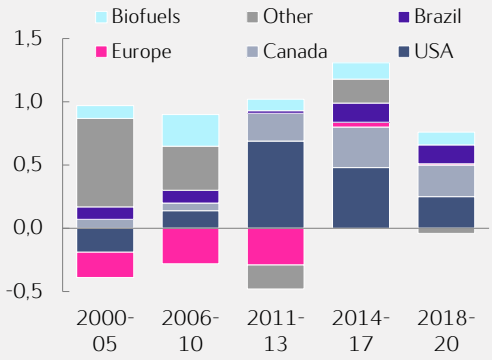
mbd



Source: IEA (historical), Statoil (forecast)

Non-Opec production*

Average annual change, mbd



*Total liquids, including biofuels and processing gains

Source: IEA (history), Statoil (forecast)

Outlook to 2020 – Rising spare capacity, but supply risk

Oil demand growth will most likely recover

Between 2000 and 2012, global oil demand increased on average by 1.2 mbd per year, but this global aggregate masks large differences between the mature OECD countries and the emerging economies. Since 2005, oil demand in all OECD regions has been in steady decline. Over the last three years, it has fallen annually on average by 0.5 mbd, affected by weak economic growth, rising efficiency gains and conservation efforts spurred by high retail prices. Oil demand in non-OECD Asia and other emerging economies has increased by about 0.5-0.7 mbd each, more or less in line with historical trends. Over the medium term, global oil demand will probably grow significantly faster than it has in recent years, mainly due to a likely consolidation of OECD demand, which is expected to be supported by rising economic growth, potential for some pent-up demand and moderately lower oil prices. Based on the assumption of steady growth in the Chinese economy, non-OECD oil demand will most likely rise in line with historical trends. The vulnerability of the US, the European and the Chinese economies suggests that there is downside risk to this forecast.

US tight oil production is bound for the 4 mbd level

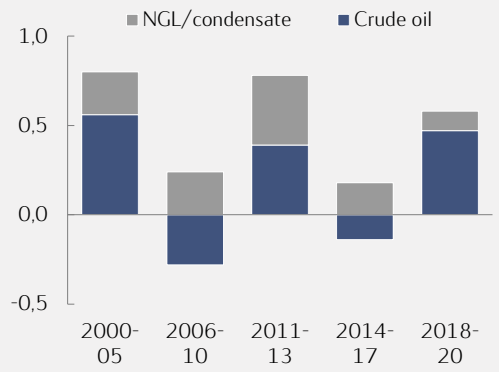
In the late 2000s, the shale gas revolution in the US started to spread to oil. From modest output levels in the late 2000s, US tight oil production increased sharply over the last four years, and production could reach 2 mbd in 2013. The Bakken and the Eagle Ford formations in North Dakota and Texas, respectively, currently account for two thirds of total production. The tight oil revolution has exceeded most expectations. A stronger increase in drilling activities than expected and significant improvements in well and rig productivity have been important drivers behind the surprisingly strong growth. Furthermore, the limitations of the pipeline system, which potentially could have restrained the production growth, have effectively been dealt with through a fast expansion of the rail capacity. Looking forward, most underlying dynamics suggest that US tight oil production will continue to rise very strongly up to 2020. Further growth in production from existing formations and from several "new" plays should bring US tight oil production towards 4 mbd by 2020. Potential downward pressure on oil prices could lead to a slower increase in active rigs and number of wells, and thus a slower increase in production.

North America ensures sustained growth in non-Opec production

On top of rising tight oil output, other conventional crude oil production as well as NGL production are expected to grow over the medium term, and should take total US liquids production excluding bio-fuels to more than 12 mbd by 2020; a rise of 3 mbd since 2012. Furthermore, Canadian oil production which in recent years has increased by about 0.25 mbd annually, mainly driven by the oil sands production expansion, has a large potential. However, the combined growth in US and Canadian oil production has so far led to bottlenecks in the major export pipelines and to large price discounts on Canadian crudes. Given that sufficient transportation capacity is implemented and global oil prices remain above 80-90 USD/bbl, total Canadian oil production could rise by up to 0.3 mbd annually towards 2020. The uncertainties about oil prices and transportation capacity suggest that there is a downside risk to this

Opec oil production

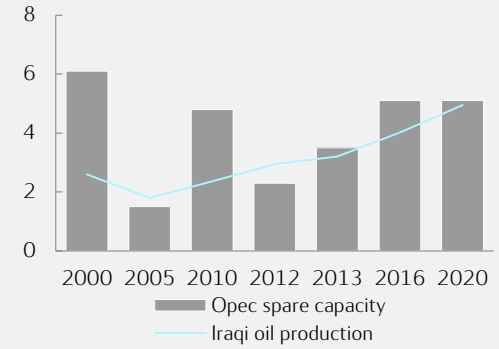
Average annual change, mbd



Source: IEA (history), Statoil (forecast)

Opec spare capacity and Iraqi oil production

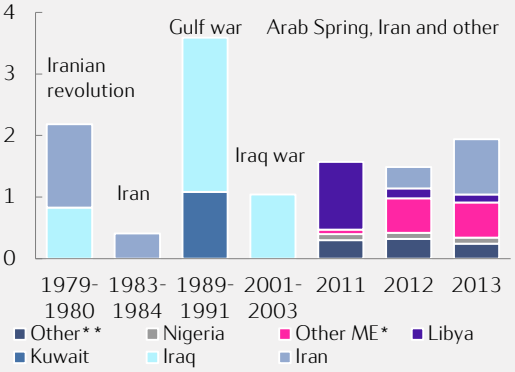
Average annual change, mbd



Source: IEA (history), Statoil (forecast)

Supply disruptions

mbd



*Yemen, Syria, South Sudan

**Technical related losses outside ME and Africa

Source: IEA (history), Statoil (forecast)

forecast. Outside North America, Brazil and Kazakhstan have the largest potential for production growth. However, new project developments have been hampered increasingly by local content requirements and capacity problems. These restraining factors will probably continue to affect future projects and suggest only moderate output growth. In aggregate, non-Opec production is bound for record growth over the next four years, before it lessens in the last few years of the decade. USA and Canada will contribute about two thirds to the overall growth.

Stagnant demand for Opec crude for several years to come

Driven by rising natural gas production, Opec NGL production since 2009 has increased annually on average by 0.4-0.5 mbd. This growth is currently slowing, with production expected to increase only moderately over the rest of the decade. In order to balance the overall oil market Opec, led by Saudi Arabia, reduced crude supplies from 31.7 mbd in 2Q12 to an estimated level of 30.4 mbd in 2Q13, Based on the forecasts for oil demand, non-Opec production and Opec NGL production, Opec crude production has to be kept around 30 mbd at least for the next 3-4 years. The slower growth in non-Opec production in the last part of this decade leaves room for moderately higher Opec crude production.

Rising Opec capacity contributes to higher spare capacity, but ...

In Iraq the investment climate, affected by an array of political and commercial problems, continues to deteriorate, and its production capacity is still expected to grow only moderately in the years ahead. The UAE, Angola and Saudi Arabia all have fields under construction which will add new capacity over the next few years. Opec's total production capacity is expected to grow by 1.5 mbd over the next 3-4 years and contribute to an increase in its spare capacity from about 3.5 mbd in 2013 to more than 5.0 mbd in 2015-2020.

....the Arab Spring has lifted the supply risk and the risk premium

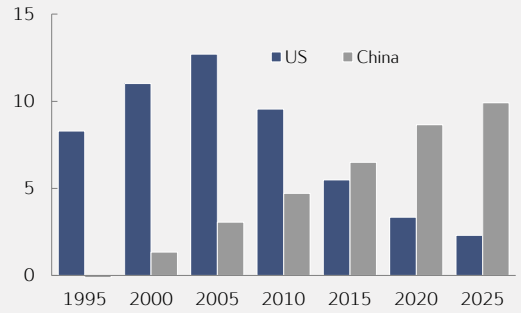
The Arab Spring has led to the overthrowing of several autocratic regimes in the region, but the experiences so far show that it is hard to establish new, broadly supported and effective governments. For several years to come, it is likely that the new authorities and states will remain weak, protracting a serious security situation. Furthermore, the on-going Syrian civil war is also a playground for the conflicts between regional powers, and the hostilities may spread into an increasingly fragmented Iraqi state and to other countries in the region. In total; the elevated supply risk associated with the Arab Spring will probably last for several years and support oil prices.

Rising Iraqi production will create internal Opec tensions

Our base line projection of even a moderate growth in Iraqi production, in a market environment with stagnant call on other Opec crude indicates that other Opec members must provide room for higher Iraqi production. This is becoming an increasingly controversial issue within Opec. Saudi Arabia has already suggested that Iraq should be reintegrated into the quota system quite soon. Iraq may eventually be persuaded to hold back some volumes, which together with production cuts by Saudi Arabia and other Opec members can balance the market. Alternative political scenarios for Iraq and the wider Middle East could either alleviate or intensify the potential conflict over Opec production quotas.

US and Chinese net oil imports

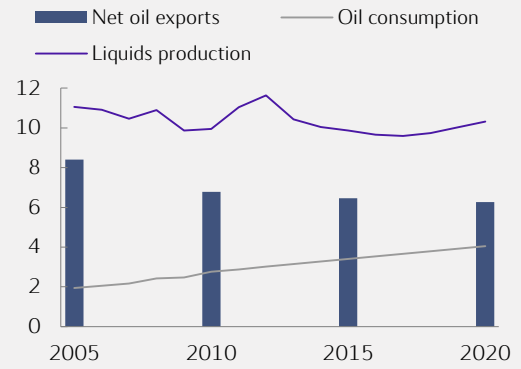
Average annual change, mbd



Source: IEA (history), Statoil (forecast)

Saudi Arabia's oil balance

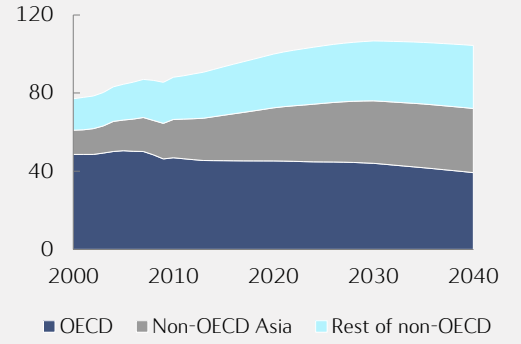
Average annual change, mbd



Source: IEA (history), Statoil (forecast)

Global oil demand

mbd



Source: IEA (history), Statoil (forecast)

The 2020-2040 outlook – Towards peak in oil demand

Energy policy remains critical

The economic, environmental and oil import/export position of the US, China and Saudi Arabia are bound to change significantly over the medium term and could motivate new energy policy initiatives. The magnitude and timing of new targets and measures are crucial for global oil demand development over the next decades.

Could the shale revolution reduce the pressure to save oil?

In the US, the energy policy for decades has been motivated mainly by concern for energy security, especially in terms of oil security. High oil prices, and to a lesser extent climate concerns, have also played a role. All these factors were imperative when the combined fuel efficiency and emissions standards were tightened in 2010-2011. However, in recent years the severe economic challenges have been the US' main priority. While many previously have assumed that support for further tightening of efficiency standards and climate initiatives would rise when the economy eventually rebalanced, the US tight oil revolution, which has led to a sharp increase in its total liquids supply and to a steady reduction in US oil imports, challenges this view. On the other hand, the outlook for continued instability in the Middle East means oil prices will continue to fluctuate and also affect the US economy. Thus, efficiency standards in the US will likely be further tightened through the 2020s.

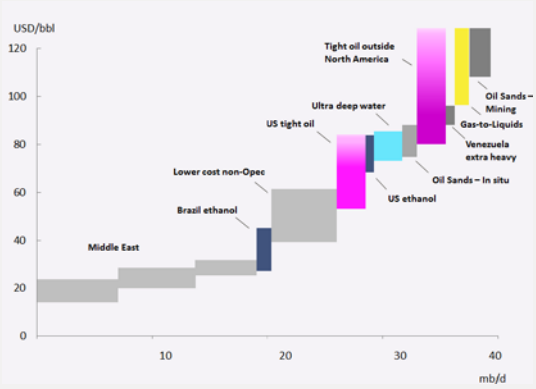
China oil import dependence continues to grow sharply

During the 1990s China was roughly self-sufficient in oil. This position changed rather dramatically through the last few years. China is now importing almost 6 mbd in order to cover its domestic oil demand of 10 mbd. With a strong preference for self-sufficiency, this trend is worrisome and politically sensitive and has led to governmental initiatives to raise the oil and energy efficiencies. Despite the expected implementation of further efficiency measures up to 2020, oil demand will probably reach about 13 mbd in 2020 and take total oil imports to 9 mbd. Thus, renewed and sustained efforts to raise energy efficiency beyond the 2020s are likely. Even with some success in raising domestic oil production, including contribution from shale oil, Chinese oil imports requirement will probably increase further through the 2020s. Given the rebalancing of global oil trade flows, most of the imports must be covered by the Middle East, which suggest that China probably will be forced to take a more interventionist approach in foreign policy, particularly towards the Middle East.

Saudi Arabia could be forced to undertake policy reforms

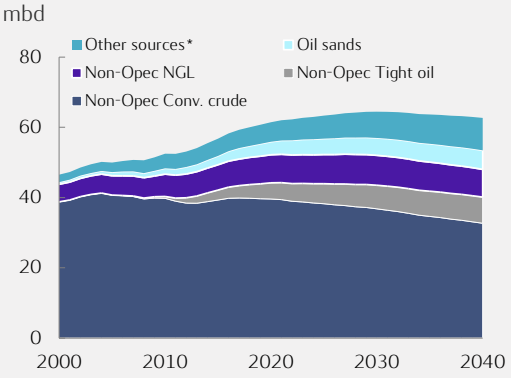
Almost since Saudi Arabia was founded questions have been raised about the sustainability of its political and economic model, based on an autocratic power structure, but also with generous welfare spending and high subsidies on domestic oil and gas use in order to secure legitimacy and political support. However, the underlying trends, with high population growth, high unemployment, and steadily growing demand for welfare spending are considered unsustainable. Furthermore, high oil subsidies have fuelled growth in domestic demand. Based on projections of stagnant to lower oil production, and a further rise in internal oil demand, net exports and oil revenues will probably fall during this decade. Combined with rising demand for political participation, inspired by the Arab Spring, the harder economic realities will eventually force the regime to undertake wider political and economic reforms.

Marginal cost of new supplies
USD/bbl, WTI equivalents



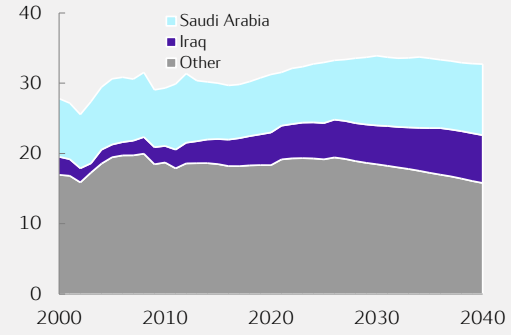
Source: IEA, various research institutions

Non-Opec production



* Bio-fuels, GTL, processing gains
Source: IEA (history), Statoil (forecast)

Opec crude oil production
Mbd



Source: IEA (history), Statoil (forecast)

Oil demand growth decelerates and peaks around 2030

Driven by slower GDP growth, higher oil efficiency and gradually rising substitution away from oil to gas and electricity, regional oil demand growth slows in all regions. After a period of consolidation, OECD oil demand falls steadily through the 2020s. In China, annual demand growth falls from 0.3-0.4 mbd in the early 2020s towards stagnation and decline in the 2030s. In other emerging economies, oil demand continues to rise modestly through the 2030s. As described in the separate chapter on the transportation sector, steady tightening of fuel efficiency standards and further progress in hybrid and battery technologies, which make alternative engine technologies competitive, are major contributors to the slowing of oil demand growth.

Technology and prices drive the economically recoverable resources

The elevated level of oil prices since 2011 led to increased exploration activities, several new finds and a significant upward revision of the estimated recoverable resources, especially to the US shale (tight) oil resources. The size of the shale oil resources outside North America is still unclear, but the total resource picture for various oil sources, including conventional oil, tight oil and Canadian unconventional oil continues to improve. The economic recoverable resources depend on access, the associated cost level, including the capacities and competence of the supplier industry, fiscal regimes and the level of oil prices. Although low cost production in the Middle East potentially could replace much of the high cost production outside Opec, the full cycle costs of marginal projects in North America, tight oil in other regions and ultra-deep water products will probably continue to be important determinants of the long-term price formation.

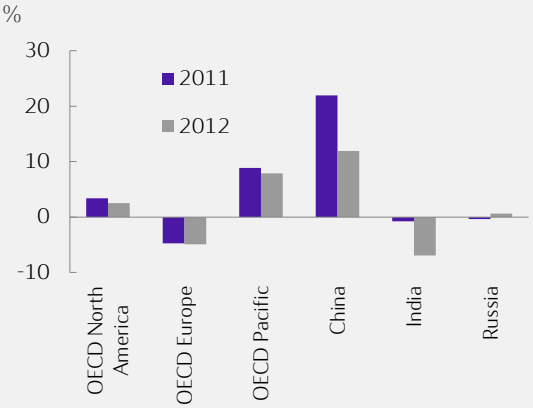
Total liquid supplies are becoming more diversified

As the conventional crude oil production (excluding tight oil), at least outside the Middle East, is gradually depleted, the share of non-Opec conventional crude production out of total liquids supply declines sharply; from 46% in 2010 to only about 30% in 2040. However, the technology-driven shale revolution and continuous improvements in oil sands technology mean that several "new" types of oil liquids; like tight oil, NGLs from shale gas and oil sands have become economic. Together with rising bio-fuels and gas-to-liquids production, these sources will replace most of the declining conventional non-Opec crude production over the next decades. Although Opec crude production will rise somewhat, total liquids supplies are becoming less dependent on crude and more diversified. Total non-Opec liquids supply, which previously was expected to peak in the mid-2020, is now assumed to peak in the late 2020.

Room for higher Opec crude in the 2020s - before oil demand peaks

The decelerating growth in non-Opec production through the 2020s leaves room for a gradual increase in Opec crude output from about 31 mbd in 2020 to a level of 34 mbd in 2030, when global oil demand is expected to peak. Opec's total production of crude oil and NGL as a share of global liquid supplies will remain around 32% through the 2020s and 2030s, only marginally lower than current levels. Saudi Arabia and Iraq, which holds the largest oil resources, will increasingly provide most of the Opec volumes, about 10 and 7 mbd, respectively, in 2040, close to 50% of total Opec crude production.

Changes in gas consumption in key regions

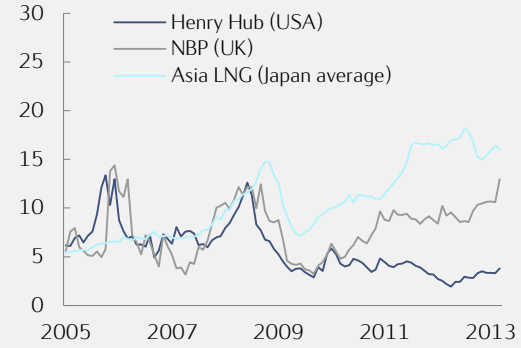


Sources: Cedigaz

European gas demand suffered big set-backs in 2011 and 2012

Key gas prices

USD/MMBtu



Source: IHS CERA

The interregional gas price gaps that opened up in 2008 widened further in 2012

The natural gas market

Status

In 2011, IEA published the report "Are we entering the golden age of gas?" Noting the advantages of gas as a fuel for the power sector, the improved gas supply outlook, and the booming interest in LNG, IEA concluded that global gas demand could increase nearly 30% faster than it had assumed in its "New Policies" scenario introduced the previous year.

The last couple of years have indeed been good for gas, in most regions if not uniformly across the globe. CEDIGAZ estimates 2012 global gas demand growth to be 2.2%. Emerging market demand growth was particularly strong, with Chinese demand increasing by 11.9%, African by 7.6%, Latin American by 5.9% and Middle Eastern by 4.6% the same year. However, growth was not limited to these markets. The Asian OECD countries' demand was up 7.9%, while North American demand saw a respectable 2.6% increase.

The main exception to the "golden age of gas" rule was Europe, where demand dropped by 4.8%. IEA assumes a less dramatic decline of about 2% in 2012. Whatever the exact number, last year's drop came on top of a massive decline in gas demand in 2011. Europe has "lost" no less than 10-12 years of gas demand growth.

Europe, Asia and North America are on different gas demand growth tracks for distinct reasons. European energy consumption is depressed by the Eurozone crisis. European gas consumption suffers twice; because gas fired power generation is under attack from renewables based generation on the one hand and from coal fired generation on the other. Wind and solar power have captured market shares because European governments provide financial and pricing support. Coal fired power has captured market share because coal imports have become cheaper and because the EU carbon price is not sufficiently high to impact relative economics.

North American gas demand reflects favourable supply and – from a consumer's point of view – price developments. A 33% growth in indigenous (mainly unconventional) gas production between 2005 and 2012 depressed the Henry Hub (US reference price) from USD 13/MMBtu in December 2005 to below USD 2/MMBtu in April 2012. US electricity companies have switched from coal to gas on a big scale, increasing their use of the latter fuel by 21% in 2012.

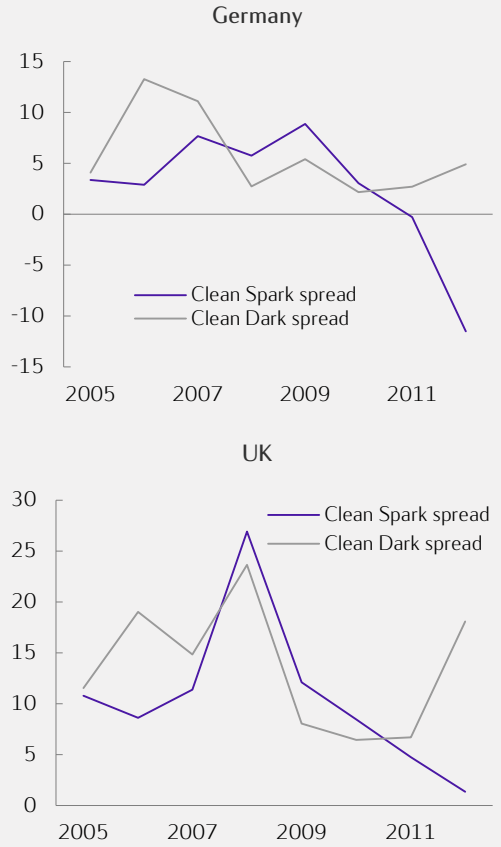
Asian gas demand growth is sustained by high economic growth in China and other emerging markets, policies in place in many countries to encourage substitution from coal and oil to gas, and Japanese utilities' frantic buying of LNG to compensate for the impacts of the Fukushima disaster in 2011. Asian LNG import prices reached record levels in 2012. This has triggered strong interest in LNG pricing mechanisms other than the traditional linkage to a crude oil index.

Medium-term outlook

Looking a few years ahead, North American gas demand will likely continue to grow at a brisk pace by historical standards. New regulation will underpin the power sector's appetite for gas. The number of gas rigs operating in the US has dropped by 77% since 2008. US gas production is however holding up, testifying to the backlog of interconnected wells, more efficient use of the rigs still in use, and to the fact that many of the

Gas demand is seen to continue growing in Asia and North America, and stage a slow recovery in Europe, towards 2020

Clean spark and clean dark spreads*
Euro/MWh



* Clean spark and clean dark spreads indicate the profitability of gas and coal fired power generation respectively, with clean signifying that the carbon price is taken into account. In 2012 gas fired generation became less profitable than coal fired generation in both Germany and the UK. In Germany the margin on gas fired generation turned negative.
Source: Statoil calculations

US gas production is holding up in spite of an almost 80% decline in the number of gas rigs in operation

rigs counted as oil rigs also produce associated gas. This indicates that although US gas prices will strengthen, they will remain comparatively low through the medium term.

The European gas market is expected to level out and then recover. The Eurozone crisis will abate and so will the competition from imported coal, with higher US gas prices reducing the exports of surplus coal across the Atlantic. European gas demand will also receive support from the continued implementation of the Large Combustion Plant Directive and the Industrial Emissions Directive. The EU ETS price is however not expected to contribute much to a European gas revival this side of 2020.

Asian gas demand will continue to increase on the strength of the emerging Asian economies and on their desire – motivated by steadily worsening pollution problems – to reduce coal burning. South Korea is the only major gas consumer in the region officially expecting demand to level out, but Korean authorities have a history of erring on the downside with their projections. Japanese demand is uncertain since the fate of the Japanese nuclear sector remains open.

We see global gas demand increasing by around 3% a year in the five-year period 2014-18. This demand growth can be fairly easily supplied. North America is awash with gas. Russia is struggling with a gas bubble and could accommodate any conceivable Eurasian gas demand rebound.

The global LNG market, and thereby the Asian gas market, will, however, remain fairly tight for another 2-3 years. Last year only one new LNG plant, the Australian Pluto project, started to operate. 2013 could see the addition of three trains to the global plant fleet, one in Angola and two in Algeria. This moderate growth indicates that LNG imports will remain supply constrained for some time.

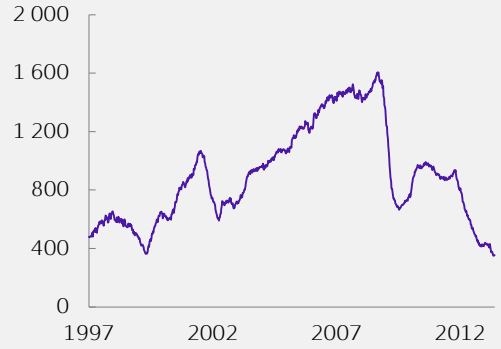
Things could change later in the decade when large amounts of new Australian LNG hit the market and the first US L48 LNG trains go into service. Exactly when and how sharply the tide will turn is uncertain. Australian supply could increase at a slower pace than assumed recently due to project cost overruns and delays, and the future scale of US exports remains subject to speculation. By late May two projects had been permitted by the US DOE to export up to 37 bcm/y of gas as LNG. More permits will likely follow. However, US industrial gas buyers remain concerned about losing the competitive edge that cheap gas provides, and keep lobbying the government to hold back. Thus, predictions of a carefully staged permitting process seem the most plausible. We assume that another 1-2 projects will receive the green light in the medium term.

Long-term market outlook

Echoing to some extent the "Golden age of gas"-arguments, we continue to see gas as a winner among fossil fuels and assume a global demand growth of 1.5-2% a year to 2040. This projection puts us in line with most other forecasters.

The advantages of gas relative to coal have catapulted gas into the North American, European and FSU power sectors. The recent set-back in Europe does not nullify this longer term trend. The advantages of gas relative to oil products as a road and marine transportation fuel are beginning to be realized.

Number of rotary rigs drilling for gas in the US

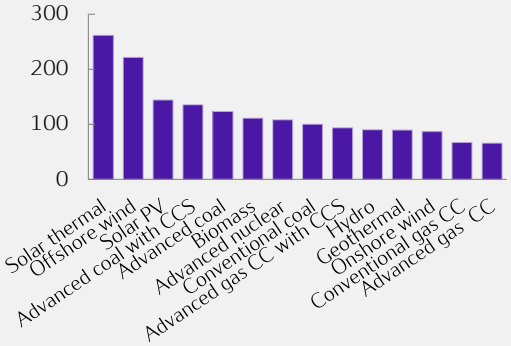


Sources: Baker Hughes

The Sabine Pass LNG plant under construction

Source: LNG worldnews.com

Estimated levelized cost of power generation for plants entering service in 2018
USD/MWh



Source: US DOE EIA Annual Energy Outlook 2013

The main competition for gas is from new renewables. This will be the case everywhere, but currently it is felt most acutely in Europe where wind power generation capacity grew on average by 16.5% a year, and solar capacity by an amazing 67% a year, between 2002 and 2012. In 2012, wind, solar, hydro, biomass and geothermal capacity made up some 40% of the total European power generation capacity. And this could only be the beginning. In the EU Commission's Energy Roadmap scenarios, renewables-based capacity makes up between 73% and 86% of total power generation capacity by 2050.

Gas is needed even by 2050 in all the Roadmap scenarios, but on a lesser scale as the decades go by. EU inland gas consumption is projected to be 34-53% lower in 2050 than in 2010. Energy efficiency improvements lower energy use across fuels, and the shrinking energy demand pie is redistributed towards renewables. Since intermittent power sources like wind and sunshine need backup in the form of flexible thermal power plants, utilities are supposed to hold on to their CCGTs and build new ones when needed. However, since backup plants by definition are used only intermittently, a future role for gas as preferred backup fuel is cold comfort to Europe's gas suppliers.

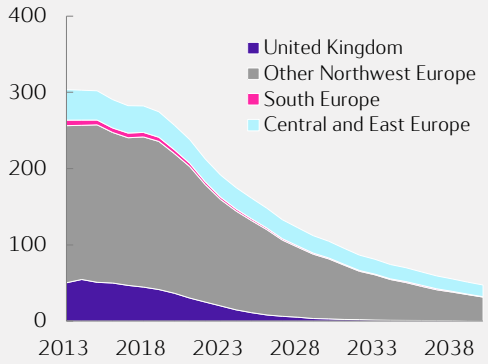
The competitiveness of individual power generation technologies and fuels are typically expressed in terms of new plants' so-called levelized costs. Estimates suggest that combined cycle gas plants remain the most economic by a considerable margin. New renewables have become cheaper, but with the exception of onshore wind they have some way to go to reach grid parity. Governments' political will and ability to continue propping up renewables economics will critically affect gas demand.

Barring major and, for the moment unexpected, changes in attitudes to nuclear, and/or breakthroughs for CCS, the contributions of wind and solar to European power generation will continue growing. There are however signs that the current economic malaise is eroding governments' resolve to continue subsidizing these technologies as generously as they have in the recent past. This, on top of concerns about the integrity of the power supply systems of the countries that have taken the lead in bringing on renewables based capacity, could depress the pace of growth.

Assuming that the arguments for preserving a major role for gas will prevail, European gas demand is projected to grow by around 1% a year from late in this decade through the 2020s and 2030s. This growth is below the rates observed prior to the financial crisis but will still present suppliers with major gas business opportunities. One reason is that there will be a need for new gas not only to supply incremental demand, but also to compensate for declines in indigenous production.

North American gas demand is expected to grow slightly faster than European gas demand, with the US economy remaining comparatively healthy, gas supply continuing to grow, gas prices remaining competitive with oil prices and coal based power generation facing increasingly severe regulatory restrictions. Demand growth will be driven primarily by the power sector and secondarily by the industrial sector, but with transportation playing an increasingly important role.

Gas production from European fields under development or ready for development
Bcm/year

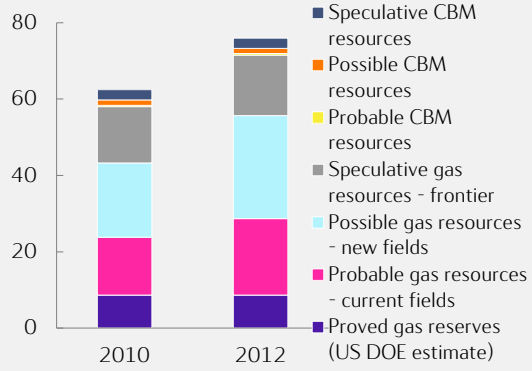


Note: The reserves considered for this chart are those in the proven and probable categories. Possible reserves, yet-to-find gas and shale gas are excluded from consideration.
Source: Wood Mackenzie Corporate Analysis Tool

Asia will continue driving the global gas market in the 2020s and 2030s, with China's and other emerging economies' demand set for sustained growth

Long-term upturns in European and North American coal demand unlikely; regulations will drive coal power plant owners to retire high shares of their fleets and replace them with other technologies

Changes from 2010 to 2012 in the US Potential Gas Committee's US gas resource estimates
Bcm, thousands



Source: US Potential Gas Committee

The North American shale gas revolution has not at all run its course. In April 2013, the US Potential Gas Committee released a new estimate of the US' technically recoverable gas resources, which at 2,384 trillion cubic feet or 67,535 bcm were 20% above the previous estimate. Recent US gas supply cost curves show that even more gas seem to be producible at moderate prices, compared to last year's estimates.

The pace of US gas demand growth may be checked by gas and/or coal price developments eroding gas' recent competitiveness in the power sector. A renaissance for coal based power generation is, however, unlikely. Coal use is under sustained regulatory attack. The Environmental Protection Agency will continue to implement the Regional Haze Rule, start implementing the Mercury and Air Toxics Standards and finalize yet other rules issued in draft form during Obama's first period. These will, in different ways, force power producers to either invest heavily in upgrading their plants or retire them. A high share of older plants will likely be scrapped. Coal's share of the US generation mix is steadily declining, with coal being replaced by natural gas and renewables.

Asian gas demand will reflect the future pace of economic growth in China, India and the other Asian emerging markets, and on governments' future preparedness to pave the way through price reform and other policy measures for gasification. We expect GDP growth rates to fall compared with the levels typical for the 2000s, but to remain healthy. We also expect governments to continue prioritizing energy supply, fuel mix diversification and local air pollution mitigation, and therefore to increase their efforts to lift supply constraints on gas demand. Hence we see Asian gas use continuing to expand faster than other regions' gas use.

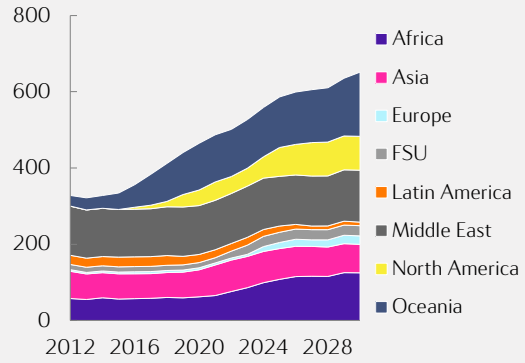
Forecasts of Chinese gas demand vary only in their degree of bullishness. Statoil's working assumption is that Chinese gas use will increase on average by 7-8% a year between 2010 and 2030, but taper off towards the end of this period and slow further in the 2030s, resulting in an average for the full 2010-40 period of 5-5.5% a year. The Indian and the other emerging Asian gas markets will not exhibit this level of dynamism. Indian gas use is, nevertheless, projected to increase annually on average by some 3.5% between 2010 and 2040, and other non-OECD Asian gas demand by at least 2%.

Gas supply in Asia will be a mixture of indigenous production, LNG imports, and pipeline gas imports. China and India have high hopes for unconventional gas production, and China is considered to be the country outside North America (and perhaps Russia) with the biggest shale gas potential. However, China faces obstacles in the form of limited water resources, a patchy infrastructure, supply industry and contractor capacity constraints, and gas market rigidities. China is also possibly slowing developments by insisting on lead roles for local, mainly state owned companies with no shale gas experience. The jury is still out on how fast and how far Asian shale gas industries will develop.

Asia will remain a magnet for LNG, and China and India are also popular with FSU, Asian and Middle Eastern pipeline gas vendors. Chinese LNG imports could increase four- or fivefold over the next 20 years from last year's roughly 20 bcm. Chinese imports of Central Asian pipeline gas reached 22 bcm in 2012 and will likely continue to increase towards 60-

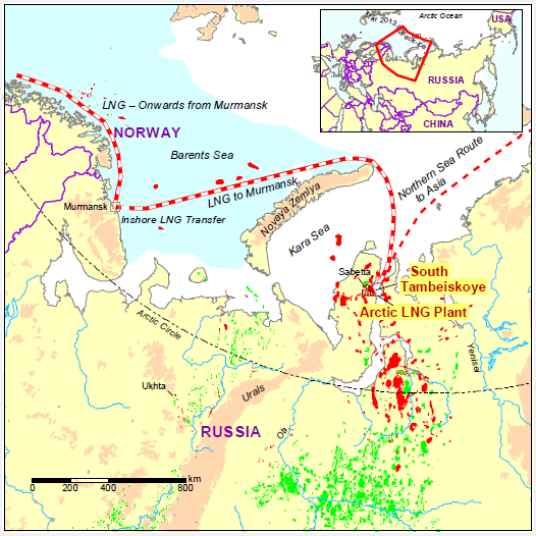
Assumed LNG supply 2012-30

Bcm/year



Source: Statoil estimates

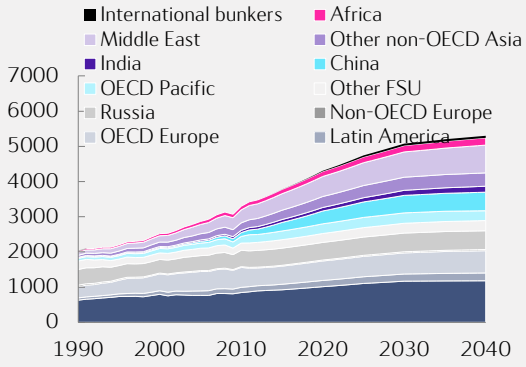
Alternative roads to markets for Russian Barents LNG



Source: Wood Mackenzie

Assumed evolution of world gas consumption

Bcm



Source: IEA (historical data), Statoil (forecast)

70 bcm annually. A pipeline carrying gas from Myanmar to China commenced operations in May 2013. And this spring negotiations between CNPC and Gazprom on imports of Russian pipeline gas have come to life again after a long period of apparent standstill.

India last year imported almost as much LNG as China due partly to disappointing indigenous production results, and has like China a string of new regasification plants under construction or planning. India pursues pipeline gas import options, too, but so far unsuccessfully due mainly to the political risks involved – one option would have Iran supply gas via Pakistan, another would have Turkmenistan provide gas via Afghanistan and Pakistan. In the long term, these risks could, however, abate, allowing for new trade routes and accelerated gasification in the entire region.

With world LNG demand likely to more than double over the next 20 years from its 2012 level of almost 300 bcm, a relevant question is whether supply will materialize in a timely manner. Though temporary mismatches between supply and demand cannot be ruled out, there are more than enough liquefaction projects up and running, under construction, at the planning stage or in the back of oil and gas companies' minds to fulfil supply requirements. During the 2020s the Australian projects will debottleneck and several will launch expansion trains, and more US and Canadian supply will become available. Further into the 2020s another two supply regions, the Eastern Mediterranean and above all East Africa, will come into play. Mozambique's and Tanzania's proven gas reserves now amount to well over 3,000 bcm. Most of this gas will be available for exports, and the IOCs active in the region plan massive liquefaction centres.

The Arctic is another potential source of LNG. Novatek's Yamal LNG project is at an advanced stage of planning. The Shtokman field remains under consideration for LNG. 1-2 other Barents area project proposals have been tabled. Gazprom and Rosneft plan separate LNG plants in the Vladivostok area. Russian and foreign companies have agreed to carry out exploration in the Barents, Kara, Laptev and Okhotsk Seas that could, since the area is known to be gas prone, pave the way for more projects. The companies that hold Alaskan North Slope gas reserves have turned from the idea of building a pipeline to Canada and the US L48 states, to the idea of building an LNG facility in the Valdez area. Other companies are looking at the Canadian Beaufort area, East Baffin Bay and East Greenland. What all these places have in common are negligible local gas commercialization opportunities and a need for enormous pipelines if the gas is to be evacuated in its natural state, making LNG the obvious solution.

In the very long term, a new gas supply source – methane hydrates – could come into play. That methane molecules may be trapped in ice, and that a lot of gas is held in place in this way on the seabed or under permafrost conditions, have been known for a long time, but no one has known how to safely produce it. The reported results of tests in Alaska in 2012 and Japan in 2013 indicate, however, that the companies that have spearheaded research on this resource may be close to cracking the code. Major cost and environmental challenges remain, but gas market observers have begun to factor in some methane hydrates based gas production from the late 2020s.

Other energy carriers

The coal market – status and outlook

After oil, coal is currently the world's biggest energy source. Coal supplied around 27% of the world's primary energy demand in 2010, with the majority going to power generation. Due to the historically close link between electricity demand and economic growth, there has also been a correlation between coal demand and GDP growth. Accordingly, coal demand growth is currently concentrated in Asia, the region with the most dynamic economies, and this trend is expected to continue. Due to this linkage, coal consumption remained resilient while global oil and gas consumption fell considerably due to the economic downturn. We see coal demand growing briskly by around 20% towards 2020, primarily as a consequence of growth in electricity production in Asia. On average, we expect coal demand to grow by 0.7% annually between 2010 and 2040, with coal's share of TPED peaking at 28.5% in 2015, before gradually tapering off to 23.3% in 2040.

China accounts for almost half of global coal consumption. The resulting emissions cause huge local air pollution problems and contribute massively to global CO_2 emissions. Chinese authorities aim to reduce the pace of coal consumption growth, but not at this stage to stabilize – let alone reduce – demand. US coal use is declining, partly because of new and tighter environmental regulations, but recently also because of the ample availability of cheap natural gas. On the supply side, Indonesia is currently the largest exporter of coal, followed by Australia. China and India, with around 20% of the world's coal reserves, will continue to consume almost all of their production at home.

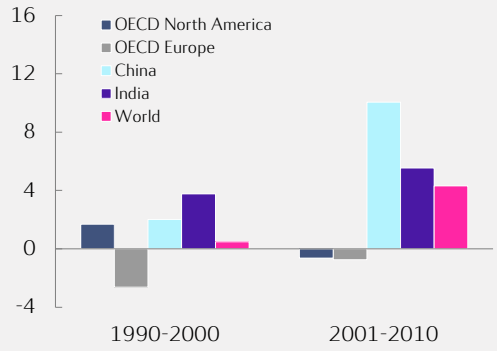
As coal reserves are abundant and coal production is relatively inexpensive, demand faces no supply constraints, Global coal use is still seen to level out in the early 2020s because of its environmental consequences. The "bite" of global climate policy regimes, and the future availability and cost competitiveness of alternatives to coal such as renewables and gas, will determine how soon coal consumption will peak and what will happen thereafter. Conceivably, carbon capture and storage could pave the way for resurgence in coal use, but for the moment a breakthrough for CCS seems a longer term possibility at best.

We believe that the combination of moderate natural gas prices and gradually tougher climate and other environmental policies, combined with higher carbon prices, will contribute to lower – in parts of the world negative - growth in coal consumption from 2020 onwards. This development will also be fostered by development of electricity production based on new renewables.

We assume that Chinese and Indian coal demand will increase annually by an average of 1.5% and 1.8%, respectively, between 2010 and 2040, and level out only towards the end of the forecast period. By 2025, emerging Asia will burn an amount of coal corresponding to 19% of total world energy consumption, and India will have surpassed OECD Europe and OECD North America to become the second largest consumer. OECD consumption – which has fluctuated around a flat trend since the late 1980s – is seen to go into long-term decline from around 2015. Also Russian coal use is seen to drop off from the middle of this decade.

Regional growth in coal demand

CAGR, %

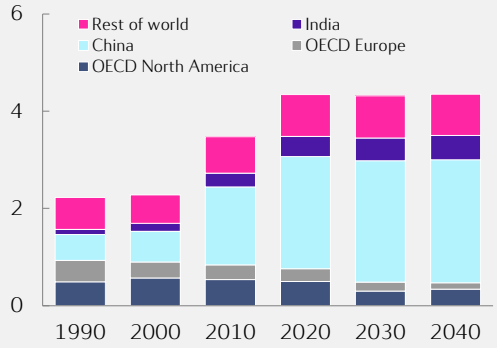


Source: IEA

Close link between coal demand and GDP growth

Regional composition of coal demand

Bn toe

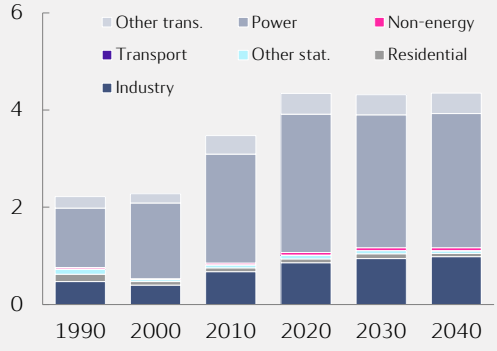


Source: IEA (history), Statoil (forecast)

Overall growth will peak and gradually decline

Composition of coal demand, by sector

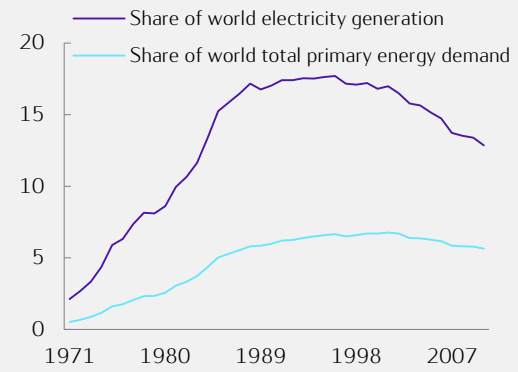
Bn toe



Source: IEA (history), Statoil (forecast)

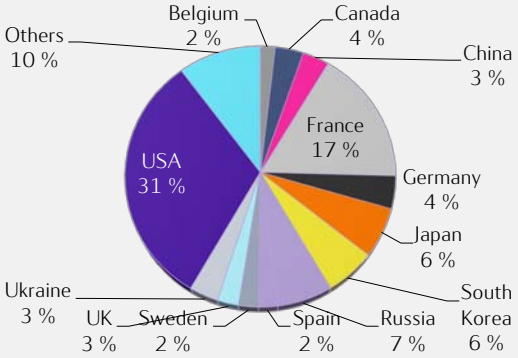
Nuclear energy in decline

%



Source: IEA

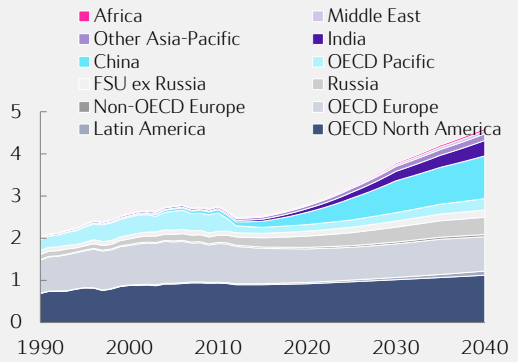
Country shares of nuclear power generation 2011



Source: World Nuclear Association

World nuclear power generation to 2040

GWh



Source: IEA (history), Statoil (forecast)

Nuclear energy - status and outlook

The US Nuclear Energy Institute reports that world wide a total of 436 nuclear power units, with a combined capacity of 372,643 MW, generated a total of 2,351 billion kWh of electricity in 2012. Other sources put nuclear power generation in 2011 at 2,518 billion kWh. Thus, it appears that the industry suffered a 6.6% set-back in 2011. Nuclear power generation has in fact declined every year since 2006 except for 2010. The share of nuclear in total world power generation has dropped from around 17.5% in the early-mid 1990s to around 12% today. Looking ahead, 66 nuclear reactors with a combined capacity of 68,309 MW are under construction, and another 160 reactors with a capacity of 176,740 MW are at the planning stage or under consideration. The latter would lift global capacity by 18% - if no existing plants are taken offline before all the new ones are put online. Since some decommissioning will take place, the net increment will be smaller. Barring major delays, we could see a growth in global capacity of only 2-3% per year over the next years.

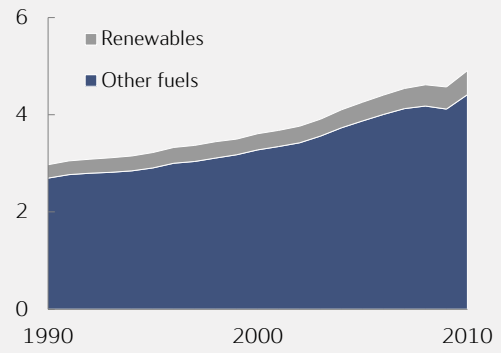
The long-term outlook for the Japanese nuclear industry remains uncertain. At the moment, only 2 of the country's 50 reactors are operating. During summer, however, the Nuclear Regulation Agency will publish revised safety guidelines, enabling the owners of idled nuclear power plants to start filing restart applications. The Abe government will be supportive. It is not clear, however, that this will be enough to ensure their passage. In the US a mix of reliability and cost concerns are holding nuclear back. Only three reactors are under construction. They will increase US nuclear power plant capacity by a mere 3.6%. Another nine reactors are at the planning stage, but whether and when they will be built, remains to be seen. Cheap gas, a stagnant electricity market and relatively low electricity prices have made the funding of new plants increasingly difficult. Doubts about the commerciality of nuclear power are also widespread in the UK.

The picture is not uniformly bleak. As indicated, the new Japanese government is markedly less anti-nuclear than its predecessor, which responded to Fukushima by promising to phase out nuclear altogether. Chinese authorities responded to Fukushima by delaying the permitting of new reactors for some months, but they remain supportive of nuclear power. 17 reactors are in operation, 28 are under construction, 49 are at the planning stage and another 120 have been proposed. Those under construction make up 30% of the number of reactors being built worldwide. Russia also aims to supply an increasing share of electricity demand from nuclear power plants. A revised energy plan published this spring foresees the construction of 33.1 GW of new power generation capacity between 2013 and 2019, one third of which will be nuclear.

IEA is concerned about the set-back for nuclear. The generation capacity additions registered since the mid-2000s have been way below those envisaged in the Agency's so-called 2-degrees scenario The jury is out on whether the public eventually will respond to global warming by embracing nuclear as a major tool in the mitigation toolbox, or continue to shun it. The jury is also out on whether improved designs and standardization will succeed in bringing construction and operating costs down. We now assume an average growth in global nuclear power generation by 1.7% per year to 2040.

Power generation

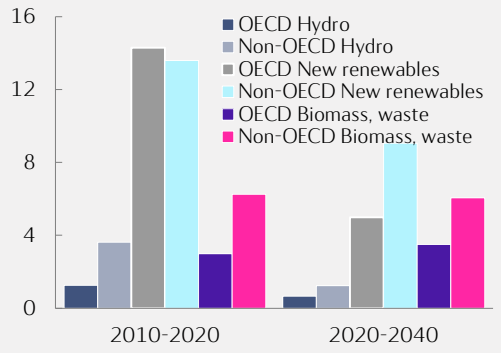
1990-2010, Bn toe



Source: IEA

Growth in renewables

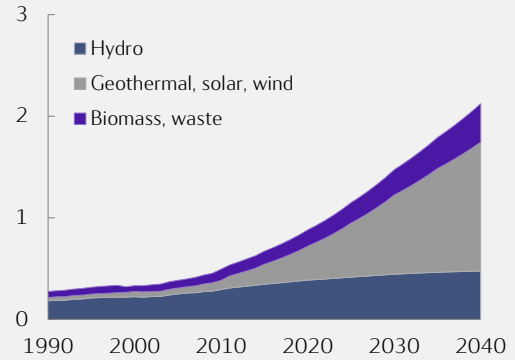
CAGR, %



Source: Statoil

Renewables in power generation

Bn toe



Source: IEA (history) Statoil (forecast)

High growth in new renewable power generation

Whereas hydro power plants continue to account for the bulk of world renewable power generation, the new renewables – mainly wind and solar – already account for significant shares of power generation in parts of the world and are coming into use everywhere else. This trend is driven mainly by the need to combat climate change, but also by countries' desire to mitigate local pollution, diversify energy supply and bring electricity to remote areas. The Fukushima disaster tilted the playing field between the zero carbon options and made wind and solar power seem even doubly attractive.

The consensus opinion which we share is that the new renewables will continue to gain power sector market share. Electricity demand growth rates have slowed due to the economic crises which began in 2008, but in the medium to long term electricity will likely grow faster than other final energy consumption, with households acquiring ever more appliances and the transport sector turning increasingly to electric or hybrid engines. These two drivers – the power sector's shift to the new renewables, and energy consumers' shift to electricity – will together support continued rapid growth in both wind and solar power generation, encourage geothermal generation wherever that is an option, and pave the way for new, as yet too expensive options, such as wave power.

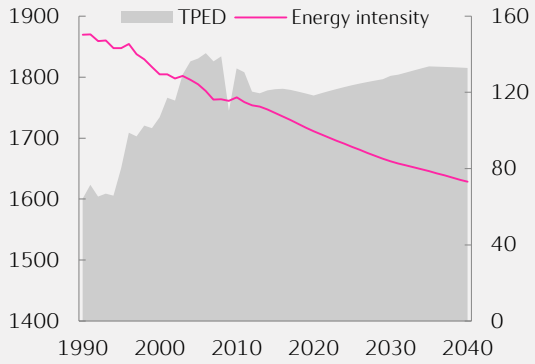
Attractive renewables on the rise

OECD Europe is expected to see the fastest growth in new renewables based power generation. These technologies, which in 2010 accounted for 5.3% of regional power generation, are by 2040 assumed to contribute almost 28%. In OECD North America the share is assumed to increase from 2.6% to 19%. In China the corresponding numbers are 1.1% and 14.5%. Hydropower will be outpaced by the new renewables by wide margins. In OECD Europe wind power, solar power etc. are by 2040 seen to be twice as important as hydropower.

However, many downside risks remain. Increasing shares of intermittent power put power grids to severe tests. Since the wind does not always blow and the sun does not always shine, and since electricity cannot easily be stored, there will be a need for massive investments in backup thermal power generation capacity that can be quickly ramped up and down, investments in interconnecting power lines that can carry electricity between surplus and deficit areas and/or investments in smart grids ensuring demand side flexibility. These investments need to be carried out in a timely manner. If they fall behind to the point of causing grid breakdowns and power supply shortages in the deficit areas, the new renewables could quickly become discredited.

Another issue is that since the build-out of new renewables based power generation capacity proceeds at different speeds in different countries, and since the new renewables still require subsidization that in turn drives electricity prices, the front-runners risk problems with their international competitiveness. This is being felt in EU and could put a damper on the front-runners' will to continue leading the way. Renewables cost declines may eventually solve this problem, but so-called grid parity is not an imminent prospect for the most expensive of the new renewables.

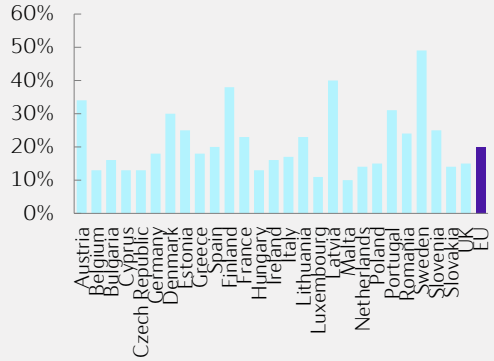
Past and assumed future changes in OECD Europe's primary energy demand and energy intensity
Ktoe (thousands), toe/million 2005-USD (rhs)



Source: IEA (history), Statoil (forecast)

Energy demand in Europe on a downward trend since 2006, although GDP has increased

EU member countries' renewables 2020 targets



Source: EU Commission

EU's renewables targets for 2020 have played an important role in shaping Europe's fuel mix; the energy efficiency targets have proven less effective

Special topics

European energy developments

Whereas the US energy market "story" is one of booming shale gas and oil supplies, and the Asian market story is one of relentlessly growing demand, it is harder to see the European story. Falling indigenous oil and gas production, continuous economic crisis, low or negative energy demand growth, planned and unplanned fuel mix changes driven by policies and changing economic and energy realities, and emerging doubts about the consistency of Brussels's 2020 targets and EU's stamina as a global climate policy frontrunner, divergent policy priorities both within EU, within many member states and between Brussels and national capitals. The smokescreen Europe presents to energy market analysts is thick.

IEA puts OECD Europe's primary energy demand growth in 2011 at minus 3.7%. IEA has recorded energy consumption growth for over 40 years and only once before, in 2009, did it register an even bigger set-back for European demand. IHS Global Insights puts OECD European economic growth in 2011 at 1.8% in real terms. Thus it appears that OECD Europe in 2011 managed to reverse the normally positive link between economic growth and energy demand growth.. This could have been a one-off event related to the weather, but energy demand has trended down, while GDP has grown in Europe almost every year since 2006.

Whether energy efficiency policy has been a major factor is, however, also a moot point. Europe's energy intensity has declined at a fairly steady pace since 1971. Energy policy priorities have changed many times, with interest in energy efficiency flowing and ebbing over this period. However it is hard to detect the impacts of these changes in the data.

In recent years, policies have been influenced by the EU's 20-20-20 targets. These targets say that by 2020, EU must reduce its greenhouse gas emissions by 20% relative to 1990 levels, and raise the share of final energy consumption produced from renewables to 20%, and should increase energy efficiency by 20%. The renewables target was transformed into binding national plans and has proven effective. The efficiency target was not given mandatory status and was formulated in such a way – countries were to cut energy consumption relative to a business as usual-forecast that quickly became outdated because of the financial crisis – that it has had less of an impact. In 2012, EU adopted a binding energy efficiency directive to bring member states back on track.

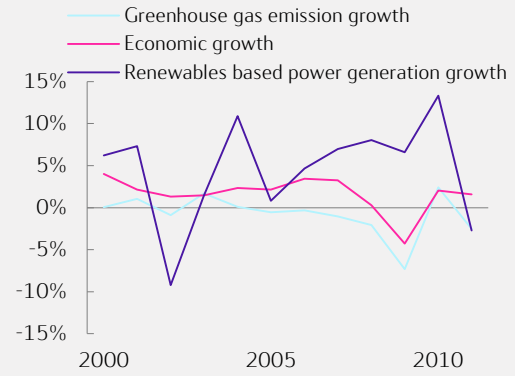
The "flagship measure" among EU's climate policies is the EU Emission Trading System (EU ETS). It was premised on the idea that setting a price on carbon emissions would incentivise fuel switching and energy efficiency improvements and thereby deliver reductions in emissions in a market-based and cost-effective manner. Part of the revenue generated by this system was to be set aside for investment in R&D and new technologies. However, after a promising start, the emission allowance spot price dropped to EUR 15-20/ton CO_2 in 2009, EUR 5-10/t in 2011 and below EUR 5/t towards the end of 2012. The main problem is that the supply of allowances to the market was decided in advance and has been kept fixed. Following the drop in demand triggered by the economic crisis, the market found itself to be oversupplied.

EU ETS price, May 2008 - May 2013
Euro/ton CO_2

Source: Thomson Reuters

The proposal to prop up the EU ETS price by delaying the auctioning of 0.9 billion emission allowances was voted down

EU 27 greenhouse gas emissions and select drivers



Source: IHS Global Insight, IEA

The ETS works in a technical sense, but does not incentivize fuel switching and investments in clean energy technologies

In 2012-13, the European Commission has strived to prop up the EU ETS price by attempting to delay the auctioning of 0.9 billion allowances from the near term to 2018-20. It was hoped that this would restore some confidence in the EU ETS and allow it to function until longer term solutions could be put in place. In the end, the European Parliament in April refused to acknowledge the Commission's right to shift the auctioning of allowances to later dates. The ETS price promptly fell to an all-time low, and in May 2013 it averaged EUR 3.50/t. The "backloading" proposal is to be voted on again during the summer of 2012.

The EU ETS functions insofar as it provides a price that correctly reflects the allowance supply-demand balance. It is not the market's fault that this balance for the moment does not support a higher price. Critics of the Commission's proposals to withhold supply and change the rules of the price formation game emphasize this. They warn that tampering with the market to force it to provide a more expedient price signal in the short term could erode confidence in it in the longer term. The Commission and others reply that the EU ETS was established for a reason, not only to function in a technical sense. Since a price of EUR 3-4/ton has hardly any impact on fuel mix and investment decisions, and since incentivizing better decisions is an urgent matter, the system cannot be said to work and should not be left to itself.

Whereas the UK has taken the matter into its own hands by introducing a carbon floor price, the Commission has published ideas for deeper structural reforms of the EU ETS including, among other things, to raise the annual emission reduction factor or include more sectors in the system. Another debate is underway on the formulation of emission, renewables and efficiency targets for 2030 to be used for checks of compliance or non-compliance with the Commission's longer-term energy visions laid down in its Energy Roadmap 2050 scenarios.

An argument often used by NGOs and green politicians is that encouraging a bigger and more permanent role for gas in European power supply will lock in CO_2 emissions at an unsustainable level. To this the gas industry and many other have replied that opting for renewables plus energy efficiency policies only runs the risk of sacrificing major short- to medium-term cuts in emissions at the altar of an imagined, desirable, but arguably unrealizable long-term state of the European energy system. A better solution could be to go for gas now with a view to retrofit all fossil fuel fired power plants with CCS at a later stage when that technology becomes commercial.

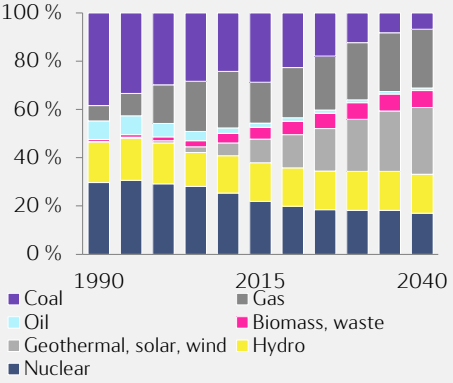
While the outlook for gas fired power generation is uncertain, the European Commission is pressing ahead with other initiatives that could pave the way for gas penetration in the transportation sector. A directive released in January 2013 mandates the construction of infrastructure to facilitate a gradual conversion of road, marine and to some extent air transportation from gasoline, diesel, etc. to alternative fuels including LPG, gas, electricity, biofuels and hydrogen. It is too early, the directive argues, to formulate precise transportation sub-sector fuel mix targets, since the technologies involved are not fully optimized. However, the Commission proposes that member states install LNG refuelling facilities for the heavy trucks travelling Europe's highways at intervals not exceeding 400 km, and provide for LNG refuelling possibilities in Europe's main ports. It also recommends to establish CNG refuelling points at

The Nabucco and TAP pipeline routes

Source: BP

The transportation sector's fuel mix is coming into policy focus

Assumed technology and fuel shares of power generation in OECD Europe



Source: IEA (history), Statoil (forecast)

Diversifying Europe's gas imports and improving the interconnectivity of Europe's gas and power grid are other important policy areas

distances not exceeding 150 km, and that member states where hydrogen vehicles are already in use shall build out networks of filling stations not further apart than 300 km. The directive finally recommends a lower limit of 8 million for the number of electric vehicle. recharging points in Europe, one tenth of which should be publicly available.

EU's and many European countries' interest in broadening the transportation sector's fuel mix is driven not only by emission worries but also by more general considerations. Europe is becoming increasingly reliant on imported oil supply. High oil prices and the fact that major shares of this oil come from unstable regions raise both economic and fuel supply security issues. Europe needs to import more and more of its gas supply too, but faces a different set of suppliers and trade routes for gas than for oil, and there are hopes that shale gas in the long term will add materially to indigenous supply. LNG as a vessel and truck fuel could also cut transportation costs and boost Europe's competitiveness. Thus some gasification, in addition to the ongoing electrification, of the transport sector could kill several birds with one stone.

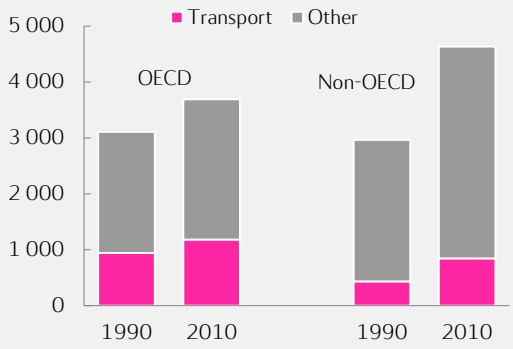
Policies to incentivize substitution from other fuels to gas are accompanied by policies to broaden Europe's base of gas supply sources and import routes, as well as steps to strengthen the region's gas and power grids, improve their interconnectedness and facilitate gas and power exchanges across borders. Efforts to make more supply available to Europe have focused on, among other things, opening a "Southern corridor" for Caspian and potentially Central Asian and/or Middle Eastern gas imports. A decade long rivalry between various consortia aiming to build pipeline systems from Azerbaijan via Turkey to Southeast Europe could come to an end in 2013, with the Shah Deniz field owners declaring either the Nabucco or the TAP proposal the winner.

EU's attempts to assess Europe's future needs for Caspian gas, and mobilize support for the Southern corridor, are complicated by Russia's plans to build a giant pipeline of its own across the Black Sea to southeast Europe. It is difficult to see the market supporting the construction of several major new import pipelines into the same parts of Europe in the same short-medium term timeframe.

This year's Energy Perspectives puts Europe's primary energy demand growth between 2012 and 2040 at 0.2% per year. The European OECD member countries' demand is seen to increase by only 0.1% per year. The rest of Europe will see faster growth, we assume an annual average of 1.6%. OECD Europe is expected to continue supporting renewables, with the combined hydro, wind, solar, geothermal and waste share of total power generation doubling from around 25% to more than 50%, and the coal share falling from around 30% to some 7%. The nuclear share of power generation is projected to decline from its 2010 level of 24%, but is still close to 17% by 2040. Gas' share of the fuel mix in the power sector drops sharply, but recovers gradually, and the gas share of total primary energy demand is, at 28.6%, three percentage points higher in 2040 than in 2010.

Final energy consumption

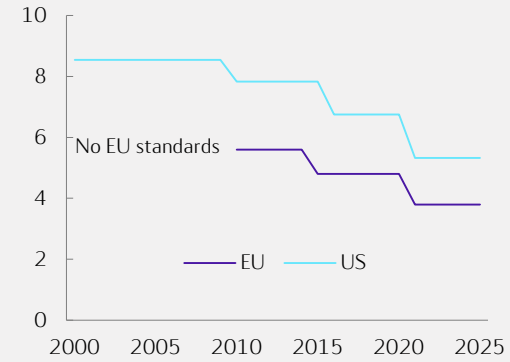
By sector, mtoe



Source: IEA

Fuel efficiency of new passenger vehicles

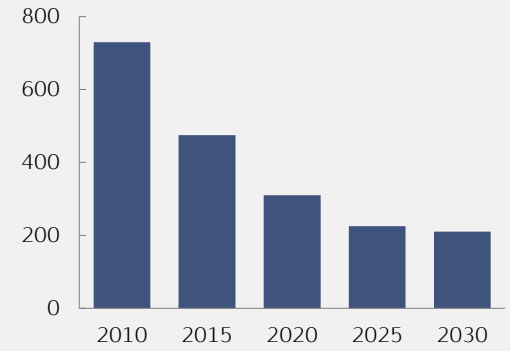
Performance standards, L/100km



Source: NHTSA, European Commission, Statoil

Battery costs

USD per kWh/ pack



Source: Element Energy

Energy use in transportation – oil is loosening its grip

Rising demand for mobility and goods transportation

Over the last two decades, global energy demand in the transportation sector has on average increased by 2.0% annually, which is significantly stronger than the 1.5% rise in total final energy demand (TFE). Its share of TFE has increased both in the advanced and in the emerging economies, a reflection of the underlying, solid demand for individual mobility and for goods transportation, nearly at all stages of the income development. More than 90% of the energy use is consumed in road transportation. Oil has traditionally had a monopoly position in the road sector, in domestic and international aviation and in marine transport. Coal and electricity have played a larger role in the rail sector.

Three forces: policy, technology and markets

The future structure of the emerging economies, including the trends towards urbanisation, is an overriding determinant of the future energy use in transportation. Furthermore, the steady rise in production and income levels in all regions will continue to stimulate energy demand. However, several counter-forces will increasingly dampen the growth rates of energy use, and especially oil use, in all regions:

- Overall transport and regional policies aiming to move travel from individual, and less energy effective transportation, to public and more energy effective modes of transportation.
- Technology improvements and policies to enhance the engine efficiency of all types of vehicles and carriers, and to stimulate the use of alternative technologies, including hybrids, plug-in hybrids (PIH) and full-electric vehicles (FEV).
- Market-driven penetration of natural gas in some segments and regions.

Thus, the outcome of these opposing drivers will eventually determine the total energy use and energy mix in transportation.

The dual effects of standards – efficiency and alternative engines

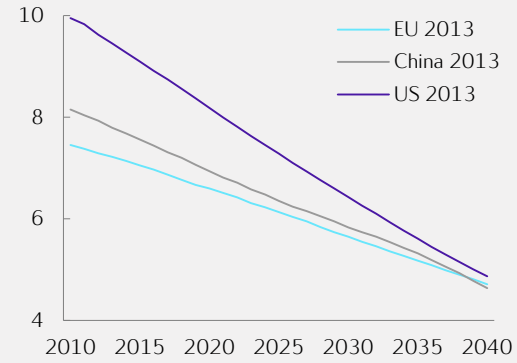
Fuel efficiency and/or emissions standards have been introduced in all major economies, including the US, EU and China. The corporate standards require that the average efficiency, and the corresponding CO_2 emission levels, of the models of an automaker, have to comply with the adopted standards. The EU emission standards require that new passenger cars to be sold in 2015 on average emit a maximum of 130 grams of CO_2 per km (5.3 l/100 km). It has been proposed to tighten the standards to 95 g/km by 2020 (3.8 l/km) and further to 60-75g/km by 2030. Since the efficiency improvements of internal combustion engines (ICE) ultimately reach its limitations, passenger vehicles with alternative engine technologies gradually must be marketed and actually sold in order for the automakers to comply with standards. Thus, the timing of tighter performance standards simultaneously give directions on the timing and size of the penetration of alternative technologies, like hybrids, PIHs and FEVs. Within this policy context, consumers' preferences about vehicle size, engine technology and other attributes also play a role.

Steady tightening of the performance standards in all markets

In the US, the joint efficiency and emissions standard for new cars and trucks for model year 2015 is currently 160 g/km. The Obama

Fuel efficiency

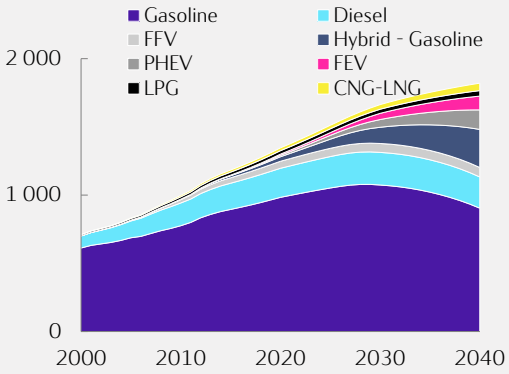
L/100 km



Source: Statoil

Vehicle Fleet Composition

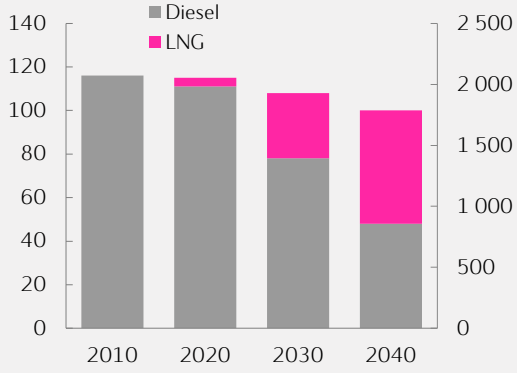
Millions



Source: Statoil

US fuel demand

Heavy trucks, bcm (lhs), kbd (rhs)



Source: Statoil

administration has for the period 2017-2025 proposed to tighten the standards further to 125 g/km, equivalent to 5.6 l/100 km for gasoline cars. As discussed in the oil market chapter, the US oil imports position improves dramatically, which potentially could reduce the incentives for further energy and oil savings. However, broader energy and climate concerns suggest that the mandated performance standards will be steadily raised over the next decades. A parallel development is assumed in China and gradually also in the other, larger emerging economies.

Gradual penetration of hybrids and electric vehicles

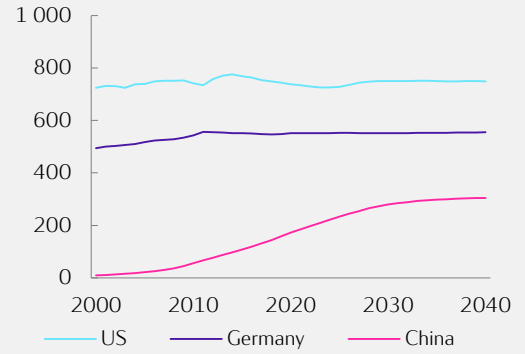
The US has the largest fleet of hybrids, PIHs and FEVs today, with cumulative sales since the mid-2000 of more than 2 million vehicles, but almost entirely dominated by hybrids. After a setback during the economic recession, the market shares of hybrids have since risen and reached 3.5% of total low duty vehicle (LDV) sales in 2012. Due to the higher level of retail fuel prices and the popularity of diesel vehicles, the European LDV market generally consists of smaller and more efficient vehicles, which have made it more challenging for hybrids to compete. Hybrids and FEVs had a market share in 2012 of only 1.1% and 0.2%, respectively. Despite China's ambitions to increase the sales of fuel efficient cars, the sale of hybrids, PIHs and FEVs has so far been modest. Payback calculations for hybrids and electric vehicles show that most of these cars are still not fully cost competitive at current oil prices. However, declining prices for batteries and electric engines are steadily reducing payback periods. Together with the assumed tightening of performance standards, the market shares of hybrids and PIHs are expected to rise gradually through the 2020s. In North America hybrids will probably remain the most popular unconventional model, while the more densely populated European market, where range is less critical, probably will see a larger share of FEVs compared with the US market. In China, there has been an intense debate among governmental agencies about the strategic directions for future car technologies. After some years with strong emphasis on FEVs, the consensus view now appears to be to strive for a diversified portfolio of efficient engine technologies. By 2040 more than half of the world's LDV fleet will still be powered by gasoline and diesel cars, while the rest is expected to be hybrids and other engine technologies.

LNG will make inroads in the heavy duty segments

The largest potential for gas penetration in the road sector is in the heavy duty truck segment (class 8 trucks) of the US market. Currently the 2.6 million long-haul trucks consume about 2 mbd of diesel or close to 60% of total US diesel demand. The use of LNG, which is the main alternative, is currently modest. However, the wide price spread between diesel and LNG encourages truck owners to switch to LNG and industrial players to develop a retail network. Based on the expected price differential between diesel and gas prices, most LNG truck cases have a payback period of less than three years, a generally accepted payback period in the industry. Several companies have announced plans to develop networks along the interstate highway system. The chicken and egg situation, where truck owners and retailers are waiting for each other, will most likely, driven by the strong price incentives, result in a gradual development of networks and rising market shares of LNG-powered trucks. Through the next decades, the loss of diesel demand could be around 1 mbd and the gain of natural gas demand about 60 bcm.

Vehicle density

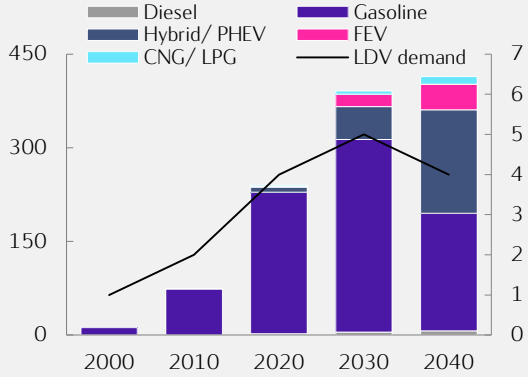
Vehicles/1000 people



Source: Statoil

China LDV fleet

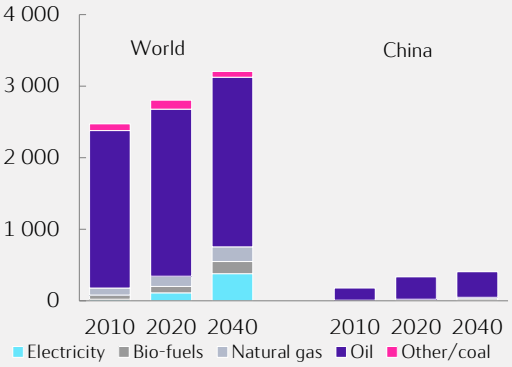
Million cars (lhs), oil demand mbd (rhs)



Source: Statoil

Energy use in transportation sector

mtoe



Source: IEA (history), Statoil (forecast)

In Europe and China, the drivers and uncertainties are different, but a similar development is expected also in these markets. In Europe, a network of EU supported filling stations is expected to be in place by 2020, and the economic benefits most likely lead to a rapid growth in the market share of LNG. In China, a large LNG network is already in place, and the economics for both truck owners and suppliers are favourable.

China's transport sector energy use is highly uncertain

Driven by the exceptional rise in Chinese GDP and income levels over the last two decades, total energy demand in the transportation sector has risen from a modest 38 mtoe in 1990 to more than 200 mtoe in 2012, As an integrated part of the growth process, China has experienced a formidable urbanisation and build-up of new mega-cities. Together with rising incomes and annual increases in the car sales of more than 10% in recent years, these trends have led to severe rush-hour traffic jams and a dramatic deterioration in local air quality. On 12 January this year Beijing saw a reading of 755 on the Air Quality Index, where 100 is regarded as "unhealthy for sensitive groups" and 500 "hazardous for all". As a response, a growing number of cities have introduced registration restrictions for new cars. In Beijing a maximum of 240,000 new registrations is allowed each year, and in Shanghai less than half of that.

Looking ahead, private ownership and distances travelled per vehicle are key drivers behind future energy use in this sector. Regarding car ownership it is generally believed that China will move towards a significantly lower level of ownership than the US and European levels of slightly more than 700 and 500 vehicles per 1,000 inhabitants respectively, perhaps into the 250-350 range. Due to infrastructure bottlenecks and environmental concerns, the distance travelled per vehicle will probably fall from the current level of about 15,000 to 9,500 kms per year. Given the lack of visibility about transport and energy policies in China in the future, these assumptions are highly uncertain.

Chinese authorities have also set ambitious targets for developing alternatives to the ICE engines. As part of the latest five-year plan released in 2011 it announced that China will invest 16 billion USD in new energy automobile industry to make China become the largest production country for new energy vehicles. In the passenger vehicle segment, the primary focus is on battery technology, but more diversified.

Natural gas penetrating international bunkers in shipping

During the forecast period, we also foresee that natural gas will gain market shares in international shipping, reaching some 10% of total energy use in international bunkers, equivalent to some 60 bcm.

Rising mobility compensate for higher efficiencies

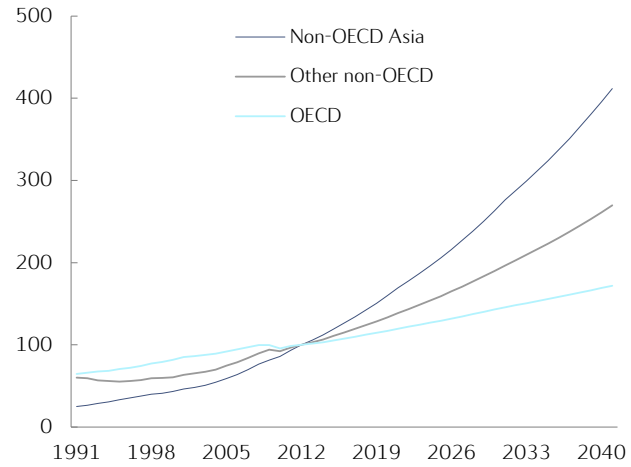
Towards 2040 the net effect of all these forces leads to a continued, although decelerating growth in the energy demand of the world's transportation sector. China and generally the emerging markets will experience the strongest growth, driven by the rising demand for mobility and continued preference for passenger vehicles. The more aggressive regional policies to redirect travel from road to rail and to public means of transportation, and enhanced efficiency, are not sufficient to arrest the underlying growth. However, due to the increasingly stronger penetration of alternative vehicle technologies oil demand in the world's transport sector is projected to reach a peak around 2030.

Chart appendix

Economic growth

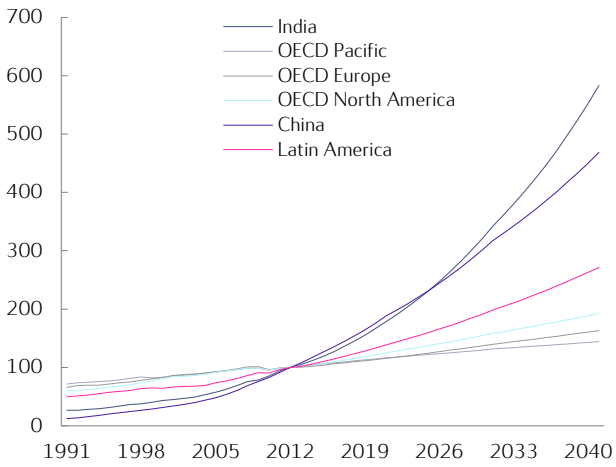
World GDP levels 1991-2040

Real, index, 2012 = 100



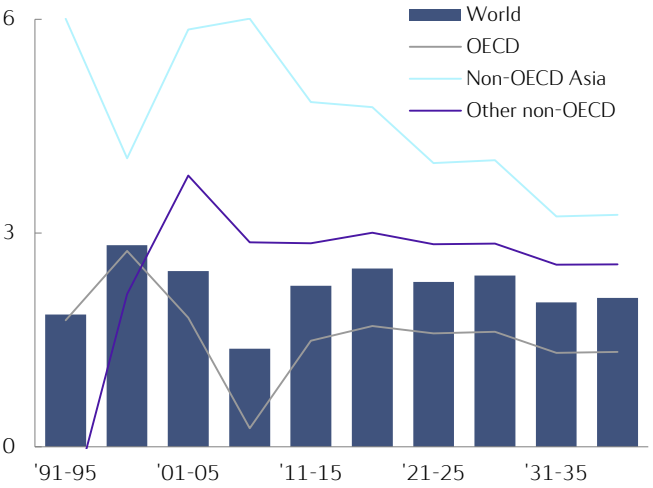
World GDP levels 1991-2040

Real, index, 2012 = 100



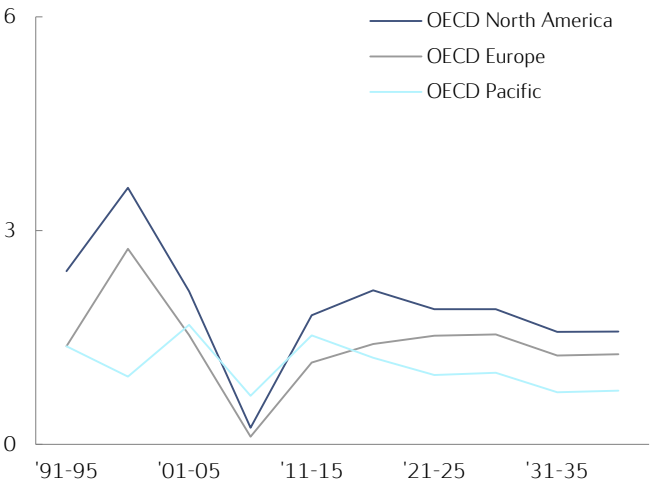
World GDP 1991-2040

5-year annual growth rate (CAGR), %



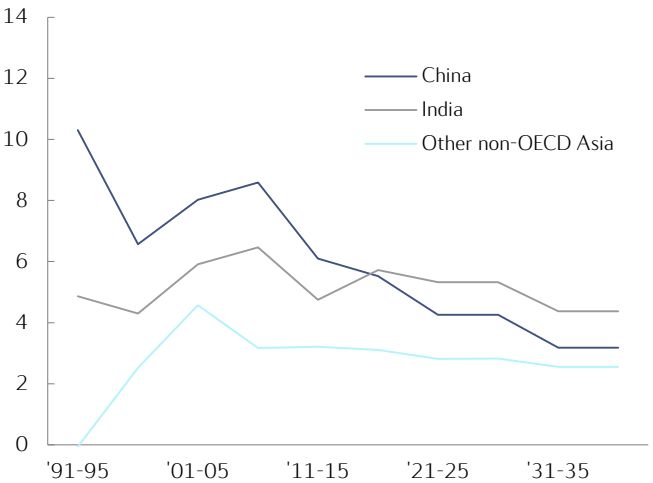
OECD GDP 1991-2040

5-year annual growth rate (CAGR), %



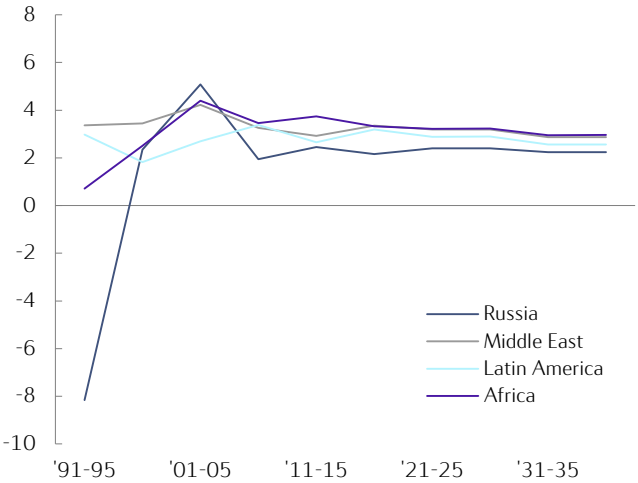
Non-OECD GDP 1991-2040

5-year annual growth rate (CAGR), %



Other countries/regions GDP 1991-2040

5-year annual growth rate (CAGR), %

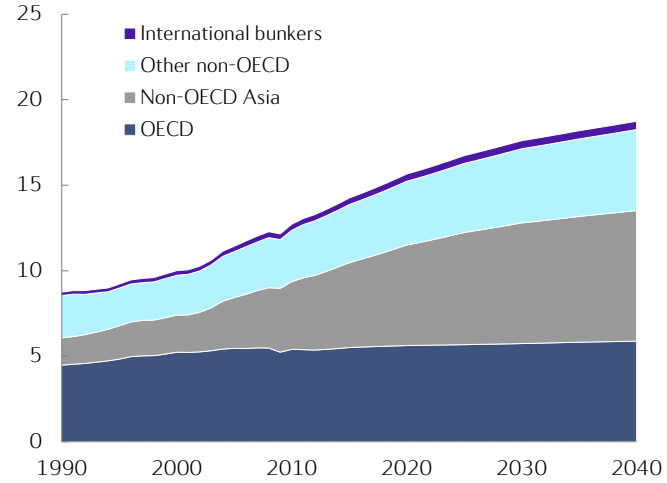


Source: IHS Global Insight (historical figures), Statoil (forecast)

Global and regional energy demand

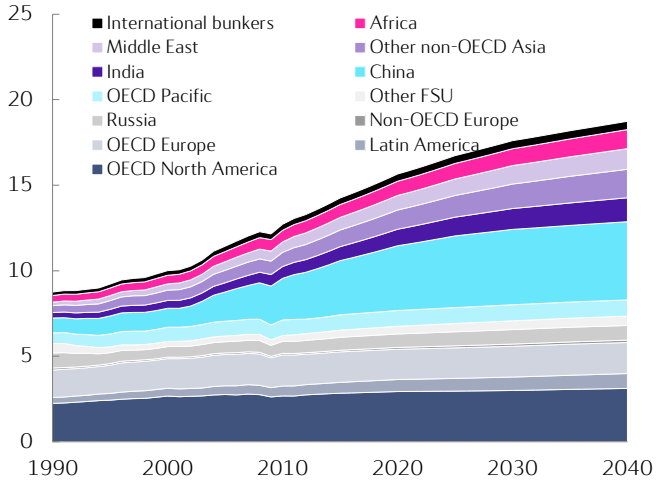
World energy demand 1990-2040

TPED, bn toe



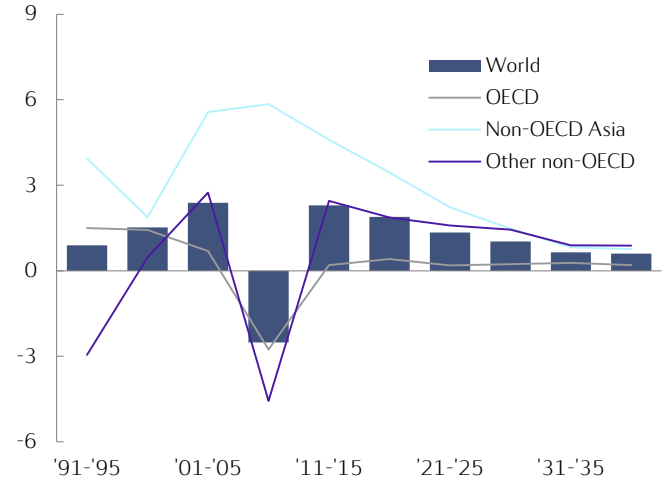
World energy demand 1990-2040

TPED, bn toe



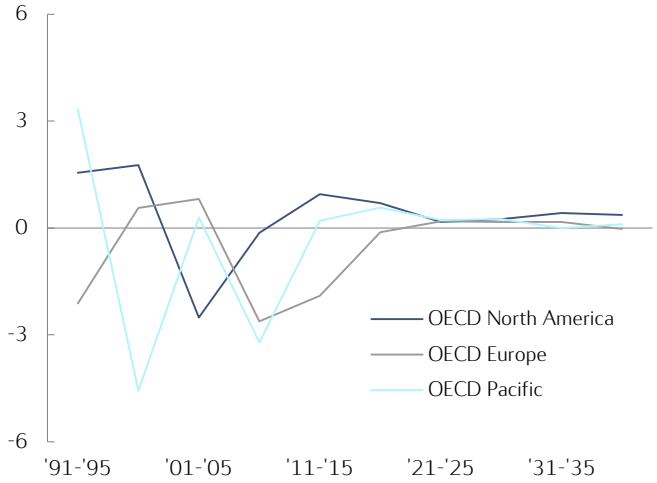
World energy demand 1991-2040

5-year annual growth rate (CAGR), %



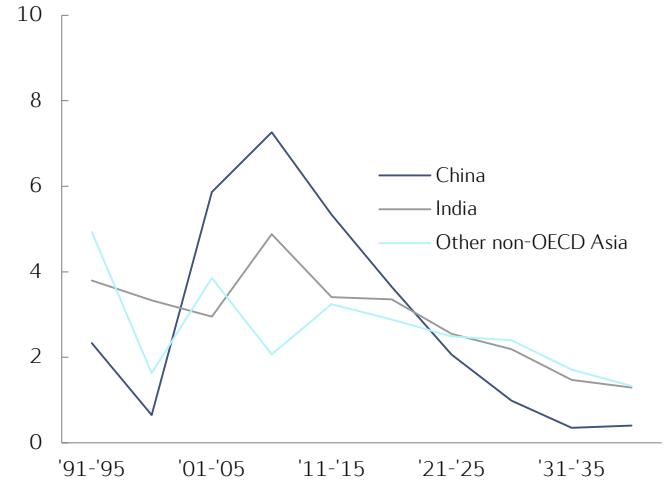
OECD energy demand 1991-2040

5-year annual growth rate (CAGR), %



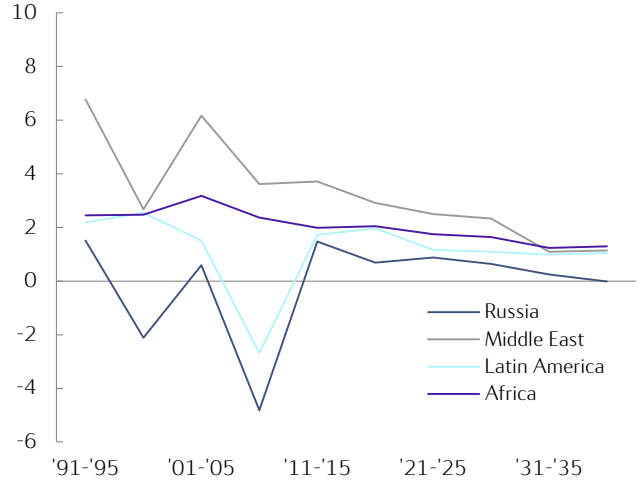
Non-OECD Asia energy demand 1991-2040

5-year annual growth rate (CAGR), %



Other countries/regions energy demand 1991-2040

5-year annual growth rate (CAGR), %

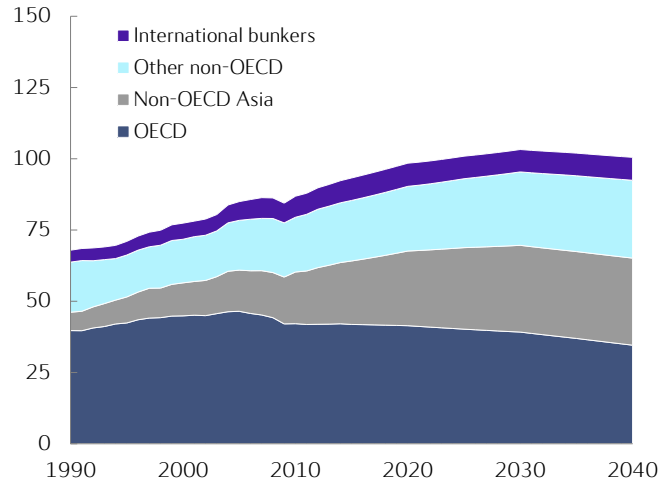


Source: International Energy Agency (historical figures), Statoil (forecast)

Global and regional oil demand (excl. bio-fuels)

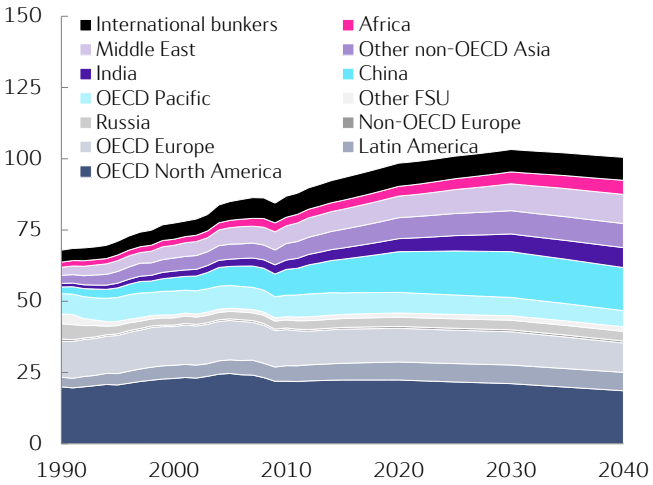
World oil demand 1990-2040

Million barrels per day



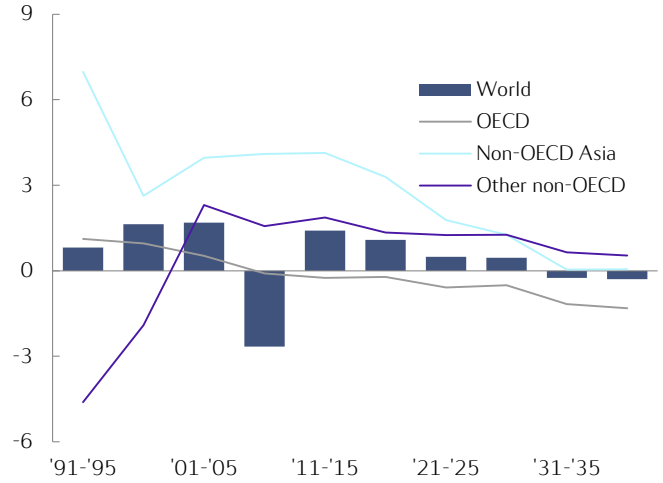
World oil demand 1990-2040

Million barrels per day



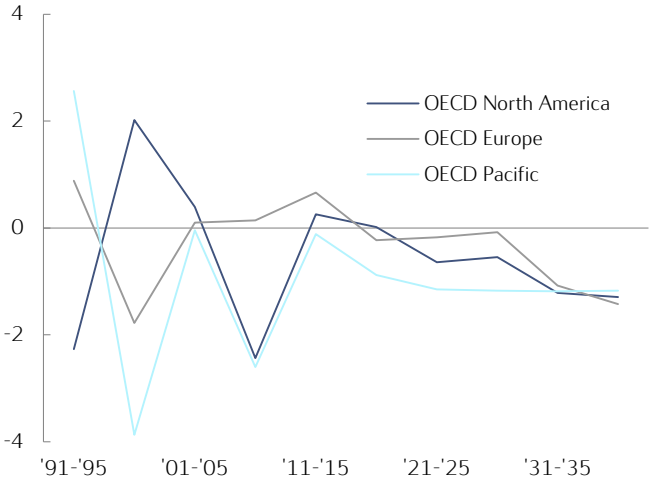
World oil demand 1991-2040

5-year annual growth rate (CAGR), %



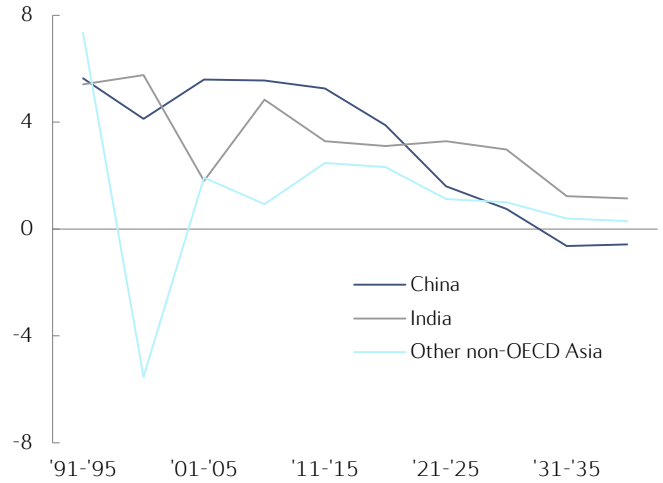
OECD oil demand 1991-2040

5-year annual growth average (CAGR), %



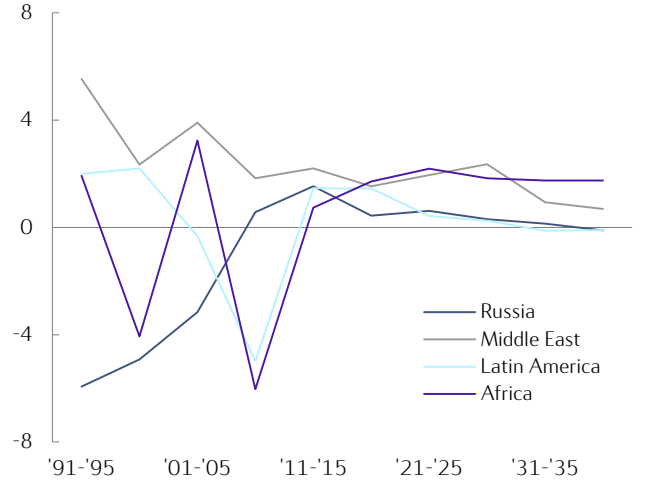
Non-OECD Asia oil demand 1991-2040

5-year annual growth average (CAGR), %



Other countries/regions oil demand 1991-2040

5-year annual growth average (CAGR), %

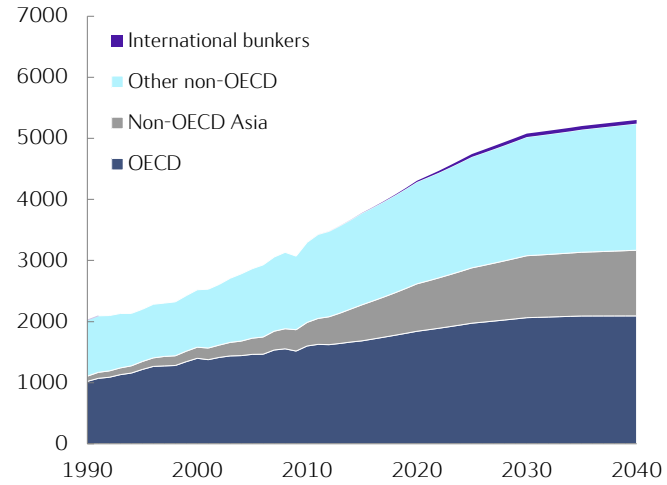


Source: International Energy Agency (historical figures), Statoil (forecast)

Global and regional gas demand

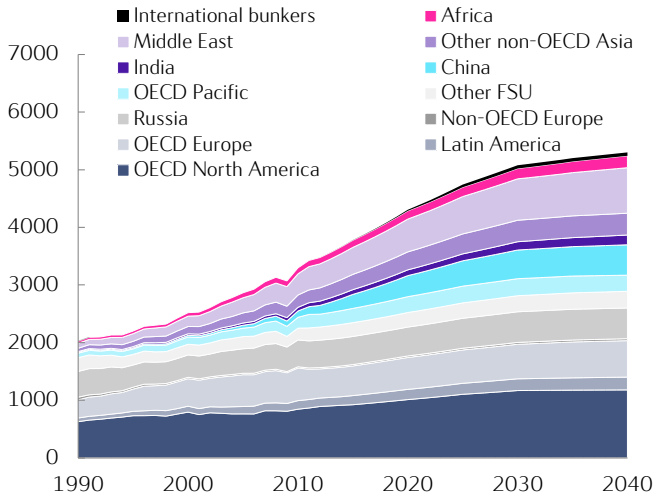
World gas demand 1990-2040

Bcm



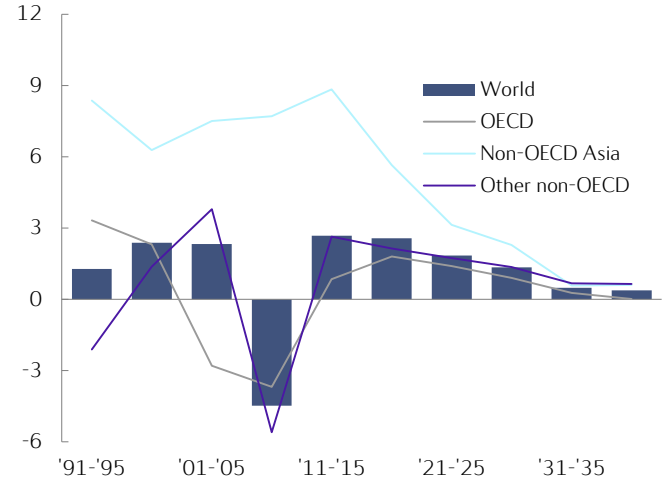
World gas demand 1990-2040

Bcm



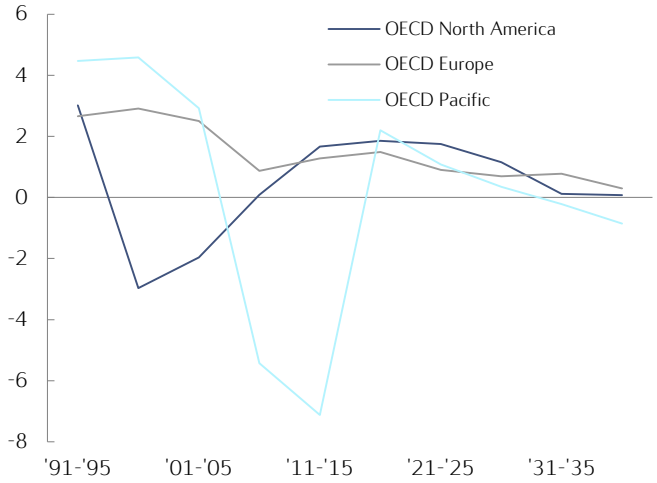
World gas demand 1991-2040

5-year annual growth average (CAGR), %



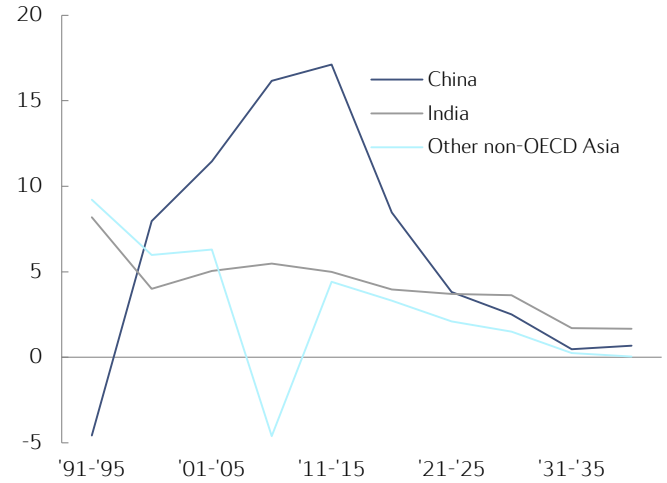
OECD gas demand 1991-2040

5-year annual growth average (CAGR), %



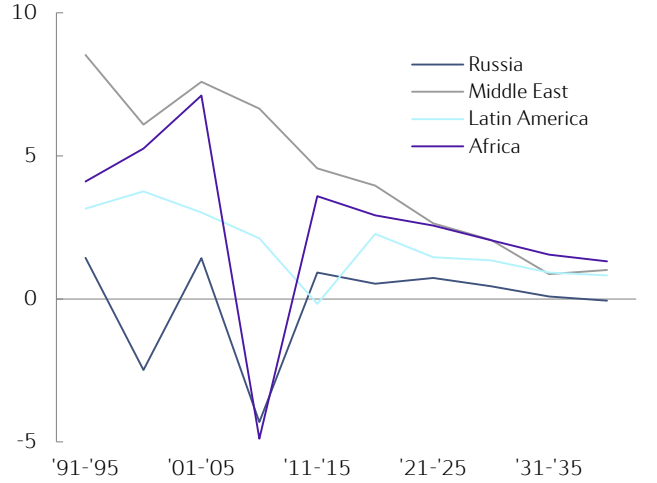
Non-OECD Asia gas demand 1991-2040

5-year annual growth average (CAGR), %



Other countries/regions gas demand 1991-2040

5-year annual growth average (CAGR), %

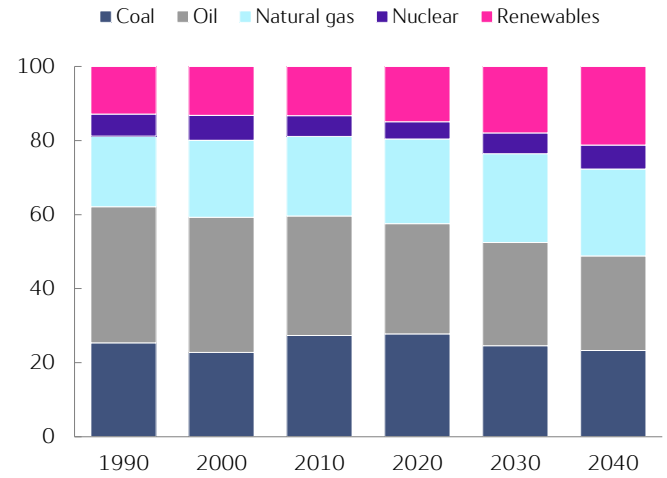


Source: International Energy Agency (historical figures), Statoil (forecast)

Global and regional energy mix

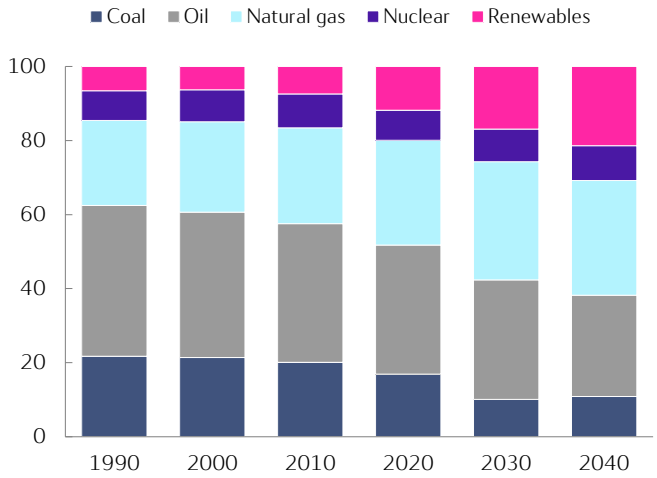
World energy mix

Share of total energy demand (TPED), %



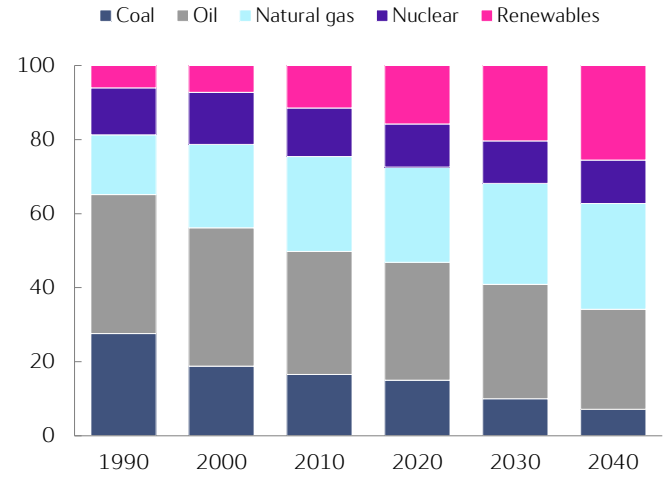
OECD North America: Energy mix

Share of total energy demand (TPED), %



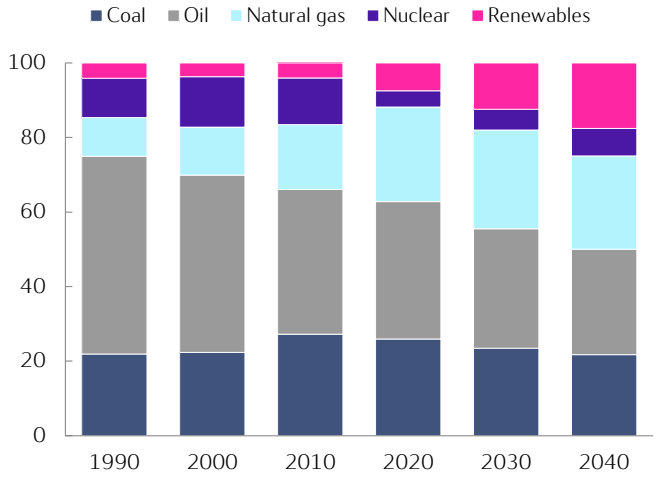
OECD Europe: Energy mix

Share of total energy demand (TPED), %



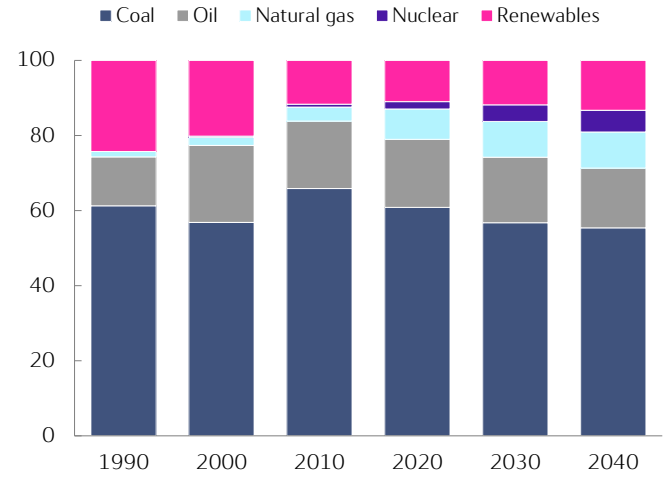
OECD Pacific: Energy mix

Share of total energy demand (TPED), %



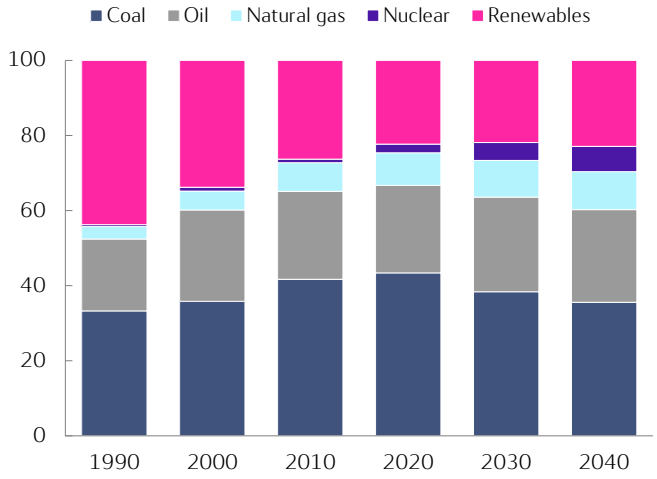
China: Energy mix

Share of total energy demand (TPED), %



India: Energy mix

Share of total energy demand (TPED), %

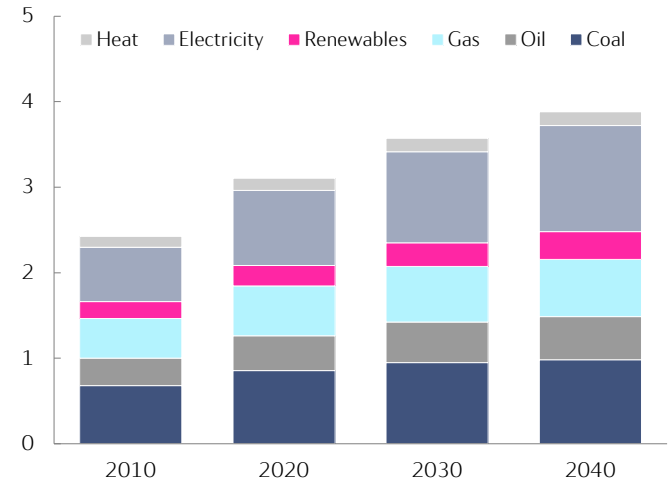


Source: International Energy Agency (historical figures), Statoil (forecast)

Sectorial energy mix

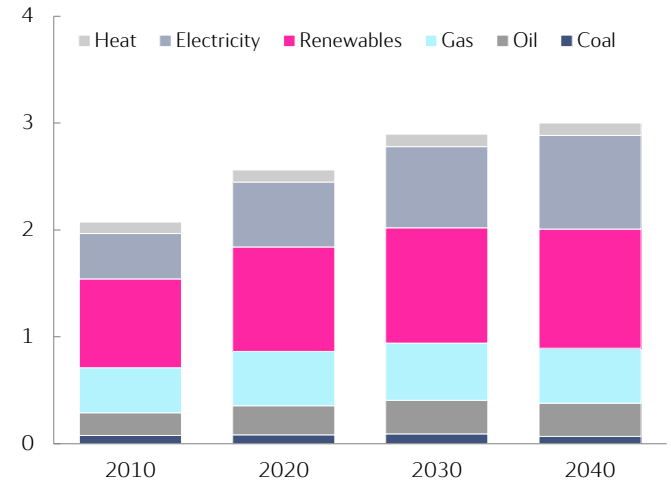
Industry

Bn toe



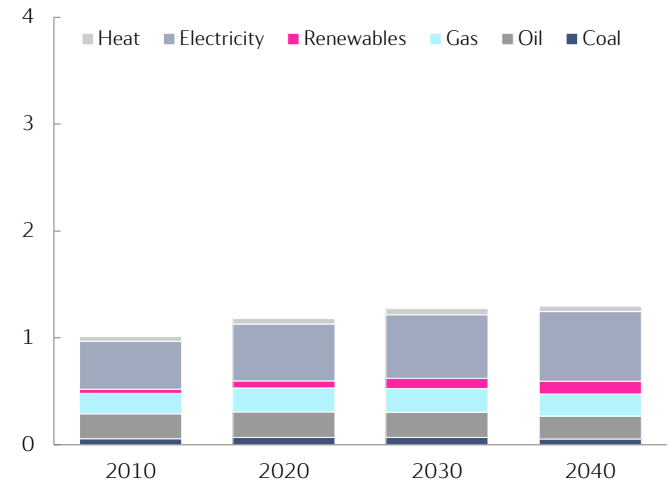
Residential

Bn toe



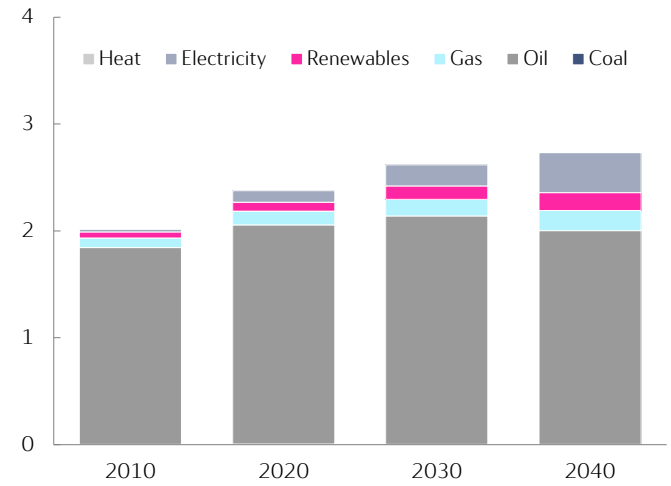
Other stationary

Bn toe



Transport

Bn toe



Non-energy

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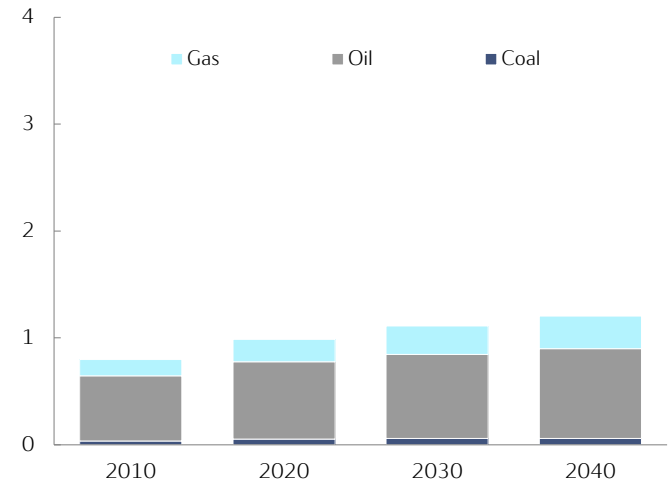
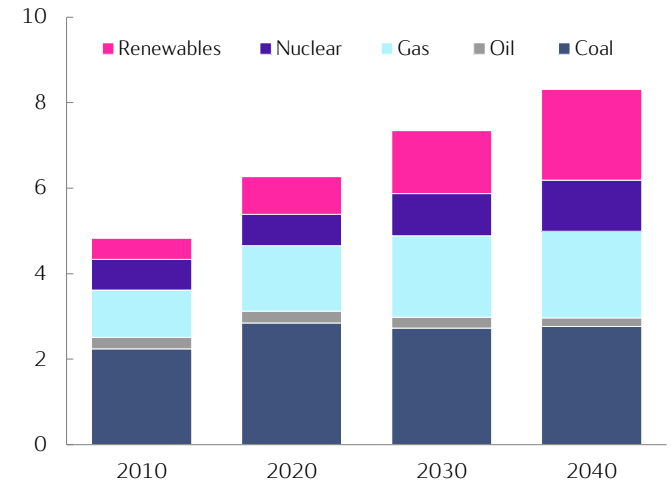


Power

Bn toe



Source: International Energy Agency (historical figures), Statoil (forecast)

Energy Perspectives 2013

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