

# Recession and Recovery: Lessons From the 2010 BP Statistical Review of World Energy

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## Introduction

2009 was a year of recession and of tentative recovery, with global energy demand falling sharply. And while individual fuel markets each have a unique story to tell, there is also a larger underlying theme: The global economy continues to undergo rapid structural change, with large swaths of the world aspiring to catch up to the income level of the OECD. Access to energy lies at the heart of this transformation. Energy data - more so perhaps than many macroeconomic indicators - show just how far we have come in this process and that the recession and recovery from 2007 to date did not interrupt this transformation. The following is a summary of the findings of the 2010 Statistical Review of World Energy, a rigorous and objective review of last year's energy data. We address the major theme of last year - recession and recovery - before turning to individual fuel markets.

## Recession and Recovery

On the face of it, the world is coming out of recession.

After the financial crisis escalated in the summer of 2008, GDP across the world fell 4% from peak to trough. It was, as has so often been repeated, the first global decline since the Second World War. Governments the world over had to deploy all the policy means at their disposal to stop it. And so they did.

Underneath these turbulences, the world's growth centres continued to shift. Asia is leading the recovery. China's stimulus package was of enormous importance in stabilizing global demand. The fiscal deficits in major OECD economies threaten their growth prospects. And after all, a deep recession has successfully been avoided in large non-OECD countries, most notably in China and India.

The current recovery takes place in the midst of deep structural change, with many industrializing countries aspiring to catch up with the income levels of mature economies. The global re-allocation of energy resources supporting this process is proceeding apace. In 2009, it accelerated.

Annual data for 2009 averages periods of growth and decline but still, it reflects the force of the underlying shift. In 2009, the global economy contracted by 2% - with the OECD falling by 3.4%, and the non-OECD rising by 2.4%.

Primary energy consumption throws this pattern into sharper relief. Global primary energy consumption also fell - by 1.1%, the first decline since 1982. In volumetric terms, this was the largest decline in our data (which goes back to 1965). OECD energy consumption fell by 5% - more than its decline in GDP. Non-OECD consumption rose by 2.7% - more than its increase in GDP.

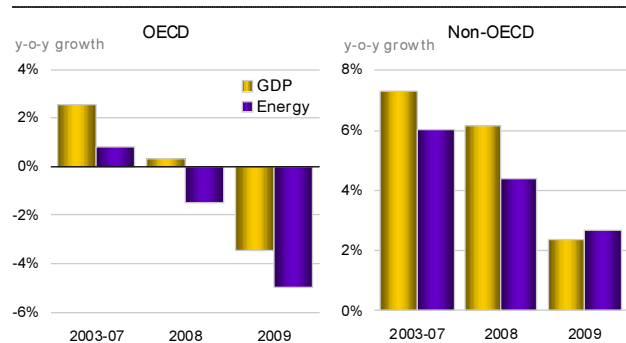
A 5% decrease in energy consumption in the OECD means that the world's 30 most developed economies consumed less energy last year than they did ten years ago, although their economies have since grown by 18%. Over the same period, the economies outside the OECD grew by 75% and increased primary energy consumption by 57%. Long term, energy consumption grows less rapidly than GDP in both camps.

Energy consumption outpacing GDP outside the OECD means that energy intensity rose last year, for only the third time in 20 years. Energy growth was concentrated in China and India, where consumption rose by 8.7% and 6.6%, respectively. Without the contribution of India and China, non-OECD energy demand would have fallen by 1.5% instead of growing almost 3%; and global energy demand would have fallen by almost 4% instead of the 1% actually recorded.

Energy consumption grew faster than GDP in China and India. In the OECD, all fossil fuels fell faster than GDP. And in the former Soviet Union, driven by Russia, energy consumption declined less than GDP. What happened?

Part of the answer lies with the disproportionate impact of the recession on industrial production and, conversely, with economic stimulus programs heavily

## GDP and Energy Consumption Growth



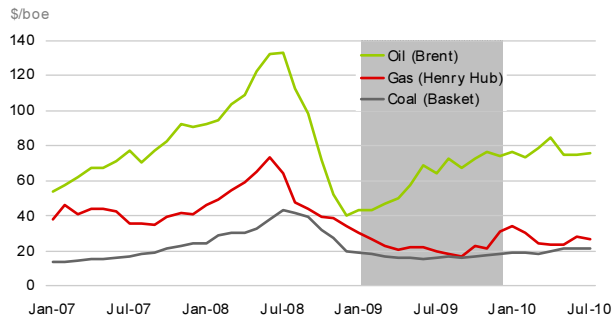
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slanted toward energy intensive activities.

In the U.S., and the OECD more broadly, energy consumption in the industrial sector fell faster than in other sectors. During a year in which overall U.S. energy consumption fell by 5%, industrial energy consumption declined twice as fast. And those declines, like the overall contraction of GDP, were concentrated in the first half of the year.

China, at the other extreme, succeeded in avoiding a collapse of industrial activity by undertaking infrastructure projects and construction on a grand scale. The increase in coal (and oil) mirrors an increase in cement and steel production, and of other industries required for infrastructure development.

## Energy Prices



### Fuel by fuel

#### *Non-fossil fuels*

Hydroelectricity and nuclear energy are still the largest non-fossil fuels, with a combined share of 12% in primary energy. Hydroelectricity, at 1.5% [39 TWh], was the fastest growing fuel in primary energy last year, on the back of growth in China, Brazil and the U.S.. But this increase was more than offset by a decrease in nuclear power generation [1.3% or 43 TWh], largely because of outages in Europe's aging nuclear fleet.

The share of non-fossil fuels in power generation (that is, of hydro, nuclear, wind, solar and geothermal) was in decline for most of the past decade because hydro and nuclear were unable to keep up with global electricity growth. The share increased for the last two years, reaching 31% in 2009. Electricity demand growth had fallen in 2009 and this helped - but it was also the rapidly growing contribution of wind that made a difference.

Overall, wind, solar and geothermal resources contributed an estimated 1.7% to total power generation in 2009 – or about 0.7% of primary energy consumption.

Fuel ethanol production grew 8% to 770 kb/d of oil equivalent. On an energy content basis, the annual production of ethanol in 2009 was equivalent to 1% of global oil production – about 0.3% of primary energy consumption.

#### *Crude oil*

Like other fuel markets, the oil market in 2009 was characterized by a rapid decline in consumption in the first half, and a slow recovery later in the year. Unlike other markets, the oil story highlights the significance of a producer cartel and its ability to manage supply. As a result of production cuts implemented in late 2008, oil prices recovered earlier than other fuels, and to higher levels.

Even with aggressive OPEC production cuts, annual oil prices in 2009 fell for the first time since 2001, breaking an unprecedented string of seven consecutive increases. Dated Brent averaged \$62 per barrel, more than \$35 below the 2008 average. Prices began the year below \$40 and recovered steadily, doubling by June. For the rest of 2009, crude traded in a range around \$70-75 and is averaging \$77 so far this year.

Global oil consumption declined by 1.7%, or 1.2 Mb/d, in 2009 – a second consecutive annual decline and the largest since 1982. The contraction was concentrated in the OECD, where consumption declined for the fourth year in a row, to reach the lowest level since 1995. The decline in OECD consumption began in 2006, when the economy was still growing rapidly – suggesting that recession has not been the only driver. Price also matters and there are good grounds for arguing that OECD demand has peaked, or is settling on a path of structural decline.

Over the course of these events global fuel prices all declined, and then stabilized or increased as the recovery took hold. But the pattern after the initial decline differs widely across fuels, each telling its own story. Crude prices recovered early in 2009, at a time when oil demand was still falling – and at a time when OPEC cut production aggressively, to catch up with falling demand. Natural gas prices declined and then stayed low until today – driven by the continued growth of unconventional gas production in the U.S. and a wave of new LNG supply. Coal prices recovered only gradually – more so in Asia Pacific and in direct response to accelerated Chinese and Indian import demand.

To appreciate and better understand these developments, we have to look at the data fuel by fuel.

Oil consumption growth outside the OECD slowed but did not contract. It rose by 860 Kb/d. All of the net growth came from China [540 kb/d], Saudi Arabia [220 Kb/d] and India [110 kb/d]. Saudi Arabia had the strongest and China the second strongest consumption growth on record.

Global oil production fell by 2.6% in 2009, about 2 Mb/d more than consumption. Of course, this decline is primarily the consequence of OPEC's supply management during the year. OPEC production fell by nearly 2.5 Mb/d or 7.3% after making three successive production cuts in late 2008. OPEC-11 crude production reached its lowest point in April last year, when output was more than 3.3 Mb/d below the September 2008 baseline; it is still 2.6 Mb/d below that mark today.

On the non-OPEC side of things, supply increased by 450 Kb/d [0.9%]. By far the biggest contribution to production growth came from the U.S. where output rose by 460 Kb/d, the strongest increase since 1970 – driven by deepwater production in the Gulf of Mexico, which grew by 390 Kb/d, triple the previous record growth.

Elsewhere, production was broadly flat. Continued growth in the former Soviet Union and Brazil was offset by continued decline in mature provinces, including Mexico – once again the largest non-OPEC decline – the North Sea and Canada. Russian crude oil production rose by 140 Kb/d, helped by a change in fiscal regime motivated by the economic crisis. Russia surpassed Saudi Arabia as the world's leading oil producer last year.

One of the reasons why OPEC cut production so aggressively was high inventories. Commercial inventories were high from the beginning of the year and with consumption falling faster than production early in the year, they rose further. Floating storage was employed and rose above 100 Mbbls early in 2009. By year-end, with consumption rising and OPEC maintaining production discipline, inventories began to fall sharply. For the year as a whole, OECD commercial inventories fell by 30 Mbbls and floating storage grew by 70 Mbbls. So far this year, commercial inventories on shore are tracking above the 5-year range, but this masks a continued decline in stocks at sea.

There are plenty of sub-plots in the oil market – the role of speculation and of subsidies, the relationship between oil and other asset classes, the persistent contango in forward prices. At a high level, however, the story for 2009 – and so far for this year – is that production fell by more than consumption, which tightened inventories and supported higher prices.

### *Refining*

In 2009, almost 2 Mb/d of new refining capacity was added globally, on top of 1 Mb/d in 2008. Capacity additions were concentrated in India [580 kb/d], China [820 kb/d], and elsewhere in the East of Suez region. For the first time, installed capacity in the non-OECD overtook that of the OECD – and the new installations have to compete, exporting surplus production into markets where demand was falling.

Needless to say, there is no cartel to shield the market for refined products. Instead, margins have to fall to the point that capacity becomes uneconomic to run. In 2009, global refining margins as measured by BP's global indicator margin averaged \$4 per barrel, the lowest level for 7 years, and triggering a 1.5 Mb/d reduction in global crude runs.

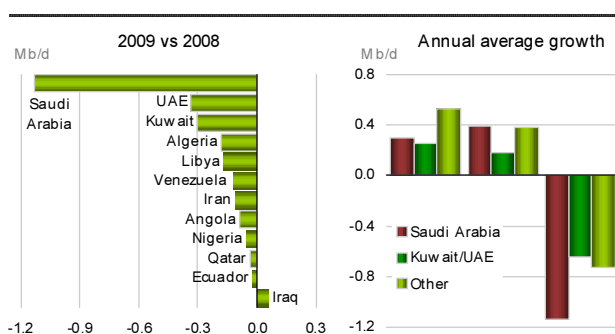
In 2009 global refining utilisation fell to 81%—the lowest for 15 years—and global unused capacity now exceeds 17 Mb/d, the highest since 1985. Still more new capacity is under construction because of decisions made during the good years; competing non refinery sourced supplies such as NGLs and biofuels will also take a significant share of demand growth. Further consolidation, therefore, seems inevitable.

### *Natural gas*

Among all the fuels we track, natural gas experienced the sharpest contraction in 2009. At the same time, unconventional production in the U.S. and a cyclical overhang of globally available LNG caused significant changes in regional gas markets. The global gas market is integrating further, but this is not a smooth and easily predictable process.

Natural gas consumption reacted to the recession with the largest decline in our data, falling by 2.1% [70 Bcm]. The plunge was concentrated where the recession hit hardest: In the OECD [-3.1% or 49 Bcm] and in the former Soviet Union [-7.3% or 46 Bcm] consumption declined more than ever before. Con-

## OPEC Production

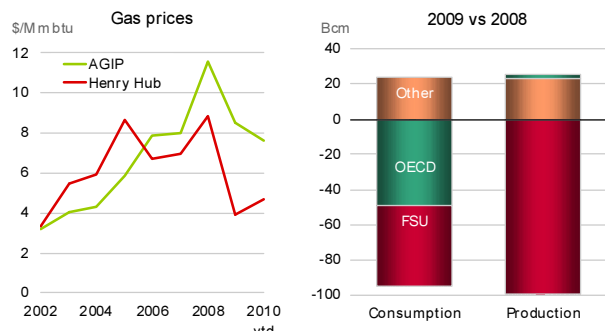


sumption grew only in the Middle East and Asia, largely driven by the growing availability of domestic resources in Iran, India and China.

Global production was scaled back in response to lower demand, falling by 2.1% [74 Bcm] - the first decline ever. The brunt was borne by the former Soviet Union, where production fell by an unprecedented 12% [99 Bcm]. OECD production, in contrast, grew slightly, led by the U.S.

Gas prices reacted to the recession in predictable ways: prices in liberalised markets dropped sharply – around 55% year-on-year in the U.S. and UK; oil-indexed prices, sheltered by the higher price of oil, fell by less – the Average German Import Price or the LNG price in Japan, for example, by 26% and 28%. Oil-indexed prices stayed above spot prices during the entire year and in 2010 to date, an unusual occurrence.

## Natural Gas Market



Underneath these adjustments to the economic situation, structural and cyclical changes are reshaping global gas markets. Regional markets remain segmented, but arbitrage increased. A wave of new supplies boosted LNG trade by almost 8% [16 Bcm] in 2009 while pipeline trade declined; LNG now constitutes 28% of all international trade. Together with a structural increase in the production of unconventional gas in the US, this accelerated the integration of global markets and challenges the traditional pattern of gas flows and pricing in Europe.

Unconventional gas, shale gas in particular, has transformed the U.S. gas market. In 2009, the overall rig count fell steeply, while production increased due to prolific shale deposits, which now have become the cheapest source of supply. For the third year running, the U.S. had the world's largest production increase and in 2009, it overtook Russia as the world's largest gas producer. Momentum is continuing so far.

As a result of investment during the years of high demand, global liquefaction and re-gasification capacities are seeing major increments in 2009 and 2010. At the same time, traditional import markets in Asia were hit hard by the recession. Reduced demand, the global rise in LNG supply and limited need for U.S. imports created a substantial LNG overhang.

To satisfy high demand growth, Asia had attracted additional cargoes in 2007 and 2008, often by offering higher spot prices to redirect cargoes from the Atlantic Basin. Flexible LNG reacted to spot prices. The recession did not stop this gradual shift toward flexible prices, but changed its driver: In 2009, it was no longer customers but producers, who made cargoes responsive to spot pricing. The prime beneficiary of this process to date has been Europe: Record LNG amounts have become available, keeping European spot prices low and offering an easily accessible alternative to the more expensive oil-indexed contract supplies.

European producers reacted to lower prices with output cuts. Indigenous European production fell by almost 5% [14 Bcm]. But the main victim of gas-on-gas competition became oil-indexed pipeline supplies. European imports of pipeline gas from North Africa and Russia slowed by 13% each [5.9 Bcm and 20 Bcm], while net purchases of LNG jumped by 23% [12 Bcm].

As a result of declining demand for European pipeline imports, signs of price flexibility emerged. A number of European buyers re-negotiated penalties or received an extension for take-or-pay deliveries. And in February of this year, Gazprom announced it would index gas deliveries above the minimum take-or-pay volumes to spot rather than to oil prices. Statoil employed similar measures. The pressure on oil indexed gas prices had spread to European pipeline trade.

Ironically, a year which had started with Russia suspending gas exports to the Ukraine and Europe in January 2009, ended with progress towards a more flexible and better integrated global market. The future will show whether the structural effects of greater trading and unconventional gas can persist, once the cyclical effects of an oversupply of LNG are corrected.

### Coal

Global coal consumption was flat in 2009. However, this masks the opposing forces of strong growth in China and India versus a steep decline in the OECD and FSU. Consumption fell by 10.4% [123 mt] in the OECD and 13.3% [24 mt] in the former Soviet Union, the largest declines on record. Reduced demand from industry and power generation was given a further twist by competition from other fuels,

such as gas in the U.S. and Europe, or recovering nuclear power in Japan.

China's coal consumption, in contrast, grew by almost 10% [131 mt] and India's by almost 7% [15 mt], in both cases faster than the ten year average and faster than GDP. Together they counterbalanced all markets where coal demand decreased.

Repeating this pattern, global production in 2009 grew by 2.4% - despite weak demand. While OECD and FSU production dropped the most in a decade, indigenous production increased in China and India at or above the ten year average in both cases [9.2% (127 mt) and 8.4% (16 mt)]. China's data dominates the global balance and so it deserves to be noted that China's National Statistical Bureau has classified the very high Chinese production numbers as preliminary.

Coal consumption growth in China and India has been facilitated by imports. In fact, China became a major coal importer for the first time in 2009, jumping to second place behind Japan. Imports surged by 211% [86 mt], by far their biggest increment ever. The major beneficiary was Australia, which saw its exports to China increase more than fourteen-fold. India's coal imports rose by about 33% [19 mt].

In the background, the Chinese state procurement system had changed, leaving it for the first time to coal users to source their own supplies. In addition, falling global consumption had brought international coal prices down; for the year 2009, prices for internationally traded coal had fallen considerably below Chinese domestic prices.

This robustness of energy consumption growth in China becomes even more intriguing if one considers one of the hallmarks of industrialization in the developing world, namely the relationship between GDP, electricity and energy consumption growth. For years, power generation in the developing world, and in particular in China, has grown faster than GDP, driving fossil fuel growth (not so in India, though, where electrification proceeded more slowly). In China, this held true for eight of the last ten years – until the relationship broke down in 2008 and 2009. In 2009, higher energy demand growth coincided with lower electricity demand growth relative to GDP: Clearly, the additional energy consumed was not driven by power generation growth.

So, what was the coal needed for and why was it imported? The increased import reliance mirrors the developments just discussed; and the increased use of coal is a function of the energy intensive nature of the stimulus package. In late 2008, the government acted quickly to avert a recession by unleashing major domestic infrastructure projects. Construction activity created heavy demand for energy intensive products. Steel and cement production, for example, rose by 13% and 16%. As a consequence, coal consumption in these sectors grew about three times faster than in power generation, and faster than coal consumption overall.

The surge in Chinese coal imports thus is the result of demand growth triggered by the economic stimulus package, the further liberalisation of domestic markets, and the availability of attractively priced coal from foreign locations. Once again, international coal markets showed that they do operate in a very competitive fashion.

## Conclusion

So many stories – but the year leaves us with a few unifying themes.

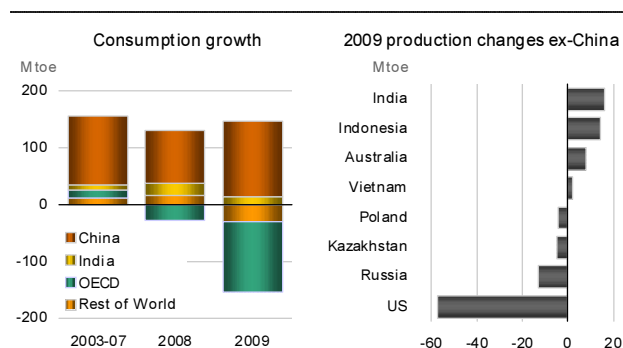
First, the strong link between energy consumption and economic growth reasserted itself. Energy demand fell – by more - where economies contracted, and it increased – by more - in growing economies.

Second, in a particular twist during the recession, the link between energy and growth extended itself to those economic stimulus programs which succeeded in supporting growth. As a rule, such programs have been energy intensive. The three largest recovery programs (as a share of GDP in 2009 and 2010) are being implemented in Russia, Saudi Arabia and China. They drove up the ratio of energy to GDP in all three countries.

The mirror image is provided by the U.S., where the drag of falling industrial production on energy demand dominated the data before the stimulus could kick in. The next few years will decide how much energy demand was lost permanently, and how the “green” components in U.S. economic policy will play themselves out.

Third, a strong variance of supply side reactions on the back of institutional differences and the inter-

## Coal Consumption and Production



face of structural and cyclical factors, allowed different price responses across the major fuel markets. The oil market was the only one where production fell faster than demand, for well known institutional reasons. In refining, cyclical overbuilding kept margins depressed. In natural gas, structural and cyclical factors combined to keep supply high and spot prices low. Coal markets saw a fast, competitive adjustment to new international patterns of demand.

Finally, underneath all the turbulence, long term energy trends remain in place. In fact, they accelerated during 2009. The decline in OECD oil demand, the ongoing global integration of gas markets, the internationalisation of competitive coal markets, and the rising weight of renewable energy are poignant examples. Crucially, this is also the case for the bigger structural shift in economic growth and energy consumption. China's and India's "catching up" process accelerated in 2009. In 1999 China's energy consumption per capita was just 20% of the UK level; in 2009 it reached 50%. More broadly, ten years ago the share of the developing world in global energy consumption was 42%, now it is 53%. Increased wealth and income levels, hopefully, will soon follow these investments.

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