

High Prices for How Long? The 2008 BP Statistical Review of World Energy

By Christof Ruehl and Neelesh Nerurkar*

Introduction

Every Spring, after we collect data for the latest BP Annual Statistical Review of World Energy – 55,000 data points in all by now – we discuss what key issues characterized a given year. This time there was little debate; the central question was why had prices climbed so high in recent years. Using the data from the Statistical Review, this article aims to answer that question, focusing on 2007 and into 2008. The short answer is that it was fundamentals driving the price up – the same set of good old supply and demand forces which have shifted prices lower in recent months.

High Energy Prices

Prices for all major fuels continued to rise in 2007 and into 2008. Oil has seen the steepest and the longest increase – it rose for six consecutive years, the longest stretch ever since 1861, where our price data begins. Between January 2003 and the summer of 2008, the world has seen cumulative price growth of 300% for oil, 200% for traded coal, and 100% for U.S. gas.

To see something comparable, one has to go back more than 30 years: The last big, synchronized commodity price cycle occurred in the early 1970s. Price increases then and now are of a comparable order of magnitude. And in the 1970s, of course the cycle faltered in text-book fashion, with supply rising, demand declining, and prices falling back for many years to come – which raises the simple but important question of whether we will see a replay? Or is there reason to suppose that a structural shift has occurred, perhaps with cyclical froth on top, but unlikely to lead prices back to where they came from?

Economic Growth and Energy Demand

The key similarity in the two episodes is the role of economic growth, the ultimate driver of energy demand, in the run-up to higher prices. The global economy grew by an annual average of 5.3% (at PPP) in the ten years preceding 1973 – the highest for any ten year period on record. And it grew by 4.6% per year over the last five years – the highest for any five year period on record, except for that very period, leading into the 1970s.

The key difference lies in the changing composition of this underlying global economic growth, and the rising importance of the “developing” world, and what this means for energy demand growth. Since the 1990s, the contribution of non-OECD economies to global economic growth has almost doubled, to well over 40% today. But their impact on energy demand growth has been disproportionate: The contribution of the developing world to primary energy consumption growth rose to approximately 90% in the same period, much faster than its contribution to economic growth. Economic growth in non-OECD economies is more energy intensive: In 2007, developing countries used 4.4 barrels of oil equivalent to produce \$1,000 worth of GDP, OECD economies used 1.4 barrels of oil equivalent.

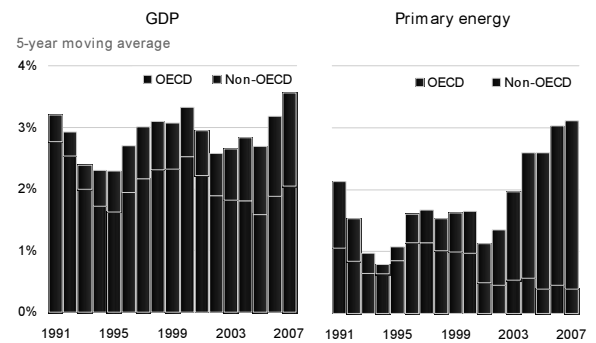
Why then does growth in poorer countries require more energy? Or, to phrase it differently, why do they seem less sensitive to the recent price spikes? The general answer lies with the different characteristics of economic growth in both country groupings.

To make this statement more precise requires an analysis fuel by fuel. We start with the market for oil, the largest and most traded fuel, where prices have increased the most, and consumption the least.

The Oil Market

As an annual average, dated Brent rose by 11% to \$72/bbl last year, the lowest percentage increase since 2003, although it also had the highest intra-year rate of increase since 1999. This is also

Contributions to Growth



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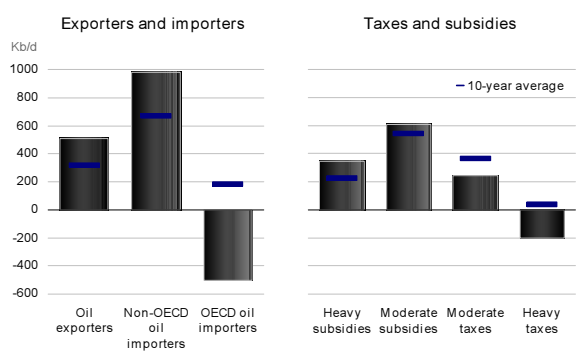
* Christof Ruehl is Chief Economist at BP plc. Neelesh Nerurkar is an Economist with the firm. Ruehl may be reached at christof.ruehl@bp.com

the highest annual average price ever, in nominal terms and after adjusting for inflation. With these price dynamics, one would expect demand to respond.

Oil Consumption Growth

However, global oil consumption grew by 1 Mb/d, or 1.1%, in 2007 – relatively close to its ten year average (1.4%). Two sources of rising consumption muted a stronger demand response: Oil exporting countries and fast growing non-OECD importers. Both groupings have in common that most of their member countries subsidize oil products. In contrast, consumers in countries where prices are liberalized and oil products taxed were first to be squeezed out of the global market place.

Global Oil Consumption Growth



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OECD consumption suffered its biggest decline since 1983. It fell for the second year, by 390 Kb/d or 0.9%. Consumption growth in importing non-OECD economies, in contrast, accelerated for the second year running to 1.4 Mb/d. This consumption growth in fast growing developing economies was led by non-OECD Asia, with an increase of 700 Kb/d, nearly half of which was in China and one quarter in India.

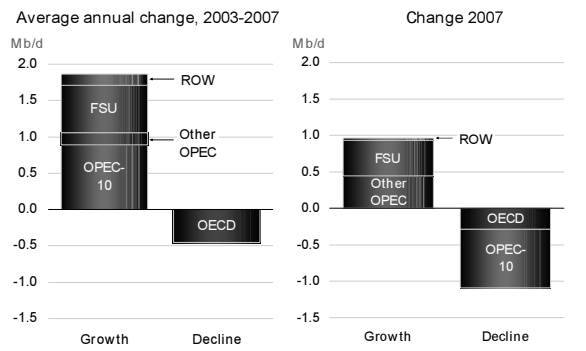
In addition, consumption of oil exporters increased by 510 Kb/d or 3% in 2007. For the first time, this surpassed the growth in all importing countries combined, despite the fact that consumption in the main Former Soviet Union (FSU) exporters declined because of an exceptionally warm winter.

All told, one quarter of global consumption thus was consumed at subsidized retail prices last year. In the subsidizing economies, consumption growth exceeded the 10 year average by 190 Kb/d; in taxing economies, it fell short by 360 Kb/d. By early 2008, the fiscal burden of subsidies has put strain on public finances in many emerging market economies, and a range of consuming nations has had to adjust – India, Indonesia, Thailand, and Egypt among them. Others, such as China, adjusted for political or economic reasons.

Crude Oil Production Growth

If there was a defining moment in oil markets in 2007, it was the re-emergence of OPEC in successfully managing its production. Prices fell rapidly in late 2006 and early 2007, the OPEC price basket breached \$50/bbl, and OPEC responded with two production cuts implemented in November 2006 and then in February 2007.

World Oil Production Changes



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This decline in production started to drain OECD inventories from the second half of the year. By September 2007, inventories had fallen from eight year highs to below their long term average. Prices continued to climb – until a production increase over the Spring and Summer 2008 (in conjunction with weakening demand and a worsening macroeconomic outlook).

In contrast to oil demand, global crude oil production last year fell by 130 Kb/d to 81.5 Mb/d. OPEC output fell by 360 Kb/d in aggregate, because growth in Angola, Iraq, and NGLs (not subject to quotas) partially offset the decline of 900 Kb/d in the crude output of those countries which participated in production cuts. OECD production fell by about

290 Kb/d. Combined these declines offset an increase of 520 Kb/d in the rest of the world, almost all of it in the FSU.

Why have six years of rising prices not triggered a much larger supply response elsewhere?

OECD production continued to fall, although at a moderating pace. Declines were halted in the UK and U.S. for the first time in many years, but large decreases in Mexico and Norway kept the overall trend downward.

FSU production continued to increase, but a major shift is taking place here as well. Russia's production, up 210 Kb/d last year, has been in year on year decline since January 2008 (mostly because of an

unattractive tax system and lack of investment in new fields).

This is an example of how limited access for private companies which has become a major issue for the global industry. While oil reserves have increased 170 billion barrels over the last decade, they often remain in countries that restrict upstream access.

Refining

Global refining margins established another record last year. Light-heavy spreads remained wide and widened again into 2008, when fuel oil values could not keep pace with the escalating price of crude. Declining product stocks last summer, as the OPEC cuts worked their way through the system, protected refining margins for a limited time even as demand started to weaken.

Nevertheless, ethanol supply is growing and gasoline exports from Europe are plentiful. As a result, gasoline cracks hit record seasonal lows in Rotterdam – while pump prices went to record highs on both sides of the Atlantic. Consistent with dieselisation in Europe and the global expansion of commercial transport, middle distillate demand in 2008 is rising further, and gasoline demand is reeling.

Meanwhile, global refining capacity is being added about twice as fast as earlier this decade. Capacity additions in 2007 totalled 1.2 Mb/d and exceeded crude run growth by more than 400 Kb/d. Most of the new capacity was installed in Asia, 60% of which (480 Kb/d) was accounted for by China, and in the Middle East (250 Kb/d). Global utilisation rates slipped to their lowest since 2003.

Financial Investment

Financial investment in energy and other commodities has increased sharply. The available data is incomplete, but NYMEX indicators provide perspective on the hotly debated question of whether they have caused crude price increases or merely amplified the underlying trends of demand and supply.

The comparison of investment profiles across fuels shows an ambiguous connection between financial investment flows (“open interest”), their positioning (“net length”) and fuel prices. In crude oil, non-commercial net length has remained fairly stable over the past year, although total open interest continued to increase, along with prices. Heating oil open interest and non-commercial net length has changed little, but heating oil prices have increased more rapidly than crude oil. Similarly, natural gas open interest was flat in 2007 and so far this year, even while natural gas prices surged. In sharp contrast to crude oil, non-commercial traders have increasingly become net sellers of gas.

In summary, it is difficult to establish a causal relationship. The data indicate that financial markets don’t create underlying fundamentals or the changing perceptions about risk or future trends. They reflect them.

Oil: Summing Up

Oil prices rose in a constrained market. First, the supply response was muted because of OPEC’s success in controlling production; a muted supply response over the longer term has also been facilitated by above ground problems in member states such as Iran, Iraq or Nigeria.

Second, the supply response is affected by an increase in state control and limits to access for private investment in other large provinces, of which several countries in Latin America and Russia are good examples.

Third, natural decline in OECD provinces, exacerbated by the limited scalability of biofuels and heavy oil, has accentuated restrictions in provinces still open to private investment.

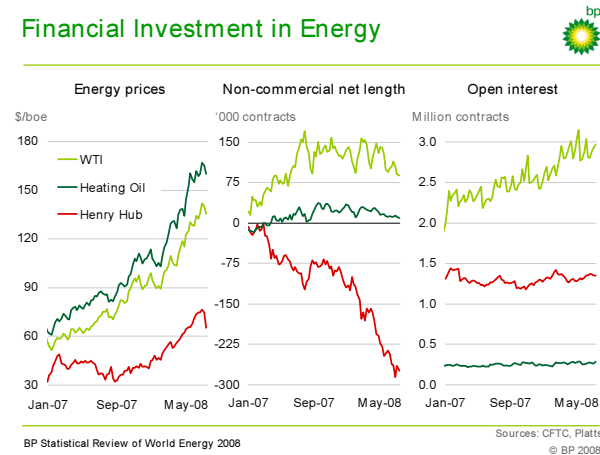
Constrained industrial capacity and cost inflation have furthered hampered project implementation.

Global demand has been dominated by the effect of high income growth more than by price effects, partially because the share of consumers with subsidised retail prices has risen to new heights.

As a result, fundamentals and long term expectations have been changing. Financial markets are not able to trigger these developments, but they are capable of following them – and, of course, are perfectly capable of accelerating movements up or down.

Did other fuels experience similar constraints?

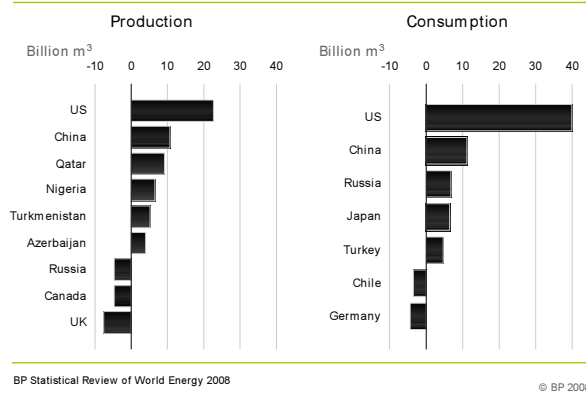
Financial Investment in Energy



Other Fuels

Natural Gas

2007 Natural Gas: Largest Changes



Natural gas is in transition between being a regional fuel, where consumers and producers are connected via pipeline systems, to an increasingly internationalized system connected by LNG.

Gas consumption grew by 3.1% in 2007, the only fossil fuel where growth accelerated. The largest increment worldwide came from the U.S., where domestic production – increasingly of unconventional gas – surged by 23 Bcm in a lagged response to high prices. The U.S. also saw the largest increment in consumption (40 Bcm, or 6.5%), driven by cold weather and the continued discount to residual fuel oil. Europe was at the other extreme – a warm winter led to a decline in consumption of 8 Bcm in the EU, just balanced by a lower than usual increase of 8 Bcm in the FSU.

The second largest increase in production (18 Bcm) and in consumption (27 Bcm) was in Asia Pacific. 60% of the

increase in production and 41% of the increase in consumption came from China – which, nevertheless, retained a very low share of only 3.3% of natural gas in total energy consumption.

International Trade

A decline in European consumption kept pipeline trade flat last year despite growth elsewhere. LNG trade grew 7.3%. While slower than the last few years, this was enough to raise its share in total gas production to 8% and in total gas trade to 29%.

Global LNG trade is becoming more integrated. The most diversified suppliers are in the Atlantic Basin, from where they export globally. Asian suppliers typically serve a smaller number of customers; none of them exports to the Atlantic basin. The ability of Atlantic basin suppliers to switch was demonstrated in 2007, when supplies to Asia Pacific doubled, in response to higher prices. After nuclear outages caused a sudden increase in the demand for power generation fuels in Japan, LNG imports increased by 8.5% or 7 Bcm, the largest increment in 2007.

Substitution

Greater flexibility in LNG trade is adding a new dimension to traditional fuel-switching, as relative fuel prices change. Japan provided one example in 2007, Europe provided another.

When European spot prices were particularly weak in the first half of the year, gas substituted for coal and oil in power generation. This was most evident in the UK power sector, where gas consumption increased by 25% in the first half of 2007 at the expense of coal, which fell 22%.

In addition to local fuel-switching, low European spot prices created an incentive to switch flexible LNG supplies to the U.S. market. The resulting flow helped to keep Henry Hub gas prices low relative to oil prices, and so encouraged fuel switching out of oil in the U.S.

Overall, global gas markets continued to integrate if at a more measured pace, partially caused by project delays and the huge needs for LNG infrastructure investment. Correspondingly, natural gas prices increased, but less so than oil or coal prices.

Coal

Coal was once again the fastest growing fuel in 2007, with consumption increasing by 4.5%. More than 50% of the increment in global primary energy consumption is from coal, and more than 70% of this increase is growth in China – almost 40% of global primary energy growth, therefore, originates from one fuel in one country.

Like GDP and primary energy growth, coal consumption growth slowed in 2007. A strong spurt in US growth (1.4%) was neutralized by decline in the EU, the FSU and the Middle East. Global consumption decelerated because China grew at 7.9% – its lowest growth in percentage, and in volume terms, since 2002.

International Trade

Coal markets are both highly concentrated by size, and very local. China accounts for 41% of global

consumption and 41% of production, the U.S. for 18% of consumption and 19% of production. Three of the next four largest producers are among three of the next four largest consumers. Correspondingly, global trade in coal is small, equivalent to only 15% of global consumption. But this simple market structure is changing.

Over the last ten years, four countries (Australia, China, India and Indonesia) accounted for 95% of the increase in global coal production (1,557 million tonnes). However, this happened for very different reasons: In China (1,164 mt) and India (159 mt), growth was driven by domestic demand; in Australia (114 mt) and Indonesia (120 mt), it was led by exports.

A sample of the five biggest coal exporters outside China (Australia, Indonesia, South Africa, Colombia and Russia) shows that fully 88% of the growth in production since 1997 has been produced for export.

But transport and infrastructure facilities have not kept pace with this expansion. Worldwide infrastructure bottlenecks became apparent in 2007, exacerbated by bad weather conditions. Exports suffered from congested transport facilities or mine closures in Indonesia, Australia and South Africa. As a result, prices for traded coal outpaced domestic prices, and shipping and freight rates reached record levels.

Deregulation in Coal Markets

The aggregate numbers continue to be dominated by China. But China also provides an illustration for the prerequisites that make market adjustment happen.

China ended the dual pricing system for coal in January of 2007, and liberalized domestic prices, which duly rose over the course of the year. The price changes were part of a drive toward greater efficiency improvement in the coal sector. They were flanked by measures to limit net exports. Generally, the drive to raise efficiency meant continued investment in new mining and rail capacity, as well as continued attempts to take smaller, less efficient mines off line.

However, coal price liberalization was not accompanied by freeing up consumer prices for electricity. Money-losing power generators responded by running down inventories, leaving the system vulnerable. In the aftermath of cold weather and ice storms this January, the government mobilised a massive effort to increase domestic coal for power generation, sometimes contradicting efficiency targets.

In 2007, economic growth in China was 11.9%, and power generation grew by 15.6%, but coal growth, at 7.9%, was much slower. The official data suggest a mix of successful policy efforts to improve energy efficiency, a rise in the share of coal for power generation, and increased use of oil and gas to the same effect.

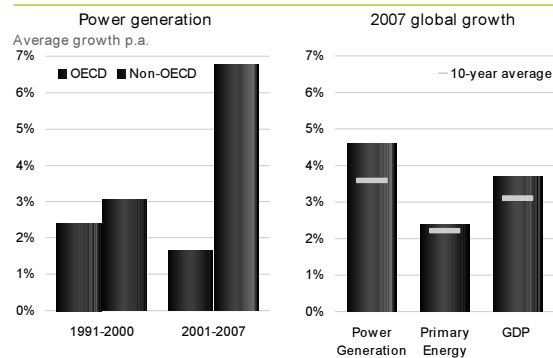
Thus, the global supply of coal continued to respond to increased demand; in 2007, this response was facilitated – and triggered – by the continued rise in the trade of coal, and domestic market liberalization, notably in China. However, both could not display their full potential: The internationalization of coal ran into infrastructure problems; and Chinese market liberalization, while improving efficiency, was marred by an inability of power generators to pass on higher prices.

Non-OECD: Economic Growth and the Need for Power Generation

This leads back to an earlier question – are there structural reasons for high non-OECD energy demand growth? The strong demand for coal in the non-OECD matches the comparatively low increase in relative price over the medium term, and also the local availability of fossil fuels. However, there is a structural reason for the shift into coal as well. For most of the developing world, high economic growth means moving labour from agriculture into industry. Building up an industrial infrastructure requires electrification. Accordingly, power generation in the developing world is surging.

The decade before the Millennium compared with the years thereafter saw OECD power generation growth slow from 2.4% to 1.6% per annum, while non-OECD growth doubled from 3.1% to 6.7%. China supplied the lion's share of this surge, doubling its share in global generation to 16% in 8 years. The right hand chart of 2007 global growth near by has become typical for fast growing non-OECD economies: Power generation growth outpaces GDP growth, and power generation requires fossil fuels.

Power Generation and Primary Energy



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Hydro and Nuclear

In 2007 global hydroelectricity production increased by just 1.7%, well down from the 4% growth in both 2005 and 2006. Drought conditions in the U.S. reduced hydroelectric production by 14% – partially offsetting strong capacity growth in China, India and Brazil.

Nuclear power generation declined by 2% in 2007, the largest one-year decline since 1965. One-off factors account for more than the entire net decline, including an earthquake in Japan, unexpectedly long maintenance time in Germany and the UK, and unscheduled maintenance in France. In addition, seven European reactors were permanently shut at the end of 2006, in pursuit of opting out of nuclear energy.

Four new reactors were brought on line in 2007, in China, India, Romania and in the U.S. (which restarted a reactor taken out of service in 1985). The high number of construction start-ups is evidence for the renewed interest in nuclear energy. Construction started on seven new units: two each in China, South Korea and Russia, and one in France.

Renewables

For renewable energy, the basic constellation has not changed – it continues to expand rapidly, and with government support, but from a very low base. However, progress over the years means that in some countries, renewables have grown enough to make a significant contribution. Examples are ethanol in Brazil and the U.S., and wind power in various European countries.

At 920 Kb/d in volumetric terms, or 0.7% of total oil consumption, global ethanol supply at the margins has had an impact on U.S. and Brazilian gasoline consumption and refining. However, this obviously was not yet enough to tip the tight balance in global oil markets described earlier.

Available estimates suggest a share of around 1-1.5% of global power generation from wind, solar and geothermal power. Under current fuel shares, this would have but a small contribution to reduced global carbon emissions from energy. However, in Denmark, Portugal, Spain and Germany, wind has become a double-digit contributor to power generation, at least in terms of capacity.

Conclusions

Where does this leave us?

We started out with the question of why energy prices are high. On a basic level, it is not that complicated.

The global economy has become more flexible in combining high economic growth with lower energy intensity. However, in the developing world, energy consumption growth is a more important companion of economic growth than in the OECD economies. At least in part, this is for structural reasons, such as the high need for electricity which comes with industrialisation; and it is also the desire for transport fuels which comes with higher income levels.

Of the three major fuel markets, oil is subject to constraints which limit the ability of private investment to go and do what it does best – create adequate supply. Gas and coal are integrating globally. Their supply is responding to rising prices, although this is limited in both cases (with coal markets experiencing most heavy constraints), as infrastructure limitations and regulations have not kept pace.

A lot, therefore, rides on whether we will allow market forces and competition to complete what liberalization of global energy markets has started – or whether additional restrictions will hamper long term supply growth in energy.

Energy Forum to Accept Letters to the Editor

The *Energy Forum* encourages members to comment on material in the newsletter via “letters to the editor”. A regular column reprinting these will be carried. The editors reserve the right to condense and edit letters as necessary.