The transformation of global energy markets

26 February 2013

Two major shifts in global energy markets have occurred over the past ten years. First, emerging economies now drive growth in global energy consumption and use more than half of all energy produced globally. The growth emphasis has clearly shifted to emerging economies. Second, traditional energy markets have been challenged by the arrival of unconventional hydrocarbons and plentiful liquefied natural gas. Renewable energy sources continue to meet an increasing share of consumption, yet even a few decades from now they will account for less than 20% of overall production. At the same time, access to unconventional oil and gas deposits has driven down production costs, especially in the United States and Canada. This has led to a dramatic drop in natural gas prices in North America even as energy prices have remained high in Europe.

Laura Solanko
Adviser
Monetary Policy and Research

Lauri Vilmi
Economist
Monetary Policy and Research

Asia consumes an ever-increasing share of the world's energy

Although energy consumption in emerging economies has been increasing rapidly for over a decade, the OECD member countries still accounted for over half of the world's energy consumption up to 2007. Today the picture has changed and almost all growth in global energy consumption – as well as increases in fossil fuel use and greenhouse gas emissions – comes from these emerging economies. China's energy consumption doubled from 2002 to 2009, making it the world's biggest energy consumer and number-one source of carbon dioxide emissions.[1] The growth in energy consumption in Asia's emerging economies is supported by urbanisation and rising personal wealth. In addition to the creation of massive infrastructure, rising energy demand is driven by the manufacturing and use of consumer electronics and home appliances. According to the 2012 forecast of the International Energy Agency (IEA), the OECD countries will account for just 35% of global energy consumption in 2035 (Chart 1).

Global energy efficiency has constantly increased. The IEA predicts that energy intensity (energy consumption in relation to global GDP) will decline about 2% a year.[2] Despite gains in energy efficiency, global energy consumption in 2035 will be about 40% higher than in 2010. Renewable energy sources (biomass, hydropower, wind, solar, etc.) are expected to play a much larger role, especially in electrical power generation, but their overall contribution to satisfying energy demand will remain small. The share of fossil fuels in world primary energy consumption will fall from around 80% at present to about 75% in 2035, while the share of renewables in the primary energy mix will increase from 13% to 18% in 2035. Nuclear power will account for most of the remainder.

Oil is currently the world's top energy source, satisfying about a third of the world's energy demand. Although reliance on petroleum products by industry and in electrical power generation should diminish, their use in

[1] BP (2012).

[2] The greatest reductions in energy intensity will occur in China, India and Russia; the world's first, third and fourth largest energy consumers, respectively.

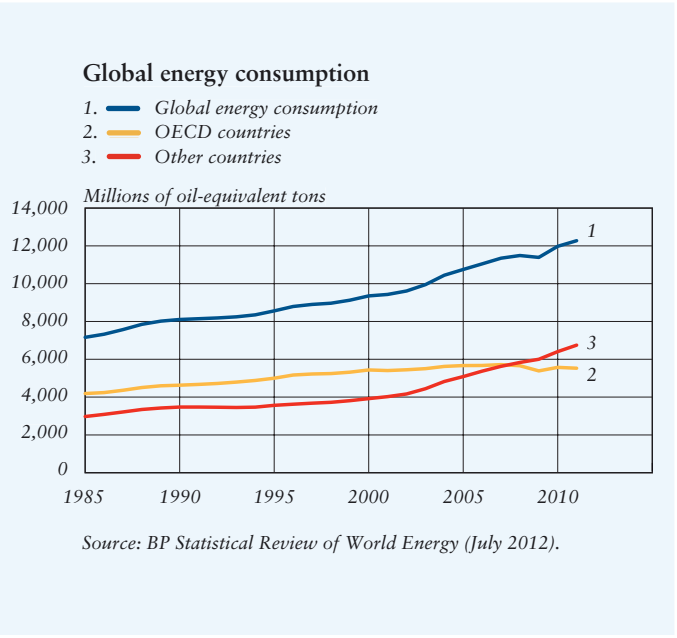
Rapid growth in emerging economies will demand renewable energy sources and increasing amounts of fossil fuels.

transportation will increase demand overall. Demand for oil and coal in particular, may even decline in the OECD countries as they shift to increased use of natural gas and renewable energy sources. The high growth in emerging economies, however, will demand both increased use of renewable energy sources and increased use of fossil fuels (oil, coal and natural gas).

International trade flows have shifted rapidly. China became a net importer of oil as recently as 1993, yet it was the world's second-largest oil importer and the largest importer of petroleum products by 2010. China and India together account for over half of the world's coal production, and yet both are important buyers of coal on the world market. India, in particular, is expected to step up its coal imports in coming years. By international standards, India's domestic coal production is extremely inefficient and unable to keep pace with rising domestic demand.[3] The share of natural gas in energy consumption outside the OECD countries and countries of the former Soviet Union has been small, but gas consumption could grow rapidly in the coming years.

Europe and North America will continue to be major markets in the future, but the growth of Asian energy consumption will shift the bulk of energy trade flows from the Atlantic to the Pacific Ocean, and will increase the importance of the South China Sea in global energy trade. Currently, about a third of the world's crude oil supplies, and about half of the world's liquefied natural gas (LNG) supplies, move through the Strait of Malacca and the South China Sea.[4] Energy companies owned by the Chinese, Koreans and Indians are increasingly influential operators in producer countries of the Mideast, Africa and Central Asia, as well as in international trade. Rising demand in China and other emerging economies also bears a direct impact on world prices of energy commodities.[5]

Chart 1.



Source: BP Statistical Review of World Energy (July 2012).

Deposits once thought intractable now drive boom in US oil and gas production

The explosion in global demand in the past decade coincided with peaking of production in mature production areas developed in the 1970s (eg Russia, the

[3] IEA Coal (2012).
[4] EIA (2012).
[5] Simola (2012).

US and Europe). The new potential oil and gas fields were known to be in increasingly challenging locations, but the relatively low oil prices in the 1980s and 1990s did not encourage large and uncertain investments. It was only when global demand took off and prices of crude oil and natural gas shot up that companies got serious about exploring production possibilities in extreme conditions such as the Arctic continental shelf (Russia, Alaska) and in the deep Atlantic (Brazil). Interest also turned to unconventional gas and oil reserves, especially in North America. Exploiting these less accessible hydrocarbons was understood to require patience, deep pockets and an ability to take on risk.

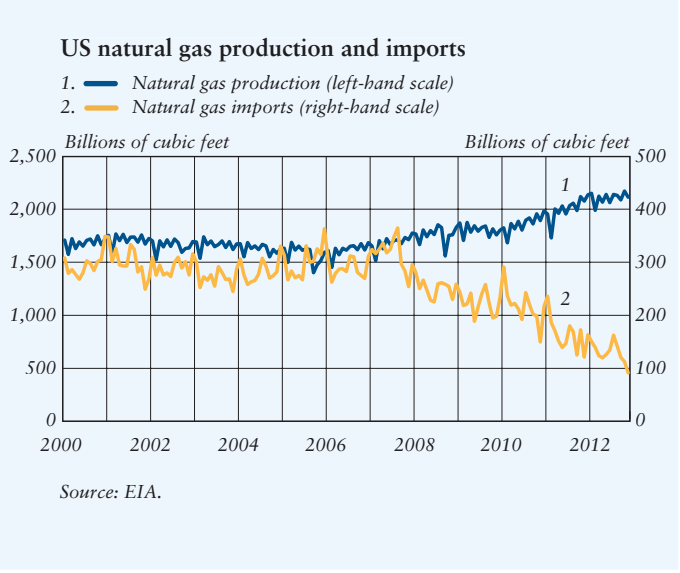
The technology, new skill sets and support services needed to extract unconventional oil and gas (see Box 1, p. 62) have evolved far faster than predicted. Lower production costs have made it attractive to develop many unconventional hydrocarbon deposits and has led to an oil and gas boom in the United States. Using new methods, substantial amounts of natural gas are now beginning to be extracted from vast shale formations. After 2006, US natural gas production began to rise – and rise much faster than earlier imagined. During 2007–2012, US gas production increased over 25% and caused a noticeable decline in gas imports (Chart 2). Just ten years ago, US gas imports were expected to continue to rise rapidly, so gas producers in eg Qatar and Russia were planning gas export terminals specifically to serve a growing US gas market. Now suddenly the US is self-sufficient in natural gas and it may become a net gas exporter. Over the last five years, natural gas originally destined for the North American market has had to be diverted to the European and Japanese markets.

The United States could soon become a net exporter of natural gas.

The technology developed to extract shale gas has been repurposed for use in oil production, and production from unconventional oil deposits once considered unprofitable has increased. The result is an impressive rise in domestic production in the US that reversed decades of decline in the US crude oil production in 2008. US production of oil and petroleum products exceeded 1993 levels in 2012 (Chart 3).[6] The latest IEA forecast sees US oil production climbing 40% a year through 2017, which

[6] EIA figures available up to November 2012.

Chart 2.



Box 1.

What are unconventional hydrocarbons?

The world's oil and gas reserves are a legacy of plant and animal life buried under layers of sediment hundreds of millions of years ago. Over time, heat and pressure converted this matter into a rich soup of hydrocarbons. Some of the liquid and gas was trapped in underground formations and some mineralised. Traditional or conventional oil and gas deposits are associated with special geological formations that include caverns in which the gas and oil collect. Oil exploration in the old days involved finding one of these underground hydrocarbon pools, drilling and casing a borehole, and pumping the oil and gas to the surface.

Unconventional hydrocarbons, in contrast, reside in a much wider variety of geological features and typically embedded in porous mineralisations. Such formations are common, but extracting these intractable hydrocarbons was traditionally quite challenging and expensive. Sources of unconventional crude oil include tar sands and oil (kerogen) shale. Sources of unconventional natural gas include tight gas, coal bed methane (CBM), shale gas, and clathrate (methane) hydrates. Over the past ten years, the techniques for extracting shale gas (eg horizontal drilling and fracking) have developed rapidly, reducing production costs and setting off a major oil and gas boom in the US. As the technology has evolved and the service sector supporting unconventional extraction have developed, the possibilities of shale gas production have begun to be examined in eg Poland, Ukraine and China. At the moment, the environmental risks associated with fracking have limited its use Europe, but in coming decades production methods now classed as unconventional are likely to be in increasing use.

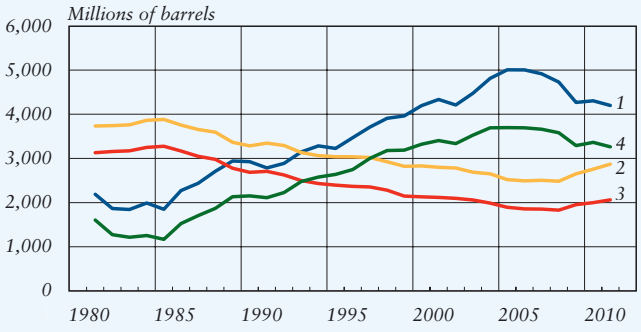
would make the US one of the world's biggest oil producers.[7] At the same time, US reliance on imported oil has fallen both due to the recent financial downturn and increased domestic production. US dependence on imports is likely to keep falling, so the domestic production in the near future could be sufficient to cover about half of total US oil consumption. The US Energy Information Administration (EIA) expects net fuel imports to the US to fall by about 20% by 2025.[8] This, together with net gas exports, should reduce the US trade deficit over the next ten years by about 0.5 percentage points of GDP.

Because the United States still is one of the world's largest crude oil and natural gas consumers, growth in its domestic gas and oil production has significant global impacts. Growth in gas production has driven gas prices in the US to record lows, which, in turn, has boosted the use of gas, especially in electrical power generation. Many US power plants have shifted from coal to cleaner natural gas, leading to a sharp decline in coal consumption in 2011–2012. This, in turn, has led coal producers to seek out export markets, which has driven down market prices especially in Europe. Unlike the US, gas prices have remained high in Europe, making coal, the environmentally less friendly fuel, an attractive option for power plants. The collapse in coal prices has in some cases made running gas-fired power plants unprofitable.

Chart 3.

US oil production and imports

1. *Imports of crude oil and petroleum products*
2. *Production of crude oil and petroleum products*
3. *Crude oil production*
4. *Crude oil imports*



Source: EIA.

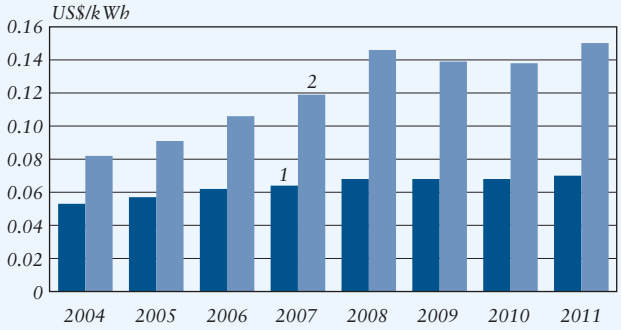
The low price of natural gas in the US has also helped keep the price of electricity fairly stable, even as electrical power rates in Europe have soared over the past decade. In 2011, the price for gas paid by industrial users in the US was about a third of that paid by their European counterparts; US electricity rates were about half of the European average (Charts 4 and 5).[9] This situation has created increased challenges for Europe's industrial competitiveness, especially in energy-intensive industries such as metals refining and chemicals. In Germany, in particular, many companies have publicly stated that they are considering transferring production to the US to take advantage of cheaper energy supplies.

At the same time, the gas and oil boom in the US is anticipated to create

[7] IEA Oil (2012).
[8] EIA (2013).
[9] Comparable figures are not yet available for 2012, but the difference is unlikely to have changed much.

Chart 4.

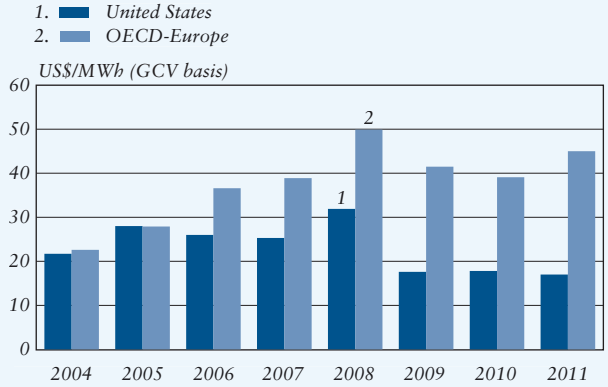
Electricity prices for industry in the United States and Europe



Source: IEA, Energy Prices and Taxes (2012).

Chart 5.

Natural gas prices for industry in the United States and Europe



Source: IEA, Energy Prices and Taxes (2012).

thousands of new jobs in the energy sector and other industries. While cheap energy may have helped revive American industry and encouraged new capital investment, the impact should not be exaggerated. The rebirth of the energy sector largely affects closely related branches such as chemicals and metals, and the employment effects are limited. The American Chemistry Council estimated in 2012 that only about 10% of the then 12 million unemployed persons in the US would benefit from the energy boom and that the impacts on industrial competitiveness would increase level of the US GDP by slightly more than 1% over the long term.[10]

How these changes affect Europe and Finland

United States natural gas imports contracted during 2006–2011, while global production capacity for liquefied natural gas doubled. As significant amounts of LNG became available, spot trade volumes increased and prices fell in several trading hubs.[11] LNG represented less than 10% of the global gas trade in 2003 and over 25% in 2011.[12] At the same time, oil prices on the world market rebounded rapidly to pre-crisis levels last seen in 2008, which, in turn, caused European and Asian oil-indexed gas prices to go up. LNG, which was once considered the expensive alternative form of gas, began to look quite attractive to many European energy companies. In 2005, there were nine LNG import terminals in Europe. There are 19 today in eight EU countries and more are planned.[13] In 2000, about 5% of gas imports to

[10] American Chemistry Council (2012).

[11] Spot and short-term LNG trade is defined as LNG traded under contracts with a duration of 4 years or less.

[12] IGU (2012).

[13] GIIGNL (2012).

the EU zone were supplied as LNG. That share rose to about 15% in 2005 and about 25% in 2011.

The increased availability of LNG and short-term supply contracts increased demands from European customers for modification of the terms of their traditional long-term supply contracts. (See Box 2 for an explanation on gas pricing arrangements in Europe, p. 67.) So far, Norway's Statoil has been much more accommodating about new pricing principles than Russia's Gazprom or Algeria's Sonatrach. Gazprom's inflexibility on modifying terms of its gas supply contracts has be widely criticised and even contributed to Gazprom's loss of market share in recent years. Even with these problems, Gazprom remains the top supplier of natural gas to the EU countries.[14]

LNG has yet to appear on the Finnish market for the simple reason that Finland does not have a LNG import terminal. At the moment, all of Finland's natural gas supplies come from Russia, as does 90% of its crude oil and 80% of its coal. Gasum, the company that manages Finland's gas market, is planning an LNG regasification terminal to be built in Inkoo or Porvoo. Environmental impact assessment studies have been initiated for both sites.

In autumn 2009, the European Commission and the EU parliament approved the Third Energy Package aimed at reforming and opening up the gas and electricity sectors in the EU. The goal of this package of legislative proposals is to increase competition and trade across national borders, separate (unbundle) energy distribution from energy production, as well as improve energy security of EU member states through the construction of trunk transmission pipelines and grids. To support these goals, EU's Baltic Energy Market Interconnector Plan (BEMIP) project may co-finance construction of an LNG import terminal in Lithuania, Latvia, Estonia or Finland, along with construction of trunk pipelines connecting all the BEMIP countries. Given that the EU support will be available only for one large project, the member countries must first agree on the best location for the LNG terminal. The Finnish market by itself is too small to support a very large terminal.

The EU's BEMIP project could co-finance construction of a large LNG receiving terminal in Lithuania, Latvia, Estonia or Finland.

The availability of LNG on the Finnish market would increase security of supply and introduce gas pricing that more closely tracks price formation in European trading hubs. In the future natural gas may travel under the Baltic seabed from east to west via the Nord Stream gas pipeline, while on the surface of the Baltic Sea LNG tankers will sail from west to east to deliver their cargoes.

The reduction in the production costs of unconventional oil and gas has opened new opportunities to increase energy production elsewhere than in the traditional oil and gas producing countries. Given that domestic production will meet a larger share of US oil demand than previously thought, the significance of emerging Asian economies as export destinations will increase. Natural gas is increasingly

[14] Simola, Solanko and Korhonen (2013).

becoming a globally traded commodity that can be readily shipped to distant destinations in liquid form. This implies that, gas pricing on European regional markets is moving towards market-based pricing. At the same time, the shift in focus to growing energy demand in Asia's rising economies will alter global trade flows and erase the relative dominance of the OECD member countries. Shifts in global supply and demand will become more apparent in European energy prices in the future.

Keywords: energy markets, shale gas, liquefied natural gas (LNG)

Box 2.

How is the price of natural gas set?

As natural gas is expensive to transport and difficult to store, there is no world market price for natural gas. Gas has traditionally been piped from production fields to end users. In some cases, transmission pipelines can stretch thousands of kilometres. Alternatively, natural gas (after liquefaction) can be transported by sea in special tanker vessels. Unloading an LNG cargo requires a special-built regasification terminal to offload the LNG and restore it to gas form. Natural caverns suited to natural gas storage are extremely rare, and none exist in Finland.

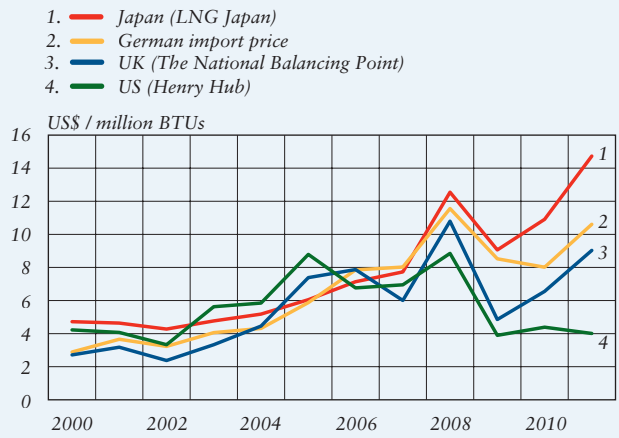
Due to the large investments needed for the transportation, gas markets have typically been oligopolistic. Before the mid-1990s, it was common for countries in Europe to have a single gas company with a monopoly on the domestic gas market. There were only a handful of gas producers from which to purchase gas. Even today, most of the gas producers are large state-owned companies (eg Gasterra, Statoil, Sonatrach, Gazprom).

For these reasons, natural gas trade has traditionally be based on long-term supply contracts that committed both buyer and seller to deals lasting as long as 25 years. Typically, these contracts define both the volumes supplied and the pricing mechanism. In Asia and Europe, this usually meant linking the gas price to the market price of crude oil or certain petroleum products.[1] The long-term nature of the supply contracts and the lack of cross-border transmission pipelines meant that a single gas price shaped by current supply and demand could not emerge in continental Europe. Instead, the market price of natural gas is typically quoted in terms of a regional or local price. At the moment, the only liquid marketplace for natural gas in the world is Henry Hub in the US, which shapes the gas price on the US regional market.

In recent years, changes in the gas sector in Europe have increased pressure to end the traditional oil-indexed pricing mechanism and to increase the role of marketplaces (hubs) where short-term gas contracts are traded. At the moment, the UK's virtual gas marketplace, the

Chart.

Average natural gas prices by regional market



Source: BP Statistical Review of World Energy (June 2012).

[1] *Precise data on price formation is scarce. Stern (2007) reports that the pricing of 90% of the gas supplied by Norway, Algeria and Russia in 2004 was tied to pricing of petroleum products with a lag of about 6 months. As long as the supply contract included a "final destination" clause that forbids the buyer from selling supplied gas to third parties, producers could discriminate on price among their customers. In addition to petroleum products, in some markets, the pricing formulas could incorporate prices of other energy carriers or trends in electricity prices. Oil indexation of the gas price is a legacy from the 1960s, when heavy fuel oil was also used extensively in electrical power generation in Western Europe.*

National Balancing Point (NBP), is Europe's most liquid market for gas. Norway's Statoil ties a significant share of its gas pricing to regional pricing set by traders on the NBP. Continental Europe boasts a number of smaller marketplaces that should have a growing impact on regional gas pricing in coming years. The creation of similar marketplaces in Asia has been slower, and trading is still almost exclusively conducted on the basis of oil-indexed long-term contracts.

References

American Chemistry Council (2012). Shale Gas, Competitiveness and New U.S. Investments: A Case Study of Eight Manufacturing Industries. May 2012.

BP (2012). BP Statistical Review of World Energy 2012. http://www.bp.com/statisticalreview.

GIIGNL (2012) The LNG Industry in 2011. http://www.giignl.org/fr/home-page/publications/.

IGU (2012) World LNG Report 2011. International Gas Union.

EIA (2012) World Oil Transit Chokepoints. U.S. Energy Information Administration. http://www.eia.gov/countries/regions-topics2.cfm?fips=WOTC. Cited 11 February 2013.

EIA (2013). Annual Energy Outlook 2013 Early Release Overview. U.S. Energy Information Administration.

IEA (2012). World Energy Outlook 2012. International Energy Agency. Paris.

IEA Coal (2012). Medium-Term Coal Market Report. International Energy Agency. Paris.

IEA Oil (2012). Medium-Term Oil Market Report. International Energy Agency. Paris.

IEA Prices (2012) Energy Prices and Taxes. 4th Quarter 2012. International Energy Agency. Paris.

Simola, H (2012). How have emerging economies changed global price trends? Bank of Finland Bulletin 4/2012.

Simola, H – Solanko, L – Korhonen, V (2013). Perspectives on the Russian Energy Sector. BOFIT Online 2/2013.

Stern, J (2007). Is There a Rationale for the Continuing Link to Oil Product Prices in Continental European Long Term Gas Contracts? OIES Working Paper. April 2007.