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Energy prices and costs report

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COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Energy prices and costs in Europe

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3. Energy prices in a global context

This chapter discusses the role of energy in cost competitiveness from a global perspective. It provides analysis of recent developments in global oil and coal markets as well as regional developments in the wholesale prices of electricity and gas in some of the EU's major economic partners. The chapter looks into retail price levels of electricity and gas and their evolution over time, providing estimates of the breakdown of electricity and gas prices and indications of energy price subsidies in some major economies.

In the case of electricity and natural gas, price differences in regional prices across regions have always existed, but the last few years have seen widening price gaps, in particular the price of natural gas in the US, Europe and Asia. This process has been driven by factors such as the shale gas boom in the US, the impact of oil-indexation on gas price dynamics in the EU, and sharply increased gas demand in Japan in the aftermath of Fukushima.

It discusses the significance of energy prices and costs for the competitiveness of different sectors of the economy, looking into the role of the EU in global export markets for energy intensive goods.

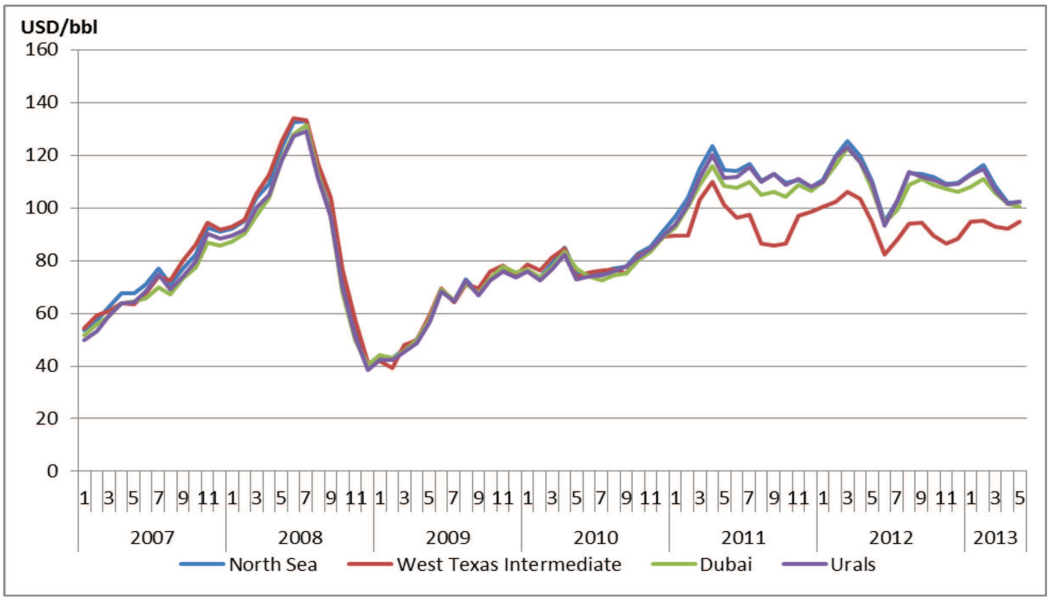
3.1. Global energy commodity and wholesale prices

Energy commodity prices vary across global regions - the degree of variance partially depends on the existence of highly liquid global markets and may reflect factors such as degree of competition, production or import costs and contractual terms, cost of transportation, as well as taxes and subsidies.

3.1.1. Crude oil, coal and uranium

Crude oil is the most commonly traded energy commodity with major price markets for the world trade in crude oil moving largely in step (Figure 1). The presence of highly liquid international markets and relatively low costs of transporting crude oil and petroleum products explain the modest differences in prices across countries and regions (Figure 106). The peak of crude oil prices in 2008 was followed by a fall in 2009 and recover to levels exceeding 100 USD/bbl in early 2011. Crude oil spot market prices have remained volatile since 2011 despite a recent drop to the lowest level since July 2012. Spot prices for West Texas Intermediate (WTI) and North Sea Brent crude oil benchmarks neared parity in mid-2013. By contrast, the average Brent-WTI price spread in 2012 was about 19 USD/bbl and exceeded 20 USD/bbl in February 2013. Since spring 2013, prices for these benchmarks have moved much closer together, as WTI increased in relation to Brent as a result of new US crude oil transport infrastructure and US refineries running at near-record levels.

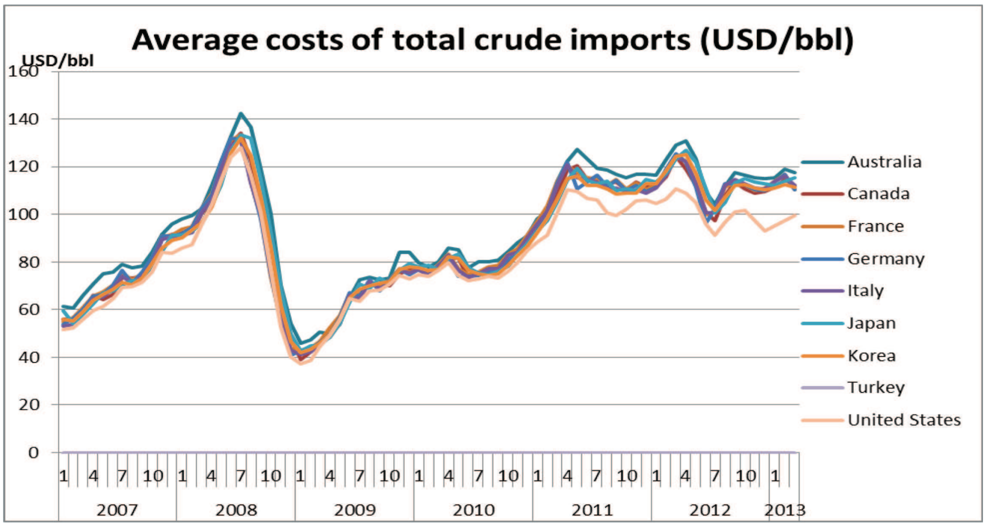
Figure 1. Evolution of global crude oil prices 2007-2013



Source: IEA 2013. Note: North Sea on this graph is set by the lowest of the Brent, Forties, Oseberg and Eko-fisk components.

Average crude oil import prices are affected by the quality of the crude oil that is imported into a country. For a given country, the mix of crude oils imported each month affects the average monthly price. Analysis of the IEA shows that over the first quarter of 2013 crude oil import costs increased over fourth quarter 2012 levels in all major IEA member countries except the United States. Year on year, average import costs in IEA member countries fell by 5.5%, with the United States (-9.2%) and Korea (-5.6%) reporting the largest decreases.

Figure 2. Evolution of average import costs of total crude imports

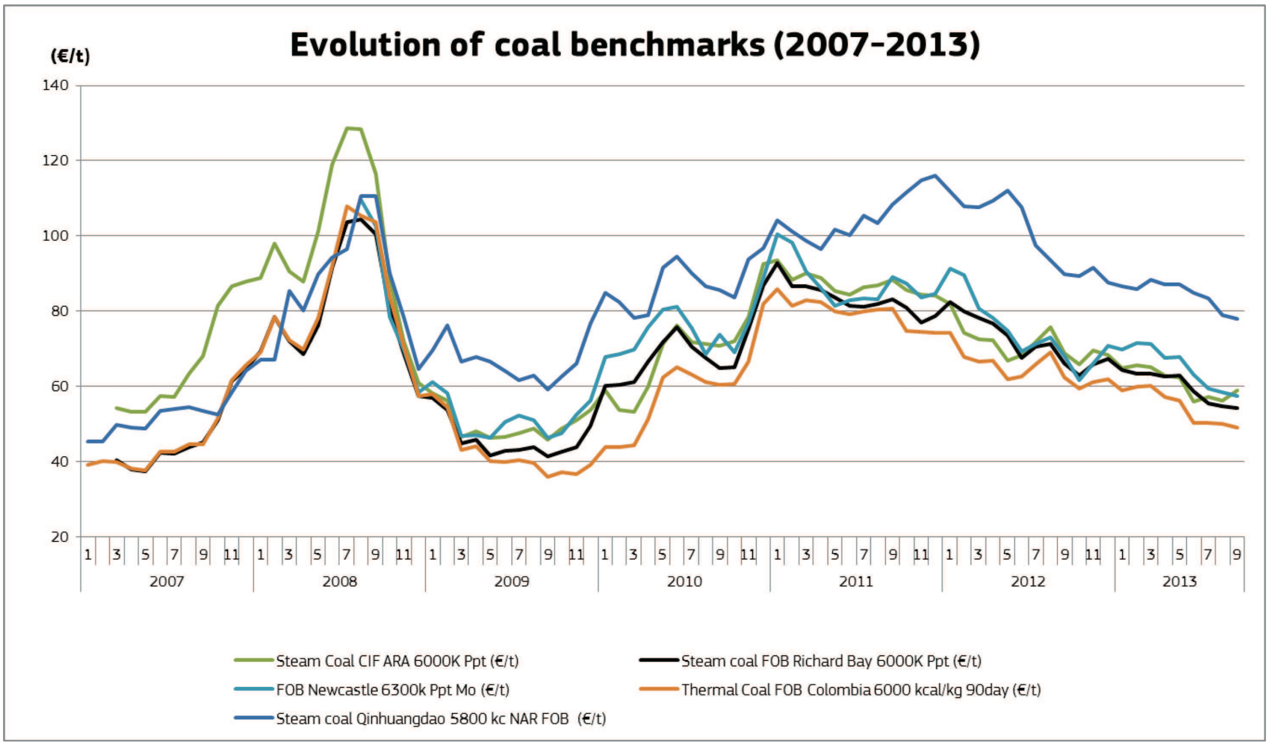


Source: IEA 2013. Energy Prices and Taxes, 2^{nd} quarter 2013.

Unlike oil, which is widely traded internationally, the world **coal** market is predominantly supplied by domestic production with internationally traded coal accounting for a relatively small part of the market (around 20%). Internationally traded steam coal is split into two major markets; the Atlantic basin (focussed on the Amsterdam-Rotterdam-Antwerp, ARA hub) and the Pacific basin (focussed on the Newcastle hub). Europe is increasingly an import led coal market and international prices act as leverage to negotiate price contracts with domestic coal producers. The Atlantic market for steam coal is made up of the major utilities in Western Europe and the utilities located near the US coast, with major suppliers being South Africa, Colombia, Russia and Poland; the share of US coal in total coal imports to the EU has increased from 12% in 2008 to 17% in 2012 [1] [2]. The Richards Bay port in South Africa plays an important role in constraining price divergence across the two basins.

Coal prices can differ due to differences in coal quality and transportation costs. In recent years the spreads between the major coal benchmarks for internationally traded coal to the Atlantic market have been edging ever lower. China became a significant net importer of coal in 2009, since when prices of Chinese coal imports have risen above those in Europe and have remained at a price premium of up to 50% (see figure below).

Figure 3. Evolution of coal price benchmarks



Sources: Platts and Bloomberg

The uranium spot market typically exhibits low levels of liquidity and can deviate significantly from the term market depending on the shorter term supply/demand balance of market participants[3]. There is no formal exchange for uranium. The most liquid traded form

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[1] Nalbandian, H. and Dong, N. 2013. Coal and gas competition in global markets. IEA Clean Coal Centre.

[2] The Pacific market is made up of the utilities in Japan, South Korea and Taiwan, as well as increasing trade going into China and now India; Australia, Indonesia, and recently Vietnam, have been the main suppliers to this market

[3] Uranium price indicators are developed by a small number of private business organizations, like The Ux Consulting Company, LLC (UxC), that independently monitor uranium market activities, including offers, bids, and transactions. Such price indicators are owned by and proprietary to the business that has developed them. The Ux U3O8 Price® indicator is one of only two weekly uranium price indicators that are accepted by the uranium industry. The Ux U3O8 Price® is used as the settlement price for the NYMEX UxC Uranium U3O8 Futures Contract (UX).

of **uranium** is U308 in the form of yellowcake (uranium concentrate powder) for shipping to nuclear power stations.

Figure 4. Uranium prices 2009-2013

Source: Timera Energy 2013

3.1.2. Natural gas

The physical properties of gas make it more expensive to transport than other energy commodities. Historically, as gas was produced and consumed locally or regionally, international trade in gas was quite limited. Therefore, in contrast with the relatively narrow price range of other global energy commodities such as crude oil and coal, there are pronounced inter-regional price differentials in **natural gas** traded across the globe that have increased over recent years. The convergence or divergence of prices differs in periods of tight supply or surplus relative to demand; these are also determined by pricing mechanisms (gas-on-gas competition or oil-indexation). Development of price signals, growth in the LNG spot market and expansion of infrastructure may over time reduce global gas wholesale price differentials. The growing LNG market is expected to also have an impact on price convergence as is the liquidity and transparency of gas trading in regional markets.

Analysis by the International Gas Union points to different drivers of spot gas prices across different regions[4]. *North America* is a market where gas prices are driven by demand and supply fundamentals and gas is traded at the liquid and transparent Henry Hub. Current Henry Hub spot price levels reflect the impact of a surge in shale gas production over the last 5 years.

Northern Europe is also a market driven by liquid hub prices, primarily at the UK NBP, Dutch TTF, the German NCG and Gaspool and the Belgium Zeebrugge. In 2012 about 70% of gas in North-West Europe[5] was priced on a gas-on-gas basis. Yet, unlike North America, marginal price dynamics at European hubs are influenced by oil-indexed pipeline contract prices.

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[4] IGU 2013. Wholesale Gas Price Survey - 2013 Edition. A global review of price formation mechanisms 2005 -2012

[5] In the survey of IGU North-West Europe is defined as UK, Ireland, France, Belgium, Netherlands, Germany, Denmark

Southern Europe seems increasingly influenced by the larger and more mature Northern European market. The Italian market has largely converged with European hub prices and the relative isolation of the Iberian peninsula is expected to decline with the development of new interconnection with France. In contrast, *Eastern Europe* has not yet developed a liquid gas trading hubs and is yet to benefit from liquid markets where long-term contracted gas is complemented by short-term and spot deals[6].

Asia is the key driver of LNG market growth, with most gas delivered under long term oil-indexed contract prices, typically at a substantial premium to US and European hub prices. Even though *South/Central America* is a relatively small gas market by volume, buyers in countries such as Argentina, Brazil and Mexico can have an impact on global spot pricing with spot price levels typically trading within a band of Asian spot prices – and indeed at premium in the second quarter of 2013.

Figure 5 illustrates the continuing variation among global wholesale prices for natural gas and indeed the volatility of prices in the period 2007-2013.The gap between regional gas prices has started widening in 2010 and reached its highest level in April 2012, when the day-ahead price on the National Balancing Point (NBP) in the UK – the most liquid and traditionally lowest price gas hub in the EU – was 4.2 times the price buyers paid at Henry Hub in the US; in the same month the German border price was 5.8 times the price at Henry Hub. For comparison, in 2010 spot prices at NBP were twice as high as these at Henry Hub and a year earlier were at only 50% above those at Henry Hub.

Over the course of 2012, wholesale buyers at the NBP (UK) paid over 3 times as much for gas as buyers at Henry Hub (US). Over the course of 2012 the German border price was around 4 times greater than the price paid by US wholesale buyers at Henry Hub. This trend is explained mostly by the surge in US shale gas, which has driven prices down to historical lows. At the same time, high oil prices have exerted upward pressure on gas prices in Europe and Asia Pacific, which are mostly linked to oil[7].

The beginning of 2013 saw spot prices at Henry Hub double from their historical lows of April 2012. The decline in international oil prices of early 2013 contributed to the stability or slight reduction of gas prices outside of the US.

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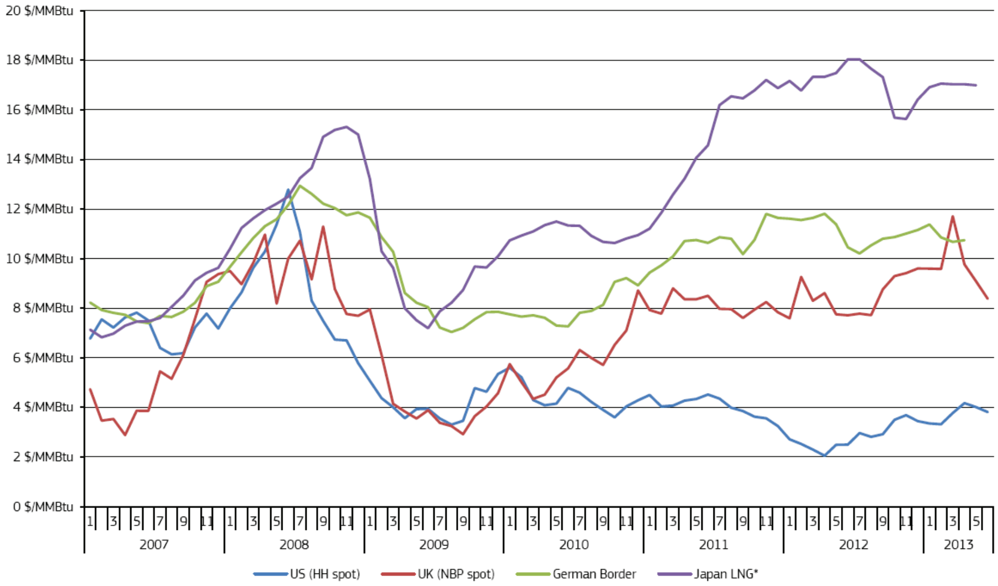
[6] In December 2012 a gas exchange was launched on the Polish Power Exchange (PolPX) and in January 2013 a gas exchange was launched in Hungary.

[7] As indicated on **Error! Reference source not found.**, data from the 2012 annual survey on wholesale price mechanisms by the International Gas Union shows that 44% of gas consumption in Europe was priced on a gas-on-gas competition basis, as opposed to 51% which was still oil-indexed. The share of oil-indexed volumes has gone down from representing almost 80% of consumption in 2005 to 51% in 2012. Yet, strong regional differences persist in price formation mechanisms with about 70% of gas in North-West Europe (defined in the survey as UK, Ireland, France, Belgium, Netherlands, Germany, Denmark) priced on a gas-on-gas basis in 2012, compared to less than 40% in Central Europe (Austria, Czech Republic, Hungary, Poland, Slovakia and Switzerland)..

Figure 5. Evolution of wholesale gas prices: US, UK, Germany and Japan (USD/mmbtu)

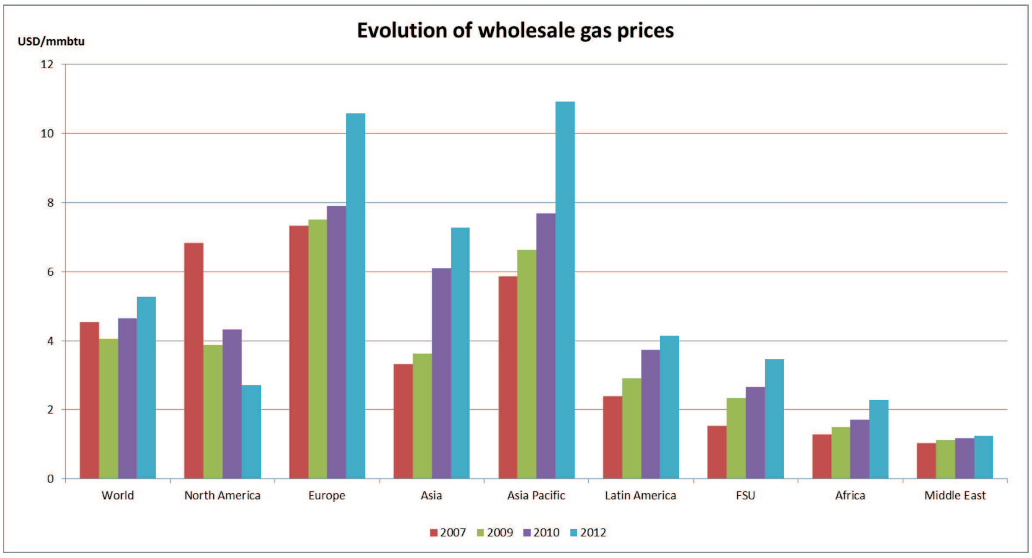


Sources: Platts, Thomson Reuters, BAFA. For Japan: simple average price of LNG from Qatar, Malaysia, Indonesia and Nigeria

Between 2007 and 2012 wholesale gas prices in Europe and Asia Pacific – two regions where oil-indexation remains an important pricing mechanism – rose, cementing their position as the two regions with highest priced wholesale gas.

Globally, analysis by the International Gas Union shows that since 2007 wholesale gas prices have increased consistently in all regions except North America. There have been wholesale gas price increases in China and India, owing to greater import levels and increases in regulated domestic prices. Latin America has also seen a doubling of wholesale gas prices and in the former Soviet Union average prices have more than doubled, largely due to the rise in regulated prices in Russia as they move towards the netback value from Europe. In Africa, where over 85% of prices are effectively subsidised, there have also been price increases and in the Middle East prices have risen slowly, with a significant increase in 2012 over 2010 as a result of regulatory changes in Iran (IGU 2013).

Figure 6. Evolution of wholesale price levels by world region (2007-2012)



Source: International Gas Union and Nexant. Wholesale Gas Price Survey - 2013 Edition

Note: Comparisons of wholesale price levels need to be treated with caution. The wholesale price can cover different points in the gas chain – wellhead price, border price, hub price, city-gate price – so the comparison of price levels is not always a like for like comparison. Most of the regions are defined along the usual geographic lines, although the IGU includes Mexico in North America, and divides Asia in two: a region including the Indian sub-continent plus China, called Asia, and another region including the rest of Asia plus Australasia which is called Asia Pacific.

IGU's analysis also shows that the combination of falling prices in North America and rising prices in Asia, Latin America and the former Soviet Union, has led prices in the latter regions to overtake those in the former. Only in the Middle East and Africa, where prices are often restricted to the cost of production or below as a subsidy, are average prices lower than in North America.

The widening of regional gas price differentials has come against a backdrop of a number of important global trends: from the surge in oil and gas production in the US due to exploitation of shale gas[8] and other unconventional resources to opening up of new hydrocarbon provinces in Africa and elsewhere and a shift in the energy balance towards renewables in the EU (IEA, WEO 2013).

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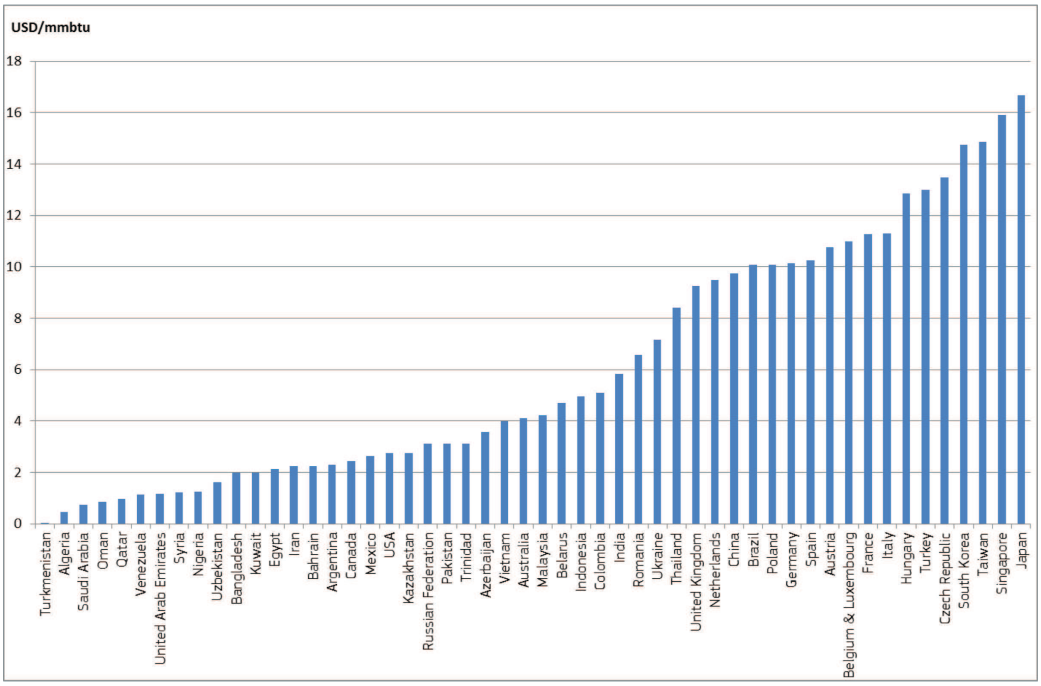
[8] See textbox and ECFIN 2013. Energy Economic Developments in Europe.

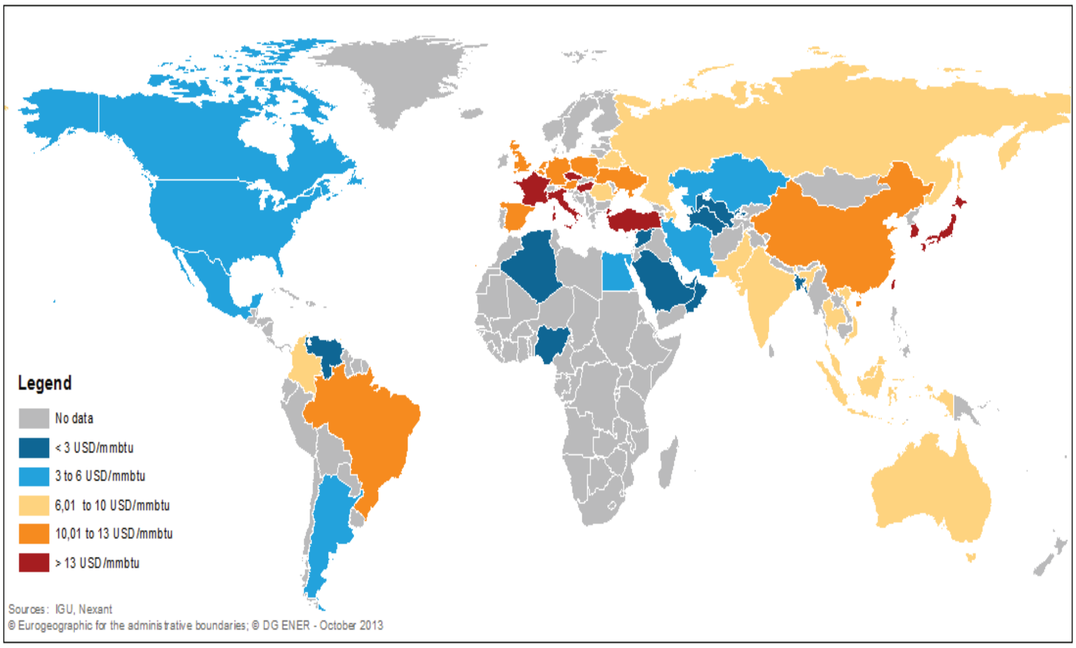
Figure 7. Wholesale prices gas prices globally (USD/mmbtu, 2012)



Source: International Gas Union and Nexant. Wholesale Gas Price Survey - 2013 Edition

Figure 8. Average wholesale gas prices in 2012 (USD/mmbtu)

Source: International Gas Union and Nexant. Wholesale Gas Price Survey - 2013 Edition



Note: In the definition of the International Gas Union, gas wholesale prices can cover a wide range: from hub prices in fully liberalised traded markets to border price in case of internationally traded gas and to wellhead or city-gate prices in producer countries.

Looking at LNG price levels confirms once again that Asia Pacific, along with some EU countries, remains at the high end of LNG import prices. It also shows that Latin America is starting to pay dearly to satisfy its increasing appetite for LNG supply, due to falling indigenous production coupled with growing gas demand for electricity generation. Traditionally LNG has been traded under long-term contracts, mostly indexed to oil, with spot markets starting to emerge at the turn of the 21st century and exceeding 30% of global LNG trade in 2012[9]. In 2012 LNG accounted for 19% of gas needs in Europe, as opposed to 46% in Asia and 21% in Latin America[10], with Europe's share of global LNG demand down against increased competition from coal, availability of renewables and higher pipeline gas imports.

Figure 9. Overview of global spot gas prices for LNG in the first half of 2013 (USD/mmbtu)

Source: Thomson-Reuters Waterborne

From a competitiveness point of view, future US LNG exports have been in the primary focus, in particular when evaluating whether US LNG is cheap vis-à-vis alternative sources of supply such as Australia and East Africa. From the perspective of potential importers, equally if not more important is the fact that the structure of US supply contracts is fundamentally different to that of conventional LNG supply: US LNG supply is hub indexed and inherently flexible. As a result, the possible ramping up of US exports may have a significant impact on global LNG pricing dynamics.

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[9] The worst drought in decades depleted hydroelectric reserves in Brazil and increased its LNG imports by a factor of three in the first four months of 2013 as compared to the same period in 2012.

[10] Regional weighted averages. Significant differences among LNG importers in the EU with Spain meeting around 60% of its gas demand by LNG and Italy around 10%. Source: International Gas Union. World LNG Report - 2013 Edition

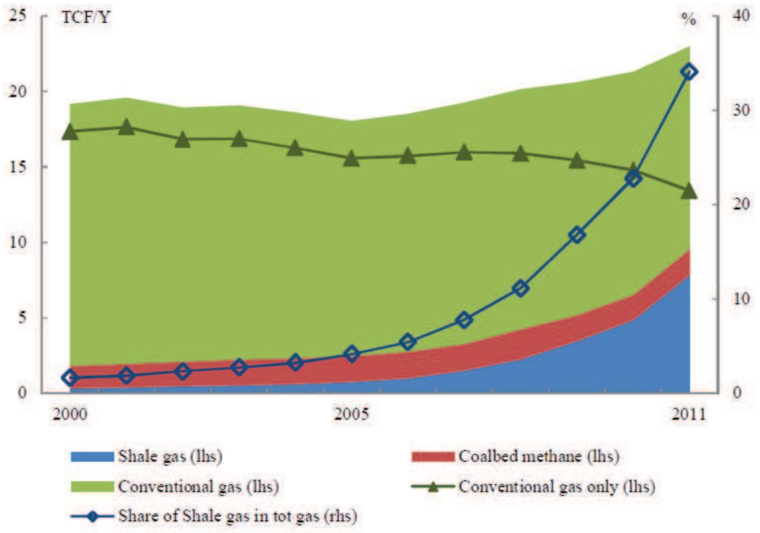
SHALE GAS PRODUCTION IN THE US[1]

Shale gas production became significant in the US only from 2007/2008 onwards. In 2011 shale gas constituted more than one third of total natural gas production in the US – compared to only around 5% in 2005. The EIA estimates that in 2013 the US is set to overtake Russia and Saudi Arabia and become the world's largest producer of petroleum and natural gas.

Shale gas has revived otherwise declining natural gas production in the US and therefore its impact on the overall energy mix of the country should not be overstated. The share of natural gas share in the US energy mix increased by only 2% between 2000 and 2011. A more significant increase could be observed in the electricity mix where the gas share went from 18% to 25%.A similar pattern can also be observed in the EU where the share of gas in the energy mix increased from 23% to 25% over the same period while it went from 17% to 24% in the electricity mix.

The implications for energy dependence have been profound. Since the US has been able to source most of its increased natural gas consumption domestically, the country's overall import dependency has fallen to a record low of 18% in 2011, down from about 25% in 2000. In contrast the EU's total energy import dependency has increased from 47% to 54% in the same period (and from 49% to 67% in the case of natural gas).

Natural Gas Production in the US and share of shale gas in total gas production



Source: Energy Economic Development in Europe, DG ECFIN

3.1.3. Electricity

Electricity is not a global commodity: the need for proximity between electricity plants and customers makes it a regional industry. Differences in energy mix and generation portfolios determine regional variances between wholesale electricity prices. At the same time markets in generation technology are global. Regional differences in wholesale prices for electricity appear to be far less pronounced than in the case of spot gas prices: over the second quarter of 2013 prices at the major wholesale markets in Europe, the US and Australia all traded in the range 30-50 Euro/MWh.

The US has many regional wholesale electricity markets. Wholesale electricity prices are closely tied to wholesale natural gas prices in all but the centre of the country. EIA analysis shows that average on-peak, day-ahead wholesale electricity prices rose in every region of the

US in first-half 2013 compared to first-half 2012[11]. The most important factor was the rise in the price of natural gas in 2013 compared to 10-year lows in April 2012; spot natural gas prices at the major hub in the US increased from 2.4 USD/mmbtu in the first half of 2012 to 3.7 USD/mmbtu in the first half of 2013.

The increase in electricity prices was not uniform across regional electricity markets in the US. Prices in the wholesale electricity market of Texas increased less than much of the rest of the nation, largely because of the mild weather this spring[12].

Analysis of the Australian Energy Regulator shows that electricity spot prices fell steadily from 2010 until the introduction of carbon pricing on 1 July 2012, with prices at the National Electricity Market at or near record lows in 2011-2012. Following some initial market volatility, the introduction of carbon pricing caused an uplift in electricity spot prices of around 21%, in line with expectations[13]. The Australian Energy Market Commission states that nominal wholesale prices rose nationally by 14% from 2011-2012 to 2012-2013, in part reflecting the impact of the carbon price[14]. In New South Wales wholesale energy prices rose by almost 30% between 2012 and 2013.

In Europe, falling coal prices since the beginning of 2011, low carbon prices and the increasing share of renewables have led to relatively stable electricity wholesale prices over 2012 and early 2013 and sharply decreasing prices in the second quarter of 2013 (see **Error! Reference source not found.**). Regional wholesale electricity prices showed a higher degree of convergence than in the last couple of years with the exception of the UK and Italy, two markets in which electricity usually trades at a premium in price to most continental peers due to high dependence on natural gas and reliance on imports. In the Central Western Europe (CWE) region, renewable electricity generation in Germany and nuclear availability in France were important determinants of wholesale electricity prices. A jump in the levels of renewable generation helped to drive regional prices down in both the CWE and CEE regions to four-year lows by the end of Q2 2013.

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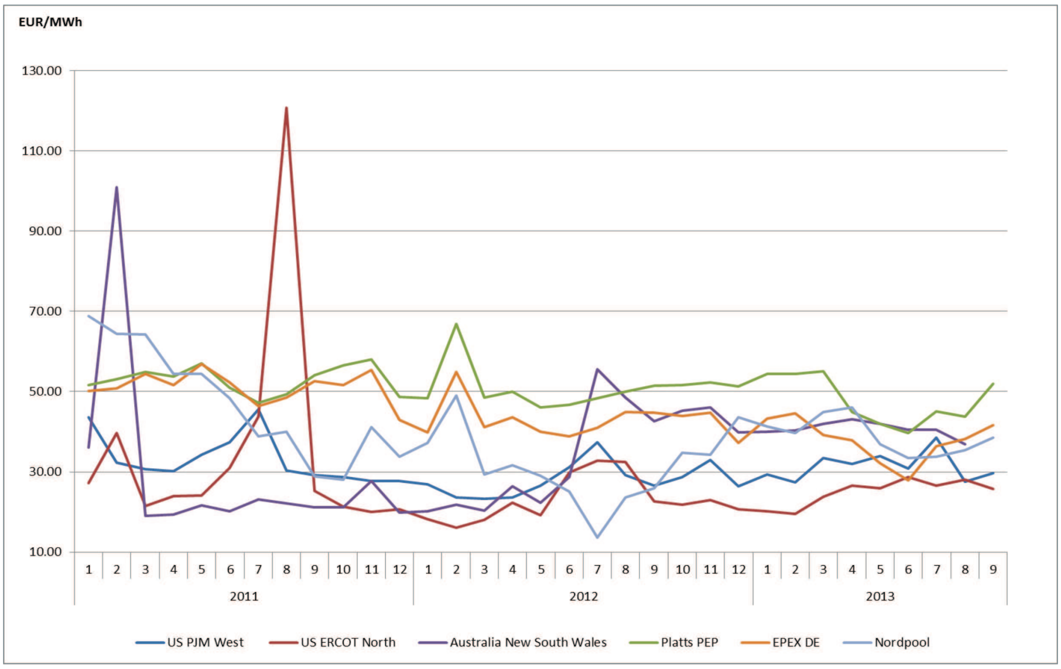
[11] Refers to the lower 48 state, e.g. to the US states located on the continent of North America south of the Canadian border, which excludes the states of Alaska and Hawaii. Washington D.C., is also included when the term is used.

[12] In April 2012, wholesale prices in Texas spiked because of a sharp increase in temperature near the end of the month.

[13] Australian Energy Regulator. State of Energy Market 2012.

[14] On 13 November 2013, its first working day, the new Government of Australia introduced the package of bills to repeal the carbon laws, including the emissions trading scheme.

Figure 10. Electricity wholesale prices in Europe, US and Australia (2011-2013)



Source: Platts, Energy Information Administration, Australian Energy Market Operator

Note: The PJM Interconnection's Western Hub in the US stretches from southern Maryland north to Washington D.C. and northwest to central and western Pennsylvania. The PJM price is a weighted average between on-peak price (on-peak hours: hour-ending 8 through 23) and off-peak hours (hour-ending 1 through 7 and 24); this gives a good proxy of baseload price. ERCOT North is one of the five zones operated by the Electric Reliability Council of Texas. The ERCOT North price is weighted in the same manner as PJM West to give a proxy of baseload. The Australian National Electricity Market (NEM) interconnects five regional market jurisdictions (Queensland, New South Wales, Victoria, South Australia and Tasmania). West Australia and Northern Territory are not connected to the NEM. New South Wales is the largest among the five regional markets. All electricity in the National Electricity Market (NEM) is traded via a gross pool which is settled on a half hourly basis. Each jurisdiction or state settles their own pool price, known as the Pool Price or Regional Reference Price (RRP).

3.2. International comparison of retail prices of electricity and gas[15]

This chapter compares the level of retail prices for electricity and gas for medium-sized industrial consumers and households in the EU with those in major global economies. Unless otherwise specified, comparisons are made for 2012 and all prices are converted into Euro/MWh using the annual exchange rate of the ECB (average of period).

One major caveat when dealing with international comparisons is the lack of a common harmonised data source for retail prices for electricity and gas. A wide variety of reputable sources of data have been used and validated as far as possible (see sources and explanatory notes under each chart). Nevertheless, different countries apply different reporting standards and conventions, inter alia with regard to categories of consumers. In addition, industrial retail prices can vary significantly within countries and industrial sub-sectors – both in the EU and in other economies.

This chapter does not take into account exemptions and preferential prices - neither in the EU nor in other economies as data is scarce and information difficult to quantify in a global

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[15] Data as of September 2013. The comparison is made after converting all prices in EUR/MWh using 2012 annual exchange rate of the ECB.

comparative context. Wherever possible, industrial prices are presented net of recoverable taxes, while household prices include all taxes and duties. When it comes to large and very large consumers, the reported retail prices (by Eurostat and other international bodies and data providers) for electricity and gas may in fact be considered a conservative overestimate. This holds both for retail prices within the EU reported to Eurostat and for retail prices of other economies. Large consumers may purchase directly from wholesalers and be partially or completely exempt from certain network charges, taxes and levies that are nevertheless reported as non-recoverable in general electricity and gas retail price statistics.

Due to the considerable divergence in levels of retail prices paid by industrial and residential consumers across the EU, in international comparisons three retail prices are presented for each consumer group in the EU: weighted average, highest and lowest. This is done because the difference between the highest and the lowest priced country in the EU is often in the order of magnitude of 3-4: beyond 4 in the case of residential gas (incl. all taxes) and below 3 in the case of industrial gas prices (ex. VAT and other recoverable taxes).

3.2.1. Electricity retail prices

In 2012, in 18 EU Member States industrial electricity prices (ex. VAT and other recoverable taxes) were below the EU weighted average. The prices reported for the EU refer to medium-size industrial and household consumers[16].

In 2012 industrial electricity prices levels for medium-size industrial consumers in the 18 Member States below EU weighted averages were comparable to those reported for industrial consumers in economies like Norway, Turkey, China, Brazil, Ukraine and Mexico. In the remaining Member States prices were comparable to those in Japan (or higher, in the cases of Cyprus and Italy). Industrial consumers in countries such as New Zealand, India, Russia, Indonesia, US, Saudi Arabia and UAE paid prices below – in some cases well below - these in the lowest priced EU Member State.

On average in 2012, across the EU and denominated in Euro, medium-size industrial consumers in the EU paid before exemptions about 20% more than companies based in China, about 65% more than companies in India and more than twice the price for electricity as companies based in the US and Russia. Industrial electricity prices in Japan were 20% higher than those faced by average industrial European consumer.

Middle East countries such as Saudi Arabia and UAE have by far the lowest prices: industrial consumers in Europe pay more than 3 times as much as industrial consumers in these countries.

In 2012 industrial retail prices in China were almost twice as high as those in the US. The IEA points out that China's industrial electricity prices have increased significantly in recent years, largely because of rising coal prices and cross-subsidies in favour of residential consumers (IEA, WEO 2013).

Data from the energy intensive case studies presented in chapters 1 and 2 supports the retail price level data. A comparison of 2 EU-based brick and roof tile producers shows that in 2012 on of these plants paid 42% more for electricity than the Russian plant with comparable

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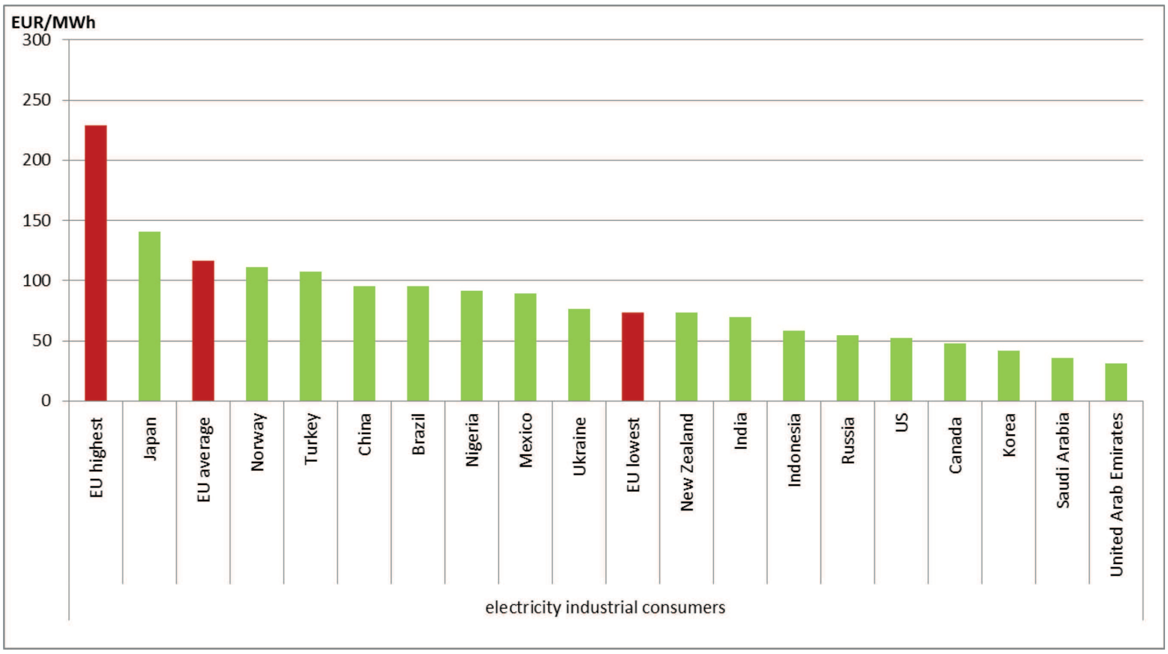
[16] Electricity industrial: 500-2000 MWh annual consumption (Eurostat band IC), electricity household: 2500 – 5000 KWh annual consumption (Eurostat band DC), gas industrial: 10 000 - 100 000 GJ (Eurostat band I3) and gas household: 20 – 200 GJ (Eurostat band D2).

characteristics, while the other EU-based plant paid almost twice as much as the Russian plant. Comparison of two EU-based brick and roof tile producers in 2012 shows that one of these paid for electricity 2.7 times as much as a US-based plant, while the other paid 10% more than the US-based competitor. The Russian brick and roof tile producer paid 54 Euro/MWh in 2012, while the US-based brick and roof tile producer paid 69.1 Euro/MWh (ENTR, CEPS).

In the case of wall and floor tiles, electricity prices paid by two EU-based producers were 2.2 to 2.6 times these in the plant in the US. The price gap between one Russian plant and the two EU-based plants is in the range of factor 8.5 to factor 10. A comparison between the price paid by the Russian-based brick and roof tile producer and the Russian-based wall and floor tile producer shows that the former paid for electricity 54 Euro/MWh, while the latter only 9 Euro/MWh, which suggests preferential treatment of the wall and floor tile producer used in this comparison. A comparison between the electricity prices paid by three steel producing plants in the US (one BOF, one EAF, and one rolling mill) and EU-based steel makers points that in 2012 EU-based plants paid twice as much for electricity as US-based ones. **Error! Reference source not found.** illustrates these comparisons.

Figure 11. Retail prices of electricity in 2012: industrial consumers

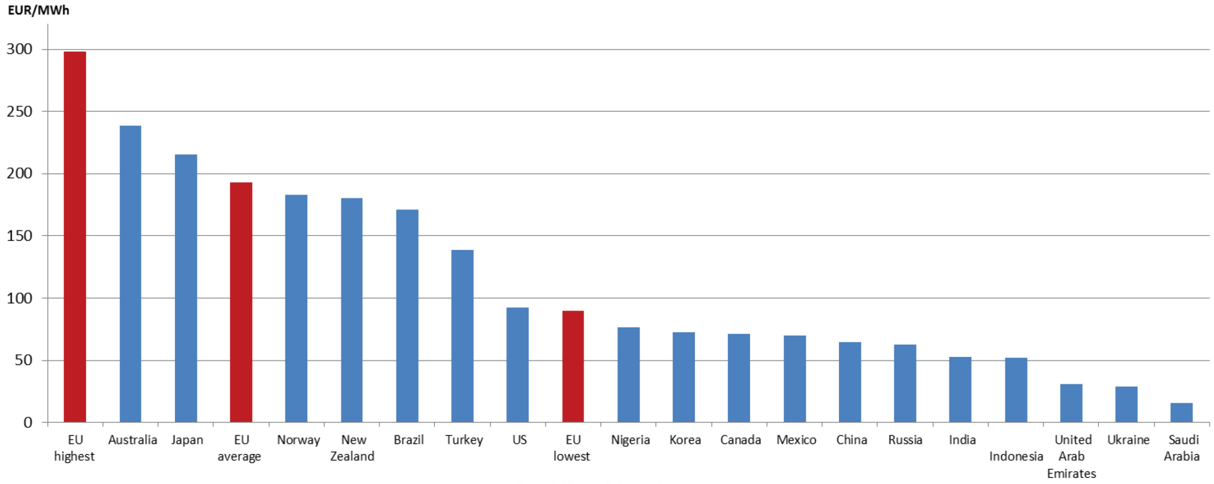


Note: EU electricity prices for industry refer to consumption band IC, exclusive of VAT and other recoverable taxes. Electricity prices for industry for Canada refer to 2010 and for Korea to 2009. ECB annual exchange rates have been used. Industrial prices exclude taxes as reported by ERRA for Nigeria, Russia and Ukraine, by ANEEL for Brazil, by the IEA for Japan, Canada (2010) and New Zealand. IEA reports zero taxation of industrial prices for Mexico; ERRA reports zero taxation for Saudi Arabia and UAE. No data on taxation of industrial prices in South Korea (IEA); until 2009 natural gas prices reported by South Korea indicated 12-14% taxation of industrial natural gas prices. Prices reported by CEIC for China are actual averages of industrial use electricity prices in 36 cities; no consumption taxation on industrial retail prices in China, but prices include production tax (17% for electricity, 13% for gas, note that these are production taxes). Australian values are exclusive of general sales tax (GST). EIA numbers for the US include state and local taxes; electricity consumption is not taxed at the federal level in the United States, but it is taxed in some states.

Sources: Eurostat (EU, Turkey and Norway), CEIC (China), ANEEL (Brazil), ERRA (Russia, Saudi Arabia, Nigeria, Ukraine and United Arab Emirates, data provided in Euro), Ministry of Finance of India (India), IEA (Japan, Korea, Canada, Mexico, New Zealand, Canada), EIA (USA), Australian Energy Market Commission (residential prices in Australia).

Households in the EU on average paid prices comparable to those in Norway, New Zealand and Brazil. On the other hand, European households on average paid more than twice as much as US households.

Figure 12. Retail prices of electricity in 2012: residential consumers



Note: EU, Turkey and Norway household prices refer to consumption band DC, including all taxes. Residential prices include all taxes and levies, as reported by the respective sources. ECB annual exchange rates used.

Sources for the two electricity retail price charts: Eurostat (EU, Turkey and Norway), CEIC (China), ANEEL (Brazil), ERRA (Russia, Saudi Arabia, Nigeria, Ukraine and United Arab Emirates, data provided in Euro), Ministry of Finance of India (India), IEA (Japan, Korea, Canada, Mexico, New Zealand, Canada), EIA (USA), Australian Energy Market Commission (residential prices in Australia).

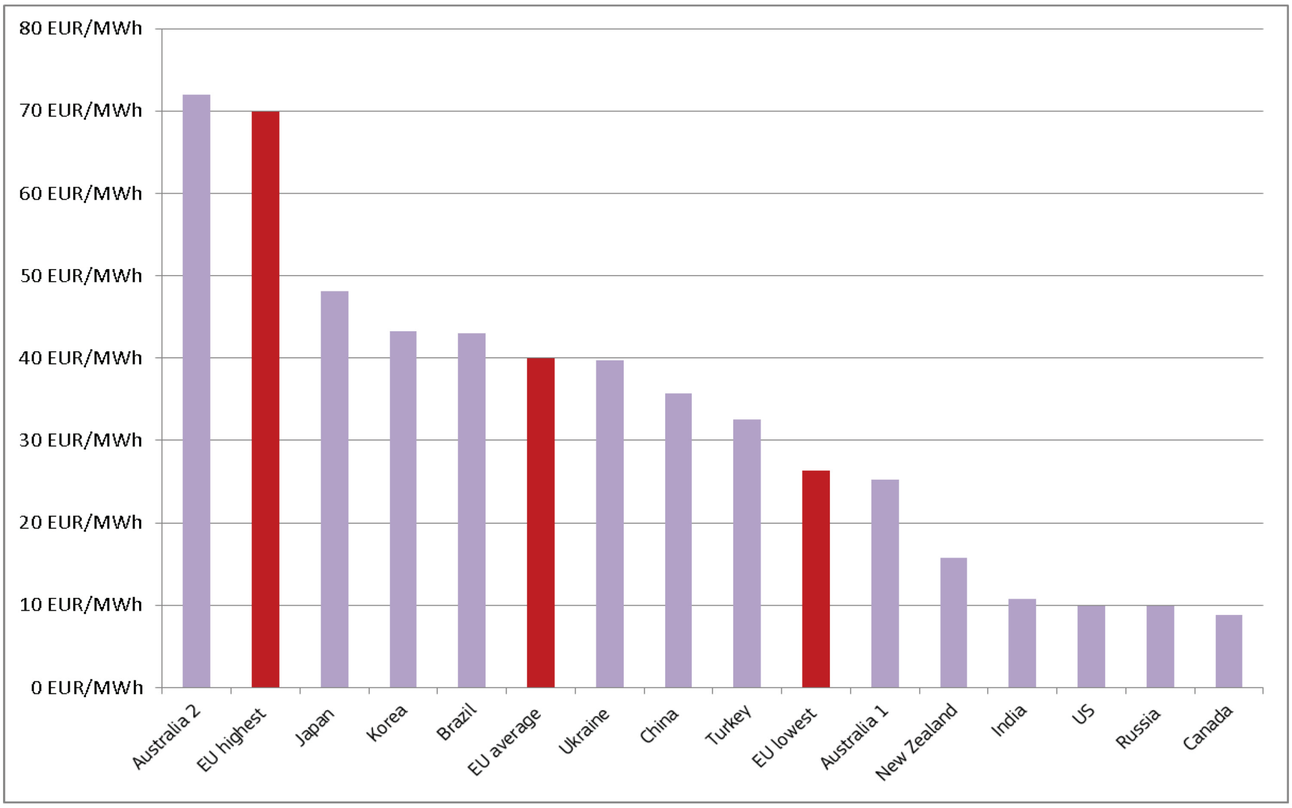
3.2.2. Gas retail prices

On average and denominated in Euros, in 2012 medium-sized industrial consumers in the EU paid four times as much for gas as industrial consumers in the US, Canada, India and Russia and about 12% higher retail prices than those in China. Prices in the 10 Member States where industrial prices were below the EU weighted average paid prices comparable to those in Ukraine, China and Turkey. Industrial gas prices in Brazil and Japan were above the EU weighted average.

In the case of households, EU average prices were 2.5 times higher than these faced by households in the US and Canada, but were half the level of gas prices faced by households in Japan and 30% below those in New Zealand. Households in 14 Member States paid less than the EU weighted average in 2012, putting their prices at levels comparable to these in South Korea, Turkey and the US.

This is indeed re-confirmed by the case study data from two EU-based bricks and roof tile producers that pay about 3.7-3.9 times as much for gas as a similar plant in Russia. The comparison of two other EU-based plants producing bricks and roof tiles point that these pay for gas 2.8-3 times as much as a similar US-based plant. A of two wall and floor tile producers in the EU point to a difference in the range of 3-4 times with natural gas prices paid by a Russian plant. A comparison between two EU-based wall and floor tile plants and a US-based plant point to a natural gas price difference in the range of 3.6-3.7 times. A comparison of prices paid by three steel-making plants in the US (one BOF, one EAF and one rolling mill) with the prices paid by EU-based steel makers in the sample (see Annex 2) also point that EU-based producers paid four times as much for natural gas than the three US-based plants. In the case of ammonia, the steep fall in natural gas price in the US transformed it from a marginal producer to one of the lowest-cost producers in the world. **Error! Reference source not found.** illustrates these comparisons.

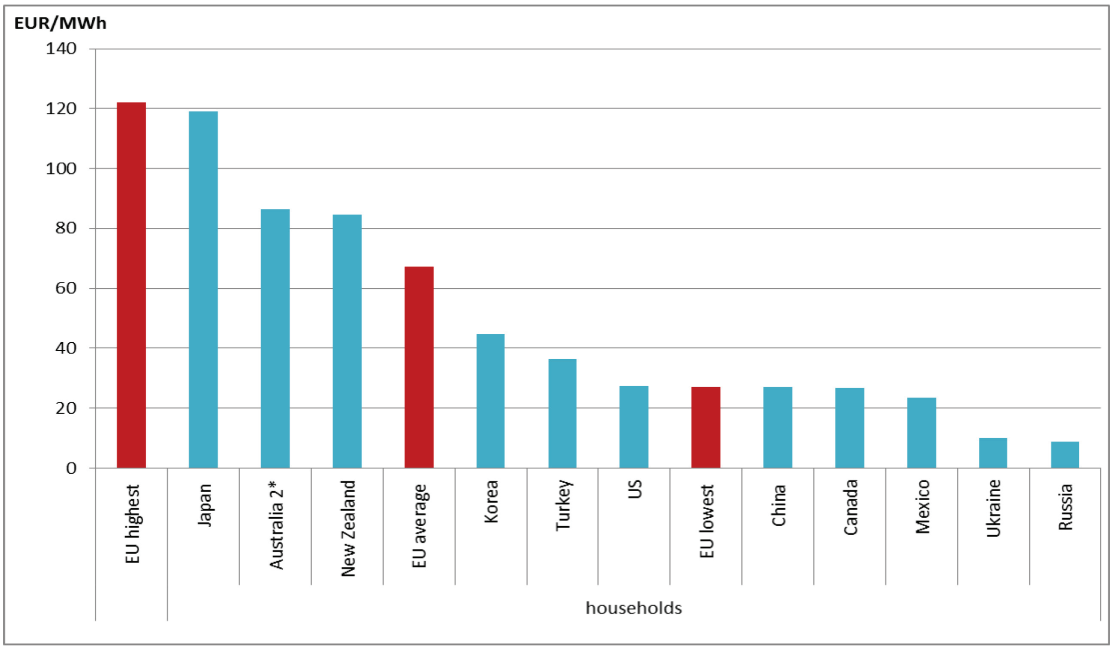
Figure 13. Retail prices of gas in 2012: industrial consumers



Notes: Australia 1 refers to prices paid under new contracts by large industrial consumers; Australia 2 means prices paid by small business consumers and by households, respectively and is based on information on standing offers (default tariffs, exclusive of general sales tax). Prices for Korea and Japan refer to 2011. Prices for Japan, Ukraine, China, Turkey, New Zealand, Russia, Canada and the EU exclude VAT (in the case of EU and Turkey also other recoverable taxes, if any). Prices for Korea (2011) and the US include taxes. No data on taxation in India. The price for Brazil includes federal taxes as PIS and COFINS (social contribution taxes) and state taxes such as ICMS (tax on circulation of goods and services; no value-added or general sales tax in Brazil) which has different rates for each state. In June 2013 the government of India approved a new pricing formula for gas proposed by the Rangarajan Committee, which is expected to double natural gas prices starting from April 2014.

Sources: Eurostat (EU and Turkey), CEIC (Brazil, China), ERRA (Russia, Ukraine), IEA (Japan, Korea, New Zealand, US, Canada), KPMG (India), Australian Industry Group (Australia 1 = large industrial consumers, new contracts) and Office of Tasmanian Economic Regulator (Australia 2 = small business consumers)

Figure 14. Retail prices of gas in 2012: household consumers



Note: Data for Korea and Japan refers to 2011. Prices include all taxes.

Sources: Eurostat (EU and Turkey), CEIC (China), ERRA (Russia, Ukraine), IEA (Japan, Korea, New Zealand, US, Canada, Mexico), Australian Energy Regulator (household consumer prices)

3.3. Retail price evolution[17]

Looking at the evolution over time of the real index of industrial electricity prices, one can see that between 2008 and 2009 industrial consumers in OECD Europe faced an increase in electricity prices of about 10%. In real terms the index of industrial electricity prices stayed fairly stable between 2009 and 2012. All in all, between 2008 and 2012 industrial consumers in OECD Europe faced an increase in electricity prices of almost 10% in real terms[18].

In comparison, the real index of industrial electricity prices is down by 10% in 2012 in comparison to 2008, with the biggest drop coming in the period 2010-2012.

Between 2008 and 2012 the respective national indices of industrial electricity prices increased by 4% in Canada, 14% in Korea and Japan, at 19% in Australia.

Year on year in the first quarter of 2013, the IEA reports that the real price index of industrial electricity prices went up by most in Ireland (+20.3%), Italy (+13%) and Turkey (+10.9%), while the biggest drop across OECD countries was in Poland (-4.9%).

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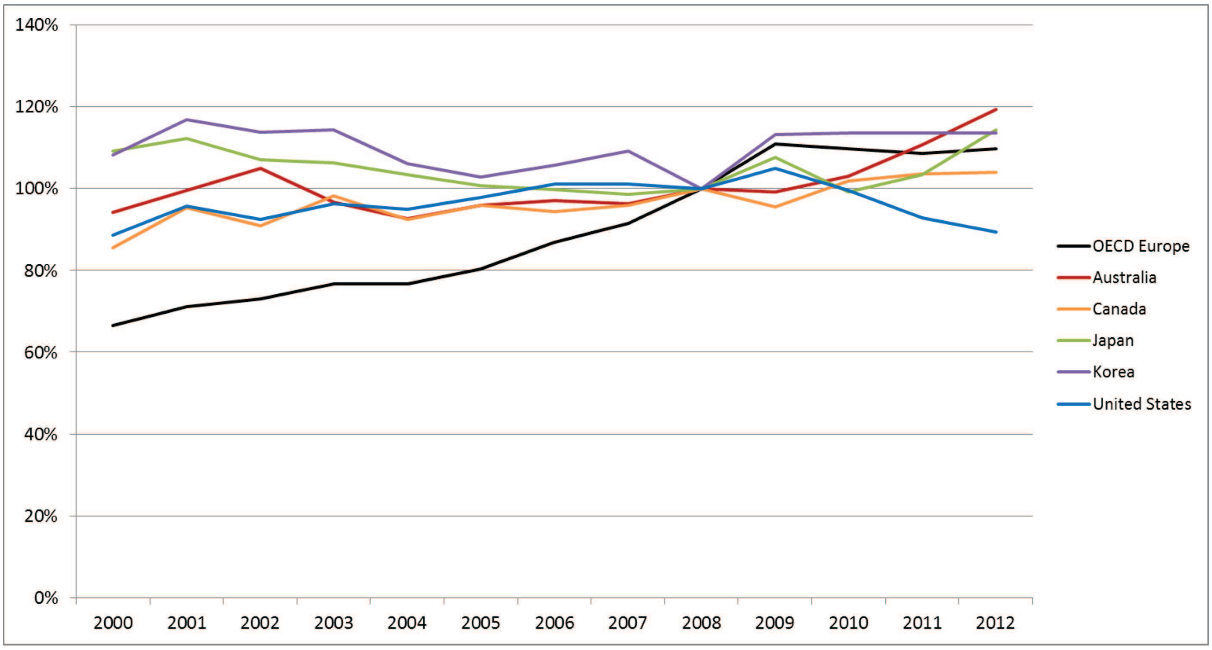
[17] Arguably, over time exchange rates of national currencies, as well as inflation levels, may account for a certain level of fluctuation if one looks at price levels. Here we present IEA industrial price indices in real terms (deflated with PPI) calculated in national currencies. Therefore these figures are not affected by fluctuations in exchange rates.

[18] IEA publishes retail price evolution data for OECD Members only. OECD Europe excludes Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta and Romania.

Figure 15. Index of real electricity prices for industrial end-users (2008=100)



Source: IEA, European Commission calculations

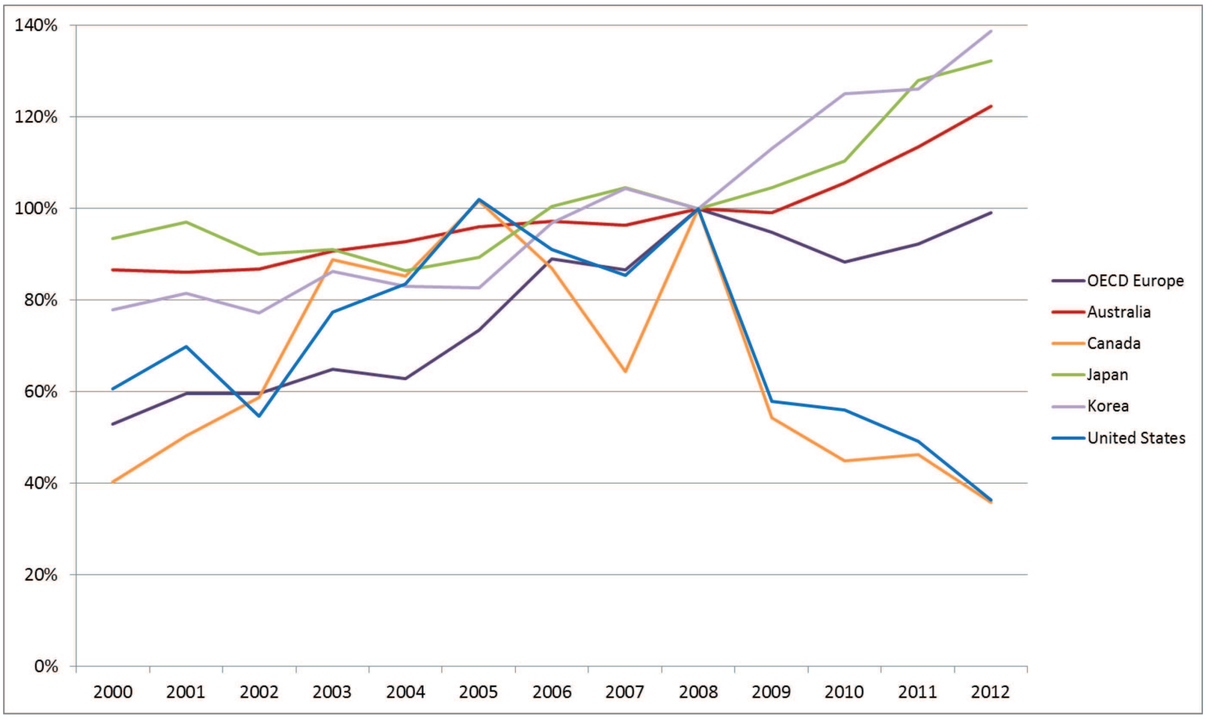
Note: The indices have been re-referenced (re-based) to year 2008 from the original calculation of the IEA that uses 2005 to fit the overall timeline of the price analysis (2008-2012). The IEA computes the real price index from prices in national currencies and divided by the country specific producer price index for the industrial sector and by the consumer price index for the household sector.

The divergence in the evolution paths is even greater when it comes to industrial prices for natural gas. Industrial gas price indices show that users in Canada and the US are now benefiting from prices comparable in real terms to those in mid-90s (in the case of US) and late 90s (in the case of Canada) which decreased by more than 60% between 2008 and 2012.

In 2012 the index of real natural gas prices for industrial users was at its level of 2008. Industrial users in Japan and Korea saw the steepest growth in gas prices, with 2012 prices standing 32% and 39% above their respective 2008 levels.

IEA analysis shows that in the first quarter of 2013 year on year the real price index of industrial end-use prices for gas rose most in Turkey (+30.5%) and New Zealand (+18.9%) and fell most in Slovenia (-15.3%) and the Slovak Republic (-5.6%).

Figure 16. Index of real natural gas prices for industrial end-users (2008=100)



Source: IEA, European Commission calculations

Note: The indices have been re-referenced (re-based) to year 2008 from the original calculation of the IEA that uses 2005 to fit the overall timeline of the price analysis (2008-2012). The IEA computes the real price index from prices in national currencies and divided by the country specific producer price index for the industrial sector.

3.4. Retail price composition: examples

Below we attempt to decompose retail prices for electricity and gas in some major economies. Ideally the aim was to decompose retail prices into the same components as the ones used in our decomposition analysis of European retail prices. In reality this is not always feasible as different countries provide profoundly different degrees of disaggregation.

The comparison of **household electricity prices** shows that the energy component in Germany and especially in the UK tends to be at levels much higher than in the US, Australia and Turkey. The network component in Germany and France is higher than in the US, while in the UK and Turkey it is lower than in the US. Australia stands out as a country with exceptionally high network costs as well as other charges. Estimates based on data from the Australian Energy Regulator show that more than a fifth of the household electricity bill comes from retail and energy scheme costs - including the 'shop front' for a consumer's electricity supply and costs from schemes for energy efficiency and renewables, as well as carbon costs.

Table 1. Breakdown of household electricity prices

	US (2011)	Australia	Turkey	Germany	France	UK
	Eurocent/kWh					
energy	5.8	7.6	8.3	8.5	5.3	13.4
network	4.2	11.0	3.4	5.9	5.0	3.6
taxation	n.a.		3.0	12.4	4.2	0.9
other		5.2				
Total	10.0	23.9	14.7	26.8	14.5	17.8

Source: Eurostat for Germany, France, UK and Turkey, second half of 2012. Notes: United States: electricity - 2011 data from EIA Annual Energy Outlook 2013. Transmission accounts for 1.1 Eurocent/kWh, distribution accounts for 3.1 Eurocents/kWh. No data on taxation. Australia: European Commission calculations based on data on household price levels published by the Australian Energy Market Commission (Electricity Price Trends Report 2013) and breakdown of household bills by the Australian Energy Regulator (State of the Energy Market 2012). Other costs: in the case of electricity in Australia these include carbon costs, green costs and retail costs.

In the case of prices of natural gas for households, the energy component in Germany, France and the UK is much higher than in the US and Australia[19]. The network component in Germany, France and the UK is much higher than in the US, but much lower than in Australia.

Table 2. Breakdown of household gas prices

	US	Australia	Germany	France	UK
	Eurocent/kWh				
energy	0.7	2.0	3.6	3.4	3.6
network	0.9	4.5	1.7	2.4	1.5
taxation	0.1		2.2	1.1	0.5
other	1.1	2.1			
Total	2.8	8.6	7.4	6.8	5.6

Source: VaasaETT for Germany, France and UK, prices in capital cities in 2012. United States: European Commission calculations based on data on household price levels by the EIA and breakdown of household bills by the American Gas Association. Other costs: in the case of Australia these include retail costs and carbon costs. In the case of the US these include net interest, other and net income, depreciation and amortisation, administrative and general, customer accounts, bad debt.

When looking at the share of network charges in EU retail electricity prices, it is worth noting that in a ranking of 144 countries undertaken by the World Economic Forum on quality of electricity supply, 5 of the top 10 positions are occupied by EU Member States. There remain differences between Member States, with 15 EU Member States in the top 30 (NL, DK, AT, UK, FR, FI, SE, BE, LUX, CZ, IE, DE, SK, PT, SI, ES) , while the remaining 13 rank lower down the list with RO and BG in positions 88 and 95 respectively.

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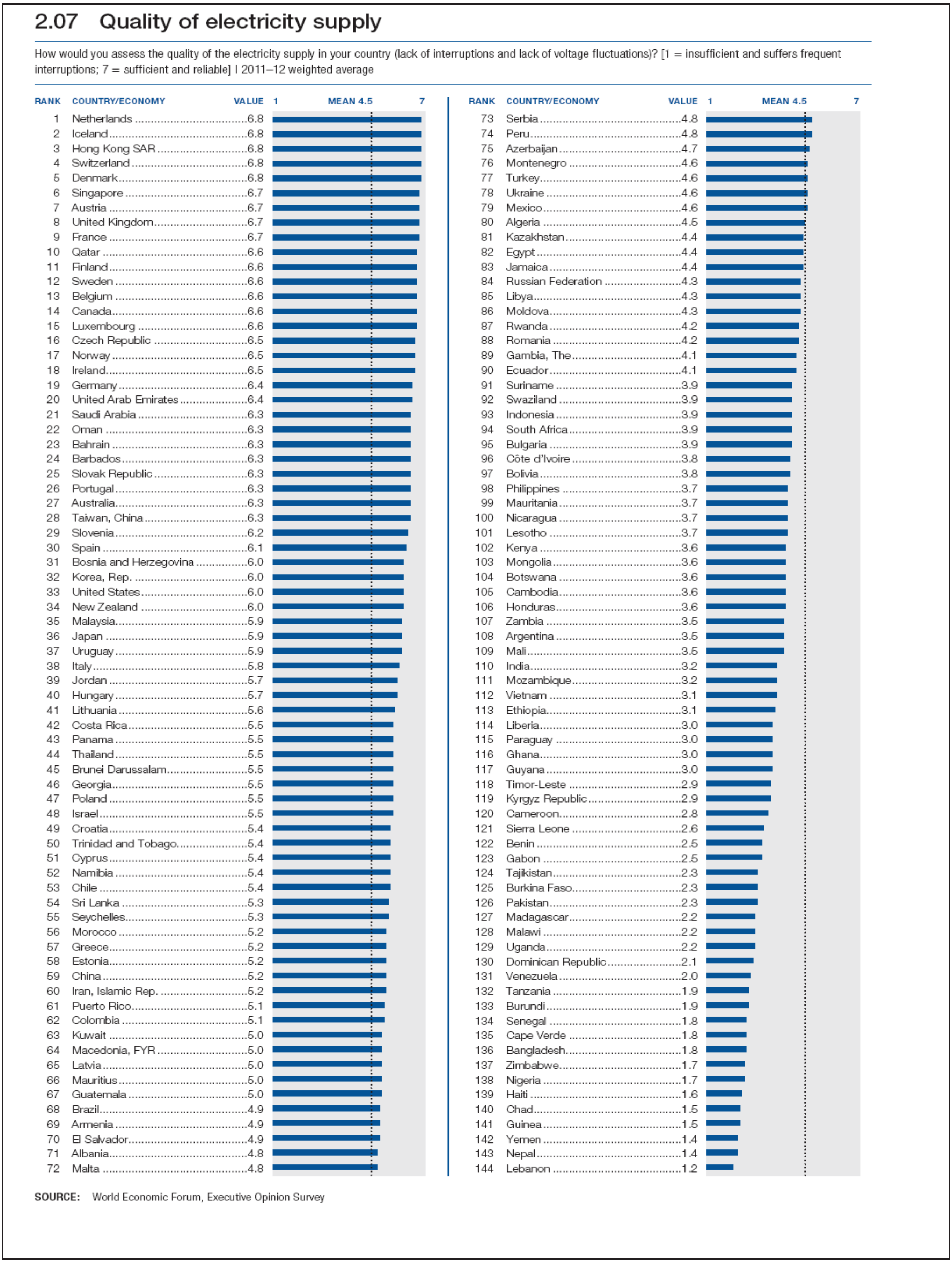
[19] This holds also in case one assumes that some – or even all – of costs classified under 'Other' should be included under the energy component.

Table 3. Quality of electricity supply globally



2.07 Quality of electricity supply

How would you assess the quality of the electricity supply in your country (lack of interruptions and lack of voltage fluctuations)? [1 = insufficient and suffers frequent interruptions; 7 = sufficient and reliable] | 2011–12 weighted average

RANK	COUNTRY/ECONOMY	VALUE
1	Netherlands	6.8
2	Iceland	6.8
3	Hong Kong SAR	6.8
4	Switzerland	6.8
5	Denmark	6.8
6	Singapore	6.7
7	Austria	6.7
8	United Kingdom	6.7
9	France	6.7
10	Qatar	6.6
11	Finland	6.6
12	Sweden	6.6
13	Belgium	6.6
14	Canada	6.6
15	Luxembourg	6.6
16	Czech Republic	6.5
17	Norway	6.5
18	Ireland	6.5
19	Germany	6.4
20	United Arab Emirates	6.4
21	Saudi Arabia	6.3
22	Oman	6.3
23	Bahrain	6.3
24	Barbados	6.3
25	Slovak Republic	6.3
26	Portugal	6.3
27	Australia	6.3
28	Taiwan, China	6.3
29	Slovenia	6.2
30	Spain	6.1
31	Bosnia and Herzegovina	6.0
32	Korea, Rep.	6.0
33	United States	6.0
34	New Zealand	6.0
35	Malaysia	5.9
36	Japan	5.9
37	Uruguay	5.9
38	Italy	5.8
39	Jordan	5.7
40	Hungary	5.7
41	Lithuania	5.6
42	Costa Rica	5.5
43	Panama	5.5
44	Thailand	5.5
45	Brunei Darussalam	5.5
46	Georgia	5.5
47	Poland	5.5
48	Israel	5.5
49	Croatia	5.4
50	Trinidad and Tobago	5.4
51	Cyprus	5.4
52	Namibia	5.4
53	Chile	5.4
54	Sri Lanka	5.3
55	Seychelles	5.3
56	Morocco	5.2
57	Greece	5.2
58	Estonia	5.2
59	China	5.2
60	Iran, Islamic Rep.	5.2
61	Puerto Rico	5.1
62	Colombia	5.1
63	Kuwait	5.0
64	Macedonia, FYR	5.0
65	Latvia	5.0
66	Mauritius	5.0
67	Guatemala	5.0
68	Brazil	4.9
69	Armenia	4.9
70	El Salvador	4.9
71	Albania	4.8
72	Malta	4.8
73	Serbia	4.8
74	Peru	4.8
75	Azerbaijan	4.7
76	Montenegro	4.6
77	Turkey	4.6
78	Ukraine	4.6
79	Mexico	4.6
80	Algeria	4.5
81	Kazakhstan	4.4
82	Egypt	4.4
83	Jamaica	4.4
84	Russian Federation	4.3
85	Libya	4.3
86	Moldova	4.3
87	Rwanda	4.2
88	Romania	4.2
89	Gambia, The	4.1
90	Ecuador	4.1
91	Suriname	3.9
92	Swaziland	3.9
93	Indonesia	3.9
94	South Africa	3.9
95	Bulgaria	3.9
96	Côte d'Ivoire	3.8
97	Bolivia	3.8
98	Philippines	3.7
99	Mauritania	3.7
100	Nicaragua	3.7
101	Lesotho	3.7
102	Kenya	3.6
103	Mongolia	3.6
104	Botswana	3.6
105	Cambodia	3.6
106	Honduras	3.6
107	Zambia	3.5
108	Argentina	3.5
109	Mali	3.5
110	India	3.2
111	Mozambique	3.2
112	Vietnam	3.1
113	Ethiopia	3.1
114	Liberia	3.0
115	Paraguay	3.0
116	Ghana	3.0
117	Guyana	3.0
118	Timor-Leste	2.9
119	Kyrgyz Republic	2.9
120	Cameroon	2.8
121	Sierra Leone	2.6
122	Benin	2.5
123	Gabon	2.5
124	Tajikistan	2.3
125	Burkina Faso	2.3
126	Pakistan	2.3
127	Madagascar	2.2
128	Malawi	2.2
129	Uganda	2.2
130	Dominican Republic	2.1
131	Venezuela	2.0
132	Tanzania	1.9
133	Burundi	1.9
134	Senegal	1.8
135	Cape Verde	1.8
136	Bangladesh	1.8
137	Zimbabwe	1.7
138	Nigeria	1.7
139	Haiti	1.6
140	Chad	1.5
141	Guinea	1.5
142	Yemen	1.4
143	Nepal	1.4
144	Lebanon	1.2

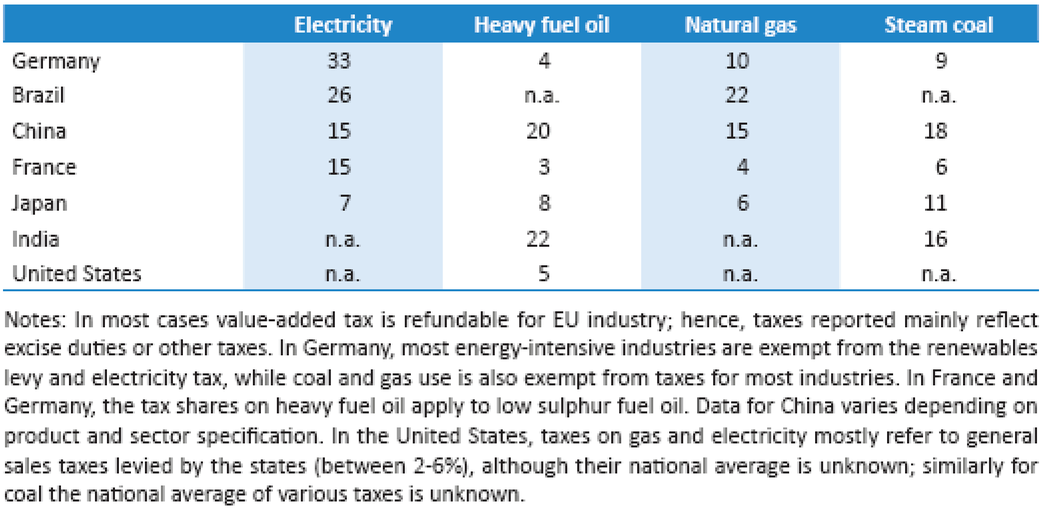
SOURCE: World Economic Forum, Executive Opinion Survey

3.5. Energy taxation

Globally, countries differ in the way they tax energy in terms of the range of products taxed, definitions of tax bases, tax rate levels and rebates and exemptions. There are often substantial differences in the way in which different forms, uses and users of energy are taxed. While EU industry generally pays lower rates of taxation on energy products in comparison to households, the share of tax in the total energy price for industrial users remains high in some EU countries, especially in the case of electricity. This in many cases is moderated by various exemptions and preferential tax treatment of industrial consumers meeting certain criteria[20].

In a global comparative context, EU Member States tax electricity and natural gas more heavily than other global competitors and also more heavily than other economies that face high energy prices, such as Brazil and Japan. For example, the share of tax in industrial electricity prices in Germany is five times as high as in Japan and more than double than it is in Brazil (Table 4). On the other hand Brazil and China tax natural gas for industrial use more heavily than Germany and France.

Table 4. Share of tax in industrial energy prices in selected countries, 2012



	Electricity	Heavy fuel oil	Natural gas	Steam coal
Germany	33	4	10	9
Brazil	26	n.a.	22	n.a.
China	15	20	15	18
France	15	3	4	6
Japan	7	8	6	11
India	n.a.	22	n.a.	16
United States	n.a.	5	n.a.	n.a.

Notes: In most cases value-added tax is refundable for EU industry; hence, taxes reported mainly reflect excise duties or other taxes. In Germany, most energy-intensive industries are exempt from the renewables levy and electricity tax, while coal and gas use is also exempt from taxes for most industries. In France and Germany, the tax shares on heavy fuel oil apply to low sulphur fuel oil. Data for China varies depending on product and sector specification. In the United States, taxes on gas and electricity mostly refer to general sales taxes levied by the states (between 2-6%), although their national average is unknown; similarly for coal the national average of various taxes is unknown.

Source: IEA WEO 2013 and sources therein.

Some major economies have lower consumption-based taxes on electricity and gas (VAT, general sales tax): for example Japan has a 5% VAT on electricity and gas and South Korea has a 10% rate on electricity. General sales taxes levied by the states in the US are in the range 2-6%. In comparison, in the EU VAT rates for electricity and gas range from 6% in Luxembourg to 27% in Hungary.

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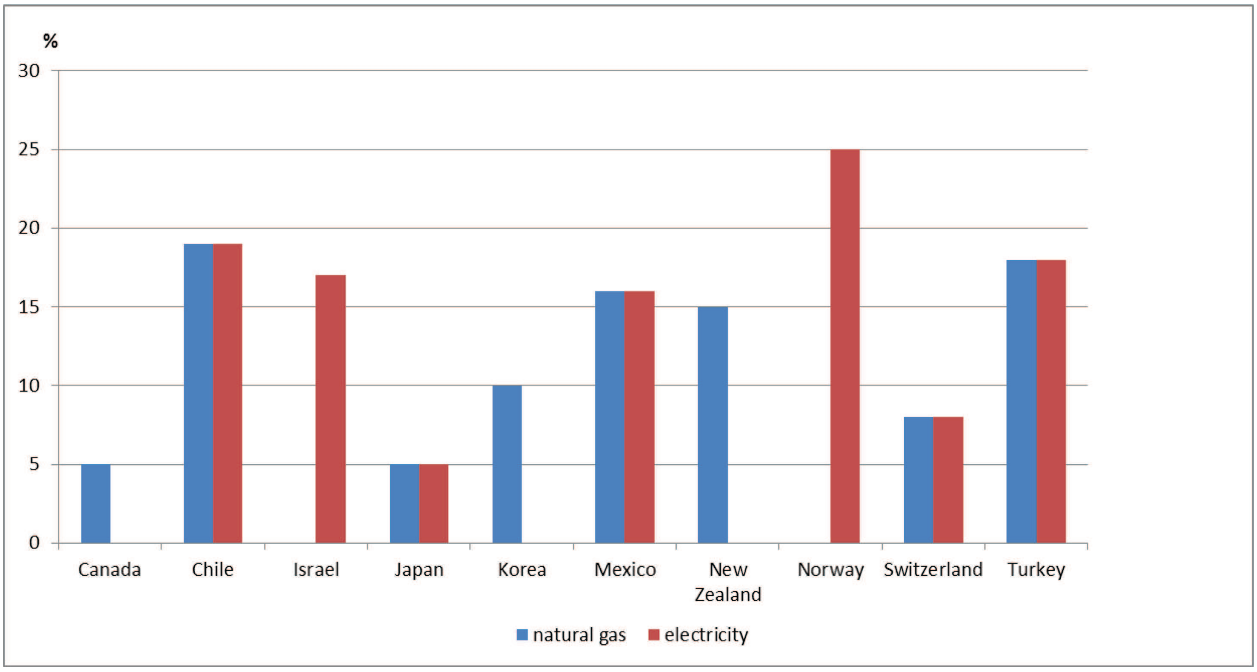
[20] Data on excise duty special regimes in the EU available here regiuhttp://ec.europa.eu/taxation_customs/resources/documents/taxation/excise_duties/energy_products/rates/excise_duties-part_ii_energy_products_en.pdf

Figure 17. VAT rates on natural gas and electricity



Source: IEA Energy Prices and Taxes, 2013Q2

The OECD has looked into the effective tax rates on electricity and natural gas across all OECD members[21]. In Australia the consumption of electricity is not taxed. Most electricity producers are required to pay the carbon price (set at AUD 23 per tonne of carbon emitted and rising 2.5 per cent per annum in real terms[22]). Natural gas for heating and process use is untaxed (OECD 2013).

In Canada the consumption of electricity and fuels used to produce electricity is not taxed federally except where the electricity is used primarily in the operation of a vehicle. Natural gas is not taxed at federal level (only British Columbia has a tax on natural gas) (OECD 2013).

Japan taxes the consumption of electricity taxed at a rate of 375 JPY/MWh (less than 4 Euro/MWh). In addition, fuels used for electricity production are taxable under the petroleum and gas tax. For energy used for heating or process purposes, natural gas and petroleum gases are taxed at 1,080 JPY/tonne (about 10.5 Euro/tonne) (OECD 2013).

South Korea taxes fuels used to generate electricity, but not the consumption of electricity. An individual consumption tax is applied to LPG and natural gas (including liquefied forms) on a per kilogram basis. An education tax also applies to LPG (butane gas) on the same basis.

Electricity consumption is not taxed at the federal level in the United States but is taxed in some states (OECD 2013).

Due to the generally lower tax burden on energy consumption outside the EU, it can be expected that the importance of energy-related tax exemptions is much smaller.

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[21] OECD. 2013. Taxing energy use in OECD countries. In: Taxing Energy Use: a Graphical Analysis. OECD Publishing. The OECD report covers taxes such as excises levied directly on a physical measure of energy product consumed and excludes general taxes, such as VAT. The OECD methodology "looks through" taxes on electricity consumption to calculate upstream the implicit tax rates on the primary energy used to generate electricity.

[22] In November 2013 two years after Australia's carbon price passed parliament and almost 18 months after the initial fixed-price carbon tax took effect, the House of Representatives has voted to repeal it. The fate of the4 repeal now rests with the Senate.

3.6. Energy price subsidies

Increasing global competition and integration of production chains are developments with far-reaching social, political and economic consequences. Various stages of production may be offshored to countries with less stringent or unenforced regulations or ones that subsidise energy.

At the global level, much remains to be done to phase out inefficient fossil-fuel subsidies that encourage wasteful consumption. Even though the large part of fossil fuel subsidies are focussed on oil and petroleum products, the IEA's 2013 World Energy Outlook quotes the results of a survey of 40 countries, showing that in 2012 subsidies to natural gas and coal consumed by end-users amounted to 124 billion USD and 7 billion USD respectively, while subsidies to electricity stood at 135 billion USD[23]. Iran, Saudi Arabia, Russia, India, Venezuela and China are the countries with the highest levels of subsidy to fossil fuels.

Significant subsidies to natural gas and electricity in major economic partners for the EU, such as Russia, India and China, does little to establish a level-playing field to for consumers based in different parts of the world.

At the same time, the IEA signals that several major reforms to reduce or phase out fossil-fuel subsidies have been announced since 2012, increasing the momentum of recent years on this issue. These include reforms to energy pricing made by India and China. India has announced that power stations that need to buy imported coal will be able to pass on the extra costs to their customers[24]. India has also announced that prices of domestically produced natural gas will be adjusted on a quarterly basis from April 2014, to match the average of the prices of the LNG it imports and of gas on other major international markets. According to the IEA, this is expected to result in a doubling of domestic gas prices.

In 2013 China increased natural gas prices by 15% for non-residential users. In a move to ease electricity shortages, in July 2012 the country implemented a tiered electricity pricing system for households whereby customers who use more electricity will pay higher rates per kilowatt-hour than those who use less. Russia raised electricity and gas prices by 15% on average in July 2013 and plans to increase them further in July 2015.

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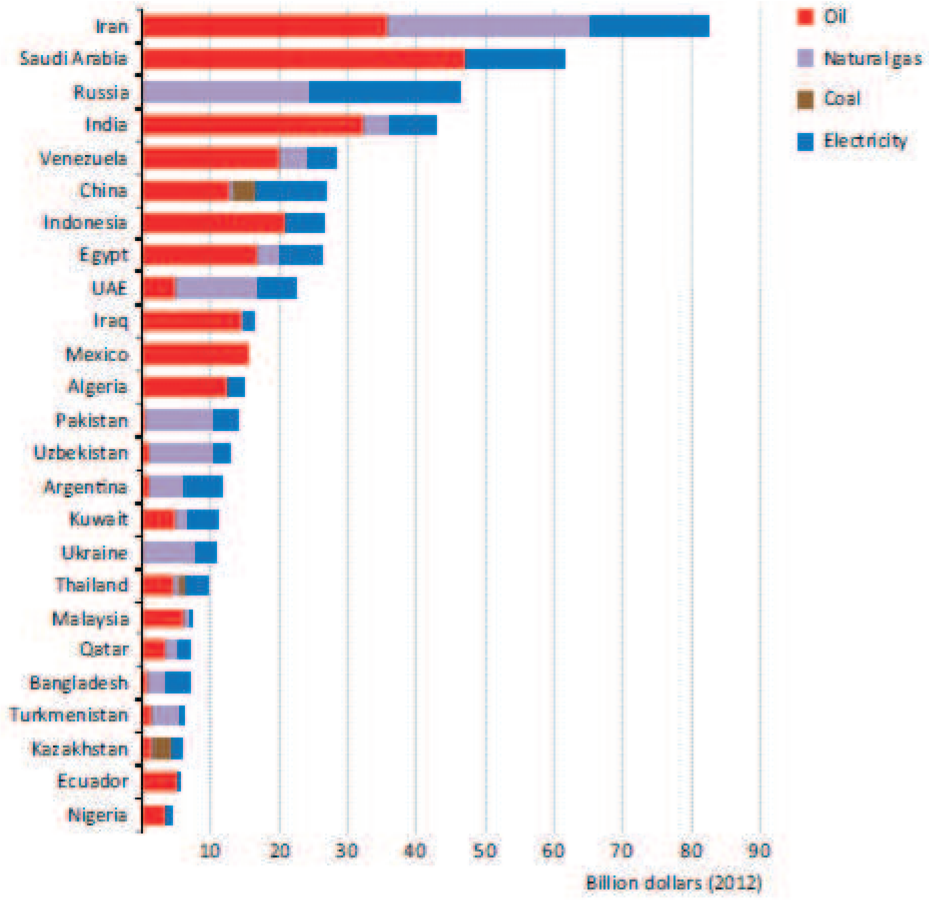
[23] To estimate subsidies the IEA looks whether energy prices are set below reference prices, which are defined as the full cost of supply based on international benchmarks. The estimates cover subsidies to fossil fuels consumed by end-users and subsidies to fossil-fuel inputs to electricity generation, but do not cover subsidies to petrochemical feedstock. For electricity, subsidy estimates are based on the difference between end-user prices and the cost of electricity production, transmission and distribution.

[24] Under the old system, tariffs could not be increased to reflect fuel prices, sometimes leaving generators with little incentive to increase generation to meet peak demand and causing frequent blackouts and rolling outages.

Figure 18. Economic value of fossil-fuel consumption subsidies by fuel for top 25 countries, 2012[25]



Source: IEA WEO 2013

3.7. Energy and cost competitiveness

The current difficult economic climate exacerbates concerns about loss of competitiveness. Competitiveness is a broad macro-economic concept related to quality of living and different from the notion of cost competitiveness. For example, the 2012-2013 Global Competitiveness Index (GCI) of the World Economic Forum ranks 144 economies on a set of 12 pillars of competitiveness grouped in three sub-indexes: basic requirements, efficiency enhancers and innovation and sophistication. Global competitiveness implies a comparison of performance with trade partners and market shares in world markets. In contrast, cost competitiveness applies more specifically to input factors.

Many factors drive productivity and competitiveness, from macroeconomic environment, infrastructure and institutions to health and education systems, goods and labour market efficiency, market size, technological readiness and innovation[26].

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[25] Given that currently no comprehensive database is available in all EU Member States on energy subsidies, based on a uniform methodology, European Commission is going to prepare and publish an in-depth study on energy costs and various subsidies in the energy sector in 2014.

[26] See, for example, the pillars of competitiveness in the Global Competitiveness Index of the World Energy Forum

The price of energy – together with cost of labour, capital and raw materials – affect overall production costs and the profitability of economic actors. Rising energy prices and volatility are a factor with direct impact on businesses' production costs, their economic activity, external accounts and competitiveness.

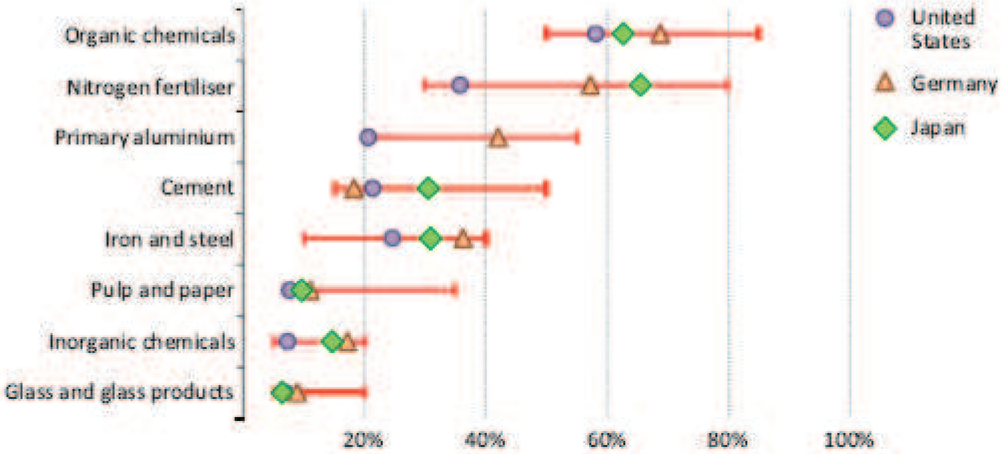
A comparison of the cost-competitiveness of different geographical locations needs to take into account the cost elements that vary between those locations. One of the major drivers of energy costs is energy price; the price of energy commodities like gas and (to a lesser extent) electricity differs substantially across locations. For this reason, regional disparities among energy prices are often centre stage in debates about competitiveness, even more so in countries and regions dependent on imports.

The extent to which a country is vulnerable to energy price increases, relative to other economies, depends on the structure of its economy, in particular its share of energy intensive manufacturing, the energy efficiency of its manufacturing sectors and sub-sectors and its degree of energy dependence.

The significance of energy to competitiveness also varies between industries, segments and sub-segments of the global value chain, depending among other things on the energy intensity of manufacturing processes and the degree to which manufactured products are globally tradable (ease and cost of transportation).

Energy costs are particularly important for the international competitiveness of energy intensive industries, which often have a strategic position in the economic value chain. Energy costs as a share of total production costs vary significantly by sectors and region. For example, the IEA shows that the share of energy costs in the production of organic chemicals varies between approximately 50% and over 80%, with the share in Germany and Japan higher than that in the US. In other cases, such as glass and glass products, the share of energy costs in total production costs ranges up to 20%, with German and Japanese manufacturers in the lowest band of this range.

Figure 19. Share of energy in total production costs by sub-sector, 2011



Notes: Red horizontal lines show typical ranges for the world. In chemical industries, energy is used both in the production process and as a feedstock. Pulp and paper excludes printing. There are no data for primary aluminium in Japan as production there is minimal.

Source: IEA WEO 2013 and sources therein. Note: To calculate the share of energy in total production cost, IEA has used official sources for the USA, Germany and Japan for all industrial sub-sectors apart from primary aluminium in Germany (estimated based on the US data accounting for differences in electricity prices and specific energy consumption).

As of 2011 the **EU dominates the export market for energy-intensive goods**, accounting for more than two-thirds of export value, which makes it the largest export region for energy intensive goods.

The effects of energy prices on the EU's international competitiveness differ by product and trading partner; they are difficult to isolate from the effects of other cost factors and to quantify on the basis of statistical time series. In addition it may be difficult to empirically establish and monitor global industrial shifts related to regional energy price disparities, due to the lead times associated with production and investment decisions and time lags with statistical data on manufacturing output, trade flows, employment statistics and retail prices of energy.

Despite these analytical challenges, one can expect that **regional price disparities increase the risk of reduced production levels and investment in higher priced countries and bring changes in global trade patterns, in particular affecting industries that have a high share of energy costs and are exposed to international competition** because their production is easy and relatively cheap to transport[27].

This is supported by analysis undertaken by the IEA in the 2013 World Energy Outlook, which shows that **persistently high energy price disparities can lead to important differences in economic structure over time and have far-reaching effects on investment, production and trade patterns**. For example, IEA projections to 2035 point to marked

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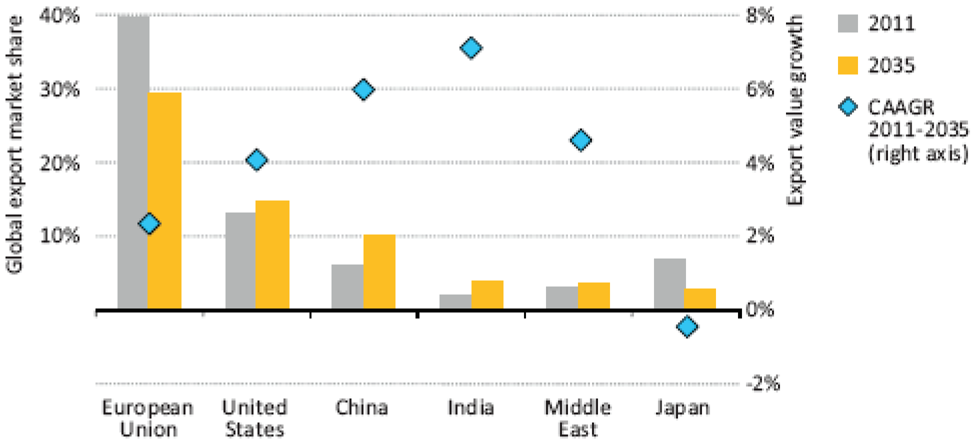
[27] With increasing competition and integration of global production chains offshoring - the decision by European manufacturing firms to move their production to locations abroad – has gained momentum and attention. The European Competitiveness Report 2012 refers to data from the European Manufacturing Survey for two periods - mid-2004 to mid-2006 and 2007 to mid-2009 – covering firms from four industrial sectors and showing that cost reduction is the dominant motive for relocating production activities abroad, with factors such as vicinity to customers and expansion of markets the next most important motivation for offshoring.

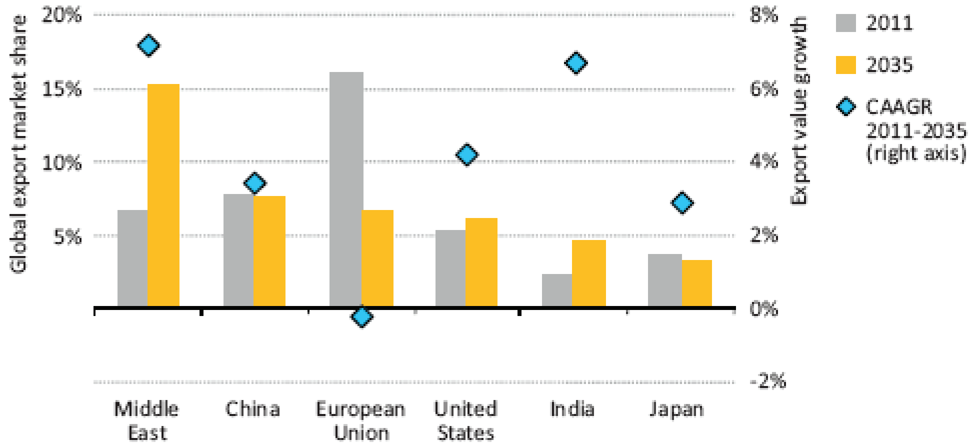
differences in production and export prospects for the energy-intensive sectors across regions determined by their stage of economic development – with strong domestic demand for energy intensive goods in some emerging economies – but also by energy price levels, particularly through relative energy costs among developed countries. Projections show that in 2035 the EU will remain the leading exporter of energy-intensive goods, exporting more than the US, China and Japan together, but that **in 2035 market shares in global export markets for energy intensive goods of the EU decline** - by 10 percentage points in the case of chemicals in the EU and by 9 percentage points in the case of non-ferrous metals - as opposed to developing Asia that is projected to increase its export market share to a level equal to that of the EU. A combination of factors drive this trend, including energy prices, relatively high wages and longer shipment distances to growing consumption centres in Asia (IEA WEO 2013).

Figure 20. Regional shares of global export market and growth in export values in the chemicals and non-ferrous metals sectors, New Policy Scenario of the IEA (2011-2035)

(a) Chemicals



(b) Non-ferrous metals

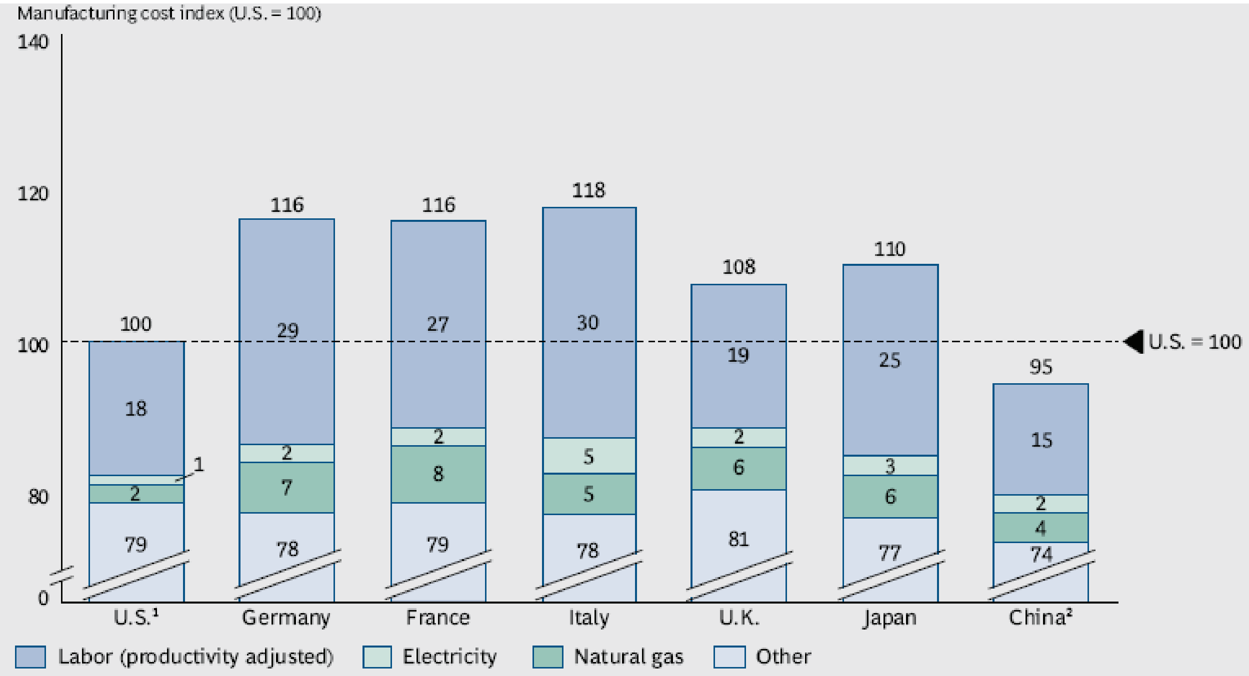


Notes: CAAGR is compound average annual growth rate. Chemicals include base chemicals (*e.g.* petrochemicals), specialty chemicals, pharmaceuticals and consumer chemicals. Non-ferrous metals include aluminium, copper, lead, nickel, tin, titanium, zinc and alloys such as brass. Intra European Union trade flows are excluded. Sources: OECD ENV-Linkages model and IEA analysis.

Source: IEA WEO 2013

A recent study by the Boston Consulting Group (BCG) indicates that the US already has a production costs advantage compared with other developed economies that are leading manufacturers[28]. Due to three factors – labour, electricity and natural gas – by 2015 average manufacturing costs in the UK, Japan, Germany, France and Italy will be 8-18% higher than in the US. BCG's projection shows that by 2015 average labour costs in the US will be around 16% lower than in the UK, 34% lower than in Germany and 35% lower than in France and Italy. BCG expects that the gap between electricity and gas prices in the US and major European economies will remain or even increase by 2015.

Figure 21. Average projected manufacturing cost structures of the major exporting nations relative to the US in 2015



Sources: U.S. Economic Census; U.S. Bureau of Labor Statistics; U.S. Bureau of Economic Analysis; International Labour Organization.
Note: Cost structures were calculated as a weighted average across all industries. No difference was assumed in "other" costs (e.g., raw materials inputs and machine and tool depreciation). Differences in values are a function of the industry mix of each exporting country.
¹U.S. figures represent costs in a set of select lower-cost states specified in previous publications.
²Chinese figures represent the Yangtze River Delta region.

Source: BCG 2013

Impacts on US shale gas on trade[29]

Besides its downward pressure on domestic gas and electricity prices, the most evident effect of shale gas development in the US has been a fundamental contribution to the sizeable reduction of the US energy trade deficit over the past few years (about 1%-point of GDP). While the US gas trade has tended to move closer to balance, the coal trade surplus has increased since its consumption has been displaced by cheaper natural gas. This means that the current energy trade deficit of the US corresponds only to its trade deficit for oil (about 2% of GDP). On the contrary, in the EU the trade deficits for natural gas, oil and coal kept on growing,.

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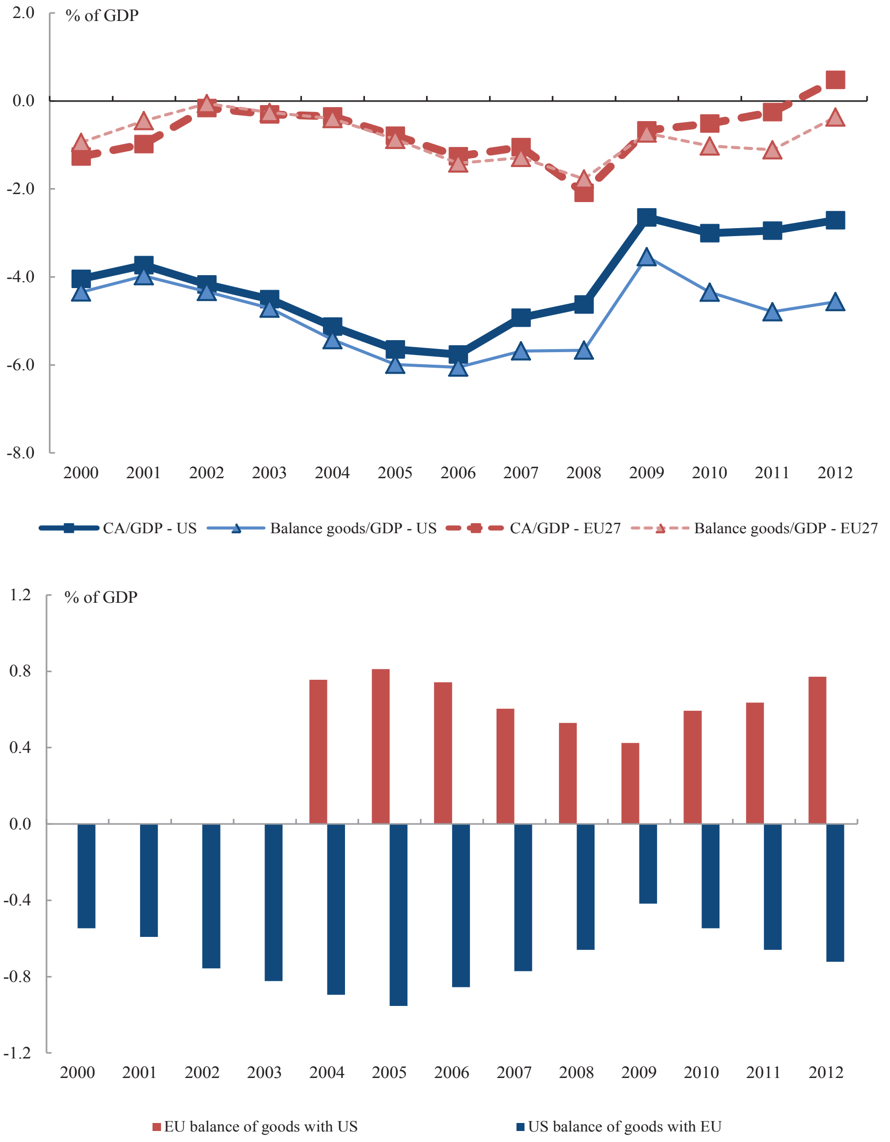
[28] BCG. 2013. Behind the American Export Surge.

[29] DG ECFIN. Energy Economic Development in Europe.

The repercussion of the surge in shale gas production is less visible when looking at the overall current accounts of the two regions. The EU-US goods balance shows a persistent surplus for the EU without any clear sign of deterioration. This may indicate that until 2012 the EU-US energy price gap has not visibly affected the export capacity of the EU industry and their competitiveness vis-a-vis their US counterparts. In addition, the EU in 2012 had a current account surplus while the US ran a consistent deficit.

Figure 22. Current account balance, external balance of goods and bilateral balance of goods, 2001-2012 - US and EU



Source: DG ECFIN. Energy Economic Development in Europe.

While the surge in US shale gas has led to significant changes in the US energy sector, reducing the US energy trade balance in GDP terms and its energy dependency, the impact on the EU so far can be considered limited; no major shift in the EU-US goods trade balance has been observed yet, nor are there any significant divergent trends in the overall production structure of manufacturing industry which can be ascribed to the shale gas revolution.

The resilience of the EU industry can be explained at least partially by better performance in terms of energy intensity, which may have helped to buffer the persistent energy price gap. However the relatively small decline in energy intensity sectors' share in total EU GVA signals that not all the industrial segments have been equally able to maintain their performances.

These observations should not however lead to complacency. Future developments will depend largely on how the energy price gap evolves. A reduction in price differences may come with the beginning of gas exports from the US and/or the depletion of the cheapest shale gas basins. At the same time, however, EU industry may have less margin for further energy intensity improvements, and US counterparts may be able to catch up in this respect. Reducing EU energy dependency would help to offset the effects of energy price fluctuation and security of supply risks. Finally, the pace of the EU's economic recovery will play a fundamental role in determining its capacity to withstand global competition.

Energy costs in a global comparative perspective[30]

To compare the role of energy in production processes globally and evaluate the role of energy in competitiveness, one needs to explore the interaction between energy costs, energy prices and energy intensity. One way to do this is by looking at the level and evolution of the so-called real unit energy cost, which measures the amount of money spent on energy sources needed to obtain one unit of value added.[31]

The level of real unit energy cost indicates the importance of energy inputs and sensitivity to energy price shocks – a greater increase in some countries/sectors than others can signal an increased vulnerability to energy costs in a particular sector, but could also indicate a restructuring of production towards more energy intensive production processes. It is therefore important to also analyse the drivers of real unit energy costs: energy intensity and the real price of energy (which measures energy inflation above sectoral inflation). A shift-share analysis can shed further light on the role of restructuring in energy cost developments.

A global comparison of real unit energy costs in the manufacturing sector[32] shows that in the period **1995-2011energy costs increased not only in the EU but in the rest of the world as well.** The EU manufacturing sector as a whole enjoyed some of the lowest real unit energy costs together with Japan and the US. This means that to obtain 1 USD of valued added at the level of EU manufacturing as a whole, businesses spent less money on energy sources than counterparts in Russia or China.

Certain sectors in the EU however show a significant vulnerability in a global comparison, because of high real unit energy cost levels and/or growth rates, indicating elevated sensitivity to energy-cost pressures. For example, the **production of coke, refined petrol and nuclear fuel** is the sector that shows the worst performance in the EU, **with real unit energy costs several times above levels in the US, Japan, China and Russia** and increasing between 1995 and 2011 unlike any other country analysed (US, Japan, Russia and China).

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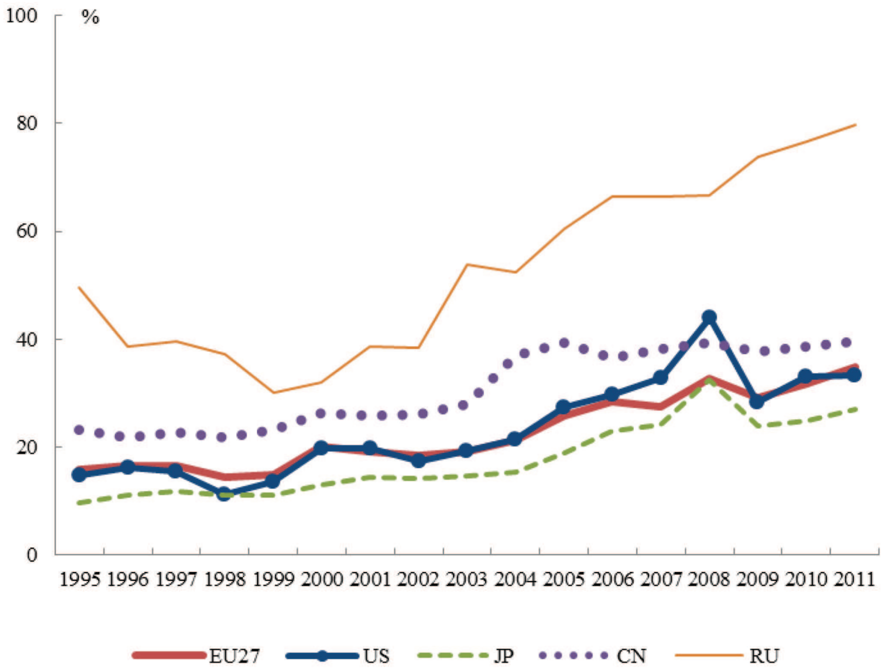
[30] Energy Economic Development in Europe, DG ECFIN.

[31] Energy costs are defined here as the costs of all energy inputs (oil, petrol, coal, gas, electricity) used for production purposes including inputs used as feedstock.

[32] This analysis is based on the WIOD database (national accounts), whereby manufacturing refers to industrial manufacturing and includes refining. The analysis includes feedstock.

Energy prices in the EU and Japan are among the highest in a global comparison (see section 3.2 on price levels and 3.3 on price evolution), while the US and China experienced consistently lower energy prices throughout the period 1995-2009[33]. At the same time, the **EU manufacturing sector, together with Japan, showed the lowest energy intensity levels –** probably partially linked to the declining share of energy-intensive industry in total industrial output and to EU manufacturing specialising in low energy intensity and high value added production – which generally explains the low real energy unit costs observed in the EU. The US and China have been catching up in terms of energy intensity improvements but the difference in absolute levels remains substantial.

Figure 23. Evolution of real unit energy costs as % of value added, manufacturing sector (1995-2011)



Source: DG ECFIN. Energy Economic Development in Europe.

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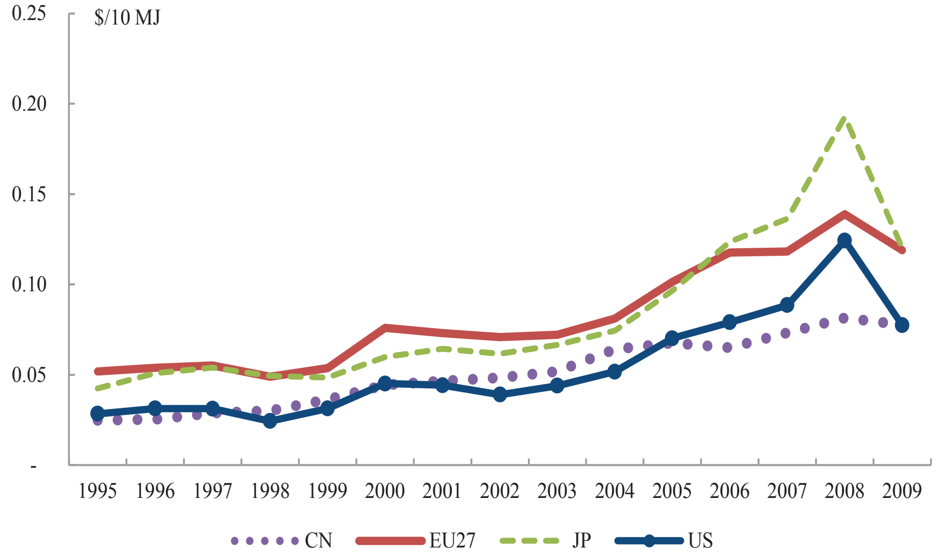
[33] Due to data limitations, figures for energy prices and energy intensity for the years 2010 and 2011 are not available.

Figure 24. Evolution of real energy prices in the manufacturing sector (1995-2009)



Source: DG ECFIN. Energy Economic Development in Europe.

Note: Real energy prices are defined here as the USD value of 1 unit of the **energy inputs** used by the manufacturing sector measured in 2005 USD.

A shift share analysis of the evolution of real unit energy costs shows that in the period 1995-2011 increasing energy costs were driven by cost increases within manufacturing subsectors worldwide. The only exception is the **US, which experienced a significant restructuring towards high energy cost production**. The shift share analysis confirms that in **2005-2011** there is **evidence of EU industry restructuring away from energy intensive sectors. The increase in energy costs was the steepest in the EU** (relative to the other countries in the scope of the analysis) and this increase in energy costs was associated with EU industry restructuring towards low energy intensity. In comparison, in the US the energy cost increase was much less pronounced.

Between 2005 and 2011, EU manufacturing saw the highest increase in energy costs within subsectors in a global comparison. As a result of this unparalleled increase in energy costs within subsectors the EU witnessed a move towards subsectors with low energy costs. These developments follow similar trends in the period 1995-2000 characterised by a marked increase in real unit energy costs dominated by the within subsector effect - indicating pure energy cost pressure - in the EU, US and Japan. The period 2000-2005, however, was significantly different, with the US being the only country with a negative within subsector effect. At the same time the US showed a very large positive restructuring effect mitigated to some extent by a negative interaction term. **Overall this indicates that the US had already started specialising in high energy cost production in the period 2000-2005**[34]. Finally, the last period – 2005-2011 – includes the 2008 peak in oil prices and subsequent fall in 2009 and has brought a significant adjustment and restructuring on a global scale.

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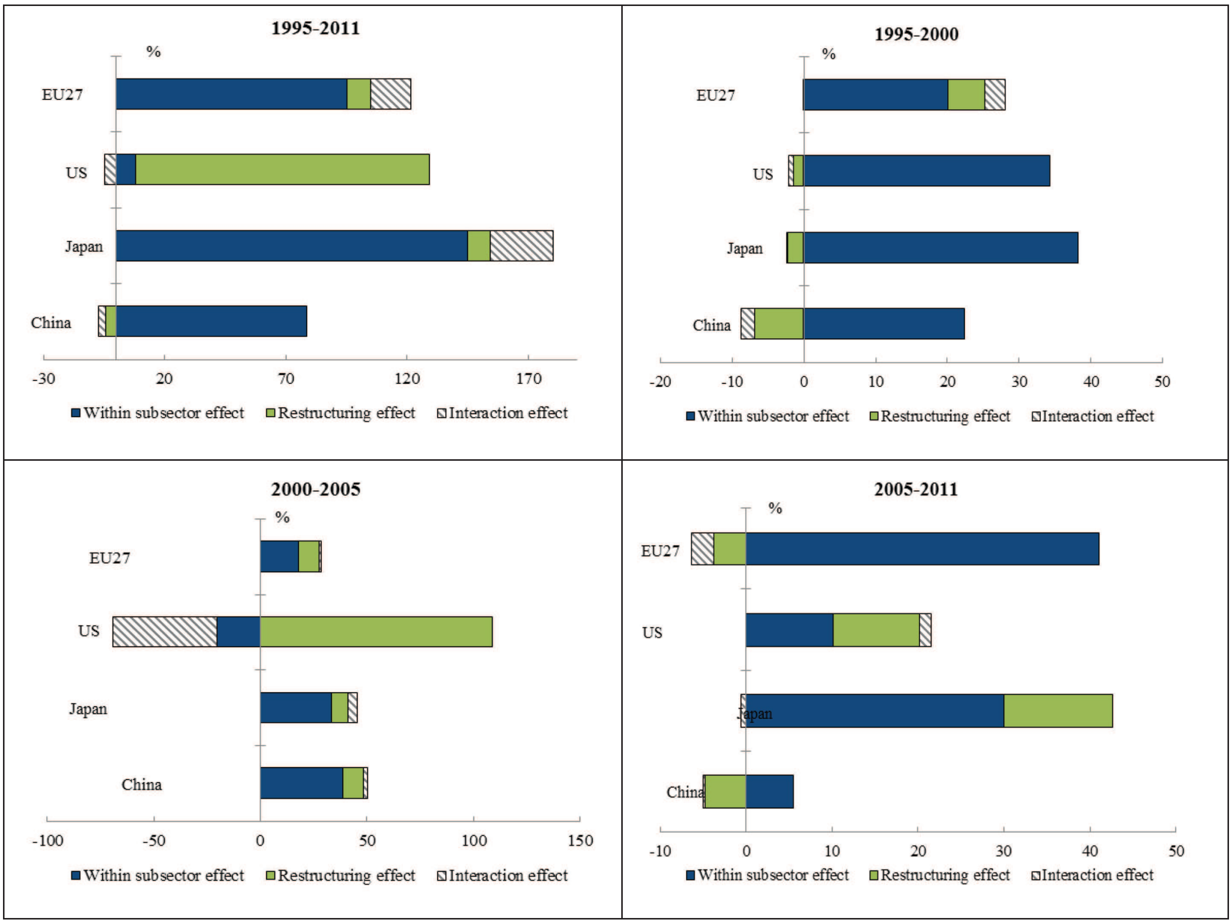
[34] This evolution could be explained by a domestic restructuring or investment of foreign companies in the US. The analysis here does not differentiate between these factors.

In the US, the increase in real unit energy costs during this period was due to a combination of considerable real unit energy cost growth within subsectors and a positive restructuring effect. The increase, however, has been significantly smaller in the US than in the EU. Japan saw a positive within subsector effect with a positive restructuring effect. Finally, China experienced positive but modest within subsector effect and a similarly modest negative restructuring effect.

Figure 25. Shift share analysis of real unit energy costs in the manufacturing sector (1995-2011)



Source: DG ECFIN. Energy Economic Development in Europe.

Note: The *within subsector effect* shows what would be the growth of real unit energy costs of the total manufacturing sector **if** the shares of the subsectors had stayed unchanged throughout the period of analysis. Therefore this effect shows the pure energy cost pressure filtering out the effect of restructuring. The *restructuring effect* measures the contribution of changes in value added shares of the different subsectors to overall manufacturing real unit energy cost growth keeping the real unit energy costs of subsectors unchanged. This component therefore shows the static restructuring effect. A negative restructuring effect could show that the share of industries with high energy costs has fallen. The *interaction effect* captures the dynamic component of restructuring by measuring the co-movement between real unit energy costs and value added shares. If it is positive, it signals that energy costs are rising in subsectors that are expanding, and/or they are falling in shrinking sectors, i.e. the two effects complement each other. If it is negative, then real unit energy cost growth is positive in shrinking sectors, and/or negative in expanding sectors, i.e. the two effects are offsetting each other. A negative interaction effect could signal that businesses in a country are reallocating resources from high to low energy cost sectors in response to rising energy costs.

If the refinery sector is excluded from the above calculation of the real unit energy cost[35], the levels decrease substantially (more than halved) and the ranking of the countries changes with the US displaying the lowest level of unit costs, followed by the EU and Japan. This result indicates the importance of the refining sector in the US and it also highlights the fact that in the other industrial sectors, less dependent on oil, the real unit energy cost level is somewhat higher in the EU than in the US. However, even excluding the refinery sector, the unit cost in the EU remains among the lowest in the world. While the restructuring observed in the shift-share analysis of the manufacturing sector seems to have been driven largely by developments in the refinery sector, the method does not capture any potential restructuring taking place at a lower aggregation level than the 2-digit NACE sectoral breakdown.

International energy efficiency trends

The importance of energy efficiency as a competitiveness factor is growing over time with globalisation. Energy prices and energy intensity are the two drivers of real unit energy costs. Increasing energy efficiency provides the means for economic actors to partially counterbalance the impact of increasing energy prices.

Analysis by the IEA in the 2013 World Energy Outlook points to diverging energy intensity developments by sector at a regional level.

Industrial energy intensity in the EU saw a decline of about 15%, partially linked to the declining share of energy-intensive industry in total industrial output. Energy intensity levels in Japan’s industry sector decreased by about 9% from 2005 to 2012, helped by structural changes in the economy away from energy-intensive sectors.

In the United States, energy intensity in industry as a whole decreased only slightly in the period 2005-2012, as efficiency improvements were almost fully offset by increased oil and gas production and increased activity in the chemicals industry which shifted the economy, to some extent, to more energy-intensive sectors.

In contrast, the bulk of China's decrease in industrial energy intensity can be attributed to energy efficiency gains. During the 11th Five-Year Plan (2006-2010) the share of energy-intensive industries in total industrial value added did not change significantly, due to strong growth in cement and steel production. Efficiency improvements were strongest in the cement and paper industries.

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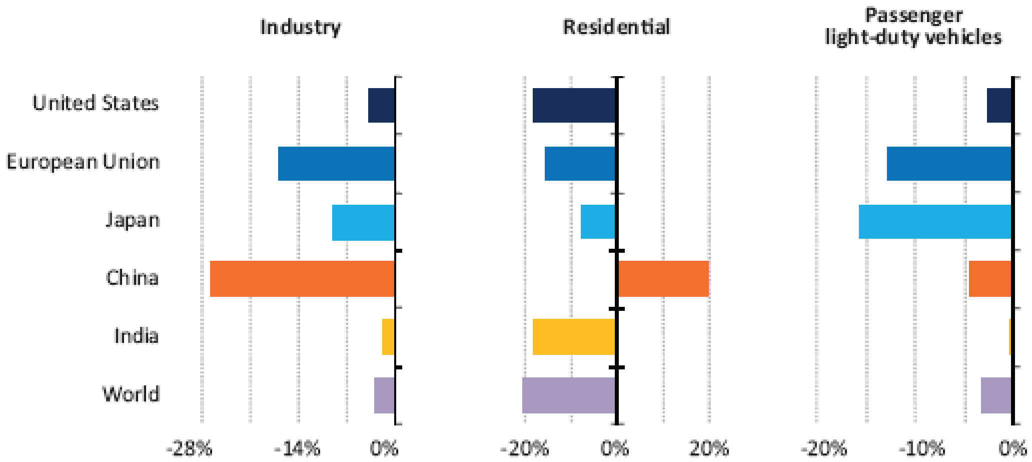
[35] See Appendix 3 of Energy Economic Development in Europe, DG ECFIN.

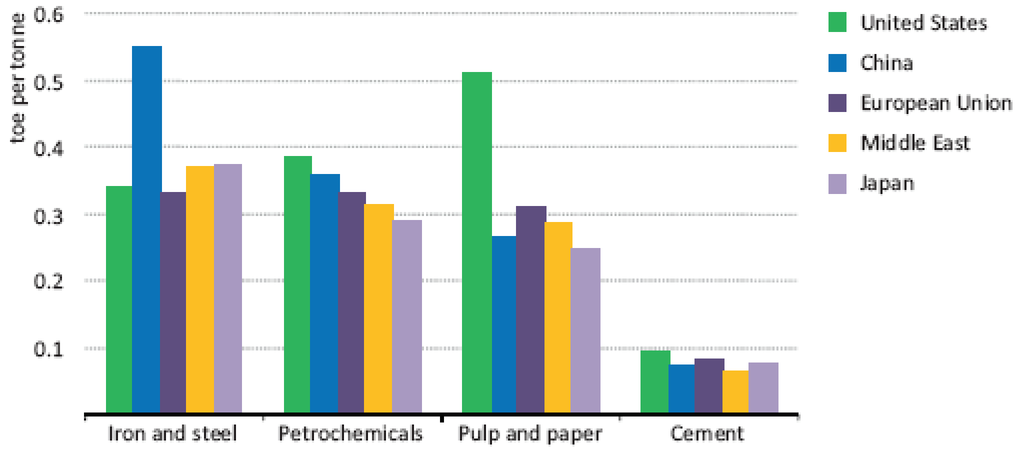
Figure 26. Energy intensity change by sector and region (2005-2012)



Source: IEA WEO 2013

The intensity of industrial sectors such as iron, steel and cement is lower in Europe than elsewhere, whereas for sectors such as petrochemicals and pulp and paper it is higher (Figure 27). Differences in energy intensity at sub-sectoral level are explained by efficiency improvements, along with differences in production processes and types of products.

Figure 27. Energy intensity by sub-sector and region, 2011



Note: Petrochemicals in this graph refers to ethylene production excluding feedstocks.

Source: IEA analysis.

Source: IEA WEO 2013

Projections from the IEA's World Energy Outlook point to a narrowing of the energy intensity gap between North America and Europe, with roughly half of global efficiency-related energy savings between 2011 and 2035 achieved in China, North America and Europe, with the largest savings coming from China (in particular due to a shift from energy-intensive industries to light industry and services) and North America (more ambitious energy efficiency policies in transport, industry and buildings).

3.8. Chapter conclusions

While Europe has never been a cheap energy location, in recent years the energy price gap between the EU and major economic partners has increased substantially. Over time manufacturing in the EU has undergone a restructuring towards lower energy intensity and higher value added production, while relatively high energy prices have incentivised improvements in energy efficiency. The extent to which a country is vulnerable to energy price increases, especially relative to other economies, depends on the structure of its economy. The share of energy intensive manufacturing in its economy, the energy efficiency of manufacturing sectors and sub-sectors and its degree of energy dependence all play a role.

- **Persistent regional energy price disparities cause changes in global trade patterns.** For industries with a high share of energy costs and exposed to international competition because products are easy and cheap to transport, they increase the risk of reduced industrial manufacturing growth or even in production levels and investment in higher priced countries.

- Between 2005 and 2011, EU manufacturing saw the highest increase in energy costs within subsectors relative to the US, China and Japan.

- The low energy intensity of EU manufacturing cannot be considered apart from its relatively high energy prices. The decrease in energy intensity can be attributed to **EU manufacturing specialising in low energy intensity and high value added production**.

- Certain sectors in the EU show significant vulnerability to energy price levels because of their high real unit energy cost levels and/or growth rates in a global comparison

- There is evidence of EU industry restructuring away from energy intensive sectors in the period 2005-2011; developments in the refining sector have had a very large impact on the restructuring observed.

- The level of real unit energy costs in the EU is somewhat higher than in the US[36]. The increase in real unit energy costs in the period 2005-2011 was the steepest in the EU relative to other countries in the scope of the analysis and this increase in energy costs was associated with EU industry restructuring towards lower energy intensity. Energy cost increase in the US was much less pronounced.

- **The importance of energy efficiency as competitiveness factor is growing over time with globalisation**. Despite their good efficiency performance, EU manufacturers have steadily improved their efficiency performance, converging towards Japanese levels. The US and China have been catching up even though the difference in absolute levels remain substantial.

- Europe is price-taker in **global hydrocarbon markets (**oil and coal).

- Unlike internationally traded commodity markets, in particular crude oil and coal, **natural gas** has disparate regional benchmark prices. Over the recent years the gap between regional gas prices has widen driven by diverging regional gas price drivers.

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[36] Results excluding refining

- **In recent years wholesale gas prices** have increased in all world regions except North America. Europe and Asia Pacific remain the highest priced wholesale gas markets. This widening gap has been driven by factors such as the US shale gas boom, increases in oil-indexed gas prices in Europe and skyrocketing gas demand in Japan in the aftermath of Fukushima. Only in the Middle East and Africa, where prices are often held down to the cost of production or below as a subsidy, are average wholesale prices for gas lower than in North America.

- Even within the EU, the difference between the lowest and highest wholesale gas price remains significant. Member States with a diverse portfolio of gas suppliers and supply routes and well-developed gas markets reap the benefits by paying less for imports and generally having lower prices.

- **Similar though less pronounced is the case of regional electricity prices.** Regional differences in **wholesale electricity prices** are less pronounced than for gas, at least in major economies (data for US, Europe and Australia). The net effect of low US natural gas prices on the difference between US and EU electricity prices is mitigated by lower EU coal prices (as a result of cheaper gas in North America).

- **Retail electricity for industry**[37]: on average across the EU and denominated in Euro and in nominal terms (ex. VAT and recoverable taxes), in 2012 medium-size industrial consumers in the EU paid about 20% more than companies based in China, about 65% more than companies in India, more than twice as much as companies based in US and Russia and more than three times as much as Middle Eastern industrial consumers in e.g. Saudi Arabia and United Arab Emirates. Industrial electricity prices in Japan were 20% higher than these faced by the average industrial European consumer.

- **Retail electricity for households**: on average European households paid more than twice as much as US households for electricity and comparable prices to Norway, New Zealand and Brazil.

- **Retail gas for industry**: in 2012 medium-sized industrial consumers in the EU paid four times as much for **natural gas** as industrial consumers in the US, Canada, India and Russia and about 12% more than those in China. Industrial gas prices in Brazil and Japan (2011) were above the EU weighted average.

- **Retail gas for households**: EU average gas prices were 2.5 times higher than those faced by households in the US and Canada, but were half the levels of gas prices faced by households in Japan (2011) and 30% below those in New Zealand. Households in 14 Member States paid less than the EU weighted average in 2012, putting their prices at levels comparable to those in Turkey and the US.

- Between 2008 and 2012 European industrial consumers faced a **10% increase in real terms in electricity prices**.

- **Other parts of the world,** in real terms over the same period, **saw more pronounced growth in electricity prices for industrial consumers** (14% in Korea and Japan, 19% in Australia, in some cases from a higher starting point). In the US there was a 10% decrease in real terms.

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[37] Price levels are nominal and converted in Euro using ECB XR. Price indices are in real terms (deflated) and calculated in national currencies (IEA methodology)

- This divergence was even greater for **industrial prices for natural gas**. Industrial users in Canada and the US are now benefiting from prices comparable in real terms to these in the mid- and late 90s. **Industrial users in European OECD countries are paying in 2012 prices comparable to 2008 levels in real terms.** Industrial users in Japan and Korea saw the steepest growth in gas prices, with 2012 prices 26% and 33% above their respective 2007 levels.

- In a ranking of 144 countries globally on **quality of electricity supply,** 5 of the top 10 positions were occupied by EU Member States.

- **EU countries tax natural gas and electricity more heavily** than some other major global competitors, such as the US and Canada.

- At global level much remains to be done to phase out inefficient fossil-fuel subsidies that encourage wasteful consumption.