Deutsche Rohstoffagentur

Bundesanstalt für Geowissenschaften und Rohstoffe

15

DERA Rohstoffinformationen

Energy Study 2012

Reserves, Resources and Availability of Energy Resources

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Drilling rig of well Düste Z10 in Barnstorf, Germany – Wintershall (front cover).
Laying of the North Stream Pipeline in Russia – Wintershall (foreword).

Foreword

Fossil fuels are finite: this may be a platitude but it is also a source of controversial points of view. Shrinking supplies or depletion in the near future would have dramatic consequences for the German economy. In addition to the commitment to climate protection, this is one of the key factors in many arguments in the discussion concerning the restructuring of energy systems. This study presents facts to lend this discussion a well researched foundation. The questions looked at in this context include: how large are the available volumes of crude oil, natural gas, coal and nuclear fuel? Can shortages of one or more of these fossil fuels be expected in the near future? This last question can be answered with a clear “No” from a geological point of view. Depletion in the near future can be excluded – even in the case of crude oil. The production-related declines in conventional reserves around the world have been balanced out by the conversion of resources into reserves. In addition, technical innovations are leading to a further rise in the exploitable proportions of non-conventional potentials. A crucial aspect is the extent to which the volumes of natural resources as they occur in nature can be made available in the form they are required by the consumer. Supply shortages – associated with jumps in prices – therefore also need to be incorporated into future planning. This is not so much due to problems with geological availability, but much more as a result of unforeseen natural disasters, inadequate investment, or political-economic crises.

This study is based on estimates of the geological inventory of energy resources. Credible conclusions on the reserves and resources of crude oil, natural gas, coal and nuclear fuels are reported based on long standing trends and developments. The availability of fossil fuels will be considered in the traditional way, and their statistics presented in comprehensive tables. In addition, the study looks at the latest and frequently discussed issues. This year, these also include an estimate of the global potential of tight oil (oil in low permeability rocks and shale oil), a critical analysis of the shale gas resources, and a discussion of the viability of reach in the debate on the availability of fossil fuels. Non-conventional crude oil and natural gas deposits also continue to attract attention: compared with the reserves and resources in conventional reservoirs, the estimated volumes of non-conventional oil and gas are still associated with large uncertainties so that further revisions can be expected in the future.

In this energy study by the Federal Institute for Geosciences and Natural Resources (BGR), we analyse, evaluate, and place into a regional context, the reserves, resources, production and consumption of crude oil, natural gas, coal, uranium and thorium around the world as at the end of 2011. This study is published annually and forms the basis for the consultations of the Federal Ministry for Economics and Technology (BMWi) and German industry on economic aspects concerning natural resources. The study has been published since 2011 in the “DERA Natural Resources Information” series issued by the German Natural Resources Agency (DERA). The database is built on the continuous evaluation of information in technical journals, scientific publications, reports issued by industry, technical organisations and political bodies, internet sources, and in-house surveys. In the absence of an explicit reference, all of the data reported in this study are derived from the BGR energy resources database.

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1 Energy Resources Overview

Energy resources in the global energy supply system

Analogous to the situation in the last 30 years, the major share of global primary energy consumption (PEC) today is derived from fossil energy resources (Fig. 1). The only effect of the recently overcome financial and economic crisis is seen in the short downturn in consumption in 2009. The overriding trend of an increase in the demand for energy continued unchanged after this blip. Even though not all countries are participating in this global development in the same way, the demand for fossil fuels will continue to increase in the foreseeable future. Ensuring reliable supplies of energy resources is therefore of major significance for each economy dependent on imported natural resources.

Changes to or the complete restructuring of energy systems take time. And even the energy U-turn adopted by the German government has a time frame of several decades. Shifts in the global energy mix in particular will not become tangible for several years at the earliest. Even dramatic events like the reactor disaster in Fukushima, Japan, at the beginning of 2011, which led to a change in energy policy in several countries – including Germany – have little consequence at a global scale. Significant changes and major shifts in the energy mix only become clearly visible over much longer – even historical – time scales. With the exception of a growing proportion of renewable energy sources, hardly any surprises are expected at a scale measured in decades – which means that the dominance of fossil fuels, including nuclear power, is also forecast to continue for many years into the future (IEA 2012a).

In its projection for rising energy demand, the International Energy Agency (IEA 2012a) assumes that the natural resources needed to satisfy this demand will actually be provided. Although there can be few doubts from a geological point of view about this assumption in the case of hard coal and lignite, as well as uranium, there are doubts about whether the volumes of crude oil forecast for 2035 can actually be made available. A larger absolute and relative proportion of natural gas in the global energy mix is forecast, which appears realistic given the large potential for natural gas in conventional and non-conventional reservoirs.

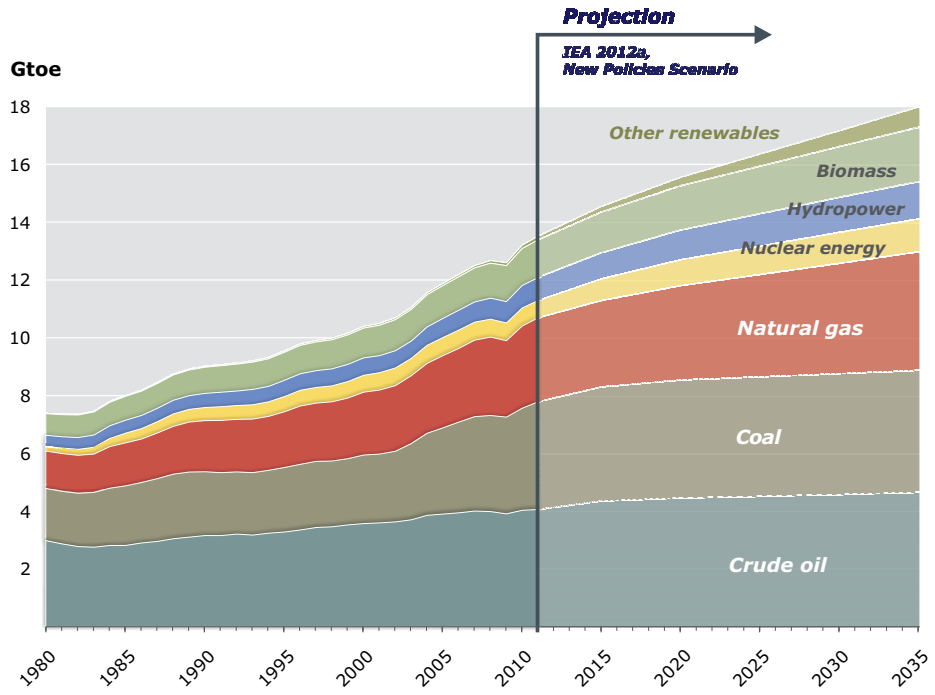


Fig. 1: *Development of global primary energy consumption versus fuels, and a possible future development scenario ("Scenario based on the new energy policy conditions" - New Policies Scenario, IEA 2012a).*

Energy resources for Germany

As a highly-developed industrial nation, Germany is one of the largest energy consumers in the world. The main burden of primary energy consumption is satisfied by crude oil, or its refined mineral oil products – which cover over one third of the demand (Fig. 2). Together with natural gas, hard coal and lignite, these fossil fuels still satisfied more than three quarters of the overall energy consumption in 2011 – however, the proportion of renewable energies exceeded that of nuclear power for the first time. In a ten year comparison, the absolute energy demand in Germany has declined by more than 8 %, with a direct impact on all fossil fuels. As expected, the use of nuclear fuels declined the most (minus 37 %). The smallest reduction was for lignite (minus 4.3 %). The only significant rise was in the proportion of renewables. Although there was a significant drop in the importance of nuclear power, there is no comparable decline in the use of coal.

Considered overall, and when including the mineral resources category, Germany has a wealth of natural resources. However, it is largely dependent on imports with respect to energy resources because of the high domestic demand as well as the inadequate domestic production. Only 2.5 % of its oil demand and around 14 % of its natural gas demand are satisfied by production from domestic fields (Fig. 2). Although tight gas has been produced in Germany for many years already, exploration activities for additional non-conventional natural gas deposits such as shale gas and coal bed methane only began in 2008. Potential deposits of tight oil will probably also attract more attention, and if successful, play a part in upholding the country's energy supplies. The exploration work being carried out in the search for these fuels is currently also being accompanied by a broadly-based social dialogue between politics, the general public and industry. Whether reserves are found, and if so, when production from non-conventional fields (especially shale gas) will actually take place is currently unforeseeable. Because of the planned termination of subsidised hard coal production in 2018, there will be a rise in the dependency on imports of hard coal in particular. Lignite is the only energy resource present in Germany in large economically exploitable quantities. With regard

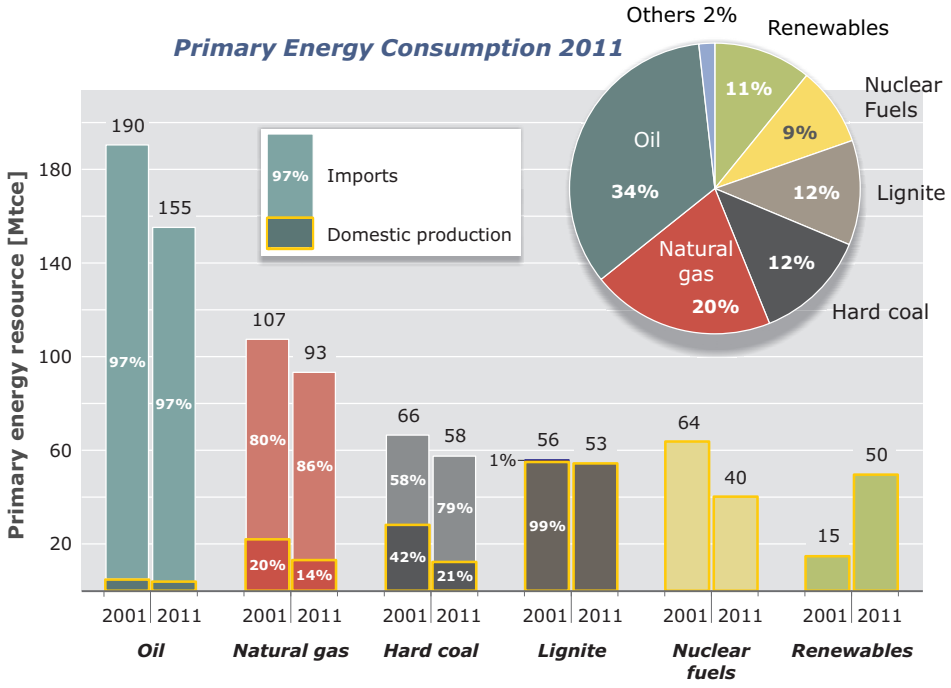


Fig. 2: *Comparison of the use of primary energy sources, and the relationship between domestic supply and imported commodities for Germany from 2001 to 2011, as well as relative proportions for 2011 (after AGEB 2012, LBEG 2012).*

to lignite, Germany satisfies all of its needs from domestic resources at the same time as being the world's largest consumer. All of the natural uranium required for the production of nuclear fuels has to be imported. The production of fuel elements does take place in Germany however, so that the country can itself guarantee to supply its nuclear power plants for a long period of time from its own inventory. In line with international convention, nuclear energy is therefore classified as a domestic energy source in Germany.

With the exception of lignite, Germany is dependent on many countries for its imports of energy resources (Fig. 3). The energy suppliers are currently dominated by European or near-European neighbouring countries. The Russian Federation has a special status here because Germany imports more than twice as much energy from here as the second largest energy supplier Norway. Moreover, Germany imports large quantities of three fossil fuels from Russia – crude oil, natural gas and hard coal. In the light of the declining oil production in the United Kingdom, and declining gas production in the Netherlands, one can therefore currently expect the dependency on imports from Russia to increase further in the future.

Global reserves situation

All of the available potential for fossil energy resources including nuclear fuels is presented in its totality in Table 1. In addition to the total derived from the country data, this also includes the potential which can only be estimated at a global scale at present. A more differentiated overview on the regional and country-related energy resources data is provided in Tables 2 to 36 in the Appendix.

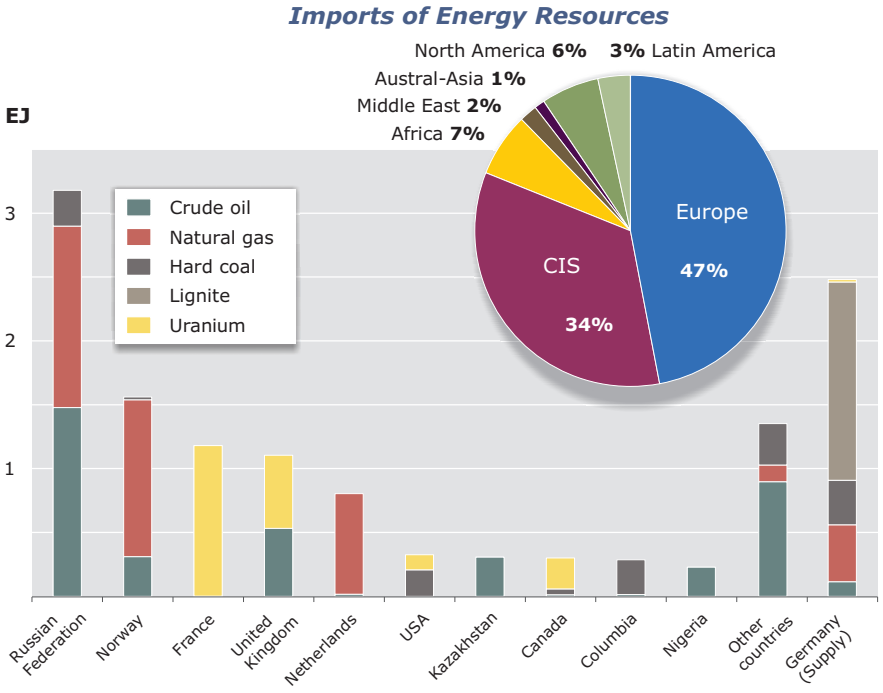


Fig. 3: *Countries exporting energy resources to Germany (Top 10) as well as regional distribution. Domestic production is also shown by way of comparison (right-hand column).*

Tab. 1: ***Reserves and Resources of Non-Renewable Fuels***

Fuel	Units	Reserves	EJ	Resources	EJ
		(cf. left column)		*(cf. left column)*	
Conventional Crude Oil	Gt	168	7,014	159	6,637
Conventional Natural Gas	Tcm	191	7,240	307	11,671
Conventional Hydrocarbons [Total]	Gtoe	341	14,254	438	18,308
Oil Sand	Gt	27	1,120	63	2,613
Extra Heavy Oil	Gt	21	886	61	2,541
Tight-/Shale Oil	Gt	< 0.5	11	87	3,636
Oil Shale	Gt	–	–	97	4,068
Non-Conventional Oil [Total]	Gtoe	*48*	*2,018*	308	12,858
Shale Gas	Tcm	2.8 [5)]	105 [5)]	157	5,984
Tight Gas	Tcm	– [6)]	– [6)]	63	2,397
Coalbed Methane	Tcm	1.8	70	50	1,886
Aquifer Gas	Tcm	–	–	24	912
Gas Hydrates	Tcm	–	–	184	6,992
Non-Conventional Gas [Total]	Tcm	4.6	175	478	18,171
Non-Conventional Hydrocarbons [Total]	Gtoe	52	2,193	742	31,029
Hydrocarbons [Total]	Gtoe	393	16,446	1,180	49,337
Hard Coal	Gtce	638	18,692	14,486	424,553
Lignite	Gtce	111	3,260	1,684	49,340
Coal [Total]	Gtce	749	21,952	16,169	473,893
Fossil Fuels [Total]	-	-	38,398	-	523,230
Uranium [1)]	Mt	2.1 [2)]	1,061 [2)]	13 [3)]	6,254 [3)]
Thorium [4)]	Mt	–	–	5.2	2,606
Nuclear Fuels [Total]	–	–	1,061	–	8,860
Non-Renewable Fuels [Total]	–	–	39,459	–	532,090

– no reserves or resources

1) 1 t U = 14 000 – 23 000 tce, lower value used or 1 t U = 0.5 x 10^{15} J

2) RAR recoverable up to USD80/kg U

3) Total from RAR exploitable from 80-260 USD/kg U, and IR and undiscovered <260 USD/kg U

4) 1 t Thorium assumed to have the same tce-value as for 1 t U

5) only United States (Status: 2010)

6) included in conventional natural gas reserves

The potential for thorium, aquifer gas, natural gas from gas hydrates, and crude oil from oil shales is only reported in the form of global figures because of the limited amount of information available, and the distribution which cannot be broken down into specific countries. However, although there are still gaps in the data on the resources and reserves of shale gas and coal bed methane, these are still shown separately, as in last year's study (Tab. 14 and 15). The resources of tight gas are also again reported separately from natural gas from conventional fields because of an improvement in the available data (Tab. 14). In general, the study pursues a rather conservative approach and places a significant emphasis on the criterion reflecting the potential economic exploitability of energy resources. With this approach, the enormous in-place volumes are ignored because they cannot be produced even in the long term. In particular, the resources of aquifer gas and natural gas from gas hydrates are therefore now reported at much lower values than in the last study only one year ago. Adding together the reserves (39,459 EJ) and resources (532,090 EJ) of all of the fossil fuels gives a total global amount of energy available of 571,549 EJ.

The largest proportion of non-renewable global energy commodities is currently defined as resources. Their energy content has declined year-on-year (BGR 2011) because of the new evaluation of the resources of aquifer gas and natural gas from gas hydrates undertaken in this year's study. This further increases the dominance of coal (hard coal and lignite) to raise its proportion to almost 90 % (Fig. 4). Way behind in second place come the natural gas resources accounting for 5.6 %, of which the proportion of non-conventional deposits now only slightly exceeds the proportion of conventional fields. The other energy resources including crude oil (3.6 %) only play a subordinate role. This study therefore has significant changes compared to the previous study primarily attributable to the decrease in the amounts of non-conventional natural gas (BGR 2009, 2011). Further modifications in the resource figures can be expected in future in the light of economic reappraisals and further technical developments.

The energy content of the reserves in 2011 corresponded to 39,459 EJ and has therefore grown further despite a rise in production (see below). In terms of the exploitable energy content, coal continues to be the dominant energy resource with reserves accounting for almost 56 % of the overall figure. Crude oil (conventional and non-conventional) accounts for 22.9 % of total reserves, natural gas 18.7 % and uranium 2.7 %. There have therefore hardly been any changes in this context in terms of absolute proportions or relative proportions compared to the previous year. The energy resources produced during this period were compensated for by the reclassification of resources into reserves. The relatively higher proportion of crude oil in the reserves is attributable to the intense exploration and production activity involving this energy resource over many decades.

Non-renewable energy resources with an energy content of around 494 EJ were produced in 2011. This corresponds to a growth in production of around 3 % year-on-year.

A comparison of global annual production of all of the energy resources in 2011 against the reserves and resources, reveals a relationship of around 1 to 80 to 1,000 respectively (Fig. 4). This means that from a geological point of view, the global reserves and resources of energy commodities

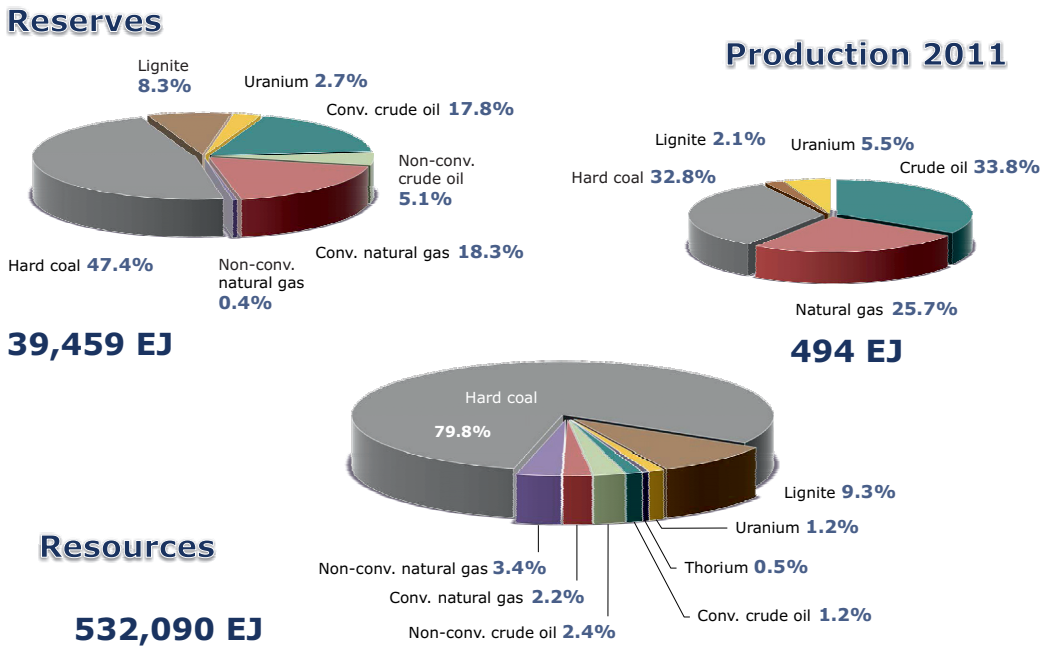


Fig. 4: *Proportions of non-renewable fuels in production, reserves and resources world-wide at the end of 2011.*

can in principle cover the growing demand for energy in the future as well. The question though is whether all of the energy resources individually can always be supplied in adequate quantities to satisfy the demand at any given point in time. This question is particularly urgent given the relatively low resources of crude oil.

The deposits of energy resources are not uniformly distributed around the world: countries with high energy consumptions are not automatically identical with regions with a wealth of natural resources or high energy resource production rates. However, there is still considerable to enormous potential in all regions when making a global comparison of the volumes of natural resources still available (reserves and resources) and the already consumed energy resources (Fig. 5). Whilst the potential seems barely touched in Austral-Asia, CIS and North America, the proportions already exploited even in Europe are still small. The wealth in energy resources is primarily attributable to the huge deposits of coal which are present on all continents instead of being concentrated in just a few limited regions as is the case with conventional oil and gas. This is why the Middle East region, which is so important for oil and gas, only accounts for a relatively small overall potential. The energy resource potential in Africa as well appears remarkably low given the size of the continent. A possible explanation is the incomplete exploration of the real geological potential and that further exploration will reveal additional discoveries.

Overall, according to the geological information currently available, there are still huge volumes of fossil fuels available. Whether and when they can be utilised depends on various factors including their technological and economic exploitability, their demand-oriented availability, environmental compatibility, and public acceptance. Answers to these complex questions are, however, not part of the brief of this study.

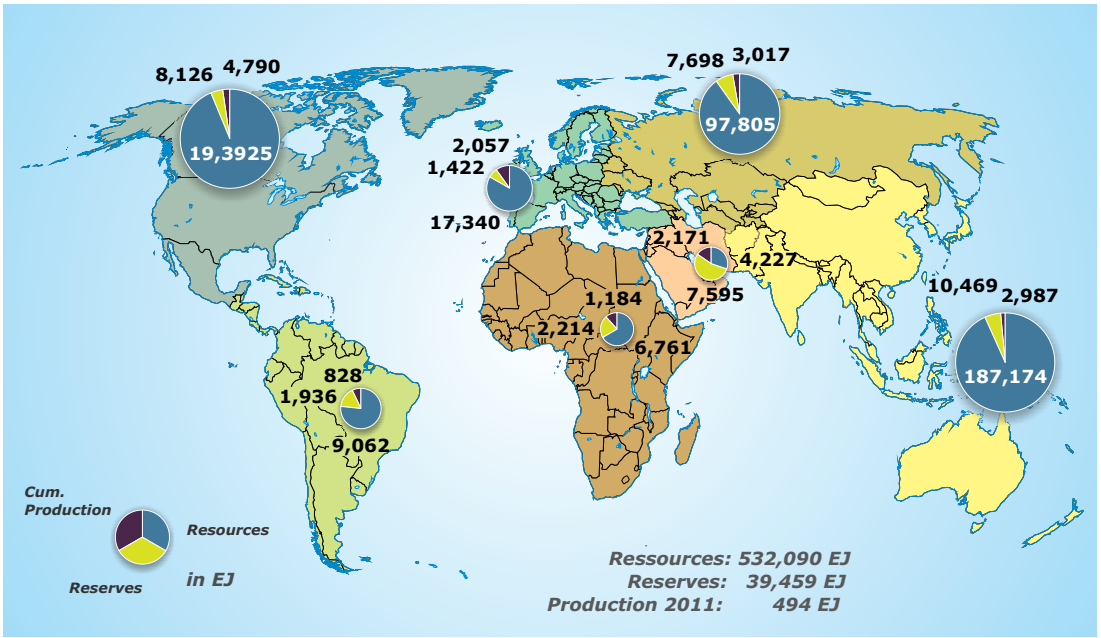


Fig. 5: *Total potential of energy resources 2011: Regional distribution (excluding the coal resources in the Antarctic, as well as resources of aquifer gas, natural gas from gas hydrate and thorium, because they cannot be broken down into specific regions), (cumulative production of coal since 1950).*

2 Energy Resources Individually

2.1 Crude Oil

With a share of around 34 % of primary energy consumption (excluding biomass), oil continues to be the most important fuel world-wide, and will probably remain so in the foreseeable future. In the 2011 reporting period, crude oil production and oil consumption rose again although at a slightly slower rate than in the previous year following the economic and financial crisis in 2008. Nevertheless, oil production at 3,998 million tons (Mt) and the consumption of mineral oil at over 4 billion t reached all-time highs in 2011. By boosting its production by 12.4 % to 525.8 Mt, Saudi Arabia regained its position as the world's largest oil producer ahead of the Russian Federation (509 Mt, plus 0.8 %) and the United States (352.3 Mt, plus 3.9 %).

To highlight the overall potential, the oil production figures are also supplemented by the reserves and resources of conventional and non-conventional oil (oil sand, extra heavy oil and shale oil). For the first time, the resources and reserves figures given for the 20 most important countries make a differentiation between shale oil/tight oil. Because of the patchy nature of the data regarding oil shale, these resources are only reported in terms of their global potential (Tab. 1).

Overall, the remaining potential of crude oil (reserves and resources) at the end of 2011 totalled around 585 billion t. The volumes of non-conventional oil (oil sand, extra heavy oil and shale oil) accounted for 258 billion t of this total. Almost 50 % of the remaining potential is accounted for by the OPEC states. Much smaller quantities of around 20 % are accounted for by the Austral-Asia, Africa and Europe regions (Fig. 6).

The overall potential (resources, reserves and accumulated production) totalling 752 billion t were almost 11 % higher than the previous year's value. The crude oil resources alone (conventional and non-conventional) have grown by over 70 billion t to 369 billion t mainly due to incorporating the first estimates of shale oil. This means that Venezuela, China and Canada now head the resource ranking ahead of Russia and the United States. Conventional resources on their own have risen by around 16 billion t (plus 11.4 %). The biggest increases are reported for Brazil (plus 7 billion t), Nigeria (plus 2 billion t) and Mozambique (almost 2 billion t). Resources

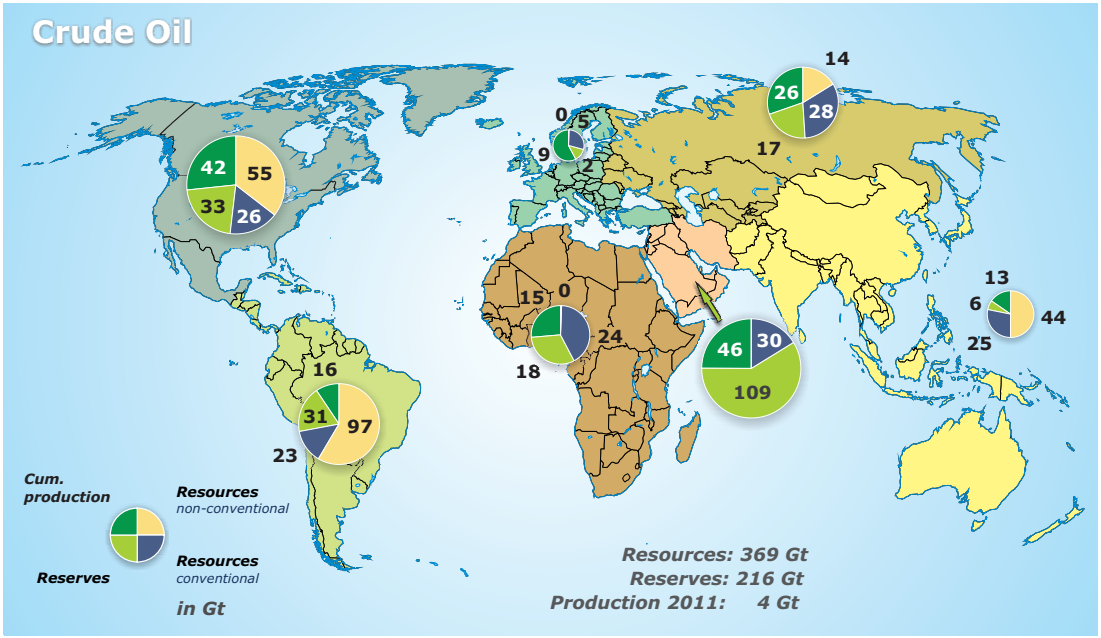


Fig. 6: *Total crude oil potential (752 billion t): Regional distribution.*

in the United States have been reduced by almost 1.6 billion t.

A subsequent revision of the oil reserves in Venezuela, India and Germany in particular quoted in the former study of 2011 (database: 2010) resulted in a reduction in reserves of around 5 billion t down to 211,653 Mt. This means that the reserves in 2011 have risen year-on-year by over 4,400 Mt to around 216,056 Mt – a rise of 2.1 %. The ranking of the most important countries remains unchanged year-on-year and is headed by Saudi Arabia, Venezuela and Canada, followed by Iran and Iraq. In addition to conventional oil reserves of 167.8 billion t, and non-conventional reserves of oil sand in Canada, and extra heavy oil in Venezuela, the figures now incorporate for the first time estimated reserves of shale oil in the United States of around 260 Mt. Around 70 % of the conventional reserves are located in OPEC member countries, whilst only slightly over 16 % in OECD countries (OPEC 2012a). The fact that more than 53 % of the reserves lie in the Middle East and North Africa (MENA) region alone emphasises the importance of this region for maintaining future supplies of oil. Because of its enormous deposits of oil sand, Canada is the only "non-OPEC" country near the top of the reserves ranking. According to the US Energy Information Administration (EIA), around 85 % of global crude oil reserves were owned by state-controlled companies in 2010, with an unbroken trend towards increasing state ownership.

Since the beginning of industrial oil production, almost 167 billion t of crude oil have been produced world-wide, which means that around 44 % of the original oil reserves (cumulative production plus reserves) of almost 383 billion t has already been consumed. The most important production regions continue to be the Middle East, CIS and North America. The countries which boosted their production the most in 2011 were Saudi Arabia (plus 58 Mt), Nigeria (plus 18.5 Mt) and Iraq (plus 17.1 Mt). This was counteracted by reductions in production in three main countries: Libya (minus 52.4 Mt), United Kingdom (minus 11 Mt) and Norway (minus 14 Mt). Usually, oil production includes significant proportions of condensate and natural gas liquids (NGL) from natural gas production.

The global consumption of petroleum products rose by almost 108 Mt in 2011 compared to 2010, totalling almost 4,045 Mt. This corresponds to an increase of 2.7 %. The strongest rise in regional consumption was in the Austral-Asian region (plus 6.1 %) and in the Middle East, and even the OECD countries increased their consumption by 2 % after a decline in 2010. The largest declines in the consumption of petroleum products in 2011 were posted by countries in the CIS and Europe (minus 4.6 % and minus 1.2 % respectively). International trade rose world-wide overall in 2011 to slightly more than 2.1 billion t of crude oil.

The temporary shut-down in production in Libya, largely attributable to the political turmoil in the spring of 2011, as well as lower exports from Norway and the United Kingdom, were balanced out by higher exports from Iraq, Iran, Saudi Arabia and the United Arab Emirates in particular. On the demand side, India (plus 29.3 %) and China (plus 7.7 %) have again significantly boosted the amount of imported crude oil. The amount of crude oil imported into Germany decreased again by around 2.8 Mt to 90.5 Mt (minus 3 %). Germany's main oil suppliers continue to be the Russian Federation, the United Kingdom, and Norway. Companies registered in Germany – Bayerngas Norge AS, E.ON Ruhrgas AG, Petro-Canada Germany GmbH, RWE Dea AG, VNG-Verbundnetz Gas AG and Wintershall AG – produced a total of around 5.4 Mt crude oil from fields outside Germany.

The annual average price of "Brent" crude oil reference type rose by around 40 % year-on-year to reach USD 111 per barrel – the highest nominal average price ever reported. The price of Brent oil from January to December 2011 rose from 96 USD/barrel to 108 USD/b (plus 12.5 %) whilst the OPEC basket price rose from around 90 USD/b to 107 USD/b during the same period (OPEC 2012b). This upwards trend continued in the first months of 2012 as well. The rise is primarily attributable to the strong demand from the emerging economies of China and India, the slightly lower production in some OECD countries (e.g. Norway and the United Kingdom) and the uncertain political situation in the Middle East. It is therefore not possible to make either a short-term or a medium-term forecast for the further development of the oil price. In the long term, however, higher prices seem unavoidable because the production of oil

is tending to come from increasingly complex and poorly accessible fields involving the use of increasingly expensive technology (e.g. non-conventional oil) and is therefore associated with higher costs.

On the other hand, technological advances also help new potential to be exploited economically. This means that as prices rise, oil resources previously classified as uneconomic can then be reclassified as reserves. The differentiation between “conventional” and “non-conventional” crude oil is becoming increasingly blurred today and no longer necessarily reflects the economic efficiency of the production.

Tables 6 to 12 in the Appendix list the country-specific resources, reserves, the production and consumption, and the export and import of crude oil (only for the 20 most important countries).

New potential from tight oil / shale oil

In recent years, the United States has been able to reverse its historic trend of declining oil production. In an analogous way to the production of shale gas, the combined application of horizontal wells and hydraulic fracking have made it possible to economically produce oil from tight rocks. This technical progress has given rise to a shale oil boom that now has the potential to fundamentally change the oil supply situation in the United States and the world.

There are two different types of reservoirs in this category: crude oil in shale or claystones, and oil in other tight rocks. In the first type, the liquid oil is still in the formation where it was first generated, i.e. in the source rock. Source rocks normally consist of shales or claystones. Oil produced from these formations is called shale oil. The second type of reservoir involves oil which has migrated over a relatively short distance into reservoirs such as silts, carbonates or sandstones with very low permeabilities and porosities. This type of oil is called tight oil or light tight oil. It is usually not possible to clearly differentiate between the two types of reservoir because they are frequently intercalated. This study therefore considers both types together and uses the term "tight oil" for both for the sake of simplicity.

Tight oil in the strict sense has already been produced for many years in the United States mainly from the Bakken (North Dakota), Austin Chalk (Texas), Spraberry (Texas) and Niobrara (Colorado) shale formations. Annual production up to around 2005 was in the order of 4 Mt to 6 Mt. From this time onwards, exploration and production focused on other “real” shale oil formations, primarily in the Barnett Shale (Texas), Eagle Ford (Texas) and Monterey (California). Production rose dramatically to around 23 Mt per year by 2010 with another major jump in 2011 to almost 36 Mt. Production levels up to 100 Mt are expected in 2012 (IEA 2012a). This means that tight oil production in 2011 accounted for around 10 % of total oil production in the United States. Combined with cuts in consumption, the enormous rise in tight oil production has helped the United States reduce its imports of crude oil by almost 25 % between 2005 and 2011 (minus 144 Mt). The current estimates of the tight oil resources in the United States are around 3 billion t. The continuing exploration activity will add additional potential from other reservoir horizons in the years to come.

Interestingly, tight oil exploration and production is still in its infancy world-wide. As a rule of thumb, tight oil can be expected in all continents and regions containing sedimentary basins with mature oil source rocks. Fig. 7 shows the initial, highly approximate estimates of countries with tight oil resources of more than 1 billion t. The largest potential is thought to be present in Eastern China and Venezuela with over 40 or 34 billion t respectively. The United States and Canada are followed by Russia, Australia and Argentina with potential resources lying between 2 billion to 3 billion t. Other countries for which initial estimates have also been published are Colombia, New Zealand, Uruguay and Japan. The European countries attracting the most interest for their potential tight oil resources are Poland, France and Germany. The Federal Institute for Geosciences and Natural Resources (BGR) is currently undertaking a study to assess the size of the shale oil potential in Germany. The global expansion of tight oil production outside of the United States, in addition to the current analysis of the geological potential for tight oil, will largely depend on the regulations stipulated by the competent authorities, the energy costs, potential effects on the environment, and the social

acceptance of fracking technology in particular in each country. Because of the very patchy nature of the global, country-related estimates of tight oil resources, the potential of 87 billion t crude oil must be considered as conservative. Intense use of this resource will be restricted in the near term to North America. In the long term, however, expansion of tight oil production into other countries such as China, Russia and Argentina, as well as countries with tight oil potential which are largely dependent on energy imports, is to be expected.

CRUDE OIL: KEY CONCLUSIONS

- **From a geological point of view, supplies of crude oil should be maintainable in the next few years against the background of a moderate rise in oil consumption.** Despite increasing production, reserves and resources in particular will rise thanks to new non-conventional potentials.

- **OPEC will continue to play an important role in the future.** The share of oil produced by OPEC countries in the Middle East already exceeds 42 % today, and is forecast to rise even further in the future.

- **Condensate from natural gas production, and crude oil from non-conventional deposits – in particular from oil sands, as well as very recently also from tight oil, will gain increasingly in significance.**

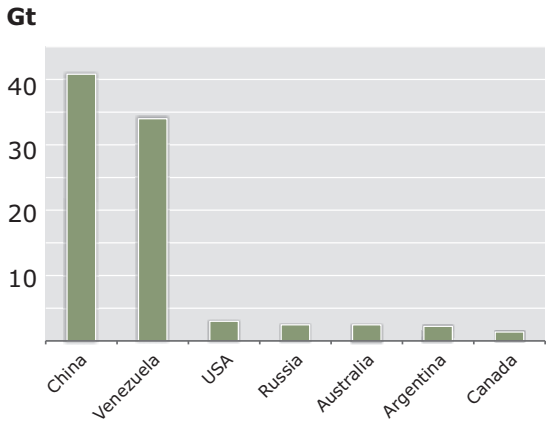


Fig. 7: *Shale oil resources in selected countries with > 1 billion t oil.*

The developments associated with shale oil reveal how fast the market can change when technological progress makes new deposits economically producible.

- **Crude oil will continue to be the world's most important fuel.** Its proportion of primary energy consumption (PEC) is around 34 %. The decline in consumption in OECD countries attributable to boosts in energy efficiency and substitution by renewable energy resources cannot compensate for the rise in consumption in emerging countries like China and India.

- **It is not possible to predict how crude oil prices will develop, but prices at permanent low levels will never establish themselves again.** Oil prices are less dependent on geological availability of crude oil than on political and economic influencing factors. More stringent safety regulations governing the production of oil in deep offshore locations, and the growing proportion of non-conventional oil, will add further to the costs of oil production.

- **Crude oil is the only non-renewable energy resource which will no longer be able to keep up with the growing demand in future decades.** The timely development of alternative energy systems will therefore be necessary given the long time periods involved in bringing about major changes in the energy sector. The increasing exploitation of non-conventional oil deposits will not lead to a paradigm change in the long term.

2.2 Natural Gas

Natural gas was again the third most important fuel behind oil and hard coal in 2011, with a share of about 24 % of global PEC (excluding biomass). Because natural gas produces relatively lower emissions and is available in large quantities, it is often considered as a “bridging” energy, and is assigned the strongest growth potential.

Global gas production in 2011 rose by 3 % to 3,337 billion m³ primarily because of the rise in demand in emerging economies. The largest percentile increase in production occurred in Turkmenistan with a rise of around 40 %. In terms of volume, however, the biggest increases were reported for the United States and Qatar. Gas production in 2011 in the United States rose around 6.5 % year-on-year to 651 billion m³ making it the largest natural gas producer in the world. The share of shale gas in overall production in the US rose to around 30 % and is predicted to account for a share of about 50 % of total production by 2035 according to predictions made by the US Energy Information Administration (EIA). Unlike the United States which is primarily expanding production of non-conventional gas deposits, Russia increased its production of natural gas from conventional fields by 3 % in 2011 to produce 630 billion m³ – the second highest production level world-wide. The combined natural gas production of the Russian Federation and the United States in 2011 was almost 1.3 trillion m³. This corresponds to more than 38 % of global natural gas production in 2011. Gas production in Europe went in the other direction and declined by more than 7 %, largely due to a 21 % drop in gas production in the United Kingdom mainly caused by the natural depletion of old gas fields. Political unrest and violence hindered or completely shut down gas production in some parts of the Arab world.

Nevertheless, the global rise in natural gas consumption in 2011 of more than 2 % year-on-year to around 3.3 trillion m³ was covered by supplies. Although the demand in OECD countries decreased slightly in 2011, it rose further in emerging economies. China increased its consumption by 20 % to strengthen its position as the largest consumer in Asia, placing it ahead of Japan who imported 19 % more natural gas in the form of liquefied natural gas (LNG) in 2011 as a consequence of the accident at the Daiichi nuclear power plant in Fukushima. The largest natural gas consumers were the United States, followed by the Russian Federation, Iran, China and Japan.

The demand for gas in Europe dropped in the face of the weakened economy, relatively high prices, warm weather and the continuous expansion of renewable energy sources – all of these factors led to a decline for the first time of almost 8 %. Despite the much lower consumption level, Europe imported around the same amount in 2011 as in the previous year because of the significant decrease in domestic gas production. Unlike Europe as a whole, which has to import natural gas to satisfy its demand, North America today now enjoys a balanced situation between production and consumption (Fig. 8). Natural gas consumption in Germany declined significantly by 12 % year-on-year primarily because of the higher temperatures throughout the heating period compared to the preceding year. Germany is therefore now only the world’s eighth largest consumer of natural gas (2010: fifth largest) behind Saudi Arabia. Germany is largely dependent on natural gas imports, which as in the past, are primarily piped in from the Russian Federation and Norway (Fig. 3).

The global natural gas reserves have risen again year-on-year and were estimated at 195 trillion m³ (2010: 192 trillion m³) at the end of 2011. Non-conventional natural gas reserves only account for a very small part of this figure. This is because the economic production of shale gas, and the associated reliable reporting of reserves, is currently exclusively restricted to North America. A negative re-evaluation of shale gas reserves is expected given the sustained very low US-American natural gas price. There is also a negative trend observable in the development of the reserves of coal bed methane (CBM) in North America even though it is gaining further in importance in the Austral-Asian zone. CBM reserves have grown in particular in Australia and China. The largest rises in conventional reserves in 2011 were reported for Iran and Turkmenistan. The latter is currently developing the Galkynish sour gas/condensate field in the eastern part of the country (previously: South Yoloten and Osman). This is one of the largest natural gas fields in the world. Over half of the remaining natural gas reserves in the world – almost exclusively conventional – are concentrated in only three

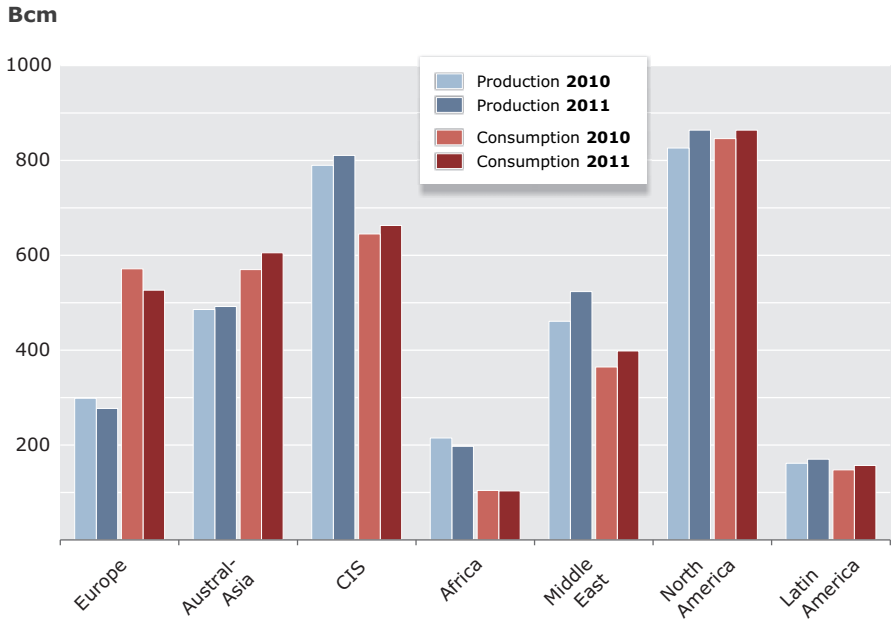


Fig. 8: *Comparison of the production and consumption of natural gas in 2010 and 2011 according to regions and country groups.*

countries: the Russian Federation, Iran and Qatar. Moreover, around 80 % of global natural gas reserves are found in OPEC countries and in the CIS (Fig. 9).

The gas resource database was updated on a country-by-country basis and contains details on non-conventional natural gas differentiated into the categories shale gas, coal bed methane, and natural gas from tight sandstones and limestones (tight gas). The global tight gas potential of 63 trillion m³ is considered to be a large underestimate because of the patchiness of the estimates for tight gas resources per country. It is generally assumed that tight gas is present in most basins around the world with natural gas potential, and in particular in Palaeozoic reservoirs within these basins.

By far the largest volumes of natural gas resources are expected in the Russian Federation, followed by China, the United States, Australia and Saudi Arabia. Russia also has the largest conventional natural gas resources in the world, with a share of one third, placing it ahead of the United States, China, Saudi Arabia and Turkmenistan (Fig. 9). The resources of aquifer gas and natural gas from gas hydrates have undergone a significant downward revision in this study. Instead of reporting the in-place amount of hydrocarbons which cannot be exploited as a whole, this study now only reports the amount of resources that could possibly be exploited economically. It has not been possible so far to make a world-wide evaluation on a country basis, which means that only a global estimate is currently feasible: 24 trillion m³ natural gas in aquifers, and 184 trillion m³ natural gas in gas hydrates are reported. It is still questionable, however, when and under what circumstances this potential could actually be economically exploited. In the case of gas hydrates, countries with very small resources of conventional fuels, such as South Korea and Japan, are pushing ahead with ambitious projects to exploit domestic gas hydrate deposits as potential sources of energy in their own exclusive economic zones. However, no breakthroughs have been reported to date. The global natural gas resources in conventional and non-conventional fields were estimated at around 785 trillion m³ at the end of 2011. Non-conventional natural gas accounts for around 60 % of this total (Tab. 1).

In 2011, around 1,025 billion m³ natural gas (around 31 % of global natural gas production) were traded internationally (excluding transit trade) (Tab. 18), of which around 32 % (331 billion m³) was in the form of liquefied natural gas. Global trade overall has risen by around 5 % in 2011, with an over-proportional rise of around 11 % in

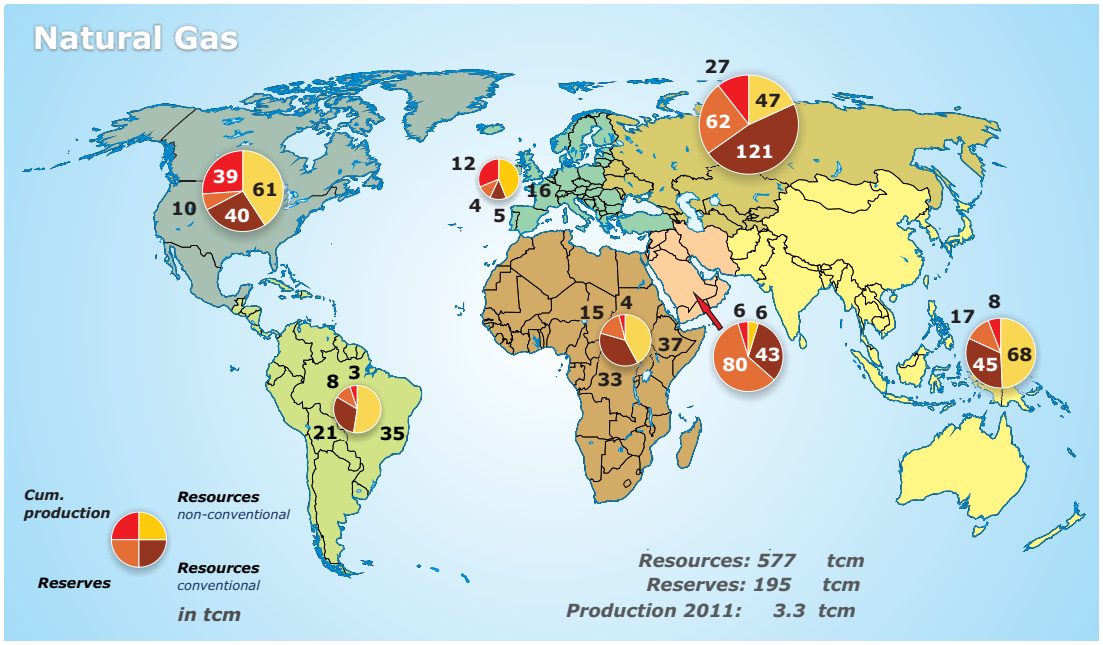


Fig. 9: *Overall natural gas potential (872 trillion m³): Regional distribution.*

the transport of liquefied natural gas. Natural gas produced in Qatar largely accounted for all of the global increase in the shipping of LNG.

Supra-regional natural gas markets exist around the world, and are largely independent of one another. Natural gas in the United States has become continuously cheaper because of the "shale gas revolution", and thanks to the large supply on the North American market, was traded here under the most favourable conditions of all of the liberalised markets (BP 2012). The expansion of shale gas production pushed down the local natural gas price (Henry Hub spot price) at the end of December 2011 to around USD 3 per thousand cubic feet. The gas price slid even lower in April 2012 to under USD 2 per thousand cubic feet. North America is an exception, however, because gas prices coupled to the oil price rose significantly in the rest of the world because of the rise in oil prices. At times natural gas in Europe was three and a half times more expensive than in the United States. The prices in Japan and the Republic of Korea which are dependent on LNG imports were about 40 % higher than those in Europe by the end of 2011.

The rising trend in the transit price of natural gas at the German border continued overall in Germany during 2011. In the past, these prices generally followed the prices of crude oil with a certain delay because of the coupling to the price of crude oil in long-term contracts. New contracts, however, already contain clauses which take into consideration gas futures market indexes or spot market prices, and thus continue the trend of an increasing uncoupling of gas prices from oil prices. In general, the price of natural gas is significantly influenced by the much higher specific transport costs compared to oil and coal. Demand can now also be more flexibly covered in previously widely separated regions because of the expansion of trading and in particular, the increasing marine transport of liquefied natural gas. Therefore, in the medium to long term, the situation is expected to evolve into a global market, with a further rise in the importance of gas spot market prices. With its integrated and growing supply network, Europe is connected to over half of the global natural gas reserves, either directly via pipelines, or indirectly via LNG. The European natural gas market therefore basically enjoys a relatively comfortable position.

Tables 13 to 19 in the Appendix provide country-by-country figures on production, consumption, imports and exports, as well as natural gas reserves and resources.

A critical look at shale gas resource estimates

The development of non-conventional shale gas deposits in North America has focused attention world-wide on these new resources. From today's point of view, shale gas is considered to have a high potential currently estimated at around 157 trillion cubic metres of technologically exploitable resources world-wide. However, unlike the many years of experience and firm trends associated with conventional natural gas deposits, the estimates of shale gas resources are frequently based on patchy data because the exploration and development of shale gas deposits world-wide is still in its infancy. Commercial production currently takes place exclusively in North America. It is therefore difficult to assess how reliable the volume estimates are and what the suitable range of error should be. The following looks at two case studies to highlight the current uncertainties affecting the assessment of shale gas resources.

The potential for US-American shale gas resources is relatively well founded (Fig. 10). EIA has access to comprehensive data going back several years and reported steadily growing figures for shale gas resources between 2004 and 2010. However, these figures were revised downwards significantly in 2011 because of a re-estimate of the potential of the Marcellus Shale on the basis of improved geological and technological findings. On the other hand, despite the increase in the knowledge base in other deposits, the new estimation of their resources largely confirmed the old results, which means that this re-evaluation overall can be considered as effectively consolidating the resource volumes. Nevertheless, the significant reduction in shale gas resource estimates in the USA in 2011 highlights the high degree of fluctuation which can also be expected in future, and which needs to be taken into account when assessing resource calculations. This is highlighted in particular by the example of Poland. A range of different sources pursuing different approaches and based on empirical data from a much shorter time period produced a broad spectrum of estimates without establishing a clear trend or the unequivocal dimensions of the deposits (Fig. 10). Differences in the estimates varying by a factor of up to 100 cannot be explained by revised geological interpretations, but are instead based on differences in the methods used and fundamental discrepancies in the input parameters. Careful examination is required here to determine which estimates have greater plausibility and have been undertaken in a comparable way to other evaluations. Unlike the situation in the United States which is considered to have major proven shale gas potential – because the figures are also supported by the high production volumes – none of this is true in Poland. A high degree of certainty will probably only establish itself when production has actually begun and empirical data is available from the economic production of the gas.

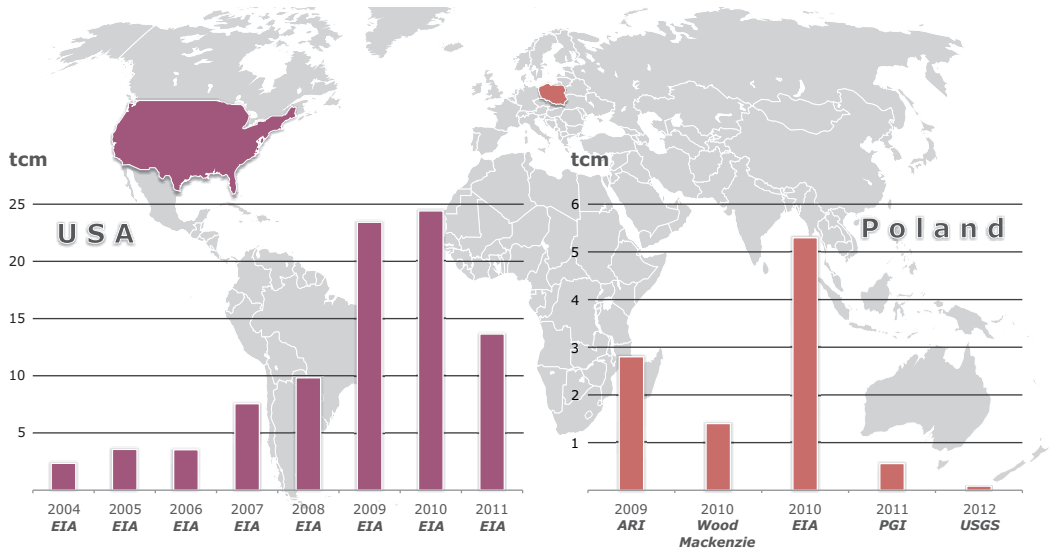


Fig. 10: *Comparison between shale gas resource estimates in the United States and Poland.*

These examples show that large error margins have to be borne in mind when looking at the estimates of the global deposits, and that significant revisions can be expected. In comparison to the figures which until recently were exclusively based on in-place estimates, determining the technologically-producible volumes of resources already gives a much more realistic assessment of the volumes involved. Notwithstanding these uncertainties, the global outlook for shale gas is certainly very favourable. It is likely that shale gas will also play an increasingly important role in the future energy mix in other countries as well, and not only in the United States. It is also expected that shale gas will significantly increase the supply of natural gas world-wide and therefore have a global impact on the natural gas markets.

Shale gas resources in Germany

Details are now also available on the shale gas potential in Germany. In 2012, BGR published a preliminary estimate of the shale gas potential in Germany (BGR 2012) in its first study on the subject issued as part of the NIKO project (non-conventional hydrocarbons). The study reports that three claystone formations with supra-regional distributions in North Germany have significant shale gas potential. The analysis looked at the claystones of the Lower Carboniferous, the Jurassic Posidonia Shale, as well as the Wealden (Lower Cretaceous). The gas in-place in these shale gas deposits is estimated at 13 trillion m³, however, with a considerable range between 6.8 to 22.6 trillion m³. The technically producible volumes – the shale gas resources – are much lower and are estimated to be around 10 % of the GIP volumes. The estimate conducted to date of the shale gas resources is therefore 1.3 trillion m³ – which is much higher than Germany's conventional natural gas resources (0.12 trillion m³ including tight gas) and natural gas reserves (0.133 trillion m³). These estimates therefore exceed the previous estimates issued by the US Energy Information Administration (EIA 2011) of 0.227 trillion m³. The EIA study also uses a gas-in-place approach but does not make it clear which data was used for the estimate, and the calculation method is also not presented in a completely transparent manner. The gas volumes calculated in Germany by BGR are also only a preliminary estimate because the current database is inadequate for a final evaluation of the natural gas potential. New data for the geological and geochemical characterisation of source rocks in Germany will be acquired during the ongoing surveying campaigns and from the results of laboratory analysis. Other geological formations which have potential for non-conventional hydrocarbons will also be looked at. The further development of the methodological approach used so far will lead to corrections in the previous volume estimates as the overall study proceeds, and will therefore provide a more realistic assessment of the shale gas potential in Germany.

Outlook for liquefied natural gas (GTL)

In addition to the global LNG trade, the GTL method (gas to liquids) has been implemented at a relatively small scale for many years for the production of synthetic fuels. This technology involves removing constituents such as ethane (C_2H_6), propane (C_3H_8), carbon dioxide (CO_2) and sulphur dioxide (SO_2) from natural gas, which largely consists of methane (CH_4). Methane is then fed into reactors alongside oxygen and steam to convert it into a synthetic gas which is then converted into synthetic oil using the Fischer-Tropsch process. Additional steps (cracking) then give rise to valuable end products such as petrol, diesel, kerosene and lubricating grease. These products are sulphur-free, have no organic nitrogen compounds, and are uncontaminated by aromatic compounds such as benzols.

Five GTL plants are currently operated world-wide in three countries and have a total capacity of around 230,000 barrels per day (Hobbs & Adair 2012). The biggest plant by far is in Ras Laffan in Qatar which boasts a maximum capacity of 140,000 barrels per day. The other plants are in South Africa and Malaysia. A plant with an initial capacity of 34,000 barrels per day is currently being constructed in Escravos in Nigeria and is scheduled to be commissioned in 2013.

The use of GTL technology could establish itself as an economic alternative for the marketing of natural gas because of a growing interest in the use of gas produced as a by-product of oil production and "stranded" natural gas (uneconomic natural gas fields usually located in areas far away from any infrastructure). Analyses in the United States have revealed that GTL could be an economically feasible alternative as

part of the development and production of non-conventional natural gas. The further expansion of GTL production capacities is expected in the light of higher and increasing natural gas prices, and the relatively cheaply available natural gas in some parts of the world. A continuing increase in the efficiency and optimisation of the GTL process could therefore have a long-term impact on the natural gas market, at the same time as relieving the pressure on the crude-oil-based fuel market.

NATURAL GAS: KEY CONCLUSIONS:

- **From a geological point of view, natural gas is still available in very large quantities.** Even in the face of the forecast growth in demand, the very high remaining natural gas potential would be able to maintain global supplies for many decades to come.

- **The gas production in Europe is already beyond its peak.** This increases the dependency on gas imports from the CIS, Africa and the Middle East.

- **The recent successes in developing non-conventional natural gas deposits, particularly in the United States, have improved the global supply situation.** The supply situation in Europe could also be enhanced if these resources can be successfully developed here.

- **A further expansion in GTL production capacities can be expected given the high and increasing crude oil prices and the availability of relatively cheap natural gas in some areas.** A continuing increase in the efficiency and optimisation of the GTL process could therefore have a long-term impact on the natural gas market, at the same time as relieving the pressure on the crude-oil-based fuel market.

- **The increase in the maritime transport of liquefied natural gas is expected to lead to the development of a global LNG market in the medium to long term.** Qatar is continuing to expand its position as an LNG exporter and is therefore increasing the global gas supply. This is another factor behind the further rise in the significance of the gas spot market.

- **With its integrated and growing gas supply network, Europe is connected to a large proportion of global natural gas reserves.** This means that the European natural gas market basically is in a comfortable position.

2.3 Coal

Coal continues to be the most important fossil energy resource and has by far the largest global total resources (reserves plus resources). With a share of 30.3 % (hard coal 28.5 %, lignite 1.8 %) of global primary energy consumption (PEC), coal was the second most important fuel in 2011 behind crude oil (BP 2012). Coal was the most important fuel for power generation in 2010 accounting for about 40 % of the global power generation (IEA 2012b).

To enable a better comparison between the data, coal in this study is only divided into either lignite or hard coal. Hard coal with an energy content of > 16,500 kJ/kg includes sub-bituminous coal (hard brown coal), bituminous coal and anthracite. Because of the relatively high energy content hard coals are traded world-wide. Lignite (energy content < 16,500 kJ/kg) is primarily used for power generation close to the extraction site because of its lower energy content and higher water content.

Coal reserves world-wide at the end of 2011 totalled around 1,038 Gt, of which around 755 Gt is hard coal and around 283 Gt is lignite. The reserves therefore changed significantly compared to the preceding study (BGR 2011). Hard coal reserves rose by around 26 Gt (plus 3.6 %) largely as a result of more intense coal exploration in recent years, particularly in Australia, Indonesia and India. There are no major changes in the global resources compared to the previous year.

Global coal production rose again in 2011 to reach a new level of 7,710 Mt. This corresponds to a 5 % rise compared to the previous year. In detail, this corresponds to 6,640 Mt of hard coal (plus 4.7 %) and 1,070 Mt of lignite (plus 6.9 %). Unlike oil and conventional natural gas deposits, coal deposits and their production sites are located in many countries and exploited by numerous companies. Tables 20 to 31 in the Appendix list country-by-country production, consumption, imports and exports as well as reserves and resources of hard coal and lignite.

Hard coal

Figure 11 shows the regional distribution of hard coal reserves and resources, and the estimated cumulative production since 1950. The Austral-Asia region has the largest remaining potential of hard coal with 7,198 Gt, followed by North America with around 6,875 Gt and the CIS with around 2,964 Gt. The world's largest reserves of hard coal are located in the United States with 225 Gt (29.8 % global share) followed by the People's Republic of China with around 181 Gt (23.9 %), and India with 77 Gt (10.2 %). These are followed by the Russian Federation (9.1 %), Australia (7.6 %) and South Africa (4.5 %). The producible volumes (reserves) of subsidised hard coal in

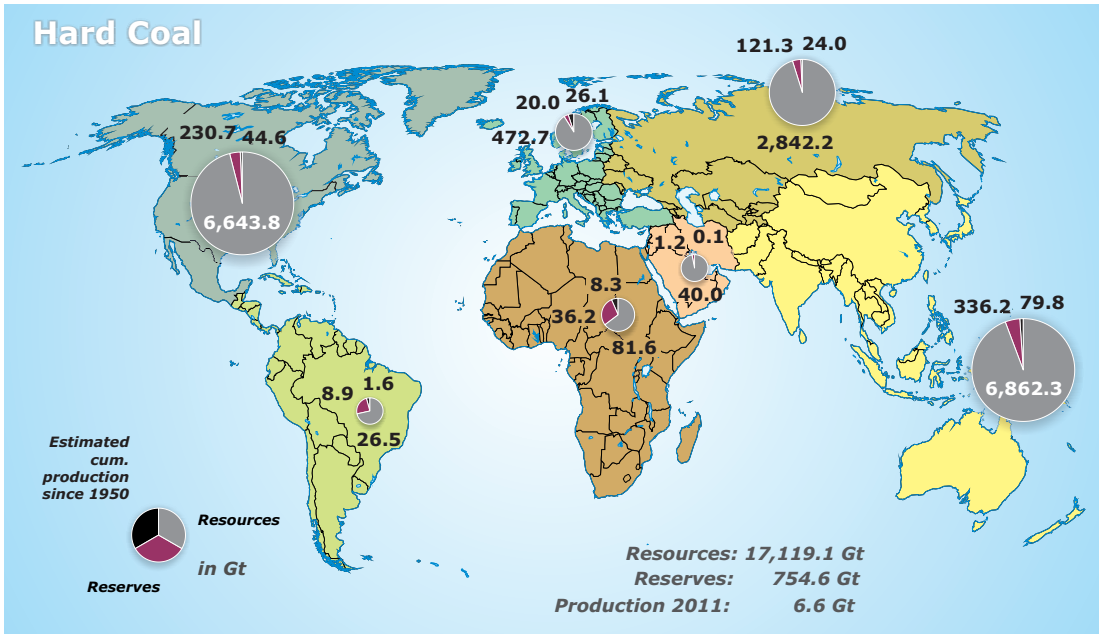


Fig. 11: *Total hard coal potential 2011 (17,874 Gt): Regional distribution.*

Germany (which are subsidised until 2018) total around 0.05 Gt. In terms of resources, the United States alone accounts for 6,457 Gt or around 38 % of global hard coal resources, followed by China (29.3 %) and the Russian Federation (15.3 %).

The three largest hard coal producers in 2011 were China with a share of 51 % (around 3,384 Mt), the United States (13.9 %) and India (8.1 %). Unlike China, which again significantly boosted production by around 8.6 % year-on-year, India and the United States only increased their production to a minor extent by around 0.4 % and 0.7 % respectively. Approximately 16 % or around 1,082 Mt of the hard coal produced in 2011 was traded, of which 978 Mt was transported by sea. This corresponds to a slight rise in the global volumes of traded hard coal of around 1.4 % year-on-year.

Despite the disastrous floods which affected large parts of Eastern Australia over the 2010/2011 New Year period, Australia continues to dominate the world hard coal market with exports of 284.5 Mt (26.3 %), closely followed by Indonesia (25 %) and the Russian Federation (10.2 %). The significant rise in hard coal exports from the United States which rose by around 23 Mt to 97 Mt (plus 31 %) is largely attributable to the US shale gas boom which has led to a fall in the price of coal in the country. There was also a world-wide rise in demand for coking coal.

The largest hard coal importers were China, Japan and the Republic of Korea with a combined volume of around 487.5 Mt (45.2 %). China, which increased its imports in the last year to 166.2 Mt (plus 31.2 %), boosted its imports by another 10.2 % in 2011 to 183 Mt, and therefore knocked Japan off its perch for the first time as the largest hard coal importer in the world. As a consequence of the major earthquake and the associated Tsunami on the east coast of the main Japanese island of Honschu in March 2011, Japan reduced its imports and consumption of hard coal during the three months that followed because of major damage to coal-fired power plants and the coal ports. The Republic of Korea imported around a sixth more coal year-on-year with an amount totalling 129.2 Mt (plus 13.8 %). Other major importing nations in 2011 were India (9.2 %) and Taiwan (6.2 %). As in previous years, Asia dominated the global hard coal import market with a share of 67 %.

The hard coal imported by Germany (around 44.2 Mt, excluding coke) was largely sourced from Colombia (24.4 %), the Russian Federation (24.3 %), the United States (18.4 %), Australia (9.7 %), South Africa (6 %) and Poland (6 %). Whilst hard coal imports from Colombia rose to 10.8 Mt in 2011 (plus 41.8 %), and imports from the United States rose by 42.1 % to 8.1 Mt, imports from South Africa dropped by a fifth to 2.6 Mt. The trend of declining imports of South African coal to Europe and Germany which began around 2005 has therefore continued unabated. South African hard coal is increasingly sold to Asia and primarily to India (VDKI 2012a). At 202.5 Mt (plus 16 Mt year-on-year) almost one fifth of global hard coal imports were accounted for by the European Union (EU-27).

The north-west European spot prices for steam coal (ports of Amsterdam, Rotterdam and Antwerp; cif ARA) rose on an annual average basis by 33.3 % from 107.16 USD/tce in 2010 to 142.81 USD/tce in 2011. However, monthly spot prices began to drop at the end of the reporting year to 130.19 USD/tce in December (the lowest nominal monthly price in 2011) and continued on this downward trend almost continually into 2012 sliding down to around 101 USD/tce in October 2012 (VDKI 2012b). The rise in prices in 2011 was largely influenced by the strong increase in coal imported by China and India. The decline in prices in 2012 though was primarily attributable to the oversupply of coal on the world market – for both steam coal as well as coking coal. The current slow down in global economic growth combined with the major world-wide increase in coal production capacities in recent years, and particularly the rapid expansion of US exports, has already led to the shutdown – in some cases temporary – of mines in the USA and Australia.

The prices of coking coal have risen significantly compared to the previous year (200 to 220 USD/t in 2010). In the first and second quarters 2011, coking coal prices reached levels of between 300 and 330 USD/t (an all-time nominal high) as a result of the massive flooding which affected the state of Queensland in Australia, and the associated significant shortfall in the supply of high-quality coking coal. Compared to the high

prices in the first half of 2011, the prices for coking coal up to autumn 2012 have almost halved, and were around 160 USD/t in October 2012.

Lignite

The North American region has the largest remaining potential of lignite in the world with around 1,519 Gt. It is followed by the CIS (1,372 Gt, including sub-bituminous coal), and Austral-Asia (1,123 Gt) (Fig. 12). Of the global lignite reserves of 283 Gt in 2011, around 91.2 Gt (including sub-bituminous coal) or around a third, are in the Russian Federation (32.2 % global share), followed by Australia (15.6 %), Germany (14.3 %), the United States (10.8 %) and China (3.9 %). The United States has the largest lignite resources with around 1,368 Gt (32.9 % global share), followed by the Russian Federation (30.36 %, including sub-bituminous coal) and China (7.4 %). 80 % of global lignite production of 1,069.8 Mt was accounted for by only 11 of 36 producing countries in 2011. Germany was the largest producer of lignite with a share of 16.5 % (176.5 Mt), followed by China (12.7 %), and the Russian Federation (7.3 %).

COAL: KEY CONCLUSIONS

- **The reserves and resources of hard coal and lignite are adequate to cover the foreseeable demand for many decades from a geological point of view.** Coal boasts the largest potential of all non-renewable energy resources with a share of around 56 % of the reserves and 89 % of the resources.

- **Coal will continue to play a significant role against the background of the continued rise in global primary energy consumption.** In 2011, coal was the second most important source of energy, accounting for 30.3 % of global primary energy consumption – the highest share since 1969. Coal consumption rose significantly by 5.4 % year-on-year and was therefore the non-renewable primary energy resource with the highest growth in consumption (BP 2012).

- **A further rise in the coal demand on the global coal market will also be able to be satisfied in future.** However, weather-related production outages, particularly on the coking coal market, could give rise to temporary shortages in supply – associated with corresponding price fluctuations.

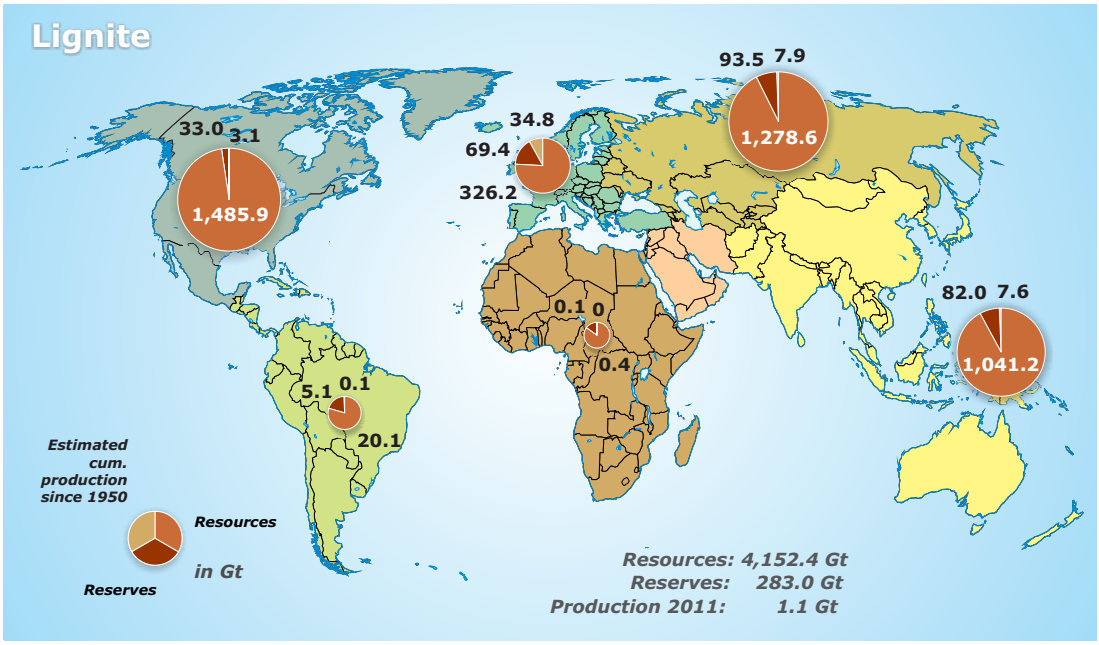


Fig. 12: *Total lignite potential 2011 (4,435 Gt): Regional distribution.*

- **The development in the global and therefore also the European coal prices has been increasingly influenced by rising Asian coal imports since 2009.** At the same time, the current significant increase in US exports is giving rise to a palpable easing of the global coal market, which benefits European consumers in particular.

2.4 Nuclear fuels

Uranium

The situation in 2011 was largely influenced by the accident at the Daiichi nuclear power plant in Fukushima, Japan, on 11 March 2011. A chain of complex events ultimately resulted in the emission of radioactive material into the environment. Even today, the condition of the nuclear power plant complex in Fukushima is only considered safe but not stable. The dramatic events in Japan initiated a global debate on the development and future of nuclear power. As a consequence, many countries implemented reviews of the safety of their nuclear power plants and reconsidered the role of nuclear power in their energy strategies.

In Germany, the German parliament passed legislation on 30 June 2011 to withdraw from nuclear power production, and this came into force on 6 August 2011 with the thirteenth modification of the Nuclear Act. The act stipulates that the last nuclear power plant will be shut down in Germany by 2022 at the latest. For the first time in the history of the Federal Republic of Germany, a fixed deadline has been lain down in law for the end of the use of nuclear power in the country. The withdrawal is to be undertaken in stages with precise switch-off dates. The coming into force of the revised Atomic Act means that the nuclear power plants at Brunsbüttel, Unterweser, Biblis A and B, Philippsburg 1, Neckarwestheim 1, Isar 1 and Krümmel, already shut down as part of the moratorium, will no longer be reconnected to the grid. The nine still active nuclear power plants will be switched off at the end of the specified year according to the following time schedule: 2015: Grafenrheinfeld; 2017: Gundremmingen B; 2019: Philippsburg 2; 2021: Grohnde, Gundremmingen C und Brokdorf; 2022: Isar 2, Emsland and Neckarwestheim 2.

The strongest reaction to the Fukushima accident was in Germany. The role of nuclear power is also being reconsidered in Japan including discussions of potentially withdrawing from nuclear power altogether. For the first time, China initiated no new nuclear power construction projects in 2011. In Europe, Italy, Switzerland and Belgium have shelved their plans to expand nuclear power production. The reaction in other countries was much more modest: in Europe, countries such as the United Kingdom, the Russian Federation, the Czech Republic, Finland, France, Sweden, Slovenia, Slovakia, Bulgaria, Rumania, Spain and Hungary have held on to nuclear power as an important part of their national energy mix. Poland plans to build its first nuclear power plant by 2025. In other countries as well, which had plans in place before 2011 to expand or enter nuclear power production, there will be no serious cutbacks in their nuclear energy plans, or any signs of any intentions to withdraw from nuclear power. Stress tests were carried out on nuclear power plants in many locations with the aim of improving safety standards. Overall therefore, there continues to be a growing interest world-wide in the expansion of nuclear power.

At the end of 2011, 63 nuclear power plants were under construction in 14 countries, including in China, the Russian Federation, India, the Republic of Korea, Slovakia, Bulgaria, Japan, Pakistan, Argentina, Brazil, the United States, Finland, France and Taiwan. Another 90 nuclear power plants are at the planning stage or already undergoing the approval process. As a consequence of the reactor disaster in Fukushima, 4 plants were switched off in Japan and 8 nuclear power plants in Germany. A nuclear power plant in the United Kingdom was also switched off according to plan after 43 years of operation. The 437 nuclear power plants operating worldwide in 2011, with a gross output of 389.4 GWe (DAtF 2012), consumed around 62,552 t natural uranium (WNA 2012d). Most of this uranium (54,610 t, WNA 2012c) was derived from mining output. With uranium reserves of around 2.12 Mt (cost category < 80 USD/kg U) there is therefore enough potential available from a geological point of view to satisfy global demand in the coming decades even in the light of the foreseeable growth in demand.

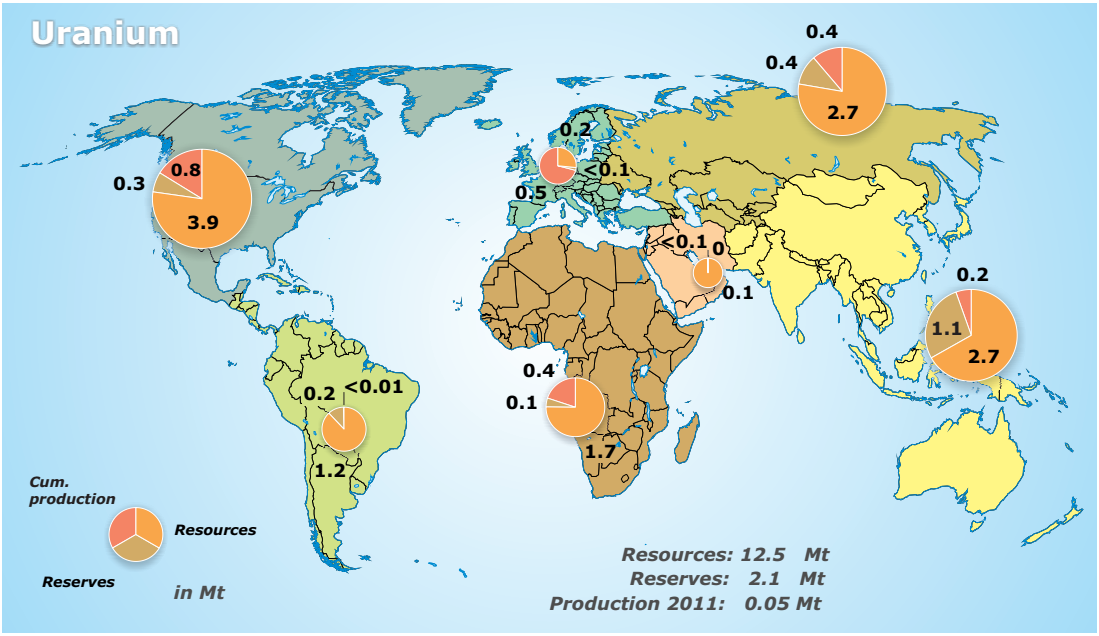


Fig. 13: *Total potential uranium 2012 (16.97 Mt U): Regional distribution.*

Unlike the other energy resources, uranium reserves are classified according to production costs. According to the definition for reserves (see glossary), the limit for the extraction costs is currently < 80 USD/kg U. The reserves inventory in 2012 declined compared to the previous year (2,122 kt in 2011, compared to 2,755 kt in 2010). The reduction in proven and economically exploitable resources at production costs less than 80 USD/kg U is primarily attributable to the rise in production costs in many countries. This means that some uranium deposits are now classified in a higher production cost category. In terms of reserves, this generally means that volumes have been shifted from the low cost category into higher cost categories. Australia's reserve figures shrunk by almost 22 % year-on-year because of the rise in production expenses and all processing costs (962 kt in 2011 compared to 1,223 kt in 2010). The reserves in Canada and South Africa also declined for the same reasons. New exploration results and re-evaluations of well known deposits also led to modifications in the < 80 USD/kt U cost category with reductions in Mongolia, Niger and the Russian Federation, as well as expansions in Kazakhstan, Namibia, China, Peru and Slovenia in particular.

Uranium deposits occur in almost every region around the world. Nevertheless, the defined uranium reserves are currently limited to just a few countries. 98 % of the total reserves of 2.12 Mt are located in only 11 countries, headed by Australia, and followed by Canada, Kazakhstan, Brazil and China. According to today's data, these five countries harbour around 85 % of the global reserves of uranium (Fig. 13).

Global resources grew by 1,137 kt compared to the previous year, primarily because of the reclassification of reserves into higher production cost categories (see above). Re-evaluations and more intense exploration activities also led to a rise in global uranium resources. Growth attributable to exploration successes was mainly reported in Canada, Niger, Botswana, Namibia, Malawi and Greenland[1]. Increases in resources on the basis of re-evaluations have only occurred in Kazakhstan, Namibia and Canada (OECD-NEA/IAEA 2012). Whilst these countries exclusively increased their proven resources, Brazil expanded again its speculative resources year-on-year. Major producing countries such as Kazakhstan, the Russian Federation, South Africa and the United States stopped giving details on speculative resources for the first time in 2009 which led to a reduction in resources. Australia stopped providing data on these resources many years ago. Because of these reporting uncertainties, the resource figures given in this study must be considered as conservative.

[1] Reported as Danish uranium resources in previous energy studies.

The global output of uranium from mining activities in the last five years lay between 41,282 t U and 54,610 t U, against an annual consumption exceeding 60,000 t U. The disparity revealed here between annual demand and primary production was covered by civil and military stocks, particularly those held in the Russian Federation and the United States. These stocks were built up from uranium overproduction between 1945 and 1990 in response to forecasts of growing civil demand as well as in response to military strategy. The military stocks in particular are currently being successively reduced. This is also in response to the treaties signed by the United States and the Russian Federation in 1992 to convert highly enriched weapons-grade uranium (HEU) into low enriched uranium (LEU). This means that demand in future can continue to be satisfied by mine output as well as stocks and the reduction in nuclear weapon stockpiles. Another source of uranium is the reprocessing of fuel rods. More research is currently being carried out in this respect to enhance the efficiency of the reprocessed materials.

Most of the uranium mined to satisfy global demand is produced by only a few countries. The main uranium producer in 2011 was again Kazakhstan with 19,451 t U (2010: 17,803 t U, an increase of 9 %), which corresponds to around 36 % (2010: 33 %) of global production. Canada, Australia, Niger, Namibia, the Russian Federation, Uzbekistan and the United States accounted for another combined share of 53 % of global production. Global production overall has risen by 2 % from 53,671 t U (2010) to 54,610 t U (2011). The major consumption countries are the United States, France, Russian Federation, China, the Republic of Korea, Japan, Ukraine and the United Kingdom (together accounting for 76 % of global consumption). However, these countries only have limited domestic production (United States, Russian Federation, China, Ukraine), or are totally reliant on imports. Because Germany switched off eight nuclear power plants in 2011, this also had an impact on Germany's uranium consumption: this therefore reduced significantly in 2011 (around 1,934 t in 2011 compared to 3,453 t in 2010). The volume of natural uranium required for the production of fuel rods in Germany is almost exclusively derived from producers in France, the United Kingdom, Canada and the United States on the basis of long-term contracts.

The growing interest in nuclear power around the world in recent years has stimulated a significant rise in exploration activities. In 2010 alone, around USD 2 billion was spent on uranium exploration and mine development world-wide. This corresponds to a rise of 22 % compared to 2008 (OECD-NEA/IAEA 2012). The World Nuclear Association (WNA 2012a) reports that USD 10 billion has been spent on exploration between 2003 and 2011. This exploration activity, which also takes place in countries with no previous production, continued in 2011 and has already led to an increase in the volumes of resources, and will probably also lead to an increase in the level of reserves. Kazakhstan for instance plans to invest around USD 25 million in exploring new deposits within its own borders between 2012 and 2014 (INTERFAX 2012). Whilst there has been a rise in the number of exploration projects, there has been a further concentration in the number of uranium producers: in 2011, 84 % of global production was accounted for by only 8 mining companies. Around half of global uranium mine production is accounted for by Kazatomprom in Kazakhstan (16 % global share), Areva in France (16 %), Cameco from Canada (16 %) and the Russian-Canadian company ARMZ/Uranium One (13 %). The largest single mine continues to be McArtur River, Canada (7,686 t U, 14 % of global production), followed by Olympic Dam, Australia (3,353 t U, 6 %), Arlit, Niger (2,726 t U, 5 %) and Tortkuduk, Kazakhstan (2,608 t U; 5 %).

After uranium prices rose in 2010 to 162 USD/kg U at the end of the year, prices moved downwards in 2011. This was largely attributable to the reactor disaster in Fukushima at the beginning of the year and an overall feeling of uncertainty in the uranium market. Spot market prices therefore fell during the course of the year from 188 USD/ kg to 134 USD/kg U. This downward trend has continued into 2012. However, the uranium price only accounts for a small proportion of the nuclear power production costs: according to calculations published by the World Nuclear Association (WNA 2012b) a doubling of uranium prices from 65 USD/ kg U to 130 USD/kg U would only increase fuel costs from 0.50 to 0.62 US-Cent/ kWh. 17,832 t U of uranium was supplied to the member states of the EU in 2011. The proportion of supplies from spot market contracts was only 4 % (ESA 2012).

Tables 32 to 36 in the Appendix provide a country-by-country listing of production, consumption, and the reserves and resources of uranium.

Thorium

Thorium is considered by the scientific community to be a potential alternative to uranium. However, it is currently not used for power generation. There are no commercial reactors operating anywhere in the world using thorium as a fuel. Nevertheless, thorium deposits have been discovered and evaluated in recent years as a by-product of the increasing exploration for other elements (uranium, rare earths, phosphate). Thorium resources world-wide in 2011 are reported to be more than 5.2 Mt.

NUCLEAR FUELS: KEY CONCLUSIONS

- **From a geological point of view, no shortage in the supply of nuclear fuels is expected in the foreseeable future.** The global uranium resources are very large and currently total 2.12 Mt reserves (cost category < 80 USD/kg U) and 12.5 Mt uranium resources.

- **Uranium production is mainly in politically stable countries.** With a proportion of around 27 % of world production, Canada and Australia together are amongst the largest uranium producing countries in the world. Canada's major McArthur River deposit alone supplies 14 % of globally mined uranium.

- **A larger number of producing countries can be expected in future.** The rise in the number of exploration projects in recent years is increasing the global uranium resources and will also give rise to an increase in reserves in future.

- **Declining spot market prices could in future slow down the further growth of uranium exploration.** The situation on the spot market is considered to be a driving force behind decisions to undertake exploration. The drop in uranium prices since 2011 could have a negative impact on the volume of investment activity.

- **The uranium price only accounts for a small proportion of power production costs.** Unlike fossil fuels, the cost of the raw material only plays a subordinate role in the overall costs for nuclear power production.

- **Even after the reactor disaster in Fukushima, there is still a growing interest in nuclear power world-wide.** Despite Germany's decision in 2011 to withdraw completely from the use of nuclear power, and the moratorium on expanding nuclear power capacities in a few countries, most governments are still planning to make use of nuclear power generation. At the end of 2011, 63 nuclear power plants were being constructed in 14 countries. Another 90 nuclear power plants are currently in the planning phase or already involved in the approval procedures.

3 Future Availability of Fossil Energy Resources

Supply situation and future demand

This study analyses the global geological inventory of fossil energy resources, and presents it on a country-by-country basis. The amounts that are actually exploited and consumed in future depend on numerous factors and can only be predicted to a limited extent. An attempt to make a long-term comparison between supply and demand can be made on the basis of the projected consumption of these energy resources up to 2035 depicted in the New Policies Scenario of the IEA (2012a) (Fig. 14). According to this scenario, the situation for the fuels uranium, coal and natural gas is comfortable from a geological point of view because the projected demand is only a small fraction of the currently proven resource inventory and can already be covered solely on the basis of today's known reserves. Coal in particular stands out with its huge inventory which overwhelmingly satisfies any predicted demand. Very high resource figures (compared to reserves) also indicate that there is still a very large and previously unexploited potential. The resource figures also, however, include figures on energy resources which have so far not been economically exploitable, such as oil shale, aquifer gas and natural gas from gas hydrates, even though their potential is incorporated in this study. The only fossil fuel with limited availability from a geological point of view is crude oil. Production is already declining for technical reasons at a time when there are still major resources available. According to the IEA scenario, most of the oil reserves currently proven would be depleted by 2035.

"Reach" of energy resources – a look at the static reach

In the discussion on the finite capacity of global energy resources, use is frequently made of the term "reach" to draw conclusions on the degree of depletion of reserves or their geological availability. However, there is usually no definition of whether the reach of a natural resource refers to how long all of the demands for the use of the natural resource can be satisfied, or whether it refers to the depletion of all deposits, or perhaps a different situation lying between these two extremes.

The so-called "static reach" does focus the term reach to a certain extent. This is calculated as the ratio of reserves to current annual production. The result is a figure which says how many years of

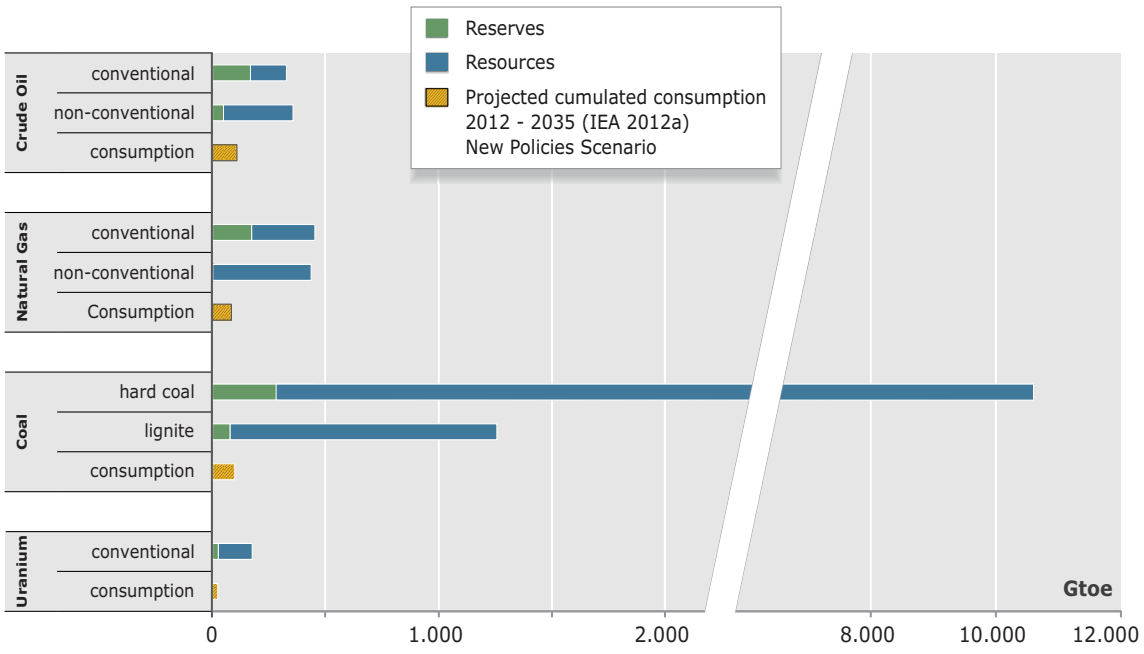


Fig. 14: *Fossil energy resources supply situation end 2011.*

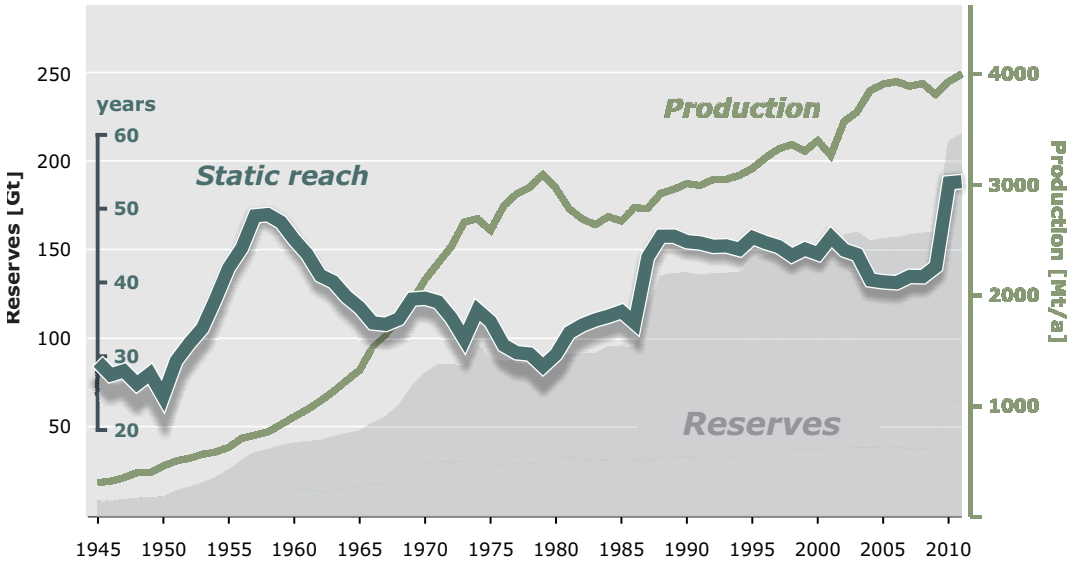


Fig. 15: *Changes in static reach over time from 1945 to today compared to the development in global crude oil reserves and production.*

consumption[2] can be satisfied in future assuming constant production and fixed reserves (hence the term static). The term static reach is therefore clearly defined, but its meaningfulness is limited because the input parameters – reserves and production – will never be static, but rather dependent on the geological and technological state-of-the-art, and economic and political developments. These factors are not taken into consideration when calculating the static reach. Static reach is therefore only of limited use for drawing reliable conclusions about the future global supply of energy resources. It is not a predictive instrument but merely provides a snapshot in time of a dynamically developing system.

Looking at the historical figures for crude oil for instance reveals that instead of declining continuously, the static reach actually remains relatively constant (Fig. 15). The static reach for crude oil from 1945 to today fluctuated within a corridor of between 20 and 50 years with notable plateau phases. This is because the oil industry is exploring continuously for oil, discovering new fields, and becomes more technically efficient at exploiting these fields. Despite a massive increase in production, this has meant that reserves in the past have actually grown. As a consequence, the static reach is better considered as a description of the status of the industry extracting the respective natural resource. A change in static reach can therefore either indicate a declining or growing degree of availability, or a sign that the interest of the industry in developing new deposits is either waning or growing. The name and the meaningfulness of the static reach are therefore completely independent of one another.

The limitations of the static reach as a useful indicator for geological availability are also linked to the definition of reserves. These are not a benchmark for the total geological inventory but only for that part of this inventory defined according to geological understanding and economic exploitability. These are juxtaposed by the resources which have undergone a lower level of exploration, have no proven economic extractability, and are therefore associated with a larger degree of uncertainty overall. If one also looks at the ratio here between the volume of resources and the current annual production, this improves the meaningfulness because, depending on the level of information available at any given time, the static reach now also incorporates the still unknown energy resource potential.

Because it is not possible to define the “reach” for the aforementioned reasons, a joint graphic depiction of the static reach based on reserves and resources, and annual global consumption, give an impression of the current potential of the various energy resources (Fig. 16). This approach

[2] For long-term averages, consumption and production can be treated synonymously because it can be assumed that all of the energy resources which are extracted will also be consumed.

shows that coal and uranium will be available for a long time into the future, and that this is also true of natural gas because of the new non-conventional potential, but that the oil inventory, even when incorporating resources, has a shorter lifetime – against the background of increasing demand.

In general, it should be noted that the diagram shown in Fig. 16 is based on a relatively simple approach which cannot do justice to the complexity of the future supply of energy resources. In the case of oil for instance, one has to take into consideration that even when large volumes of reserves still exist, production declines for production engineering reasons. Although the static reach sheds some light on how much crude oil exists, it does not show how production rates will develop or how demand can be covered in future. Conclusions on the future availability require more profound knowledge on the mechanisms affecting the natural resources industry. Considering the static reach on its own is inadequate for this purpose.

Summary and Outlook

Crude Oil

Crude oil supplies in coming years should be maintainable from a geological point of view even in the face of a moderate rise in consumption. The rebound in oil consumption in the aftermath of the financial and economic crisis in 2008 has also led to a recovery in oil production rates. The proportion of crude oil produced by OPEC countries, particularly in the region around the Persian Gulf, will increase further in the future because this region has the largest reserves potential and already has a very well established infrastructure. Despite crises and production shut-downs, global oil supplies remain stable because of OPEC's reserve capacities. No supply risks are therefore expected in the near future, with the proviso that there are no unforeseen events. The steep rise in tight oil production in North America in recent years will have a major impact on the import behaviour of the United States, and will also therefore have a knock-on effect on the world oil market. It remains to be seen whether tight oil production can be maintained in the long term and whether tight oil production will become a global phenomenon.

Natural Gas

Unlike oil, the generation of energy using natural gas will not be limited by any shortage in reserves and resources in the coming decades, even in the face of growing demand. The successes in the development of non-conventional natural gas deposits, particularly in the United States, have improved the global supply situation. The United

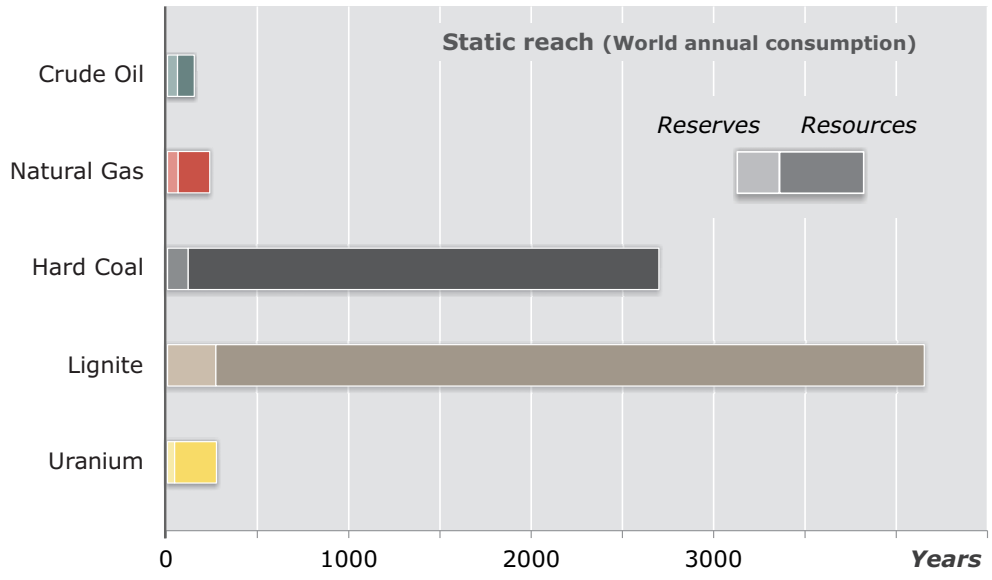


Fig. 16: *Global consumption (static reach) on the basis of the reserves and resources of the fossil fuels crude oil, natural gas, coal and uranium.*

States could become independent of natural gas imports in the foreseeable future. The successful development of these resources in Europe could also increase supply security. China increased its consumption by around 20 % in 2011 to consolidate its position as the largest consumer in Asia, even ahead of Japan, which imported 19 % more natural gas in the form of LNG in 2011 as a consequence of the reactor disaster in Fukushima. The liquefied natural gas market will continue to grow, particularly because of the rise in demand in Asia and Latin America. The European natural gas market is in a comfortable position with its access to production in the CIS countries, North Africa and the Middle East, and will also benefit from the growing supply of LNG. The increasing maritime transport of liquefied natural gas is expected to lead to the development of a global market in the medium to long term of growing importance for the natural gas traded on the gas spot market.

Coal

The growth in global coal demand has already risen strongly in recent years and will grow further in the foreseeable future driven by the demand in Asian countries. The supplies of steam coal to Asia from the Atlantic market, from countries such as the United States, Colombia, the Russian Federation and South Africa, as well as from the Pacific market, from countries such as Australia and Indonesia, is likely to increase further in the future. The global coking coal market will continue to be strongly supplied by traditional players such as Australia, the United States, Canada and the Russian Federation, as well as new providers such as Mongolia and Mozambique. For these reasons, the proportion of coal in the global production of non-renewable energy resources will continue to increase, as it has already done in recent years.

Nuclear fuels

Even after the accident at the Japanese nuclear power plant in Fukushima in March 2011, there is still a clear growing world-wide interest in the expansion of nuclear power. Despite the withdrawal from nuclear power and the moratorium on the expansion of nuclear power plants in some countries, most states are still firmly resolved to utilise nuclear power. The global uranium reserves of around 2.12 Mt (cost category < 80 USD/kg U) and the additional 12.5 Mt of uranium resources are not expected to give rise to any shortages in the supplies of nuclear fuel in the next decades from a geological point of view, even in the face of the observable rise in demand. Global production in 2011 also rose by 2 % compared to the previous year. Kazakhstan is likely to remain the largest uranium producer in the future. Production in Kazakhstan already rose by 27 % in 2010, and another 9 % in 2011. This strong upward trend will probably also continue beyond 2012. It is not possible to make any reliable prognoses at the moment on the further development of global exploration and production activities. Growing production costs and a decline in uranium spot market prices indicate that investment by the uranium extracting and exploring industry will decline in future. If the uranium price falls further, some projects will probably have to be reassessed. This may mean that the more cost-intense projects will be delayed or pursued less vigorously.

4 References

AGEB (2012): Energieverbrauch in Deutschland, Daten für das 1. – 4. Quartal 2011, Arbeitsgemeinschaft Energiebilanzen, Berlin.

BGR (2009): Energierohstoffe 2009. Reserven, Ressourcen, Verfügbarkeit. Erdöl, Erdgas, Kohle, Kernbrennstoffe, Geothermische Energie. – 284 p., Hannover.

— (2011): Kurzstudie 2010. Reserven, Ressourcen und Verfügbarkeit von Energierohstoffen. – 89 p., Hannover.

— (2012): Abschätzung des Erdgaspotenzials aus dichten Tongesteinen (Schiefergas) in Deutschland.– 57 p. Hannover. www.bgr.bund.de/DE/Themen/Energie/Downloads/BGR_Schiefergaspotenzial_in_Deutschland_2012.pdf [11.2012]

BP (2012): Statistical Review of World Energy. June 2012. – 45 p.; London. http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/reports_and_publications/statistical_energy_review_2011/STAGING/local_assets/pdf/statistical_review_of_world_energy_full_report_2012.pdf.

DATF (2012): Kernenergie Weltreport 2011. Deutsches Atomforum e. V. (DAtF). ATW-Internationale Zeitschrift für Kernenergie, Jg. 57, Heft 4, p.271-276. http://www.kernenergie.de/kernenergie/service/fachzeitschrift-atw/hefte-themen/2012/apr/07_kernenergie_weltreport_2011.php [11.2012].

EIA (2011): World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States.– 365 p., www.eia.gov.

ESA (2012): EURATOM Supply Agency (ESA), ANNUAL REPORT 2011, Luxembourg.

Hobbs, H. and Adair, L. (2012): Oil & Gas Journal, Aug. 6, 2012; Vol. 110.8, p. 68-75.

IEA (2012a): World Energy Outlook 2012. – 668 p., Paris.

— (2012b): Electricity Information 2012. – 884 p., Paris.

INTERFAX 2012: Russia & CIS Metals & Mining Weekly (2012), Vol. XXII, Issue 22 (1041), 01.06.2012-07.06.2012, ISSN 1072-2645, Interfax Ltd.

LBEG (2012): Erdöl und Erdgas in der Bundesrepublik Deutschland 2011, Jahresbericht 2011. – 62 p., 15 Anlagen, Hannover.

OECD-NEA/IAEA (2012): Uranium 2011: Resources, Production and Demand. OECD. – 488 p., Paris.

OPEC (2012): World Oil Outlook 2012. – 281 p., Wien.

OPEC (2012): Yearly OPEC Basket Price. http://www.opec.org/opec_web/en/data_graphs/40.htm?selectedTab=daily [11.2012].

VDKI (2012a): Jahresbericht 2012 – Fakten und Trends 2011/2012. – 147 p., Hamburg. http://www.verein-kohlenimporteure.de/download/2012/VDKI_Jahresbericht_2012.pdf?navid=18 [11.2012].

— (2012b): Preise für Steinkohlen/ Wechselkurse (am 20.10.2012). http://www.verein-kohlenimporteure.de/download/2012/032012%20Preise%20dt.pdf?navid=5 [11.2012].

WNA (2012a): Supply of Uranium. http://www.world-nuclear.org/info/inf75.html [11.2012].

— (2012b): The Economics of Nuclear Power. http://www.world-nuclear.org/info/inf02.html [11.2012].

— (2012c): Uranium production figures, 2001-2011. http://www.world-nuclear.org/info/uprod.html [11.2012].

— (2012d): World Nuclear Power Reactors & Uranium Requirements 2011. http://www.world-nuclear.org/info/reactors0112.html [11.2012].

Appendix

Tables

Sources of Information

Glossary

Definitions

Country Groups

Economic Policy Organisations

Units

Conversion Factors

Tab. 2: *Regional Distribution of Reserves of Non-Renewable Fuels in 2011 [EJ]*

Region	Crude Oil		Natural Gas		Coal		Uranium	Total	
	conven-tional	non-con-ventional	conven-tional [1]	non-con-ventional	Hard Coal	Lignite		EJ	Share [%]
Europe	88	< 0.5	164	–	531	631	8	1,422	3.6
CIS	728	–	2,366	2	3,050	1,361	191	7,698	19.5
Africa	754	–	556	–	850	1	54	2,214	5.6
Middle East	4,536	–	3,029	–	30	–	–	7,595	19.2
Austral-Asia	235	–	590	47	8,200	835	561	10,469	26.5
North America	268	1,131	246	126	5,799	390	166	8,126	20.6
Latin America	404	886	289	–	232	43	81	1,935	4.9
World	**7,014**	**2,018**	**7,240**	**175**	**18,692**	**3,260**	**1,061**	**39,459**	**100.0**
OECD 2000	374	1,131	511	162	7,845	1,407	653	12,083	30.6
EU-27	50	–	83	–	487	510	3	1,133	2.9
OPEC 2009	5,376	886	3,595	–	59	1	–	9,917	25.1

[1] including tight gas

Tab. 3: *Regional Distribution of Resources of Non-Renewable Fuels in 2011 [EJ]*

Region	Crude Oil		Natural Gas		Coal		Uranium Thorium		Total	
	conven-tional	non-con-ventional	conven-tional	non-con-ventional[1]	Hard Coal	Lignite			EJ	Share [%]
Europe	194	3	183	616	12,632	3,039	85	588	17,340	3.3
CIS	1,155	571	4,600	1,776	69,551	18,705	1,341	105	97,805	18.8
Africa	1,004	14	1,253	1,408	1,920	4	834	325	6,761	1.3
Middle East	1,251	–	1,643	244	1,008	–	65	15	4,227	0.8
Austral-Asia	1,025	1,823	1,697	2,566	168,069	9,876	1,353	763	187,174	36.0
North America	1,067	2,311	1,509	2,325	166,861	17,543	1,963	346	193,925	37.3
Latin America	941	4,067	786	1,332	686	173	612	465	9,062	1.7
World	**6,637**	**8,790**	**11,671**	**10,267**	**424,553[2]**	**49,340**	**6,254**	**2,606[3]**	**520,118**	**100.0**
OECD 2000	1,297	2,423	1,883	3,887	219,838	21,960	2,416	1,196	254,900	49.0
EU-27	103	3	103	499	12,562	2,727	85	56	16,138	3.1
OPEC 2009	1,818	3,963	1,787	996	1,225	3	23	185	9,999	1.9

[1] without natural gas from gas hydrates and aquifer gas (7.904 EJ)

[2] including hard coal in the Antarctic (3.825 EJ)

[3] including Thorium without country allocation (62 EJ)

Tab. 4: *Regional Distribution of Production of Non-Renewable Fuels in 2011 [EJ]*

Region	Crude Oil	Natural Gas	Coal	Lignite	Uranium	Total	Share [%]
Europe	7.5	10.6	3.6	5.0	0.2	26.8	5.4
CIS	27.5	30.8	11.1	1.3	13.2	83.9	17.0
Africa	18.2	7.5	6.1	–	4.5	36.3	7.4
Middle East	53.6	19.9	< 0.05	–	–	73.5	14.9
Austral-Asia	16.3	18.7	113.9	3.2	4.0	156.1	31.6
North America	27.7	32.8	24.9	0.9	5.3	91.7	18.6
Latin America	16.4	6.5	2.5	0.1	0.1	25.5	5.2
World	**167.1**	**126.8**	**162.1**	**10.4**	**27.3**	**493.8**	**100.0**
OECD 2000	35.9	44.9	37.7	5.3	8.5	132.2	26.8
EU-27	3.4	6.6	3.5	3.8	0.2	17.5	3.5
OPEC 2009	71.2	23.2	0.1	–	–	94.5	19.1

Tab. 5: *Regional Distribution of Consumption of Non-Renewable Fuels in 2011 [EJ]*

Region	Crude Oil	Natural Gas	Hard Coal	Lignite	Uranium	Total	Share [%]
Europe	28.5	20.0	9.1	4.9	10.3	72.9	14.6
CIS	8.2	25.2	8.4	1.3	3.6	46.7	9.4
Africa	6.6	3.9	4.6	–	0.2	15.3	3.1
Middle East	14.9	15.1	0.4	–	0.1	30.6	6.1
Austral-Asia	55.8	23.0	115.8	3.1	6.6	204.3	41.0
North America	42.7	32.8	22.4	0.9	10.3	109.1	21.9
Latin America	12.3	6.0	1.0	0.1	0.3	19.5	3.9
World	**169.1**	**126.1**	**161.7**	**10.2**	**31.3**	**498.3**	**100.0**
OECD 2000	85.7	58.9	40.6	5.2	23.7	214.1	43.0
EU-27	25.6	17.7	8.3	3.8	10.1	65.5	13.1
OPEC 2009	16.6	16.2	0.1	–	0.1	33.0	6.6

– no reserves, resources, production or consumption

Tab. 6: *Crude Oil in 2011 [Mt]:*

Country / Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Albania	0.8	53	30	23	107	53
Austria	0.9	121	7	10	137	17
Bosnia and Herzegovina	–	–	–	10	10	10
Bulgaria	–	–	2	5	7	7
Croatia	0.7	101	9	20	130	29
Cyprus	–	–	–	35	35	35
Czech Republic	0.7	10	2	30	42	32
Denmark	11.0	320	111	172	603	284
Estonia	0.6	5	–	–	5	–
Finland	0.5	2	–	–	2	–
France	0.9	124	11	70	206	81
Germany	2.7	294	35	20	350	55
Greece	0.1	16	1	35	53	36
Hungary	0.7	98	4	20	122	24
Ireland	–	–	–	224	224	224
Italy	5.3	175	76	250	501	326
Lithuania	0.1	4	2	20	25	22
Malta	–	–	–	5	5	5
Netherlands	1.1	143	39	60	242	99
Norway	92.2	3,363	833	2,047	6,242	2,880
Poland	0.6	61	10	42	114	52
Romania	4.2	759	82	160	1,001	242
Serbia	0.8	43	10	20	72	30
Slovakia	0.5	2	1	5	8	6
Spain	0.1	37	20	20	78	40
Turkey	2.4	138	45	70	253	115
United Kingdom	52.0	3,495	788	1,352	5,635	2,140
Azerbaijan	45.8	1,719	952	1,245	3,916	2,197
Belarus	1.7	134	27	30	191	57
Georgia	0.1	24	5	50	79	55
Kazakhstan	82.4	1,459	4,082	10,700	16,241	14,782
Kyrgyzstan	0.1	11	5	10	27	15
Moldova, Republic	–	–	–	10	10	10
Russian Federation	509.0	21,178	11,997	26,951	60,126	38,948
Tajikistan	< 0.05	8	2	60	69	62
Turkmenistan	10.4	510	215	1,700	2,425	1,915
Ukraine	3.3	358	54	150	562	204
Uzbekistan	4.1	190	81	400	670	481
Algeria	90.7	2,808	1,660	1,600	6,068	3,260
Angola	85.2	1,300	1,837	5,200	8,337	7,037
Benin	–	–	1	70	71	71
Cameroon	3.1	177	27	350	555	377
Chad	6.0	59	204	275	539	479
Congo, Democratic Republic	1.1	42	23	145	211	168

Continuation of Tab. 6

Country / Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Congo, Republic	15.2	325	264	451	1,040	715
Côte d'Ivoire	1.6	28	14	300	341	314
Egypt	35.1	1,521	585	1,608	3,714	2,193
Equatorial Guinea	12.5	179	232	350	761	582
Eritrea	–	–	–	10	10	10
Ethiopia	–	–	< 0.5	20	20	20
Gabon	12.5	512	501	1,400	2,413	1,901
Gambia	–	–	–	20	20	20
Ghana	3.6	9	85	210	304	295
Guinea	–	–	–	150	150	150
Guinea-Bissau	–	–	–	40	40	40
Kenya	–	–	–	250	250	250
Liberia	–	–	–	160	160	160
Madagascar	–	–	–	90	90	90
Mauritania	1.3	5	3	150	158	153
Morocco	< 0.05	2	< 0.5	30	32	30
Mozambique	n.s.	n.s.	2	2,000	2,002	2,002
Namibia	–	–	–	150	150	150
Niger	–	–	–	30	30	30
Nigeria	120.2	4,101	5,061	5,090	14,252	10,151
São Tomé and Príncipe	–	–	–	180	180	180
Senegal	–	–	–	140	140	140
Seychelles	–	–	–	470	470	470
Sierra Leone	–	–	60	200	260	260
Socialist People's Libyan Arab Jamahiriya	21.4	3,663	6,408	1,200	11,271	7,608
Somalia	–	–	1	20	21	21
South Africa	0.7	23	2	400	418	402
South Sudan, Republic of	–	–	647	365	1,012	1,012
Sudan & South Sudan	22.3	210	863	730	1,803	1,593
Sudan, Republic of the	–	–	216	365	581	581
Tanzania, United Republic	–	–	–	400	400	400
Togo	–	–	–	70	70	70
Tunisia	3.7	198	58	50	306	108
Uganda	–	–	136	300	436	436
Western Sahara	–	–	–	30	30	30
Zimbabwe	–	–	–	10	10	10
Bahrain	10.0	222	17	200	439	217
Iran, Islamic Republic	205.8	9,200	21,061	7,200	37,461	28,261
Iraq	134.2	4,672	19,469	6,100	30,242	25,569
Israel	< 0.05	2	2	370	374	372
Jordan	–	–	< 0.5	5	5	5
Kuwait	134.3	5,733	13,810	700	20,242	14,510
Lebanon	–	–	–	150	150	150
Oman	42.1	1,305	748	700	2,753	1,448

Continuation of Tab. 6

Country / Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Qatar	64.4	1,420	3,310	700	5,430	4,010
Saudi Arabia	525.8	18,170	36,110	11,800	66,080	47,910
Syrian, Arab Republic	16.7	731	340	400	1,471	740
United Arab Emirates	138.4	4,174	13,306	1,100	18,581	14,406
Yemen	10.3	376	340	500	1,216	840
Afghanistan	–	–	–	290	290	290
Australia	21.0	981	527	3,550	5,058	4,077
Bangladesh	0.3	3	3	30	36	33
Brunei Darussalam	8.1	500	150	160	809	310
Cambodia	–	–	–	25	25	25
China	203.6	5,666	2,002	57,144	64,812	59,146
India	38.2	1,182	757	900	2,839	1,657
Indonesia	46.1	3,265	543	2,470	6,278	3,013
Japan	0.6	50	5	24	79	29
Korea, Republic (South)	1.0	n.s.	n.s.	n.s.	n.s.	n.s.
Laos, People's Democratic Republic	–	–	–	< 0.5	< 0.5	< 0.5
Malaysia	31.3	1,003	797	850	2,651	1,647
Mongolia	0.3	-	2	50	52	52
Myanmar	0.9	54	6	560	620	566
New Zealand	2.3	55	20	182	257	202
Pakistan	3.5	93	38	150	281	188
Papua New Guinea	1.0	63	25	290	378	315
Philippines	0.8	15	18	270	303	288
Sri Lanka	–	–	–	90	90	90
Taiwan	< 0.05	5	< 0.5	5	10	5
Thailand	10.4	159	60	327	546	387
Timor-Leste	4.2	35	71	175	280	246
Viet Nam	15.9	288	599	600	1,486	1,199
Canada	165.3	5,093	27,467	54,862	87,421	82,328
Greenland	–	–	–	3,500	3,500	3,500
Mexico	145.1	6,012	1,550	2,800	10,362	4,350
United States	352.3	30,444	4,463	19,653	54,559	24,116
Argentina	30.3	1,479	343	2,720	4,542	3,063
Barbados	< 0.05	2	< 0.5	30	32	30
Belize	0.2	1	1	15	16	16
Bolivia	2.3	75	59	200	333	259
Brazil	114.6	1,819	2,048	13,000	16,866	15,048
Chile	0.2	61	20	20	102	40
Colombia	45.4	1,092	307	1,265	2,664	1,572
Cuba	3.4	56	13	1,008	1,078	1,021
Dominican Republic	–	–	–	150	150	150
Ecuador	27.1	689	838	107	1,633	945
Falkland Islands (Malvinas)	–	–	–	800	800	800
(French) Guiana	–	–	–	800	800	800

Continuation of Tab. 6

Country / Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Guatemala	0.6	20	11	40	70	51
Guyana	–	–	–	450	450	450
Haiti	–	–	–	100	100	100
Paraguay	–	–	–	75	75	75
Peru	6.6	363	169	351	883	520
Puerto Rico	–	–	–	75	75	75
Suriname	0.8	12	10	700	722	710
Trinidad and Tobago	5.9	506	113	65	684	178
Uruguay	–	–	–	325	325	325
Venezuela, Bolivarian Republic	154.8	9,444	26,942	97,500	133,886	124,442
World	**3,998.2**	**166,705**	**216,056**	**369,057**	**751,819**	**585,114**
Europe	178.8	9,366	2,120	4,725	16,210	6,845
CIS	656.8	25,589	17,419	41,306	84,315	58,726
Africa	436.2	15,163	18,027	24,349	57,539	42,376
Middle East	1,282.0	46,006	108,513	29,925	184,443	138,438
Austral-Asia	389.5	13,415	5,623	68,142	87,181	73,765
North America	662.7	41,549	33,480	80,814	155,843	114,294
Latin America	392.2	15,617	30,874	119,796	166,287	150,670
OPEC 2009	1,702.3	65,375	149,811	138,297	353,483	288,108
OPEC-Gulf	1,202.9	43,370	107,066	27,600	178,035	134,666
MENA	1,455.2	54,408	117,224	34,413	206,044	151,637
OECD 2000	859.2	51,035	36,018	88,997	176,050	125,015
EU-27	81.9	5,668	1,193	2,535	9,396	3,728

– no reserves, resources or production

Tab. 7: *Crude Oil Resources 2011 [Mt]:*
Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Total	Conventional	Non-Conventional		
				Oil Sand	Extra Heavy Oil	Shale Oil
1	Venezuela, Bolivarian Republic	97,500	3,000	–	60,500	34,000
2	China	57,144	16,200	25	119	40,800
3	Canada	54,862	3,500	50,000	1	1,361
4	Russian Federation	26,951	20,000	4,500	1	2,450
5	United States	19,653	15,727	850	76	3,000
6	Brazil	13,000	13,000	–	–	–
7	Saudi Arabia	11,800	11,800	–	–	–
8	Kazakhstan	10,700	4,000	6,700	–	–
9	Iran, Islamic Republic	7,200	7,200	–	–	–
10	Iraq	6,100	6,100	–	–	–
11	Angola	5,200	5,000	200	–	–
12	Nigeria	5,090	5,000	90	–	–
13	Australia	3,550	1,100	–	–	2,450
14	Greenland	3,500	3,500	–	–	–
15	Mexico	2,800	2,800	–	< 0.5	–
16	Argentina	2,720	500	–	–	2,220
17	Indonesia	2,470	2,400	70	–	–
18	Norway	2,047	2,047	–	–	–
19	Mozambique	2,000	2,000	–	–	–
20	Turkmenistan	1,700	1,700	–	–	–
	...					
116	Germany	20	20	–	–	–
	other Countries [117]	33,049	32,190	81	81	698
	...					
	World	**369,054**	**158,783**	**62,516**	**60,777**	**86,978**
	Europe	4,725	4,644	30	29	22
	CIS	41,306	27,635	11,200	21	2,450
	Africa	24,349	24,010	331	8	–
	Middle East	29,925	29,925	–	*< 0.5*	–
	Austral-Asia	68,142	24,532	95	119	43,396
	North America	80,814	25,527	50,850	77	4,361
	Latin America	119,796	22,510	10	60,526	36,750
	OPEC 2009	138,297	43,500	290	60,507	34,000
	OPEC-Gulf	27,600	27,600	–	–	–
	MENA	34,413	34,405	–	8	–
	OECD 2000	88,997	31,036	50,880	103	6,978
	EU-27	2,535	2,458	30	26	22

– no resources

Tab. 8: *Crude Oil Reserves 2011 [Mt]:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Total	Conventional	Non-Conventional		
				Oil Sand	Extra Heavy Oil	Shale Oil
1	Saudi Arabia	36,110	36,110	–	–	–
2	Canada	27,467	667	26,800	–	–
3	Venezuela, Bolivarian Republic	26,942	5,742	–	21,200	–
4	Iran, Islamic Republic	21,061	21,061	–	–	–
5	Iraq	19,469	19,469	–	–	–
6	Kuwait	13,810	13,810	–	–	–
7	United Arab Emirates	13,306	13,306	–	–	–
8	Russian Federation	11,997	11,997	–	–	–
9	Socialist People's Libyan Arab Jamahiriya	6,408	6,408	–	–	–
10	Nigeria	5,061	5,061	–	–	–
11	United States	4,463	4,200	–	3	260
12	Kazakhstan	4,082	4,082	–	–	–
13	Qatar	3,310	3,310	–	–	–
14	Brazil	2,048	2,048	–	–	–
15	China	2,002	2,002	–	n.s.	–
16	Angola	1,837	1,837	–	–	–
17	Algeria	1,660	1,660	–	–	–
18	Mexico	1,550	1,550	–	–	–
19	Azerbaijan	952	952	–	n.s.	–
20	Ecuador	838	838	–	n.s.	–
	...					
59	Germany	35	35	–	–	–
	other Countries [82]	11,649	11,646	–	3	–
	...					
	World	**216,056**	**167,790**	**26,800**	**21,206**	**260**
	Europe	2,120	2,117	–	3	–
	CIS	17,419	17,419	–	n.s.	–
	Africa	18,027	18,027	–	–	–
	Middle East	108,513	108,513	–	–	–
	Austral-Asia	5,623	5,623	–	n.s.	–
	North America	33,480	6,417	26,800	3	260
	Latin America	30,874	9,674	–	21,200	–
	OPEC 2009	149,811	128,611	–	21,200	–
	OPEC-Gulf	107,066	107,066	–	–	–
	MENA	117,224	117,224	–	–	–
	OECD 2000	36,018	8,955	26,800	3	260
	EU-27	1.193	1.193			

n.s. not specified

– no reserves

Tab. 9: *Crude Oil Production 2011:*
Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	Saudi Arabia	525.8	13.2	13.2
2	Russian Federation	509.0	12.7	25.9
3	United States	352.3	8.8	34.7
4	Iran, Islamic Republic	205.8	5.1	39.8
5	China	203.6	5.1	44.9
6	Canada	165.3	4.1	49.1
7	Venezuela, Bolivarian Republic	154.8	3.9	52.9
8	Mexico	145.1	3.6	56.6
9	United Arab Emirates	138.4	3.5	60.0
10	Kuwait	134.3	3.4	63.4
11	Iraq	134.2	3.4	66.7
12	Nigeria	120.2	3.0	69.8
13	Brazil	114.6	2.9	72.6
14	Norway	92.2	2.3	74.9
15	Algeria	90.7	2.3	77.2
16	Angola	85.2	2.1	79.3
17	Kazakhstan	82.4	2.1	81.4
18	Qatar	64.4	1.6	83.0
19	United Kingdom	52.0	1.3	84.3
20	Indonesia	46.1	1.2	85.4
	...			
56	Germany	2.7	0.1	
	other Countries [76]	579.2	14.5	100
	...			
	World	**3,998.2**	**100.0**	
	Europe	178.8	4.5	
	CIS	656.8	16.4	
	Africa	436.2	10.9	
	Middle East	1,282.0	32.1	
	Austral-Asia	389.5	9.7	
	North America	662.7	16.6	
	Latin America	392.2	9.8	
	OPEC 2009	1,702.3	42.6	
	OPEC-Gulf	1,202.9	30.1	
	MENA	1,455.2	36.4	
	OECD 2000	859.2	21.5	
	EU-27	82.0	2.1	

Tab. 10: *Oil Demand in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	United States	814.6	20.1	20.1
2	China	457.9	11.3	31.5
3	Japan	221.7	5.5	36.9
4	India	162.3	4.0	40.9
5	Russian Federation	136.0	3.4	44.3
6	Saudi Arabia	121.1	3.0	47.3
7	Brazil	120.7	3.0	50.3
8	Germany	111.9	2.8	53.1
9	Korea, Republic (South)	110.8	2.7	55.8
10	Mexico	105.9	2.6	58.4
11	Canada	100.5	2.5	60.9
12	Iran, Islamic Republic	88.8	2.2	63.1
13	France	83.8	2.1	65.2
14	United Kingdom	72.0	1.8	66.9
15	Italy	69.6	1.7	68.7
16	Indonesia	64.4	1.6	70.3
17	Singapore	62.5	1.5	71.8
18	Spain	59.3	1.5	73.3
19	Thailand	46.8	1.2	74.4
20	Australia	45.3	1.1	75.5
	...			
	other Countries [143]	989.1	24.5	100
	...			
	World	**4,044.9**	**100.0**	
	Europe	681.8	16.9	
	CIS	196.5	4.9	
	Africa	158.4	3.9	
	Middle East	357.4	8.8	
	Austral-Asia	1,336.0	33.0	
	North America	1,021.2	25.2	
	Latin America	293.5	7.3	
	OPEC 2009	396.8	9.8	
	OPEC-Gulf	303.3	7.5	
	MENA	440.8	10.9	
	OECD 2000	2,049.2	50.7	
	EU-27	611.8	15.1	

Tab. 11: *Crude Oil Export in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	Saudi Arabia	360.9	16.7	16.7
2	Russian Federation	289.3	13.4	30.1
3	Iran, Islamic Republic	126.9	5.9	36.0
4	Canada	119.6	5.5	41.5
5	Nigeria	118.8	5.5	47.1
6	United Arab Emirates	113.2	5.2	52.3
7	Iraq	107.6	5.0	57.3
8	Kuwait	90.8	4.2	61.5
9	Venezuela, Bolivarian Republic	84.4	3.9	65.4
10	Angola	77.1	3.6	69.0
11	Norway	70.5	3.3	72.2
12	Mexico	70.4	3.3	75.5
13	Kazakhstan	69.5	3.2	78.7
14	Azerbaijan	40.0	1.9	80.6
15	Algeria	37.2	1.7	82.3
16	Oman	36.9	1.7	84.0
17	Brazil	35.0	1.6	85.6
18	United Kingdom	33.7	1.6	87.2
19	Qatar	29.4	1.4	88.6
20	Colombia	19.9	0.9	89.5
	...			
61	Germany	0.4	< 0.05	
	other Countries [50]	226.7	10.5	100
	...			
	World	2,158.3	100.0	
	Europe	123.5	5.7	
	CIS	401.8	18.6	
	Africa	322.4	14.9	
	Middle East	876.7	40.6	
	Austral-Asia	69.9	3.2	
	North America	201.0	9.3	
	Latin America	162.9	7.5	
	OPEC 2009	1,178.0	54.6	
	OPEC-Gulf	828.7	38.4	
	MENA	935.0	43.3	
	OECD 2000	342.7	15.9	
	EU-27	53.0	2.5	

Tab. 12: *Crude Oil Import in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	United States	443.0	20.3	20.3
2	China	252.5	11.6	31.9
3	Japan	177.3	8.1	40.0
4	India	168.0	7.7	47.7
5	Korea, Republic (South)	125.1	5.7	53.5
6	Germany	90.5	4.2	57.6
7	Italy	78.6	3.6	61.2
8	France	64.5	3.0	64.2
9	Netherlands	59.5	2.7	66.9
10	United Kingdom	57.7	2.6	69.5
11	Spain	56.4	2.6	72.1
12	Taiwan	39.8	1.8	74.0
13	Thailand	39.4	1.8	75.8
14	Singapore	35.8	1.6	77.4
15	Canada	34.2	1.6	79.0
16	Belgium	32.2	1.5	80.4
17	Australia	25.5	1.2	81.6
18	Poland	24.4	1.1	82.7
19	Sweden	19.3	0.9	83.6
20	Greece	18.3	0.8	84.5
	...			
	other Countries [64]	339.0	15.5	100
	...			
	World	**2,181.1**	**100.0**	
	Europe	619.1	28.4	
	CIS	32.6	1.5	
	Africa	21.8	1.0	
	Middle East	29.4	1.3	
	Austral-Asia	929.6	42.6	
	North America	477.5	21.9	
	Latin America	71.0	3.3	
	MENA	40.0	1.8	
	OECD 2000	1,389.8	63.7	
	EU-27	581.9	26.7	

Tab. 13: *Natural Gas in 2011 [bcm³]:*

Country / Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Albania	< 0.05	8	1	10	19	11
Austria	1.6	94	15	820	929	835
Bulgaria	0.5	7	5	655	667	660
Croatia	2.3	66	24	50	140	74
Cyprus	–	–	–	250	250	250
Czech Republic	0.3	15	3	20	38	23
Denmark	7.1	166	55	691	913	746
France	0.6	228	11	5,202	5,441	5,213
Germany	13.3	987	133	1,870	2,990	2,003
Greece	< 0.05	1	1	10	12	11
Hungary	2.8	223	9	347	579	356
Ireland	0.3	55	10	50	115	60
Italy	7.7	728	62	405	1,195	467
Lithuania	–	–	–	113	113	113
Malta	–	–	–	10	10	10
Netherlands	80.6	3,297	1,156	1,196	5,649	2,352
Norway	101.4	1,652	2,070	4,171	7,893	6,241
Poland	4.4	248	93	797	1,138	890
Portugal	–	–	–	40	40	40
Romania	11.0	1,265	109	420	1,794	529
Serbia	0.4	32	40	10	82	50
Slovakia	0.1	25	13	10	48	23
Slovenia	< 0.05	n.s.	1	15	16	16
Spain	0.1	11	5	204	220	209
Sweden	–	–	–	1,161	1,161	1,161
Turkey	0.8	12	6	908	926	914
United Kingdom	43.0	2,379	493	1,573	4,445	2,066
Azerbaijan	16.4	511	1,317	1,800	3,628	3,117
Belarus	0.2	12	3	10	25	13
Georgia	< 0.05	3	8	102	112	110
Kazakhstan	28.5	441	2,407	3,700	6,549	6,107
Kyrgyzstan	< 0.05	7	5	20	32	25
Moldova, Republic	–	–	–	20	20	20
Russian Federation	629.5	19,844	46,000	142,050	207,894	188,050
Tajikistan	< 0.05	9	5	100	114	105
Turkmenistan	59.5	2,367	10,000	15,000	27,367	25,000
Ukraine	18.4	1,947	969	3,490	6,405	4,459
Uzbekistan	58.8	2,079	1,602	1,500	5,181	3,102
Algeria	78.0	2,067	4,504	13,314	19,885	17,818
Angola	0.8	20	310	1,200	1,530	1,510
Benin	–	–	1	100	101	101
Botswana	–	–	–	1,840	1,840	1,840
Cameroon	0.3	n.s.	153	200	353	353
Chad	–	–	–	200	200	200

Continuation of Tab. 13

Country / Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Congo, Democratic Republic	n.s.	n.s.	1	10	11	11
Congo, Republic	0.4	n.s.	124	200	324	324
Côte d'Ivoire	1.7	22	16	400	438	416
Egypt	61.3	658	2,210	8,000	10,868	10,210
Equatorial Guinea	6.2	29	121	120	270	241
Eritrea	–	–	–	100	100	100
Ethiopia	n.s.	n.s.	28	20	48	48
Gabon	0.2	4	27	600	631	627
Gambia	–	–	–	25	25	25
Ghana	n.s.	n.s.	27	300	327	327
Guinea	–	–	–	200	200	200
Guinea-Bissau	–	–	–	50	50	50
Kenya	–	–	–	600	600	600
Liberia	–	–	–	200	200	200
Madagascar	–	–	–	4,700	4,700	4,700
Mauritania	n.s.	n.s.	28	200	228	228
Morocco	0.1	2	1	317	321	318
Mozambique	3.6	22	127	5,200	5,349	5,327
Namibia	–	–	62	250	312	312
Niger	–	–	–	250	250	250
Nigeria	35.9	376	5,154	3,000	8,530	8,154
Rwanda	–	–	–	50	50	50
São Tomé and Príncipe	–	–	–	100	100	100
Senegal	–	–	10	200	210	210
Seychelles	–	–	–	600	600	600
Sierra Leone	–	–	–	300	300	300
Socialist People's Libyan Arab Jamahiriya	4.1	270	1,495	9,213	10,979	10,708
Somalia	–	–	6	400	406	406
South Africa	1.0	38	12	14,962	15,012	14,974
Sudan & South Sudan	n.s.	n.s.	85	250	335	335
Tanzania, United Republic	0.8	n.s.	37	1,400	1,437	1,437
Togo	–	–	–	100	100	100
Tunisia	3.3	44	65	610	719	675
Uganda	–	–	15	-	15	15
Western Sahara	–	–	–	228	228	228
Zimbabwe	–	–	–	10	10	10
Bahrain	12.7	238	219	200	657	419
Iran, Islamic Republic	151.8	1,890	33,090	11,000	45,980	44,090
Iraq	5.3	107	3,588	4,000	7,695	7,588
Israel	4.3	15	215	2,000	2,230	2,215
Jordan	0.1	5	6	150	161	156
Kuwait	13.0	290	1,784	500	2,574	2,284
Lebanon	–	–	–	850	850	850
Oman	26.5	313	850	1,650	2,813	2,500

Continuation of Tab. 13

Country / Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Palestine	–	–	30	350	380	380
Qatar	146.8	952	25,047	2,000	27,999	27,047
Saudi Arabia	92.3	1,485	8,016	24,664	34,165	32,680
Syrian, Arab Republic	9.7	120	285	300	705	585
United Arab Emirates	51.7	1,038	6,091	1,500	8,629	7,591
Yemen	9.3	19	479	500	998	979
Afghanistan	n.s.	n.s.	50	300	350	350
Australia	45.4	936	3,701	31,265	35,902	34,966
Bangladesh	19.9	280	354	800	1,434	1,154
Brunei Darussalam	12.8	373	288	200	861	488
Cambodia	–	–	–	50	50	50
China	103.1	1,156	3,051	52,500	56,707	55,551
India	49.1	653	1,241	5,014	6,908	6,255
Indonesia	91.7	1,860	2,965	10,790	15,616	13,755
Japan	3.3	126	21	5	152	26
Korea, Republic (South)	0.5	n.s.	7	50	57	57
Laos, People's Democratic Republic	–	–	–	5	5	5
Malaysia	61.8	1,068	2,435	1,900	5,404	4,335
Mongolia	–	–	–	23	23	23
Myanmar	12.0	146	323	2,000	2,469	2,323
New Zealand	4.4	146	28	153	327	181
Pakistan	38.5	717	779	3,044	4,540	3,823
Papua New Guinea	0.2	3	442	1,000	1,445	1,442
Philippines	3.7	29	87	502	618	589
Sri Lanka	–	–	–	300	300	300
Taiwan	0.3	51	10	5	66	15
Thailand	37.0	449	282	600	1,331	882
Timor-Leste	n.s.	n.s.	101	300	401	401
Viet Nam	8.5	72	617	1,392	2,081	2,009
Canada	160.5	5,522	1,728	23,253	30,503	24,981
Greenland	–	–	–	3,900	3,900	3,900
Mexico	52.5	1,477	354	21,617	23,448	21,971
United States	650.9	32,187	7,717	52,120	92,024	59,837
Argentina	38.8	1,028	341	22,921	24,290	23,262
Barbados	n.s.	n.s.	2	150	152	152
Belize	–	–	–	10	10	10
Bolivia	15.4	201	281	1,959	2,441	2,240
Brazil	16.7	227	453	17,901	18,581	18,353
Chile	1.4	106	42	1,963	2,110	2,005
Colombia	11.0	219	153	1,618	1,990	1,771
Cuba	1.2	12	70	400	482	470
Ecuador	0.3	5	7	20	32	27
Falkland Islands (Malvinas)	–	–	–	1,500	1,500	1,500
(French) Guiana	–	–	–	400	400	400
Grenada	–	–	–	25	25	25

Continuation of Tab. 13

Country / Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Guatemala	–	–	–	10	10	10
Guyana	–	–	–	100	100	100
Haiti	–	–	–	50	50	50
Paraguay	–	–	–	2,056	2,056	2,056
Peru	11.4	78	353	200	631	553
Puerto Rico	–	–	–	30	30	30
Suriname	–	–	–	300	300	300
Trinidad and Tobago	42.8	502	381	500	1,384	881
Uruguay	–	–	–	828	828	828
Venezuela, Bolivarian Republic	31.2	1,018	5,520	2,812	9,349	8,332
World	**3,336.7**	**99,392**	**195,134**	**577,325**	**871,851**	**772,458**
Europe	278.2	11,501	4,315	21,008	36,824	25,323
CIS	811.4	27,220	62,316	167,791	257,328	230,108
Africa	197.6	3,553	14,621	70,019	88,193	84,640
Middle East	523.5	6,472	79,699	49,664	135,835	129,363
Austral-Asia	492.1	8,065	16,782	112,199	137,045	128,981
North America	863.9	39,186	9,799	100,890	149,875	110,689
Latin America	170.1	3,396	7,602	55,753	66,751	63,355
OPEC 2009	611.1	9,518	94,606	73,223	177,347	167,829
OPEC-Gulf	460.9	5,763	77,616	43,664	127,042	121,280
MENA	670.2	9,514	88,030	81,018	178,562	169,048
OECD 2000	1,181.4	50,517	17,690	151,839	220,046	169,529
EU-27	173.2	9,730	2,174	15,860	27,764	18,033

n.s. not specified

– no production, reserves or resources

Tab. 14: *Natural Gas Resources in 2011 [bcm³]:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Total	Conventional	Non-Conventional		
				Shale Gas	CBM	Tight Gas
1	Russian Federation	142,050	100,000	9,500	12,550	20,000.0
2	China	52,500	21,000	8,600	10,900	12,000.0
3	United States	52,120	25,000	13,650	4,470	9,000.0
4	Australia	31,265	5,400	11,215	6,650	8,000.0
5	Saudi Arabia	24,664	19,000	5,664	–	–
6	Canada	23,253	8,500	3,600	3.653	7,500,0
7	Argentina	22,921	1,000	21,921	–	–
8	Mexico	21,617	2,300	19,287	30	–
9	Brazil	17,901	11,500	6,401	–	–
10	Turkmenistan	15,000	15,000	–	–	–
11	South Africa	14,962	1,000	13,736	226	–
12	Algeria	13,314	1,300	6,514	–	5,500,0
13	Iran, Islamic Republic	11,000	11,000	–	–	–
14	Indonesia Socialist People's Libyan	10,790	6,000	1,610	3,180	–
15	Arab Jamahiriya	9,213	1,000	8,213	–	–
16	Egypt	8,000	8,000	–	–	–
17	France	5,202	100	5,098	4	–
18	Mozambique	5,200	5,200	–	–	–
19	India	5,014	2,000	1,784	1,230	–
20	Madagascar	4,700	4,700	–	–	–
	...					
36	Germany	1,870	20	1,300	450	100.0
	other Countries [121]	84,767	58,118	19,378	6,297	975.0
	...					
	World	**577,325**	**307,138**	**157,472**	**49,640**	**63,075**
	Europe	21,008	4,808	14,608	1,477	115.0
	CIS	167,791	121,050	10,690	16,052	20,000.0
	Africa	70,019	32,970	30,483	1,066	5,500.0
	Middle East	49,664	43,250	5,664	–	750.0
	Austral-Asia	112,199	44,665	24,654	22,680	20,200.0
	North America	100,890	39,700	36,537	8,153	16,500.0
	Latin America	55,753	20,695	34,836	212	10.0
	OPEC 2009	73,223	47,020	20,703	–	5,500.0
	OPEC-Gulf	43,664	38,000	5,664	–	–
	MENA	81,018	53,555	21,213	–	6,250.0
	OECD 2000	151,839	49,558	61,417	16,248	24,615.0
	EU-27	15,860	2,718	11,832	1,194	115.0

– no resources or no data are available

Tab. 15: *Natural Gas Reserves in 2011 [bcm³]:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Total	Conventional[1)]	Non-Conventional[2)]	
				Shale Gas	CBM
1	Russian Federation	46,000	45,955	–	45
2	Iran, Islamic Republic	33,090	33,090	–	–
3	Qatar	25,047	25,047	–	–
4	Turkmenistan	10,000	10,000	–	–
5	Saudi Arabia	8,016	8,016	–	–
6	United States	7,717	4,463	2,759	496
7	United Arab Emirates	6,091	6,091	–	–
8	Venezuela, Bolivarian Republic	5,520	5,520	–	–
9	Nigeria	5,154	5,154	–	–
10	Algeria	4,504	4,504	–	–
11	Australia	3,701	2,767	–	934
12	Iraq	3,588	3,588	–	–
13	China	3,051	2,980	–	71
14	Indonesia	2,965	2,965	–	–
15	Malaysia	2,435	2,435	–	–
16	Kazakhstan	2,407	2,407	–	–
17	Egypt	2,210	2,210	–	–
18	Norway	2,070	2,070	–	–
19	Kuwait	1,784	1,784	–	–
20	Canada	1,728	1,666	n.s.	62
	...				
49	Germany	133	133	–	–
	other Countries [82]	17,923	17,685	–	237
	...				
	World	**195,134**	**190,530**	**2,759**	**1,845**
	Europe	4,315	4,315	–	–
	CIS	62,316	62,271	–	45
	Africa	14,621	14,621	–	–
	Middle East	79,699	79,699	–	–
	Austral-Asia	16,782	15,539	–	1,242
	North America	9,799	6,482	2,759	557
	Latin America	7,602	7,602	–	–
	OPEC 2009	94,606	94,606	–	–
	OPEC-Gulf	77,616	77,616	–	–
	MENA	88,030	88,030	–	–
	OECD 2000	17,690	13,440	2,759	1,491
	EU-27	2,174	2,174	–	–

n. s. not specified
\- no reserves
1) including tight gas
2) partly 2010 data

Tab. 16: *Natural Gas Production in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	bcm	Share [%]	
			Country	Cumulative
1	United States	650.9	19.5	19.5
2	Russian Federation	629.5	18.9	38.4
3	Canada	160.5	4.8	43.2
4	Iran, Islamic Republic	151.8	4.5	47.7
5	Qatar	146.8	4.4	52.1
6	China	103.1	3.1	55.2
7	Norway	101.4	3.0	58.3
8	Saudi Arabia	92.3	2.8	61.0
9	Indonesia	91.7	2.7	63.8
10	Netherlands	80.6	2.4	66.2
11	Algeria	78.0	2.3	68.5
12	Malaysia	61.8	1.9	70.4
13	Egypt	61.3	1.8	72.2
14	Turkmenistan	59.5	1.8	74.0
15	Uzbekistan	58.8	1.8	75.8
16	Mexico	52.5	1.6	77.3
17	United Arab Emirates	51.7	1.6	78.9
18	India	49.1	1.5	80.4
19	Australia	45.4	1.4	81.7
20	United Kingdom	43.0	1.3	83.0
	...			
34	Germany	13.3	0.4	
	other Countries [68]	553.7	16.6	100
	...			
	World	**3,336.7**	**100.0**	
	Europe	278.2	8.3	
	CIS	811.4	24.3	
	Africa	197.6	5.9	
	Middle East	523.5	15.7	
	Austral-Asia	492.1	14.7	
	North America	863.9	25.9	
	Latin America	170.1	5.1	
	OPEC 2009	611.1	18.3	
	OPEC-Gulf	460.9	13.8	
	MENA	670.2	20.1	
	OECD 2000	1,181.4	35.4	
	EU-27	173.2	5.2	

Tab. 17: *Natural Gas Consumption in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	bcm	Share [%]	
			Country	Cumulative
1	United States	690.1	20.8	20.8
2	Russian Federation	474.3	14.3	35.1
3	Iran, Islamic Republic	153.3	4.6	39.7
4	China	130.7	3.9	43.7
5	Japan	112.5	3.4	47.1
6	Canada	104.8	3.2	50.2
7	Saudi Arabia	92.2	2.8	53.0
8	Germany	84.4	2.5	55.5
9	United Kingdom	80.2	2.4	58.0
10	Italy	77.9	2.3	60.3
11	Mexico	68.9	2.1	62.4
12	United Arab Emirates	62.9	1.9	64.3
13	India	61.1	1.8	66.1
14	Ukraine	56.4	1.7	67.8
15	Egypt	49.6	1.5	69.3
16	Thailand	46.6	1.4	70.7
17	Korea, Republic (South)	46.6	1.4	72.1
18	Argentina	46.5	1.4	73.5
19	Uzbekistan	46.5	1.4	74.9
20	Indonesia	45.0	1.4	76.3
	...			
	other Countries [87]	786.7	23.7	100
	...			
	World	**3,317.3**	**100.0**	
	Europe	526.5	15.9	
	CIS	662.9	20.0	
	Africa	103.4	3.1	
	Middle East	398.2	12.0	
	Austral-Asia	605.3	18.2	
	North America	863.8	26.0	
	Latin America	157.2	4.7	
	OPEC 2009	427.4	12.9	
	OPEC-Gulf	353.7	10.7	
	MENA	482.8	14.6	
	OECD 2000	1,550.1	46.7	
	EU-27	466.7	14.1	

Tab. 18: *Natural Gas Export in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	bcm	Share [%]	
			Country	Cumulative
1	Russian Federation	195.7	19.1	19.1
2	Qatar	121.8	11.9	31.0
3	Norway	96.8	9.4	40.4
4	Canada	88.0	8.6	49.0
5	Netherlands	55.9	5.5	54.5
6	Algeria	49.5	4.8	59.3
7	Indonesia	46.2	4.5	63.8
8	United States	42.7	4.2	68.0
9	Malaysia	35.6	3.5	71.5
10	Turkmenistan	34.6	3.4	74.8
11	Nigeria	26.3	2.6	77.4
12	Australia	25.9	2.5	79.9
13	Germany	21.4	2.1	82.0
14	Trinidad and Tobago	18.9	1.8	83.9
15	United Kingdom	16.3	1.6	85.4
16	Uzbekistan	13.8	1.3	86.8
17	Oman	12.1	1.2	88.0
18	Bolivia	12.0	1.2	89.1
19	Egypt	10.4	1.0	90.2
20	Myanmar	10.2	1.0	91.2
	...			
	other Countries [28]	90.6	8.8	100
	...			
	World	**1,024.6**	**100.0**	
	Europe	208.7	20.4	
	CIS	259.1	25.3	
	Africa	97.2	9.5	
	Middle East	159.3	15.5	
	Austral-Asia	130.4	12.7	
	North America	130.7	12.8	
	Latin America	39.2	3.8	
	OPEC 2009	217.1	21.2	
	OPEC-Gulf	138.9	13.6	
	MENA	221.5	21.6	
	OECD 2000	365.1	35.6	
	EU-27	111.0	10.8	

Tab. 19: *Natural Gas Import in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	bcm	Share [%]	
			Country	Cumulative
1	Japan	109.9	10.6	10.6
2	United States	97.8	9.5	20.1
3	Germany	95.0	9.2	29.3
4	Italy	70.4	6.8	36.1
5	United Kingdom	53.4	5.2	41.3
6	Korea, Republic (South)	46.8	4.5	45.8
7	France	46.1	4.5	50.3
8	Turkey	43.9	4.2	54.5
9	Ukraine	40.5	3.9	58.4
10	Russian Federation	40.5	3.9	62.4
11	Spain	35.5	3.4	65.8
12	China	30.9	3.0	68.8
13	Canada	30.2	2.9	71.7
14	Belgium	19.2	1.9	73.6
15	Belarus	18.1	1.8	75.3
16	Mexico	18.1	1.7	77.1
17	United Arab Emirates	17.5	1.7	78.8
18	Taiwan	16.0	1.5	80.3
19	Netherlands	14.4	1.4	81.7
20	India	13.7	1.3	83.0
	...			
	other Countries [55]	175.4	17.0	100
	...			
	World	**1,033.2**	**100.0**	
	Europe	463.7	44.9	
	CIS	110.2	10.7	
	Africa	6.1	0.6	
	Middle East	34.2	3.3	
	Austral-Asia	247.5	24.0	
	North America	146.0	14.1	
	Latin America	25.4	2.5	
	OPEC 2009	33.3	3.2	
	OPEC-Gulf	31.3	3.0	
	MENA	36.2	3.5	
	OECD 2000	758.2	73.4	
	EU-27	413.5	40.0	

Tab. 20: *Hard Coal in 2011 [Mt]:*

Country / Region	Production	Reserves	Resources	Remaining Potential
Belgium	–	–	4,100	4,100
Bosnia and Herzegovina	–	827	1,309	2,136
Bulgaria	2.3	192	3,920	4,112
Czech Republic	11.0	1,139	15,410	16,550
France	0.1	–	160	160
Germany	13.0	48	82,961	83,009
Hungary	–	276	5,075	5,351
Ireland	–	14	26	40
Italy	0.1	10	600	610
Montenegro	–	142	195	337
Netherlands	–	497	2,750	3,247
Norway	1.6	15	37	52
Poland	76.5	14,711	162,317	177,028
Portugal	–	3	n.s.	3
Romania	2.6	11	2,435	2,446
Serbia	0.1	402	453	855
Slovakia	–	–	19	19
Slovenia	–	56	39	95
Spain	6.6	868	3,363	4,231
Sweden	–	1	4	5
Turkey	2.6	386	802	1,188
United Kingdom	18.6	450	186,700	187,150
Armenia	–	163	154	317
Georgia	< 0.05	201	700	901
Kazakhstan	102.9	17,242	125,890	143,132
Kyrgyzstan	0.1	971	27,528	28,499
Russian Federation	258.5	68,944	2,624,612	2,693,556
Tajikistan	0.2	375	3,700	4,075
Turkmenistan	–	–	800	800
Ukraine	81.9	32,039	49,006	81,045
Uzbekistan	0.1	1,375	9,854	11,229
Algeria	–	59	164	223
Botswana	1.2	40	21,200	21,240
Congo, Democratic Republic	0.1	88	900	988
Egypt	< 0.05	16	166	182
Madagascar	–	–	150	150
Malawi	0.1	2	800	802
Morocco	–	14	82	96
Mozambique	1.4	849	23,338	24,187
Namibia	–	–	350	350
Niger	0.2	–	90	90
Nigeria	< 0.05	292	2,065	2,357
South Africa	253.1	33,896	n.s.	33,896
Swaziland	0.1	144	4,500	4,644
Tanzania, United Republic	< 0.05	269	1,141	1,410
Uganda	–	–	800	800
Zambia	< 0.05	69	820	889
Zimbabwe	3.0	502	25,000	25,502
Iran, Islamic Republic	1.5	1,203	40,000	41,203
Afghanistan	0.5	66	n.s.	66

Continuation of Tab. 20

Country / Region	Production	Reserves	Resources	Remaining Potential
Australia	345.2	57,538	1,521,732	1,579,270
Bangladesh	0.9	293	2,967	3,260
Bhutan	0.1	n.s.	n.s.	n.s.
China	3,383.7	180,600	5,010,000	5,190,600
India	539.9	77,197	175,352	252,549
Indonesia	324.9	13,512	73,299	86,811
Japan	0.9	340	13,543	13,883
Korea, Democratic People's Republic (North)	24.0	600	10,000	10,600
Korea, Republic (South)	2.1	326	1,360	1,686
Laos, People's Democratic Republic	< 0.05	4	58	62
Malaysia	2.9	141	1,068	1,209
Mongolia	27.0	1,170	39,854	41,024
Myanmar	1.1	3	248	252
Nepal	< 0.05	1	7	8
New Caledonia	–	2	n.s.	2
New Zealand	4.6	825	2,350	3,175
Pakistan	3.2	207	5,789	5,996
Philippines	7.6	211	1,012	1,223
Taiwan	–	1	101	102
Viet Nam	45.8	3,116	3,519	6,635
Canada	57.4	4,346	183,260	187,606
Greenland	–	183	200	383
Mexico	13.7	1,160	3,000	4,160
United States	925.0	225,012	6,457,386	6,682,398
Argentina	0.2	500	300	800
Bolivia	–	1	n.s.	1
Brazil	–	1,547	4,665	6,212
Chile	0.1	1,181	4,135	5,316
Colombia	85.8	4,881	9,928	14,809
Costa Rica	–	–	17	17
Peru	0.1	102	1,465	1,567
Venezuela, Bolivarian Republic	4.1	731	5,981	6,712
World	**6,640.4**	**754,595**	**17,119,082**	**17,873,677**
Europe	135.1	20,048	472,675	492,723
CIS	443.5	121,308	2,842,245	2,963,552
Africa	259.3	36,239	81,566	117,805
Middle East	1.5	1,203	40,000	41,203
Austral-Asia	4,714.6	336,154	6,862,259	7,198,413
North America	996.1	230,701	6,643,846	6,874,547
Latin America	90.3	8,943	26,491	35,434
Antarctica	–	–	150,000	150,000
OPEC 2009	5.6	2,285	48,210	50,494
OPEC-Gulf	1.5	1,203	40,000	41,203
MENA	1.5	1,291	40,412	41,703
OECD 2000	1,479.1	308,148	8,647,154	8,955,303
EU-27	130.8	18,277	469,879	488,156

n.s. not specified
– no production, reserves or resources

Tab. 21: *Hard Coal Resources in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	United States	6,457,386	37.7	37.7
2	China	5,010,000	29.3	67.0
3	Russian Federation[1)]	2,624,612	15.3	82.3
4	Australia	1,521,732	8.9	91.2
5	United Kingdom	186,700	1.1	92.3
6	Canada	183,260	1.1	93.4
7	India	175,352	1.0	94.4
8	Poland	162,317	0.9	95.3
9	Kazakhstan	125,890	0.7	96.1
10	Germany	82,961	0.5	96.6
11	Indonesia	73,299	0.4	97.0
12	Ukraine[1)]	49,006	0.3	97.3
13	Iran, Islamic Republic	40,000	0.2	97.5
14	Mongolia[1)]	39,854	0.2	97.7
15	Kyrgyzstan	27,528	0.2	97.9
16	Zimbabwe	25,000	0.1	98.0
17	Mozambique	23,338	0.1	98.2
18	Botswana	21,200	0.1	98.3
19	Czech Republic[1)]	15,410	0.1	98.4
20	Japan	13,543	0.1	98.5
	...			
	other Countries [57]	260,693	1.5	100
	...			
	World	**17,119,082**	**100.0**	
	Europe	472,675	2.8	
	CIS	2,842,245	16.6	
	Africa	81,566	0.5	
	Middle East	40,000	0.2	
	Austral-Asia	6,862,259	40.1	
	North America	6,643,846	38.8	
	Latin America	26,491	0.2	
	Antarctica	150,000	0.9	
	OPEC 2009	48,210	0.3	
	OPEC-Gulf	40,000	0.2	
	MENA	40,412	0.2	
	OECD 2000	8,647,154	50.5	
	EU-27	469,879	2.7	

[1)] Hard coal resources contains only bituminous coal and anthracite according to national classification.

Tab. 22: *Hard Coal Reserves in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	United States	225,012	29.8	29.8
2	China	180,600	23.9	53.8
3	India	77,197	10.2	64.0
4	Russian Federation[1)]	68,944	9.1	73.1
5	Australia	57,538	7.6	80.7
6	South Africa	33,896	4.5	85.2
7	Ukraine[1)]	32,039	4.2	89.5
8	Kazakhstan	17,242	2.3	91.8
9	Poland	14,711	1.9	93.7
10	Indonesia	13,512	1.8	95.5
11	Colombia	4,881	0.6	96.2
12	Canada	4,346	0.6	96.7
13	Viet Nam	3,116	0.4	97.1
14	Brazil	1,547	0.2	97.3
15	Uzbekistan	1,375	0.2	97.5
16	Iran, Islamic Republic	1,203	0.2	97.7
17	Chile	1,181	0.2	97.8
18	Mongolia[1)]	1,170	0.2	98.0
19	Mexico	1,160	0.2	98.2
20	Czech Republic[1)]	1,139	0.2	98.3
	...			
56	Germany [2)]	48	< 0.05	
	other Countries [51]	12,740	1.7	100
	...			
	World	**754,595**	**100.0**	
	Europe	20,048	2.7	
	CIS	121,308	16.1	
	Africa	36,239	4.8	
	Middle East	1,203	0.2	
	Austral-Asia	336,154	44.5	
	North America	230,701	30.6	
	Latin America	8,943	1.2	
	OPEC 2009	2,285	0.3	
	OPEC-Gulf	1,203	0.2	
	MENA	1,291	0.2	
	OECD 2000	308,148	40.8	
	EU-27	18,277	2.4	

1) Hard coal reserves contains only bituminous coal and anthracite according to national classification.
2) Deviating from the BGR reserves definition, RAG AG refers to a „Technically extractable planned inventory“ of 2.5 billion t.

Tab. 23: *Hard Coal Production in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	China	3,383.7	51.0	51.0
2	United States	925.0	13.9	64.9
3	India	539.9	8.1	73.0
4	Australia	345.2	5.2	78.2
5	Indonesia	324.9	4.9	83.1
6	Russian Federation[1)]	258,5	3.9	87.0
7	South Africa	253.1	3.8	90.8
8	Kazakhstan	102.9	1.5	92.4
9	Colombia	85.8	1.3	93.7
10	Ukraine	81.9	1.2	94.9
11	Poland	76.5	1.2	96.0
12	Canada	57.4	0.9	96.9
13	Viet Nam	45.8	0.7	97.6
14	Mongolia[1)]	27.0	0.4	98.0
15	Korea, Democratic People's Republic (North)	24.0	0.4	98.4
16	United Kingdom	18.6	0.3	98.6
17	Mexico	13.7	0.2	98.8
18	Germany	13.0	0.2	99.0
19	Czech Republic[1)]	11.0	0.2	99.2
20	Philippines	7.6	0.1	99.3
	...			
	other Countries [39]	45.0	0.7	100
	...			
	World	**6,640.4**	**100.0**	
	Europe	135.1	2.0	
	CIS	443.5	6.7	
	Africa	259.3	3.9	
	Middle East	1.5	0.0	
	Austral-Asia	4,714.6	71.0	
	North America	996.1	15.0	
	Latin America	90.3	1.4	
	OPEC 2009	5.6	0.1	
	OPEC-Gulf	1.5	0.0	
	MENA	1.5	0.0	
	OECD 2000	1,479.1	22.3	
	EU-27	130.8	2.0	

[1)] Hard coal production contains only bituminous coal and anthracite according to national classification.

Tab. 24: *Hard Coal Consumption in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	China	3,551.4	53.6	53.6
2	United States	839.7	12.7	66.2
3	India	637.0	9.6	75.9
4	South Africa	182.7	2.8	78.6
5	Japan	175.2	2.6	81.3
6	Russian Federation[1)]	171.7	2.6	83.8
7	Korea, Republic (South)	131.2	2.0	85.8
8	Ukraine[1)]	86.9	1.3	87.1
9	Poland	85.4	1.3	88.4
10	Kazakhstan	71.7	1.1	89.5
11	Taiwan	66.5	1.0	90.5
12	Australia	60.7	0.9	91.4
13	Germany	56.9	0.9	92.3
14	Indonesia	55.0	0.8	93.1
15	United Kingdom	51.5	0.8	93.9
16	Canada	34.1	0.5	94.4
17	Viet Nam	28.2	0.4	94.8
18	Turkey	26.3	0.4	95.2
19	Italy	23.3	0.4	95.6
20	Malaysia	22.5	0.3	95.9
	...			
	other Countries [88]	270.7	4.1	100
	...			
	World	**6,628.8**	**100.0**	
	Europe	348.3	5.3	
	CIS	330.9	5.0	
	Africa	195.7	3.0	
	Middle East	16.6	0.3	
	Austral-Asia	4,802.1	72.4	
	North America	894.8	13.5	
	Latin America	40.3	0.6	
	OPEC 2009	4.7	0.1	
	OPEC-Gulf	3.7	0.1	
	MENA	23.8	0.4	
	OECD 2000	1,600.7	24.1	
	EU-27	318.2	4.8	

[1)] Hard coal consumption contains only bituminous coal and anthracite according to national classification.

Tab. 25: *Hard Coal Export in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	Australia	284.5	26.3	26.3
2	Indonesia	270.0	25.0	51.3
3	Russian Federation	110.7	10.2	61.5
4	United States	97.2	9.0	70.5
5	Colombia	79.3	7.3	77.8
6	South Africa	69.4	6.4	84.2
7	Canada	32.6	3.0	87.2
8	Kazakhstan	32.1	3.0	90.2
9	Mongolia	26.8	2.5	92.7
10	Viet Nam	17.7	1.6	94.3
11	China	14.5	1.3	95.7
12	Korea, Democratic People's Republic (North)	11.0	1.0	96.7
13	Ukraine	7.0	0.6	97.3
14	Czech Republic	6.3	0.6	97.9
15	Poland	5.8	0.5	98.4
16	Venezuela, Bolivarian Republic	3.8	0.3	98.8
17	Philippines	2.7	0.3	99.0
18	New Zealand	2.2	0.2	99.2
19	India	1.9	0.2	99.4
20	Norway	1.6	0.1	99.6
	...			
28	Germany	0.2	< 0.05	
	other Countries [12]	4.5	0.4	100
	...			
	World	**1,081.7**	**100.0**	
	Europe	16.4	1.5	
	CIS	149.9	13.9	
	Africa	70.4	6.5	
	Austral-Asia	631.9	58.4	
	North America	130.0	12.0	
	Latin America	83.1	7.7	
	OPEC 2009	3.8	0.3	
	OECD 2000	433.1	40.0	
	EU-27	14.8	1.4	

Tab. 26: *Hard Coal Import in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	China	183.1	17.0	17.0
2	Japan	175.2	16.3	33.3
3	Korea, Republic (South)	129.2	12.0	45.2
4	India	98.9	9.2	54.4
5	Taiwan	66.6	6.2	60.6
6	Germany	44.2	4.1	64.7
7	United Kingdom	32.5	3.0	67.7
8	Russian Federation	24.0	2.2	69.9
9	Turkey	23.7	2.2	72.1
10	Italy	23.5	2.2	74.3
11	Malaysia	19.9	1.8	76.2
12	Brazil	18.0	1.7	77.8
13	Thailand	16.2	1.5	79.3
14	Spain	16.1	1.5	80.8
15	France	15.8	1.5	82.3
16	Poland	14.7	1.4	83.7
17	Hong Kong	12.7	1.2	84.8
18	Israel	12.7	1.2	86.0
19	Ukraine	12.1	1.1	87.1
20	United States	11.8	1.1	88.2
	...			
	other Countries [64]	126.7	11.8	100
	...			
	World	**1,077.5**	**100.0**	
	Europe	230.1	21.4	
	CIS	37.3	3.5	
	Africa	10.9	1.0	
	Middle East	14.8	1.4	
	Austral-Asia	722.3	67.0	
	North America	28.7	2.7	
	Latin America	33.4	3.1	
	OPEC 2009	3.2	0.3	
	OPEC-Gulf	2.2	0.2	
	MENA	22.1	2.1	
	OECD 2000	556.0	51.6	
	EU-27	202.5	18.8	

Tab. 27: *Lignite in 2011 [in Mt]:*

Region	Production	Reserves	Resources	Remaining Potential
Albania	< 0.05	522	205	727
Austria	–	–	333	333
Bosnia and Herzegovina	7.1	1,272	1,801	3,073
Bulgaria	34.5	2,174	2,400	4,574
Croatia	–	n.s.	300	300
Czech Republic	46.8	2,683	7,204	9,887
France	–	n.s.	114	114
Germany	176.5	40,500	36,500	77,000
Greece	58.8	2,876	3,554	6,430
Hungary	9.5	2,633	2,704	5,337
Italy	–	7	22	29
Kosovo	8.2	1,564	9,262	10,826
Macedonia, former Yugoslav Republic	6.7	332	300	632
Montenegro	1.9	n.s.	n.s.	n.s.
Poland	62.9	4,514	226,832	231,346
Portugal	–	33	33	66
Romania	32.9	280	9,640	9,920
Serbia	40.3	7,112	13,074	20,186
Slovakia	2.4	138	934	1,072
Slovenia	4.5	315	341	656
Spain	–	319	n.s.	319
Turkey	70.0	2,076	9,676	11,752
United Kingdom	–	–	1,000	1,000
Belarus	–	–	1,500	1,500
Kazakhstan	8.4	n.s.	n.s.	n.s.
Kyrgyzstan	0.8	n.s.	n.s.	n.s.
Russian Federation	77.6	91,184	1,271,672	1,362,856
Tajikistan	0.1	n.s.	n.s.	n.s.
Ukraine	0.2	2,336	5,381	7,717
Uzbekistan	3.8	n.s.	n.s.	n.s.
Central African Republic	–	3	n.s.	3
Madagascar	–	–	37	37
Mali	–	–	3	3
Morocco	–	–	40	40
Niger	-	6	n.s.	6
Nigeria	-	63	320	383
Sierra Leone	–	–	2	2
Australia	65.7	44,219	175,536	219,755
Bangladesh	–	–	3	3
China	136.3	11,000	307,000	318,000
India	43.1	4,847	35,782	40,629
Indonesia	51.3	9,002	19,021	28,023
Japan	–	10	1,026	1,036
Korea, Democratic People's Republic (North)	7.6	n.s.	n.s.	n.s.
Laos, People's Democratic Republic	0.6	499	22	521

Continuation of Tab. 27

Region	Production	Reserves	Resources	Remaining Potential
Malaysia	–	39	412	451
Mongolia	6.0	1,350	119,426	120,776
Myanmar	0.2	3	2	5
New Zealand	0.3	6,750	4,600	11,350
Pakistan	–	2,857	176,739	179,596
Philippines	–	105	912	1,017
Thailand	21.3	1,063	826	1,889
Viet Nam	–	244	199,876	200,120
Canada	9.7	2,236	118,270	120,506
Mexico	–	51	n.s.	51
United States	67.7	30,669	1,367,597	1,398,266
Argentina	–	–	7,300	7,300
Brazil	5.4	5,049	12,587	17,636
Chile	0.5	n.s.	7	7
Dominican Republic	–	–	84	84
Ecuador	–	24	n.s.	24
Haiti	–	–	40	40
Peru	–	–	100	100
World	**1,069.8**	**282,957**	**4,152,351**	**4,435,309**
Europe	563.0	69,350	326,228	395,578
CIS	91.0	93,520	1,278,553	1,372,073
Africa	–	72	402	474
Middle East	–	–	–	–
Austral-Asia	332.4	81,986	1,041,184	1,123,170
North America	77.4	32,956	1,485,867	1,518,823
Latin America	6.0	5,073	20,118	25,191
OPEC 2009	–	87	320	407
OPEC-Gulf	–	–	–	–
MENA	–	–	40	40
OECD 2000	570.3	139,715	1,955,935	2,095,649
EU-27	428.8	56,473	291,610	348,083

n.s. not specified
– no production, reserves or resources

Tab. 28: *Lignite Resources in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	United States	1,367,597	32.9	32.9
2	Russian Federation[1)]	1,271,672	30.6	63.6
3	China	307,000	7.4	71.0
4	Poland	226,832	5.5	76.4
5	Viet Nam	199,876	4.8	81.2
6	Pakistan	176,739	4.3	85.5
7	Australia	175,536	4.2	89.7
8	Mongolia[1)]	119,426	2.9	92.6
9	Canada	118,270	2.8	95.4
10	Germany	36,500	0.9	96.3
11	India	35,782	0.9	97.2
12	Indonesia	19,021	0.5	97.6
13	Serbia	13,074	0.3	98.0
14	Brazil	12,587	0.3	98.3
15	Turkey	9,676	0.2	98.5
16	Romania	9,640	0.2	98.7
17	Kosovo	9,262	0.2	98.9
18	Argentina	7,300	0.2	99.1
19	Czech Republic[1)]	7,204	0.2	99.3
20	Ukraine[1)]	5,381	0.1	99.4
	...			
	other Countries [32]	23,976	0.6	100
	...			
	World	**4,152,351**	**100.0**	
	Europe	326,228	7.9	
	CIS	1,278,553	30.8	
	Africa	402	0.0	
	Austral-Asia	1,041,184	25.1	
	North America	1,485,867	35.8	
	Latin America	20,118	0.5	
	OPEC 2009	320	0.0	
	MENA	40	0.0	
	OECD 2000	1,955,935	47.1	
	EU-27	291,610	7.0	

[1)] Lignite resources contains subbituminous coal

Tab. 29: *Lignite Reserves in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	Russian Federation[1)]	91,184	32.2	32.2
2	Australia	44,219	15.6	47.9
3	Germany	40,500	14.3	62.2
4	United States	30,669	10.8	73.0
5	China	11,000	3.9	76.9
6	Indonesia	9,002	3.2	80.1
7	Serbia	7,112	2.5	82.6
8	New Zealand	6,750	2.4	85.0
9	Brazil	5,049	1.8	86.8
10	India	4,847	1.7	88.5
11	Poland	4,514	1.6	90.1
12	Greece	2,876	1.0	91.1
13	Pakistan	2,857	1.0	92.1
14	Czech Republic[1)]	2,683	0.9	93.0
15	Hungary	2,633	0.9	94.0
16	Ukraine[1)]	2,336	0.8	94.8
17	Canada	2,236	0.8	95.6
18	Bulgaria	2,174	0.8	96.4
19	Turkey	2,076	0.7	97.1
20	Kosovo	1,564	0.6	97.6
	...			
	other Countries [22]	6,677	2.4	100
	...			
	World	**282,957**	**100.0**	
	Europe	69,350	24.5	
	CIS	93,520	33.1	
	Africa	72	0.0	
	Austral-Asia	81,986	29.0	
	North America	32,956	11.6	
	Latin America	5,073	1.8	
	OPEC 2009	87	0.0	
	OECD 2000	139,715	49.4	
	EU-27	56,473	20.0	

[1)] Lignite reserves contains subbituminous coal

Tab. 30: *Lignite Production in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	Germany	176.5	16.5	16.5
2	China	136.3	12.7	29.2
3	Russian Federation[1)]	77.6	7.3	36.5
4	Turkey	70.0	6.5	43.0
5	United States	67.7	6.3	49.4
6	Australia	65.7	6.1	55.5
7	Poland	62.9	5.9	61.4
8	Greece	58.8	5.5	66.9
9	Indonesia	51.3	4.8	71.7
10	Czech Republic[1)]	46.8	4.4	76.1
11	India	43.1	4.0	80.1
12	Serbia	40.3	3.8	83.8
13	Bulgaria	34.5	3.2	87.1
14	Romania	32.9	3.1	90.1
15	Thailand	21.3	2.0	92.1
16	Canada	9.7	0.9	93.0
17	Hungary[1)]	9.5	0.9	93.9
18	Kazakhstan	8.4	0.8	94.7
19	Kosovo	8.2	0.8	95.5
20	Korea, Democratic People's Republic (North)	7.6	0.7	96.2
	...			
	other Countries [16]	40.7	3.8	100
	...			
	World	**1,069.8**	**100.0**	
	Europe	563.0	52.6	
	CIS	91.0	8.5	
	Austral-Asia	332.4	31.1	
	North America	77.4	7.2	
	Latin America	6.0	0.6	
	OECD 2000	570.3	53.3	
	EU-27	428.8	40.1	

[1)] Lignite production contains subbituminous coal

Tab. 31: *Lignite Consumption in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	Mt	Share [%]	
			Country	Cumulative
1	Germany	175.2	16.6	16.6
2	China	129.1	12.2	28.9
3	Russian Federation[1)]	78.9	7.5	36.4
4	Turkey	70.0	6.6	43.0
5	United States	67.4	6.4	49.4
6	Australia	65.7	6.2	55.6
7	Polend	62.7	5.9	61.6
8	Greece	59.7	5.7	67.2
9	Indonesia	43.3	4.1	71.3
10	Czech Republic[1)]	42.8	4.1	75.4
11	India	42.5	4.0	79.4
12	Serbia	40.9	3.9	83.3
13	Bulgaria	34.5	3.3	86.6
14	Romania	32.9	3.1	89.7
15	Thailand	19.0	1.8	91.5
16	Hungary[1)]	9.7	0.9	92.4
17	Canada	9.6	0.9	93.3
18	Kazakhstan	8.3	0.8	94.1
19	Kosovo	8.3	0.8	94.9
20	Korea, Democratic People's Republic (North)	7.6	0.7	95.6
	...			
	other Countries [22]	46,2	4,4	100
	...			
	World	**1,054.2**	**100.0**	
	Europe	560.8	53.2	
	CIS	92.2	8.7	
	Austral-Asia	318.2	30.2	
	North America	77.0	7.3	
	Latin America	6.0	0.6	
	OECD 2000	566.6	53.7	
	EU-27	426.0	40.4	

[1)] Lignite consumption contains subbituminous coal

Tab. 32: *Uranium in 2011 [kt U]:*

Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Bulgaria	–	–	–	25	25	25
Czech Republic	0.2	111	–	1	112	1
Finland	n.s.	< 0.5	–	2	2	2
France	< 0.05	76	–	12	88	12
Germany	0.05	220	–	7	227	7
Greece	–	–	–	13	13	13
Hungary	–	21	–	24	45	24
Italy	–	–	–	16	16	16
Portugal	–	4	5	4	12	9
Romania	0.1	19	–	13	31	13
Slovakia	n.s.	–	–	16	16	16
Slovenia	n.s.	–	2	11	13	13
Spain	–	5	–	14	19	14
Sweden	n.s.	< 0.5	–	14	14	14
Turkey	–	–	9	n.s.	9	9
Kazakhstan	19.5	179	279	1,455	1,912	1,734
Russian Federation	3.0	150	12	830	992	842
Ukraine	0.9	17	45	323	384	367
Uzbekistan	3.0	43	47	74	164	121
Algeria	–	–	–	26	26	26
Botswana	–	–	–	82	82	82
Central African Republic	–	–	–	12	12	12
Congo, Democratic Republic	–	26	–	3	28	3
Egypt	–	–	–	2	2	2
Gabon	n.s.	25	–	6	31	6
Malawi	0.8	2	–	17	19	17
Namibia	3.3	109	6	512	627	518
Niger	4.4	123	6	505	633	510
Somalia	–	–	–	8	8	8
South Africa	0.6	158	96	386	641	482
Tanzania, United Republic	–	–	–	46	46	46
Zambia	–	< 0.5	–	38	38	38
Zimbabwe	–	–	–	26	26	26
Iran, Islamic Republic	–	< 0.5	–	21	21	21
Jordan	–	–	–	110	110	110
Australia	6.0	175	962	777	1,914	1,739
China	1.5	35	118	111	264	229
India	0.4	10	–	220	231	220
Indonesia	–	–	2	32	34	34
Japan	n.s.	< 0.5	–	7	7	7
Mongolia	–	1	41	1,444	1,486	1,485
Pakistan	< 0.05	< 0.5	–	–	< 0.5	–
Viet Nam	–	–	–	114	114	114
Canada	9.1	456	293	1,172	1,921	1,464

Continuation of Tab. 32

Region	Production	Cum. Production	Reserves	Resources	EUR	Remaining Potential
Greenland	–	–	–	185	185	185
Mexico	n.s.	< 0.5	–	6	6	6
United States	1.5	368	39	2,564	2,972	2,603
Argentina	-	3	5	29	36	34
Brazil	0.3	3	156	921	1,080	1,077
Chile	–	–	–	4	4	4
Colombia	–	–	–	228	228	228
Peru	–	–	2	42	43	43
World	54.6	2,338	2,122	12,507	16,967	14,629
Europe	0.4	456	16	171	642	186
CIS	26.3	388	382	2,682	3,452	3,064
Africa	9.0	443	108	1,668	2,218	1,776
Middle East	–	< 0.5	–	131	131	131
Austral-Asia	7.9	221	1,122	2,706	4,050	3,829
North America	10.7	825	332	3,926	5,083	4,258
Latin America	0.3	6	162	1,223	1,392	1,386
OPEC 2009	–	< 0.5	–	47	47	47
OPEC-Gulf	–	< 0.5	–	21	21	21
MENA	–	< 0.5	–	159	159	159
OECD 2000	17.0	1,437	1,307	4,832	7,576	6,139
EU-27	0.4	456	7	171	633	177

n.s. not specified
– no production, reserves or resources

Tab. 33: *Uranium Resources in 2011 (> 20 kt U) [in kt]:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Country / Region	Discovered		Total	Undiscovered		Total	Share [%]	
	RAR 80-260 USD/kg	Inferred <260 USD/kg		Prognosti-cated <260 USD/kg	Speculative <260 USD/kg		Country	Cumula-tive
1	2	3	4=2+3	5	6	7=4+5+6	8	9
United States	433	n.s.	433	1,273	858	2,564	20.5	20.5
Kazakhstan	179	475	655	500	300	1,455	11.6	32.1
Mongolia	–	33	33	21	1,390	1,444	11.5	43.7
Canada	129	193	322	150	700	1,172	9.4	53.0
Brazil	–	121	121	300	500	921	7.4	60.4
Russian Federation	207	432	639	192	n.s.	830	6.6	67.1
Australia	219	559	777	n.s.	n.s.	777	6.2	73.3
Namibia	357	156	512	n.s.	n.s.	512	4.1	77.4
Niger	335	105	440	14	51	505	4.0	81.4
South Africa	97	179	276	110	n.s.	386	3.1	84.5
Ukraine	99	81	180	23	120	323	2.6	87.1
Colombia	–	–	–	11	217	228	1.8	88.9
India	103	37	140	64	17	220	1.8	90.6
Greenland	n.s.	135	135	n.s.	50	185	1.5	92.1
Viet Nam	1	5	6	8	100	114	0.9	93.0
China	28	76	104	4	4	111	0.9	93.9
Jordan	45	< 0.5	45	15	50	110	0.9	94.8
Botswana	23	59	82	n.s.	n.s.	82	0.7	95.5
Uzbekistan	18	32	50	25	–	74	0.6	96.1
Tanzania, United Republic	30	16	46	n.s.	n.s.	46	0.4	96.4
Peru	–	2	2	20	20	42	0.3	96.8
Zambia	10	6	16	22	n.s.	38	0.3	97.1
Indonesia	6	2	9	24	n.s.	32	0.3	97.3
Argentina	4	11	15	14	n.s.	29	0.2	97.5
Zimbabwe	1	n.s.	1	–	25	26	0.2	97.8
Algeria	26	n.s.	26	n.s.	n.s.	26	0.2	98.0
Bulgaria	–	–	–	25	n.s.	25	0.2	98.2
Hungary	–	12	12	13	n.s.	24	0.2	98.4
Iran, Islamic Republic	1	2	3	4	14	21	0.2	98.5
...								
Germany	3	4	7	–	–	7	0.1	99.7
...								
World	**2,440**	**2,785**	**5,224**	**2,854**	**4,429**	**12,507**	**100.0**	–
Europe	46	55	101	57	13	171	1.4	–
CIS	502	1,021	1,523	739	420	2,682	21.4	–
Africa	913	533	1,446	146	76	1,668	13.3	–
Middle East	46	2	48	19	64	131	1.0	–
Austral-Asia	363	712	1,076	120	1,511	2,706	21.6	–
North America	565	327	892	1,426	1,608	3,926	31.4	–
Latin America	4	135	139	347	737	1,223	9.8	–
OPEC 2009	27	2	29	4	14	47	0.4	–
OPEC-Gulf	1	2	3	4	14	21	0.2	–
MENA	72	4	75	19	64	159	1.3	–
OECD 2000	833	927	1,760	1,454	1,618	4,832	38.6	–
EU-27	46	55	101	57	13	171	1.4	–

n.s. not specified
– no resources

Tab. 34: *Uranium Reserves in 2011 (extractable at costs < 80 USD/kg U):*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	kt	Share [%]	
			Country	Cumulative
1	Australia	962	45.3	45.3
2	Canada	293	13.8	59.1
3	Kazakhstan	279	13.1	72.2
4	Brazil	156	7.3	79.6
5	China	118	5.6	85.1
6	South Africa	96	4.5	89.7
7	Uzbekistan	47	2.2	91.9
8	Ukraine	45	2.1	94.0
9	Mongolia	41	1.9	95.9
10	United States	39	1.8	97.7
11	Russian Federation	12	0.6	98.3
12	Turkey	9	0.4	98.7
13	Namibia	6	0.3	99.0
14	Niger	6	0.3	99.3
15	Argentina	5	0.2	99.5
16	Portugal	5	0.2	99.7
17	Slovenia	2	0.1	99.8
18	Indonesia	2	0.1	99.9
19	Peru	2	0.1	100.0
	...			
	Germany	–	–	
	...			
	World	**2,122**	**100.0**	
	Europe	16	0.7	
	CIS	382	18.0	
	Africa	108	5.1	
	Austral-Asia	1,122	52.9	
	North America	332	15.6	
	Latin America	162	7.7	
	OECD 2000	1,307	61.6	
	EU-27	7	0.3	

– no reserves

Tab. 35: *Natural Uranium Production in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	kt	Share [%]	
			Country	Cumulative
1	Kazakhstan	19.5	35.6	35.6
2	Canada	9.1	16.7	52.4
3	Australia	6.0	11.0	63.3
4	Niger	4.4	8.0	71.3
5	Namibia	3.3	6.0	77.3
6	Uzbekistan	3.0	5.5	82.7
7	Russian Federation	3.0	5.5	88.2
8	United States	1.5	2.8	91.0
9	China	1.5	2.7	93.8
10	Ukraine	0.9	1.6	95.4
11	Malawi	0.8	1.5	97.0
12	South Africa	0.6	1.1	98.0
13	India	0.4	0.7	98.8
14	Brazil	0.3	0.5	99.3
15	Czech Republic	0.2	0.4	99.7
16	Romania	0.1	0.1	99.8
17	Germany*	0.05	0.1	99.9
18	Pakistan	< 0.05	0.1	100.0
19	France	< 0.05	< 0.05	100.0
	World	**54.6**	**100.0**	
	Europe	0.4	0.7	
	CIS	26.3	48.2	
	Africa	9.0	16.5	
	Austral-Asia	7.9	14.5	
	North America	10.7	19.6	
	Latin America	0.3	0.5	
	OECD 2000	17.0	31.0	
	EU-27	0.4	0.7	

* only in the form of uranium concentrate as part of the remediation of production sites

Tab. 36: *Uranium Consumption in 2011:*

Main Countries (Top 20) and Distribution by Regions and Economic Policy Organisations

Rank	Country / Region	kt	Share [%]	
			Country	Cumulative
1	United States	18.38	29.4	29.4
2	France	9.25	14.8	44.2
3	Russian Federation	4.91	7.9	52.0
4	China	4.08	6.5	58.5
5	Korea, Republic (South)	4.03	6.4	65.0
6	Japan	2.81	4.5	69.5
7	Ukraine	2.29	3.7	73.1
8	United Kingdom	2.09	3.3	76.5
9	Germany	1.93	3.1	79.6
10	Canada	1.85	2.9	82.5
11	Spain	1.38	2.2	84.7
12	Sweden	1.37	2.2	86.9
13	India	1.31	2.1	89.0
14	Finland	1.15	1.8	90.8
15	Belgium	1.00	1.6	92.4
16	Taiwan	0.81	1.3	93.7
17	Czech Republic	0.59	0.9	94.7
18	Switzerland	0.53	0.8	95.5
19	Hungary	0.33	0.5	96.0
20	Brazil	0.32	0.5	96.5
	...			
	other Countries [11]	2.16	3.5	100
	...			
	World	**62.55**	**100.0**	
	Europe	20.64	33.0	
	CIS	7.26	11.6	
	Africa	0.30	0.5	
	Middle East	0.17	0.3	
	Austral-Asia	13.14	21.0	
	North America	20.51	32.8	
	Latin America	0.53	0.8	
	OPEC 2009	0.17	0.3	
	OPEC-Gulf	0.17	0.3	
	MENA	0.17	0.3	
	OECD 2000	47.36	75.7	
	EU-27	20.12	32.2	

Sources of Information

Advanced Resources International Inc. – ARI (USA)

Agência Nacional do Petróleo, Gás Natural e Biocombustíveis - Ministério de Minas e Energia (Brazil)

Australian Bureau of Agricultural and Resource Economics and Sciences – ABARES

Australian Atlas of Mineral Resources, Mines and Processing Centres – AMIR

British Petroleum – BP

British Geological Survey – BGS

Bundesamt für Wirtschaft und Ausfuhrkontrolle – BAFA

Bundesverband Braunkohle e.V. – DEBRIV

Bureau of Ocean Energy Management – BOEMRE (USA)

Bureau of Resources and Energy Economics – BREE (Australia)

Canadian Society for Unconventional Gas – CSUG

Canadian Society for Unconventional Resources – CSUR

China Mining Association – CMA

Coalage (USA)

Coal Preparation Society of India – CPSI

Contrafed Publishing Co. Ltd. (New Zealand)

Cubapetroleo – CUPET (Cuba)

Customs Statistics of Foreign Trade (Russian Federation)

Dart Energy (United Kingdom)

Department of Business Enterprise & Regulatory Reform – BERR (United Kingdom)

Department of Energy & Climate Change – DECC (United Kingdom)

Department of Energy – DOE (Philippines)

Department of Energy (South Africa)

Department of Resources, Energy and Tourism (Australia)

DUKES (United Kingdom)

Ecopetrol (Columbia)

EcoalChina (China)

Energy Resources Conservation Board – ERCB (Canada)

Energistyrelsen – ENS (Denmark)

Euratom Supply Agency, European Commission – ESA

EuroGas Inc. (USA)

European Association for Coal and Lignite – EURACOAL (Belgium)

EUROSTAT (European Commission)

Federatión Nacional de Empresarios de Minas de Carbon – CARBUNION (Spain)

Frost & Sullivan Market Insight (Viet Nam)

Gazprom (Russian Federation)

GEOFOND (Czech Republic)

Geological Survey of Czech Republic (ČGS)

Geological Survey of India – GSI

Geological Survey of Namibia – GSN

Geological Survey of Queensland, Department of Employment Economic Development and Innovation (Australia)

Geoscience Australia

Germany Trade and Invest – GTAI (Germany)

Gesamtverband Steinkohle e.V. – GVSt

Global Methan Initiative – GMI (USA)

Grubengas Deutschland e. V. – IVG

Indian Bureau of Mines

Informationszentrum MINERAL (Russian Federation)

Instituto Colombiano de Geología y Minería – INGEOMINAS (Colombia)

Interfax Russia & CIS

International Atomic Energy Agency – IAEA

International Energy Agency – IEA

International Gas Union – IGU (Norway)

Kimberly Oil NL – KBO (France)

Kinetiko Energy Ltd. (South Africa/Australia)

KNOC (Korea Republic)

Korea Energy Economics Institute (KEEI)

Korea Gas Corporation – KOGAS

L&M Energy Ltd. – LME (New Zealand)

McCloskey International Ltd. (United Kingdom)

Methane Center of Kazakhstan, Azimut Energy Services

Mineral Resources of Russia. Economics & Management

Mineral Resources Authority of Mongolia

Ministerio de Energia y Minas (Peru)

Ministério de Minas e Energia (Brazil)

Ministerio del Poder Popular para la Energía y Petróleo (Venezuela)

Ministry of Coal (India)

Ministry of Commerce Industry and Tourism (Cyprus)

Ministry of Ecology, Sustainable Development and Energy (France)

Ministry of Economic Development (New Zealand)

Ministry of Economy and Antitrust Policy of the Kyrgyz Republic

Ministry of Energy of the Russian Federation (Russian Federation)

Ministry of Energy and Coal Mining (Ukraine)

Ministry of Energy and Energy Affairs of Trinidad & Tobago

Ministry of Energy and Mineral Resources of the Republic of Indonesia – ESDM (Indonesia)

Ministry of Energy and Mining (Algeria)

Ministry of Energy and Natural Resources (Turkey)

Ministry of Energy Myanmar

Ministry of Energy, Energy Policy and Planning Office – EPPO (Thailand)

Ministry of Energy (Iran)

Ministry of Energy (United Arab Emirates)

Ministry of Energy, Water and Communcations – MEWC (Malaysia)

Ministry of Energy and Coal Industry of Ukraine

Minister of Energy and Mineral Resources of Kazakhstan – (MEMP PK)

Ministry of Environment, Wildlife and Tourism Department of Meteorological Services – MEWT (Botsuana)

Ministry of Foreign Affairs (Ukraine)

Ministry of Industry and Trade of the Russian Federation

Ministry of Land and Resources – MLR (China)

Ministry of Minerals, Energy and Water Resources, Department of Mines (Botsuana)

Ministry of Mines (India)

Ministry of Mines and Energy - MME (Brazil)

Ministry of Mines, Industry and Energy (Equatorial Guinea)

Ministry of Mining (Mexico)

Ministry of Petroleum and Natural Gas (India)

Ministry of Petroleum (Egypt)

Nadra Luganshching LLC (Ukraine)

National Academy of Sciences (Ukraine)

National Coal and Mineral Industries Holding Corporation – VINACOMIN (Viet Nam)

National Mining Association – NMA (USA)

Natural Gas Europe – NGE

Natural Gas Asia – NGA

Netherlands Organization for Applied Scientific Research – TNO

Norwegian Petroleum Directorate – NPD

Nuclear Energy Agency – NEA (France)

Oberbergamt des Saarlandes

Organisation for Economic Co-operation and Development – OECD (France)

Office National des Hydrocarbures et des Mines (Morocco)

Oil & Gas Journal (USA)

OJSC „Uzbekcoal“ (Ukraine)

Petrobangla (Bangladesh)

Philippine Department of Energy – DOE

Polish Geological Institute - National Research Institute; Department of Deposits and Mining Areas Information – PSH

Porozumienie Producentów Węgla Brunatnego – PPWB (Poland)

Press-center (Uzbekistan)

Resarch and Markets (Ireland)

Research Institute of Petroleum Exploration & Development – PetroChina

Reuters (United Kingdom)

Russian Energy Agency (REA)

Servicio Geologico Mexicano – SGM

Servicio Nacional de Geología y Minería – SERNAGEOMIN (Chile)

Statistics Bosnia and Herzegovina

Statistics Africa

Statistics Bulgaria

Statistics Canada

Statistics China

Statistics Croatia

Statistics Czech Republic

Statistics Finland

Statistics Hong Kong

Statistics Israel

Statistics Japan

Statistics Kazakhstan

Statistics Kosovo

Statistics Macedonia

Statistics Malaysia

Statistics Montenegro

Statistics Netherlands

Statistics Norway

Statistics Pakistan

Statistics Poland

Statistics Romania

Statistics Russian Federation

Statistics Slovakia

Statistics Slovenia

Statistics Thailand

Statistics Taiwan

Statistics Viet Nam

Statistik der Kohlenwirtschaft e.V. – SdK

Statistisches Bundesamt – Destatis

Tansania Chamber of Minerals and Energy – TCME

The Coal Authority (United Kingdom)

Turkiye Taşkömürleri Kurumu – TTK (Turkey)

Turkish Petroleum Corporation

U.S. Energy Information Administration – EIA

U.S. Environmental Protection Agency – EPA

U.S. Geological Survey – USGS

Universidad Nacional de Colombia

University of Miskolc, Department of Geology and Mineral Resources (Hungary)

Verein der Kohlenimporteure e.V. – VDKI

World Coal Association – WCA

World Energy Council – WEC

World Nuclear Association – WNA

Glossary

AGEB

Arbeitsgemeinschaft Energiebilanzen e. V.; headquarters in Berlin

Aquifer gas

Natural gas dissolved in formation water

API

American Petroleum Institute: umbrella organisation of the oil, gas and petroleum industry in the USA

°API

Unit for the density of liquid hydrocarbons: the lower the degree, the heavier the oil

ARA

Abbreviation for Amsterdam, Rotterdam, Antwerp

b, bbl

barrel: standard American unit for oil and oil products; cf. Units

Butane

C_4H_{10}. A flammable, easily liquefied hydrocarbon gas present in petroleum and natural gas

BMWI

Bundesministerium für Wirtschaft und Technologie, based in Berlin
(German Federal Ministry for Economics and Technology)

boe

Barrel(s) oil equivalent: energy unit corresponding to the amount of energy released when combusting one barrel of oil

BP

British Petroleum: internationally active energy corporation; headquarters in London

BRENT

The most important crude oil type in Europe

BTL

Biomass to liquid: synthetic fuel made from biomass

BTU

British thermal unit(s): English energy unit

CBM

coal bed methane: gas contained in coal

cif

cost, insurance, freight: a typical transport clause incorporated in maritime transport transactions, corresponding to the 'free on board' (fob) clause where the seller also bears the cost of delivery, insurance and freight to a defined port

clean gas

Standardized natural gas with an upper caloric value of 9.7692 kWh / Nm^3 in Germany

crude oil

natural mixture of liquid hydrocarbons

conventional oil: Generally a liquid crude oil with an API degree higher than 10 (heavy oil, light oil, condensate) and easy to produce. Natural gas lieuids (NGL) and condensates which are produced in natural gas fields account for conventional crude oil

non-conventional oil: According to the definition by BGR: a hydrocarbon which is only marginally or non-flowing in the reservoir with an API degree less than 10 (extra heavy oil, oil sand bitumen, asphalt), or it is a light oil in a tight reservoir (tight oil, shale oil), or the hydrocarbon (kerogen) is immature (oil shale)

CTL

Coal to liquid: synthetic fuel made from coal

cumulative production

total production since the start of production operations

DOE

Department of Energy (USA)

downstream

activities in the production chain after the crude oil or natural gas has been produced from the production well: such as processing, transport, handling, sales

dry gas

natural gas that consists of little more than methane and which produces little condensable heavier compounds such as propane and butane when brought to the surface

EIA

U.S. Energy Information Administration

EOR

enhanced oil recovery: processes used to improve the natural recovery rate of an oilfield

ESA

Euratom Supply Agency, European Commission

EUR

estimated ultimate recovery (see total potential)

field growth

Increase/growth in original reserves during the production of an oil or gas field as a result of improvements in production technology, and better understanding of the deposit and production processes (see reserve growth)

gas hydrate

solid (ice-like) molecular compound consisting of gas and water which is stable under high pressures and low temperatures

GTL

Gas to liquid: using different methods to produce synthetic fuel from natural gas. Methods include Fischer-Tropsch synthesis

hard coal

anthracite, bituminous coal, sub-bituminous coal with an energy content >16,500 kJ/kg (ash-free)

HEU

highly enriched uranium: (>90 % U-235), mainly used for military purposes

IAEA

International Atomic Energy Agency: UN agency; headquarters in Vienna
(see also Economic Policy Organisations)

IEA

International Energy Agency OECD organisation; headquarters in Paris

In-place

total natural resource contained in a deposit/field (volume figure)

In-situ

located within the deposit: also refers to a reaction or a process occurring at the point of origin; also a synonym for in-place

IOC

International oil companies, including the super majors: BP plc, Chevron Corp., ExxonMobil Corp., Royal Dutch Shell plc, Total, etc.

IR

Inferred resources: resources of uranium comprising those proven resources which do not satisfy the reserves criteria. Corresponds to the now obsolete class EAR I (estimated additional resources)

J

Joule: *cf. Units*

LBEG

Landesamt für Bergbau, Energie und Geologie; headquarters in Hannover
(State Authority for Mining, Energy and Geology)

LEU

Low enrichted uranium

lignite

raw coal with an energy content (ash free) < 16,500 kJ/kg

LNG

liquefied natural gas. Natural gas liquefied at -162 °C for transport (1 t LNG contains approx. 1,400 Nm³ natural gas, 1 m³ LNG weighs approx. 0.42 t)

Methan

simplest hydrocarbon (CH_4)

natural gas

a naturally occurring gas, found in deep underground rock formations or associated with other hydrocarbon reservoirs. Gases can have variable chemical compositions but in this context are understood to be combustible natural gases mainly consisting of methane

Conventional gas: free natural gas or associated gas

Non-conventional gas: natural gas contained in non-conventional deposits (non-conventional natural gas) cannot be exploited traditionally and additional technical measures must be applied in order to produce gas in sufficient quantities. This is either due to the fact that there is no free gas phase or the reservoir rock is not permeable enough.

According to the BGR definition, these non-conventional deposits comprise shale gas, tight gas, coal bed methane, aquifer gas and gas hydrate.

NEA

Nuclear Energy Agency: part of OECD; headquarters in Paris

NGL

natural gas liquids; condensate

OECD

Organization for Economic Co-operation and Development, headquarters in Paris. Cf. Economic policy organisations

OPEC

Organization of Petroleum Exporting Countries; headquarters in Vienna. Cf. Economic policy organisations

original reserves

cumulative production plus remaining reserves

Peak Oil

point when maximum oil production level is reached

permeability

measure of the hydraulic transmissivity of a rock; unit: Darcy [D]; symbol: k; cf.: Units

porosity

pore space in a rock: unit: [%]

primary energy consumption [PEC]

describes the total amount of energy required to supply an economy

Propane

C_3H_8. A flammable, easily liquefied hydrocarbon gas present in petroleum and natural gas

raw gas

untreated natural gas recovered during production

recovery rate

amount of oil/gas which can be recovered from an oilfield/gasfield in per cent

remaining pontential

sum of reserves and resources

reserve growth

(see field growth)

reserves

proven volumes of energy resources economically exploitable at today's prices and using today's technology

original reserves: cumulative production plus remaining reserves

resources

proven amounts of energy resources which cannot currently be exploited for technical and/ or economic reasons, as well as unproven but geologically possible energy resources which may be exploitable in future

shale gas

natural gas from very fine-grained rocks (shales)

SPE

Society of Petroleum Engineers

tce

ton(s) coal equivalent, cf.: Conversion factors

tight gas

natural gas contained in tight rocks

toe

ton(s) oil equivalent: an energy unit corresponding to the energy released when burning one tonne of crude oil. Cf.: Conversion factors

total potential (EUR)

estimated total amount of an energy resource that can be extracted from a deposit (cumulative production plus reserves plus resources)

upstream

all activities in the production chain which take place before hydrocarbons leave the production site. Exploration, development and exploitation/ production

uranium

uranium is a natural component of the earth rocks. Standard uranium defines uranium in the isotopic composition that occurs in nature. Natural uranium [U_{nat}] is a mixture of U-238 (99.2739 %), U-235 (0.7205 %) and U-234 (0.0056 %). For an economic recoverability, uranium has to be enriched in the rocks. Currently the following types of deposits are of economic importance: unconformity-related deposits (dep), sandstone dep, hydrothermal vein-type dep, quartz-pebble conglomerate dep, breccias complex dep, intrusive and metasomatite dep.

non-conventional uranium

are uranium described as a very low-grade resource or those from which uranium is only recoverable as minor by-product, such as uranium associated with phosphate rocks, non-ferrous ores, black shale, carbonatite and lignite. Also seawater contains uranium (approx. 3 ppb) which is (theoretical) extractable.

USD

US-Dollars: currency of the United States of America

USGS

United States Geological Survey

VDKI

Verein der Kohlenimporteure e.V. (German Coal Importer Association); headquarters in Hamburg

WEC

World Energy Council, headquarters in London; organises the World Energy Congress

WNA

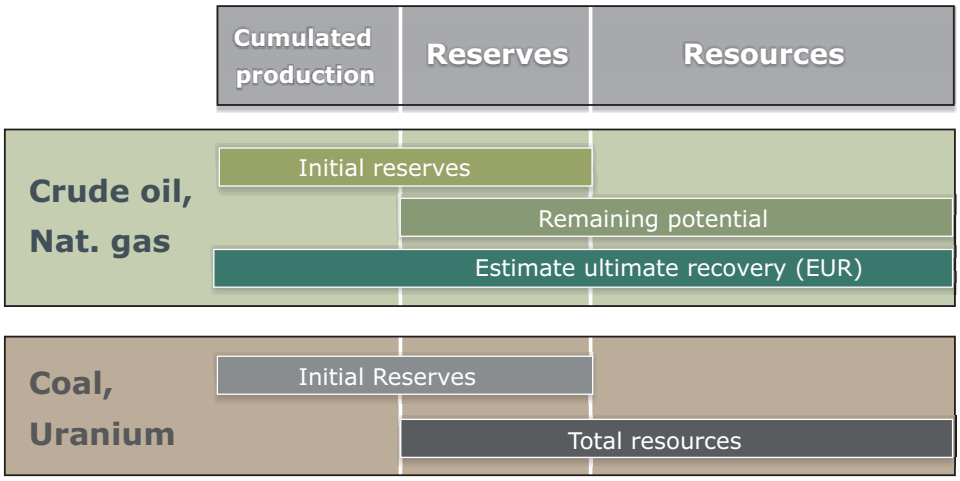
World Nuclear Association; headquarters in London

WPC

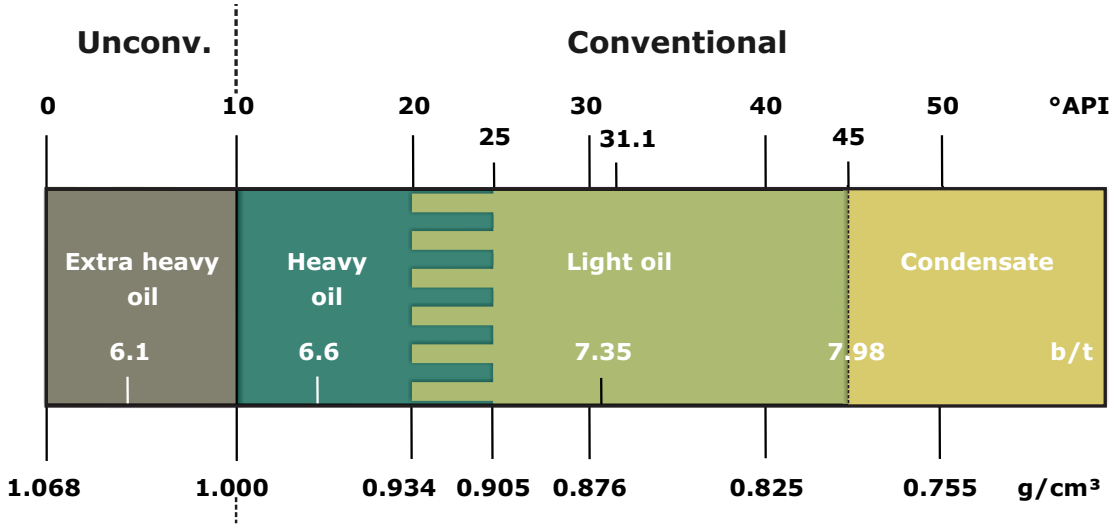
World Petroleum Council; headquarters in London; organises the World Petroleum Congress

Definitions

Differentiation between reserves and resources



Classification of crude oil according to its density



Physikalisch-chemische Definitionen für Kondensat, Leichtöl, Schweröl, Schwerstöl (Bitumen, Ölsand)

Country Groups

Europe

Albania, Andorra, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, Germany, Gibraltar, Greece, Guernsey, Hungary, Isle of Man, Ireland, Iceland, Italy, Jersey, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia (former Yugoslav Republic), Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, Vatican City State

CIS

Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova (Republic), Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan

Africa

Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Congo (Democratic Republic), Congo (Republic), Côte d'Ivoire, Djibouti, Equatorial Guinea, Egypt, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kap Verde, Kenya, Lesotho, Liberia, Libyan Arab Jamahiriya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Saint Helena, Ascension and Tristan da Cunha, Sao Tome and Pricipe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania (United Republic), Togo, Tunisia, Uganda, Western Sahara, Zambia, Zimbabwe

Middle East

Bahrain, Iraq, Iran (Islamic Republic), Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syrian (Arab Republic), United Arab Emirates, Yemen

Austral-Asia

„Austral"-Part:

Australia, Cook Islands, Fiji, French-Polynesia (Territory), Guam, Kiribati, Marshall Islands, Micronesia (Federated States), Nauru, New Caledonia, New Zealand, Northern Mariana Islands, Norfolk Island, Palau, Pacific Islands (USA), Pitcairn, Ryukyu Islands, Salomon Islands, Samoa, Timor-Leste, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna, West-Timor (Indonesia)

„Asia"-Part:
Afghanistan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Hong Kong, India, Indonesia, Japan, Korea (Democratic People's Republic), Korea (Republic), Lao (People's Democratic Republic), Malaysia, Maledives, Mongolia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Viet Nam

North America

Canada, Greenland, Mexico, United States

Lateinamerika (Middle- and South America without Mexico)

Anguilla, Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bermudas, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Falkland Islands (Islas Malvinas), (French) Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Montserrat, Nicaragua, Netherlands Antilles, Panama, Paraguay, Peru, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Pierre and Miquelon, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Turks and Caicos Islands, Uruguay, Venezuela (Bolivarian Republic), Virgin Islands (Brit.), Virgin Islands (Americ.)

MENA (Middle East & North Africa)

Algeria, Bahrain, Egypt, Iran (Islamische Republik), Iraq, Israel, Jordan, Lebanon, Libyan Arab Jamahiriya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Tunisia, United Arab Emirates, Yemen

Ecoomic Policy Organisations

European Union

EU-15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom
EU-25	European Union (from 1.5.2004): EU-15 plus new Member: Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia
EU-27	European Union (from 1.1.2007): EU-25 plus new Member: Bulgaria und Rumania

IAEA (International Atomic Energy Agency; 151 Countries)

Afghanistan, Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belarus, Belgium, Belize, Benin, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Central African Republic, Chad, Chile, China, Colombia, Congo (Democratic Republic), Congo (Republic), Costa Rica, Côte d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Eritrea, Estonia, Ethiopia, Finland, France, Gabon, Georgia, Germany, Ghana, Greece, Guatemala, Haiti, Honduras, Hungary, India, Indonesia, Iraq, Iran (Islamic Republic), Ireland, Iceland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kyrgyzstan, Korea (Republic), Kuwait, Lesotho, Latvia, Lebanon, Liberia, Libyan Arab Jamahiriya, Liechenstein, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Macedonia (former Yugoslav Republic), Mexico, Moldova (Republic), Monaco, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palau, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Saudi Arabiea, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, South Sudan, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Syrian (Arab Republic), Tajikistan, Tanzania (United Republic), Thailand, Turkey, Tunisia, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vatican City State, Venezuela (Bolivarian Republic), Viet Nam, Yemen, Zambia, Zimbabwe

NAFTA (North American Free Trade Agreement)

Canada, Mexiko, United States

OECD (Organization for Economic Co-operation and Development; 33 Countries)

Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Israel, Italy, Japan, Korea (Republic), Luxembourg, Mexico, New Zealand, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States

OPEC (Organization of the Petroleum Exporting Countries; 12 Countries)

Algeria, Angola, Ecuador, Iraq, Iran (Islamic Republic), Kuwait, Libyan Arab Jamahiriya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, Venezuela (Bolivarian Republic)

OPEC-Golf Irak, Iran (Islamische Republik),Katar, Kuwait, Saudi-Arabien, Vereinigte Arabische Emirate

OPEC-2009 OPEC-Mitgliedsländer mit Stand Ende 2009

Units

b, bbl	barrel	1 bbl = 158,984 litre
cf	cubic feet	1 cf = 0,02832 m³
J	Joule	1 J = 0,2388 cal = 1 Ws (Wattsecond)
kJ	Kilojoule	1 kJ = 10^3 J
MJ	Megajoule	1 MJ = 10^6 J
GJ	Gigajoule	1 GJ = 10^9 J = 278 kWh = 0,0341 t tce
TJ	Terajoule	1 TJ = 10^{12} J = 278 x 10^3 kWh = 34,1 t tce
PJ	Petajoule	1 PJ = 10^{15} J = 278 x 10^6 kWh = 34,1 x 10^3 t tce
EJ	Exajoule	1 EJ = 10^{18} J = 278 x 10^9 kWh = 34,1 x 10^6 t tce
cm, m³	cubic meter	
Nm³	standard cubic meter	amount of Gas in 1 m³ bei 0° C and 1,013 mbar
mcm	million cubic meter	1 mcm = 10^6 m³
bcm	billion cubic meter	1 bcm = 10^9 m³
tcm	trillion cubic meter	1 tcm = 10^{12} m³
lb	pound	1 lb = 453,59237 g
t	ton	1 t = 10^3 kg
t/a	metric ton(s) per year	
toe	ton(s) oil equivalent	
kt	Kiloton	1 kt = 10^3 t
Mt	Megaton	1 Mt = 10^6 t
Gt	Gigaton	1 Gt = 10^9 t
Tt	Teraton	1 Tt = 10^{12} t

Conversion Factors

1 t crude oil	1 toe = 7.35 bbl = 1.428 t tce = 1,101 m³ natural gas = 41.8 x 10^9 J
1 t LNG	1,380 m³ natural gas = 1.06 toe = 1.52 t tce = 44.4 x 10^9 J
1,000 Nm³ nat. gas	35,315 cf = 0.9082 toe = 1.297 t tce = 0.735 t LNG = 38 x 10^9 J
1 t tce	0.70 toe = 770.7 m³ natural gas = 29.3 x 10^9 J
1 EJ (10^{18} J)	34.1 Mtce = 23.9 Mtoe = 26.3 G. m³ natural gas = 278 billion TWh
1 t uranium (nat.)	14,000 – 23,000 t tce; different values depending on the utilization factor
1 kg uranium (nat.)	2.6 lb U_3O_8

Deutsche Rohstoffagentur

Bundesanstalt für Geowissenschaften und Rohstoffe

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