COAL 2009

Globalisation needs Security

German Coal Association

Coal
Annual Report
2009

German Coal Association

Foreword

'Globalisation needs security' is the theme of this year's annual coal convention, and it is also the key message of the German Coal Association's Annual Report for 2009. We have chosen it to underscore that globalisation is now an intrinsic part of our economic life and of our energy and coal industries. We can no longer withdraw from the global economic and political interrelations that exist in today's world. Globalisation offers special opportunities for the national economy, but it also contains certain risks. This was demonstrated all too clearly in the impact of this year's global economic and financial crisis, which plunged the German economy into the deepest recession it has known since the post-War years. In Germany the crisis also temporarily affected sales on the coal and coke markets.

Germany is a leading export nation. In the long run our prosperity depends on success on the international markets and on our ability to exploit the opportunities that globalisation affords. Our economic standing at national and European level therefore relies on having an appropriate framework, which has to include legal and planning certainty, social protection and energy supply security. The fact that energy security is facing huge challenges here at home, though these seem to feature little in the public debate, is made very clear in this year's Annual Report.

The German coal industry too relies on having a secure political framework if it is properly to fulfil its legal and contractual commitments. This framework was established by the coal industry financing act. According to our remit our mine planning activities are currently focused on achieving the gradual run-down of Germany's subsidised coal industry, which is to be carried out under socially acceptable conditions and completed by the year 2018. However, we are also prepared to continue to mine coal in the longer term should the Bundestag decide to review its decision on the phasing-out of the German coal industry.

Globalisation is necessary. But in future globalisation will also have to be accompanied by a secure set of guidelines at both regional and local level. This includes having sound energy plans – which is where we come in.

Essen, October 2009

Bernd Tönjes

Chairman of the Management Board
of the German Coal Association

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Globalisation needs security

Last November the German Coal Association's Annual Report 'Coal 2008' was highlighting the sudden surge in the price of raw materials and energy. The manner in which prices then collapsed as a result of the global economic and financial crisis came as a complete surprise to market players and analysts alike. The impact of the crisis and other global relationships connected with energy, environment and raw-materials policy is now put into context with the situation of the German coal industry as the central theme of the German Coal Association's new Annual Report 'Coal 2009'.

Coal industry restructuring continues in line with the policy laid down in the Coal Industry Financing Act, whereby the subsidised mining industry is to be phased-out by the end of 2018 – although the German Bundestag is due to review the energy policy aspects of this decision in 2012. In accordance with planning policy the industry's workforce has been reduced to some 30,000 employees (end of 2008) and production has been cut to 17 million t. This process was continued through 2009. All state aid granted in the European Union first has to be approved by the European Commission and this approval process in turn requires a legal basis. The relevant legal framework is currently provided by Council Regulation (EC) No. 1407/2002 on state aid to the coal industry, which is due to expire in 2010. A follow-up regime is now the subject of intense discussion. The European Commission has initiated a consultation process that also gave the German coal industry an opportunity to present its viewpoint in some depth. This position is explained in detail in this year's Report. The core message is that all existing instruments to grant subsidies need to be maintained if Germany is to be able to put its coal policy into practice.

One thing is clear: the ongoing adjustment process that has been mapped out for the German coal industry has implications not only for the nation's energy policy but also for the regional economy and for the social and sectoral infrastructure. These repercussions also have to be kept in mind and taken care of by the politicians. Germany's equipment suppliers are driving the development of new coal mining technologies by working in partnership with the German coal industry. The RAG prize for research is awarded each year for outstanding internal achievements in the development of innovative technologies.

Coal's overall future as an energy source is being increasingly determined by climate policy decisions. Ever since international commitments were agreed as part of the Kyoto Protocol Germany's energy policy has been targeted at low-CO_2 energy production and utilisation. This is one area that demonstrates just how much Germany is embedded in a global environment in which it has to date been playing a leading international role.

The main CO_2 emitting countries, namely the USA, China and India, which prior to the Copenhagen conference had still not signed up to the Kyoto commitments, have now come to realise that they have to make efforts of their own too. Time alone will tell whether the World Climate Conference in Copenhagen can lead to a new international and truly global agreement. As the number-one fuel for electricity generation in Germany and around the world, and the planet's most abundantly available energy resource, coal is regarded as a problem from a CO_2-emissions point of view. But coal can also be part of the solution to the climate problem. Here the global answer lies not in renewables and energy saving measures alone but in combining them with innovative coal technologies. Further research and development efforts are needed in this area.

This applies particularly to techniques that are aimed at capturing CO_2 (CCS – Carbon Capture and Storage) and achieving continued efficiency improvements – which constitute the most promising methods for limiting emissions. The CCS technique, which is currently being tested at a number of pilot installations, is still in need of further development. The technology also has to win public acceptance. Yet CCS is more than just a promising development for power station operators. CCS technologies also provide means for reducing CO_2 emissions at coal liquefaction plants and in combination with underground coal gasification. Indeed research has already commenced in this particular area. Mine-gas extraction and utilisation, which is a tried and tested technique of growing importance, is also an effective mean of protecting the climate.

The global economic developments of the last few months overlie the megatrends that we have been witnessing in recent years, including the rise in global demand for energy and raw materials. The world's population continues to grow – notably in the developing and newly industrialising nations – and energy demand is therefore rising disproportionately in these regions. The recent recession has clearly resulted in declining demand and falling prices on the energy and commodities markets. Yet in spite of the crisis overall demand and prices are still at a higher level than they were just a few years ago. And there is every likelihood that they will continue to rally as the economy recovers. China in particular continues to record a huge rate of growth and during the economic downturn it demonstrated its foresightedness as a main player in the struggle for raw materials.

The global energy mix is changing shape, but only slowly. By 2030 a good 80% of the world's energy needs will still be met by fossil fuels, e.g. according to IEA predictions. This figure will stay around 70% even if renewables are used more intensively. The growth in demand from countries like China and India will pose increasing economic and geopolitical risks for energy supply security. The formation of alliances between resource producing countries (OPEC has now been joined by GECF, the Gas Exporting Countries Forum) demonstrates that energy monopolies are very much alive and well.

Interrelationships in the energy and raw-materials sector are extremely important for an industrialised country like Germany. Indigenous resources like coal therefore assume special significance. The important thing is to keep in mind the threefold constellation of energy-policy objectives – competitiveness, security of supply and environmental acceptability – without allowing any of the three to get out of balance. The manner in which this balance is achieved will very much depend on policy decisions. We have been waiting years for an overall energy policy that gives equal rating to all three of these central objectives. Certainly there have been a number of attempts. In early 2009 the project group 'energy policy programme' (PEPP), which was set up by the Federal Economics Ministry, proposed a new set of energy-policy action

guidelines. The Federal Ministry for the Environment also applied itself to the task by producing an 'Energy policy roadmap 2020' that sought to present its own views on how previous energy-policy decisions could be made compatible in the medium and long term.

The three key energy-policy objectives were also debated intensively at European level, even though the EU 'climate package' tended to adopt a somewhat one-sided approach. Security of energy supply has not as yet been given sufficient weighting in the consideration process. The Treaty of Lisbon, which has still to be ratified, is quite definitive in calling for guaranteed energy security and the Russia-Ukraine gas dispute of January 2009 certainly highlighted just how important these issues are for Europe.

Germany has a broad-based primary energy mix. But the environmental and energy policy measures currently being adopted are clearly beginning to change things. Renewables and gas have seen their share of the power generation market double in recent years, while coal and nuclear power have lost ground. These trends are set to continue.

It is also a fact that the high and growing dependence on imports of energy from countries that tend to have a high risk valuation ratio (according to HERMES and the OECD) has driven up our own energy supply risk and will cause this to increase further. After 2020 Germany will be completely reliant on imported supplies of oil and gas. And if the decision to phase-out the indigenous coal industry is not revised this will apply to coal too. According to an indicator developed by the RWI the overall risk for German primary energy supplies has more than doubled since 1980, and by 2020 will more than triple. What can be done to reduce the increasing supply risks threatening the energy and raw-materials markets? Extended use of renewables alone will not be enough. This year's Report highlights some of the key aspects involved and reveals the type of approach that is required. And as far as energy policy is concerned the conclusion is a simple one: globalisation needs security.

The Report also includes a guest contribution by Dr Frank Umbach, Senior Associate for International Energy Security at the Centre for European Security Strategies (CESS), Munich and Berlin, who discusses 'the strategic risks to global energy security'.

The German coal industry

Photographs:
coal blending plant; modern longwall

The global financial and economic crisis has not spared the German economy, and while in the autumn of 2008 it was only the financial markets that had been affected it was not long before almost every sector of business was caught up in the crisis. This included the German coal industry. RAG, which is responsible for running the German coal industry, suffered temporary setbacks in early 2009 as a result of the recession, though it is expected that these will be resolved by the end of the year.

2009 was initially dominated by measures for implementing the planning decisions that had been taken by the RAG Management Board and Supervisory Board in the summer of 2008. The Coal Industry Financing Act of December 2007 and its associated contract arrangements have now provided the framework conditions required for this programme. All is now in place for the further restructuring of the industry. According to § 1, paragraph 1, of the Coal Industry Financing Act 'subsidised coal production in Germany will be phased out until the end of 2018'. However, § 1, paragraph 2, of the Act contains a review clause by which, on the basis of a Government report to be submitted no later than 30 June 2012, the German Bundestag will be called upon to examine *'whether under consideration of the aspects of ecomomic viability, energy-supply security and other energy-policy objectives, the coal industry will continue to be financially supported.'* The Bundestag will therefore be able to vote on maintaining a domestic coal mining industry for energy policy reasons. And RAG is geared-up for either eventuality. A crucial factor is that there will be no compulsory redundancies. This is guaranteed by the principle of social acceptability that has been agreed at Government level for the downsizing process. The manner in which this restructuring is achieved has been given top priority by the coal industry.

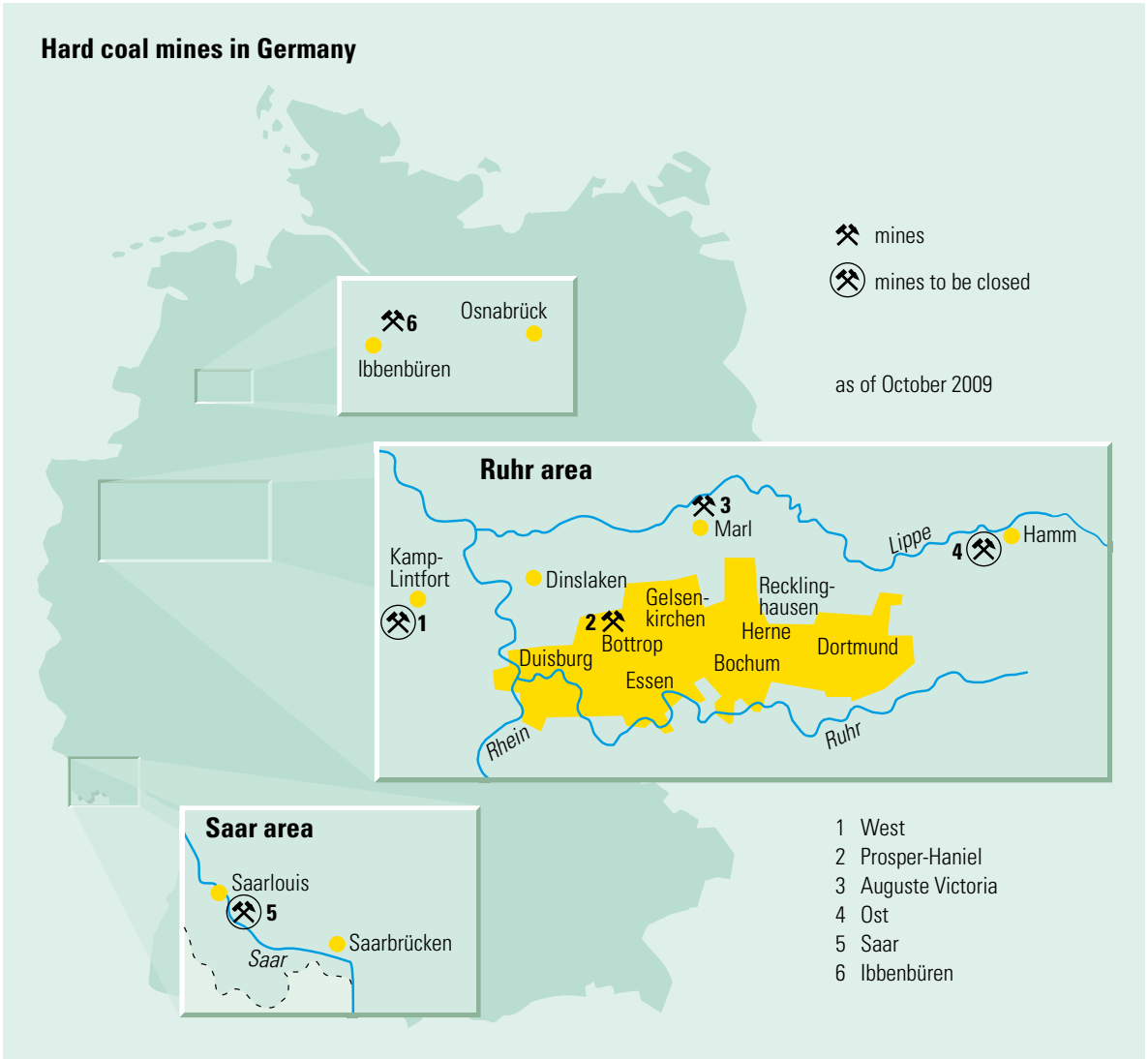
The 'new' Herne-based RAG organisation that was set up in 2008 now has under its umbrella RAG Deutsche Steinkohle AG and RAG Anthrazit Ibbenbüren GmbH, which are mining-only companies, along with RAG BILDUNG GmbH and RAG Montan Immobilien GmbH. This group was joined in mid-April 2009 by RAG Mining Solutions GmbH, which specialises in the international marketing of used and tested mining equipment and the commercial exploitation of in-house know-how on coal mining.

Lippe colliery in Gelsenkirchen was closed on 1 January 2009, while the Hamm-based Ost colliery is due to shut on 30 September 2010. The last mine in the Saar coalfield, namely Saar colliery in Ensdorf, will cease production on 1 July 2012. Planning decisions have also indicated that West colliery in Kamp-Lintfort will shut at the turn of the year 2012/2013, even though there has been no official decision on this to date. This means that after 2013 the indigenous coal industry is likely to consist of just three mines in North Rhine-Westphalia: Prosper-Haniel in Bottrop, Auguste Victoria in Marl and Ibbenbueren at the border with Lower Saxony.

Special challenges for the downsizing process

The reduction in the number of collieries will be accompanied by a decline in coal production, with output set to fall from some 17 million t in 2008 to a figure of 12 million t/a by 2012. The industry's workforce will also shrink to about 15,000. This manpower restructuring process poses huge challenges for the coal industry and requires the deployment of all available instruments for labour- and social-policy adjustments. Various collective agreements have also been put in place in order to achieve the targets that have been set.

The downsizing process is supported by a wide range of instruments. The transition payments scheme ('APG') for mineworkers, which has been in existence since 1972, will continue to play an important role. This scheme allows employees to take early retirement provided they meet certain qualifying conditions,



which essentially involves reaching a certain age limit and completing a specified period of employment within the company. In 2008 a total of 1,840 employees took early retirement on this basis.

Of course these arrangements can currently not be applied in the case of some 2,100 younger employees who are due to leave the company by 2012 and seek employment outside mining. The German coal industry has reacted to this situation by developing a wide-ranging set of manpower-policy instruments and has all kinds of measures in place for helping those affected enter the general job market. This includes the skills initiation scheme, where applicants are able to spend several months familiaris-

ing themselves in trial jobs outside the mining industry. Employees can also apply for retraining courses spanning up to three years that will prepare them for future-oriented careers in the non-mining sector. There are in addition various in-house programmes that have been in operation for a number of years and they too have a role to play. These arrangements give younger employees alternative career prospects inside and outside the RAG Group and offer incentives to promote a flexible approach to job applications.

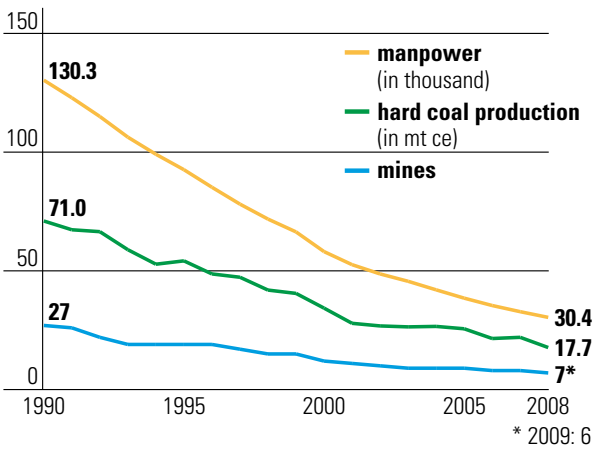
An orderly closure process for the German coal industry and the preservation of a fully functional corporate structure capable of responding to any decisions taken in line with the review clause: this was the objective of the two sides of industry – the German Coal Association and the IG BCE union – when, in June 2009, they concluded the 'collective labour agreement on socially acceptable flexible working practices for the North Rhine-Westphalia and Ibbenbueren coal mining industries'. The aim of this contract, which took effect on 1 July 2009 and cannot be terminated before 31 December 2012, is to accommodate the interests of all those involved in the process. On one hand its provisions are designed to take into account employees' concerns that their working conditions should be safeguarded as far as possible, while on the other – as a quid pro quo – they require a high degree of flexibility from the workforce not only in terms of the type of work and the location of the workplace but also as regards to a readiness to engage in retraining and upskilling if necessary.

Since the founding of Ruhrkohle AG some forty years ago instruments of this kind have been employed very effectively in order to reduce the size of the workforce from an initial 280,000 to the current figure of about 30,000 (as at end of 2008) – in other words by more than 90% – and this has been achieved in a socially acceptable way, i.e. without compulsory redundancies. And all these instruments will continue if the objective of a socially acceptable downsizing of the workforce is to be achieved by 2012. However the efforts that the industry has been putting into its manpower reduction programme are being impeded by developments on the labour market. Many firms are currently suffering from the economic downturn triggered by the economic crisis and are at present not recruiting new workers. Thus, a further worsening of the employment situation in Germany, and hence in the coalfield regions, cannot be ruled out.

The German Coal Association (GVSt) has also had to adapt by introducing structural changes. At the time of its formation in 1968 it represented and united under its roof the interests of five German coal mining associations. Today it is the industry's only lobbyist group. The functions of the UVSt (Coal Companies Confederation) were taken over and then, in 2009, the GVSt absorbed the Vbl (Association for Mining Interests), an organisation steeped in tradition that last year celebrated its 150-year anniversary. The GVSt was also entered into the Register of Associations and its workforce reduced in size in line with the restructuring of the coal industry. As part of this reorganisation the Association will move to Herne on 1 January 2010 – which is where its most important member, RAG, is based.

In spite of having to cut the size of its workforce to match the downturn in production levels the German coal industry remains one of the largest training providers in North Rhine-Westphalia and the Saarland. In this regard it is fulfilling its social and regional obligations. At the beginning of 2009 a further intake of some 300 young

Restructuring German coal industry since 1990

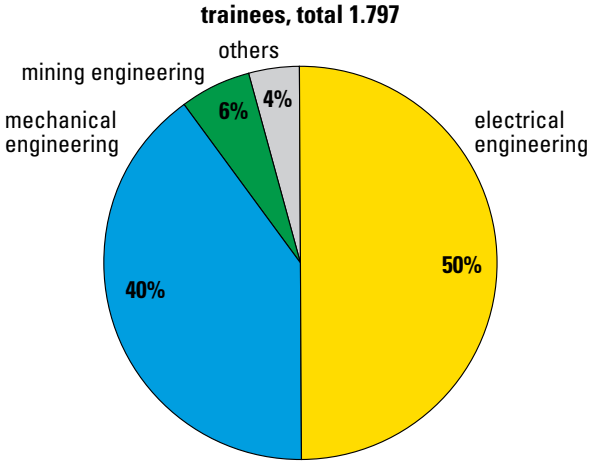


Duties and responsibilities of the Gesamtverband Steinkohle e.V.
The German Coal Association (GVSt) was originally founded on 11 December 1968 as the German Producers' Association. Today it represents and promotes the general interests of its members in the coal industry and related sectors, particularly as they concern economic and social matters, and acts as an employer's association and bargaining party for its ordinary members.

Like other trade associations GVSt is also involved directly and indirectly, via umbrella organisations, in the political decision making process in Germany. The GVSt is, for example, represented indirectly in the BDI (Federation of German Industry) through its affiliation with the VRB (German Federation of Mining and Mineral Resources). As the German coal industry's employers' association the GVSt is also a member of the BDA (Federation of German Employers' Associations) and of the North Rhine-Westphalia Federation of Employers' Associations, as well as being represented on all key committees of the social insurance providers. As the industry's lobby group the Association maintains close contacts with political representatives, ministries and authorities that have responsibility for coal-industry affairs, and has also developed ties with universities, research establishments, the Church and various public bodies.

The coal and steel industries have been at the focus of European attention since 1950 and indeed the GVSt was a founding member of EURACOAL, the umbrella organisation of the European coal and lignite industry, which now comprises 28 associations and companies from practically every European coal-producing country. From its Brussels-based office EURACOAL also represents the specific concerns of the German coal industry, particularly with regard to European environmental policy, and cooperates with international organisations such as the World Coal Institute (WCI).

The GVSt works jointly with DEBRIV (the German Lignite Industry Association) in managing the Coal Industry Statistics Unit, a service with responsibility for drawing up the official statistics for the various coal and lignite companies and as part of this remit providing support and advice to government agencies and public bodies.



Job directions of coal industry

Securing and safeguarding know-how is an important part of the manpower downsizing process. With every employee who leaves the industry there is a risk of loss of specific knowledge and experience. Tackling this problem in an effective manner first requires a company-wide survey of all the skills and expertise held in house. It was for precisely this purpose that RAG introduced its 'Know-how Backup Scheme' (KHS), which comprehensively logs the mining-relevant skills and competences of each and every member of the workforce. This system can be used to identify individuals with the specific know-how for filling the various skills gaps as and when they appear. These employees can then be re-assigned or re-trained according to the needs of the company.

people took up training courses at RAG. At the start of the training year 2009/10 the company had a total of 1,340 young apprentices on its books, with the emphasis on industrial mechanics and electronics, mechatronics and commercial qualifications.

Consultation on prolonging the European Council Regulation on State aid to the coal industry

EU approval for aid to the coal industry must remain possible if the German mining industry is to continue its process of socially-acceptable restructuring and if the coal-policy decisions are to be implemented. The legal basis for this process is Council Regulation (EC) No. 1407/2002 on State aid to the coal industry, which is set to run until 2010. A new EU regime on State aid to this sector will then be required for the period commencing 2011. Failing this the general provisions of the EU Treaty would be applied, even though these would not be sufficient to meet the needs of the German coal industry.

At European level a consultation was begun in 2009 on the expiry of the Community regime on State aid to the coal industry. This raised a number of basic questions to do with coal policy and state aid legislation. In this context GVSt and RAG put forward a joint position to the European Commission.

In their joint position they stressed that social acceptability is a key aspect of the Coal Industry Financing Act when having to reduce coal production. In view of the age structure of the workforce and the difficult employment situation, especially in the coalfield areas, it would be socially irresponsible to bring forward the timetable for phasing-out subsidies. This position is also taken up by the German Government in its 'Restructuring plan to 2018', which has been communicated to the European Commission. Approval is still pending and is closely tied in with the consultations currently under way on the expiry of Council Regulation 1407/2002.

Competition not impaired by State aid

The European Commission also takes the view that coal-industry aid has not so far impaired competition in the most important coal markets. Especially in Germany the strong decline in coal production has opened up huge opportunities for coal imports. In this respect the restructuring plan is compatible with Community law.

In its position the German coal industry also points out that mining in the EU member countries is for the most part carried out under difficult geological conditions. This fact prevents the industries concerned from reducing their production costs to the level of imported coal sourced from third countries. The coal industry as a whole could therefore not survive in the long term without measures being put in place for the granting of State aid. All the more it is reliant on aid for the reduction of activity, a process which – as in the case of the German mining industry – is to be implemented while maintaining the principle of social acceptability.

Indigenous coal means security of energy supply

The European Commission has so far justified the current Regulation also on the basis of the contribution that coal production makes to energy security. According to the Commission a complete dependence on imported coal from third countries could increase the risks and uncertainties affecting long-term security of energy supplies to the EU. In an increasingly globalised world, where there is growing competition for the available resources, security of supply based on access to indigenous coal deposits is indeed a valuable commodity.

In any case it is not at all certain that coal of the required quality will always be available on the world market at an acceptable price and in sufficient quantities. According to a study carried out in early 2008 there is every likelihood that supply and demand on the world steam-coal market will reach capacity limits as early as 2011. After 2012 we could even begin to see shortages occurring ('Development and perspectives on supply and demand in the global coal market',

Maggi Rademacher in: *Journal for Energiewirtschaft* 2/2008, pp. 67 et seq.). The global economic crisis that set-in after this paper was published suggests that this trend may be delayed somewhat. However this fact does little to alter the basic findings of the study.

Similar views are expressed in a study entitled 'The future of coal', which was published in 2007 by the Energy Institute of the EU Commission's Joint Research Centre. According to this study we cannot be sure that increases in global supply will be sufficient to meet the medium- and long-term demand for coal. Coal's supply prospects on the world market are also said to be not nearly as secure in the long run as is frequently assumed. The reason for this is the relatively rapid decline in economically recoverable reserves combined with the high geographic concentration of the supplier countries and the growing corporate concentration in this market. World market prices are set to rise significantly in any case; this was the very scenario that took place – albeit temporarily – in 2008. If we take this study seriously it would appear to be no more than logical that the EU's indigenous coal reserves should be employed in a more comprehensive and efficient way. This would not only reduce our reliance on imports but would also lead to additional synergies, such as safeguarding jobs in the mining and supplier industries. Given the current EU-wide crisis the Commission now considers that job security should be given top priority.

Even if the global economic crisis were to create a time scenario of a different kind the increasing shortage of raw materials is clearly only a matter of time. As the experience of last year has shown, there will be a marked rise in prices even before we reach full utilisation of capacity along the entire coal chain.

What is more, not all coal-fired power stations in operation at the present time could be switched over to burn world market-sourced coal – and even if they could this would only be possible after carrying out comprehensive conversion work and/or changing the transport infrastructure. Additional changes may therefore have to be made to existing generating plant to the detriment of a balanced energy mix in the electricity generation sector, and this against the background of the current debate on the building of new coal-fired power stations (see also 'Challenges for German and European energy policy' below).

From an environmental point of view the question of aid to coal production must also be considered separately from that of the impact of coal utilisation. The latter will occur just the same when burning imported coal. It is a problem that will arise irrespective of where the coal is sourced. This applies particularly when it comes to reducing CO_2 emissions from coal-fired installations, for the environmental performance of coal-fired plant depends on the emission standards currently in force in the power generation sector and on the level of efficiency that the installation can achieve – and in future it will also depend on the development and implementation of low-CO_2 CCS technologies.

Conversely, the cessation of coal mining in the EU member states would mean that production for the European market would increasingly relocate to third countries where environmental standards are generally much lower than in the European Union. The additional emissions generated, for example, as a result of long-distance coal transport operations would also have to be taken into account. Overall, the global 'eco-balance' of the coal production sector would certainly not be improved as a result, and in fact would probably worsen. On the other hand, retaining a minimum production level of subsidised indigenous coal would present obvious benefits. It would – as the existing EU Regulation has established – provide incentives and improve opportunities in the member states. This would also help European technology stay ahead of the field in the development of eco-friendly coal production and clean coal combustion methods, while at the same time enabling this know-how to be transferred to the main coal-producing regions outside the EU.

Safeguarding access to the deposits

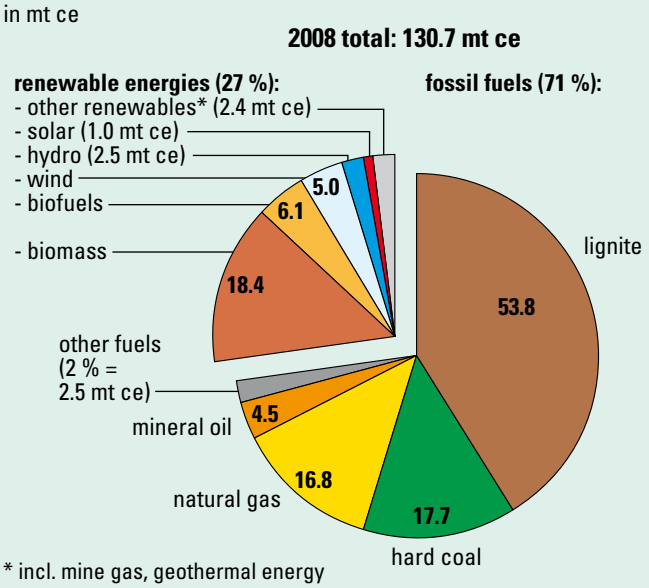
Continuing coal mining will also help safeguard access to the deposits. The technically recoverable reserves of Germany's coalfields constitute by far the largest energy reserves in the entire EU. On a German scale they represent 63% of the nation's total energy stocks.

But apart from the need to maintain access to the deposits German-mined coal – which accounts for about 4% of primary energy consumption and approximately one third of coal-based electricity output – continues to make a significant contribution to Germany's energy supplies. And given the reserves that exist below ground it will still be in a position to do this for several hundred years. The coal market today is quite different from that of 25 years ago, with 77% of production now going to the power generating industry. In 2008 some 21% of output was purchased by the steel makers, while smaller amounts were delivered – free of subsidy – to the heat market (anthracite grades).

The almost stagnating electricity consumption that followed the onset of the recession as early as 2008 was succeeded in 2009 by a month-long downturn in electricity generation – caused by the fall in industrial consumption. Since the beginning of the year Germany's crude steel production, for example, recorded a huge decline that in some cases was as much as 42%.

Primary energy production in Germany

in mt ce



Because of the economic situation sales of steam coal and of coking coal and coke fell considerably in the first half of the year. After years of operating at full load the Prosper coke works, which is RAG's sole remaining plant, was for a while forced to reduce its capacity utilisation to its lowest operating range, as indeed were all steel industry-owned coking plant in Germany.

However, since the summer of 2009 there are again clear signs that the downturn has bottomed out (as at September 2009).

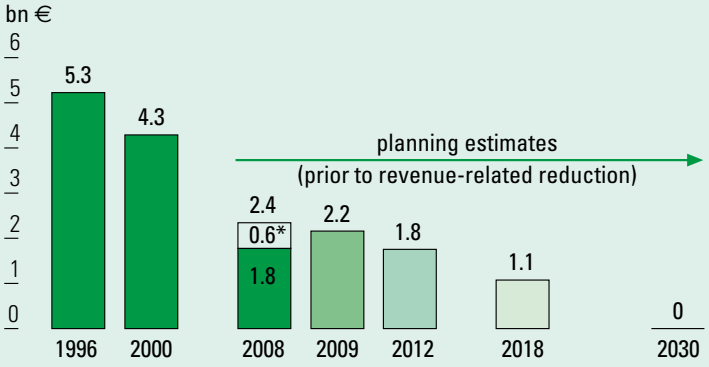
State aid

In accordance with budget provisions some € 2.378 bn was allocated to the German coal industry in 2008 as State aid to cover the cost of current production, inherited liabilities and mine closures. Of this, € 1.862 bn came from the Federal budget and € 0.516 bn from the regional budget of North Rhine-Westphalia. Saarland does not contribute to this aid. In view of the rising prices on the import coal market, however, requirements have fallen in this sector with the result that at the beginning of 2009 nearly € 600 million less aid was paid out.

While coal subsidies have been strongly condemned particularly by economists over the years it would appear that some in this quarter have now begun to revise their

views. The economic and financial crisis, along with the extensive rescue measures that the State has had to employ as a result, has brought with it a pronounced shift in relations when it comes to subsidies and State intervention. In his book 'Can the market still be saved?' Prof. Peter Bofinger, who is a member of the German Council of Experts, writes as follows on the subsidy studies carried out by the Kiel Institute for World Economy (IfW): *'You can argue over either position, whether public funds should be used for this purpose or not. But there definitely is economic justification for most aid of this kind. This even applies to coal, which may well become attractive again as energy prices continue to rise.'*

Public aid for German hard coal



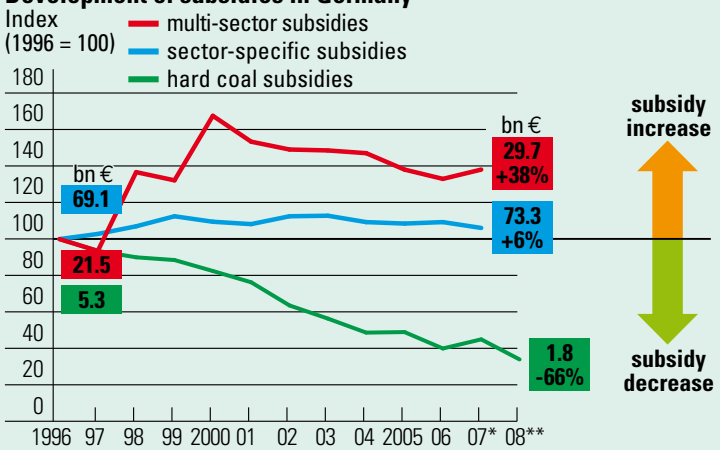
without RAG's own contribution, * revenue-related reduction

until 2008: as in the 2003 coal-policy agreement (not considering deferred payments); as from 2009 planning estimates according to the 2007 framework agreement; 2018 subject to revision in 2012; as from 2019: no aid for coal sales

Fiscal follow-up costs

Coal mining continues to be of considerable significance for the coalfield towns and communities. An expert opinion on the regional-economic significance of coal mining in the Ruhr area, which was published by Prognos AG in early 2008, shows that each coal industry job creates an additional 1.3 workplaces in the wider economy – of that about one job in the Ruhr region itself. Mining therefore creates job opportunities both directly and indirectly. It not only safeguards employment in the supplier sector but also generates all kinds of jobs that rely on the purchasing power of coal industry employees – which means local shops and businesses. This is the reason why many former mining areas and communities affected by colliery closures have experienced unemployment levels that are typically well above average.

Development of subsidies in Germany



* 2006/07: lower devcrease due to changed payment modalities and arrears of deferred payments ("bow wave")

** 2008: coal aid after revenue-related reduction

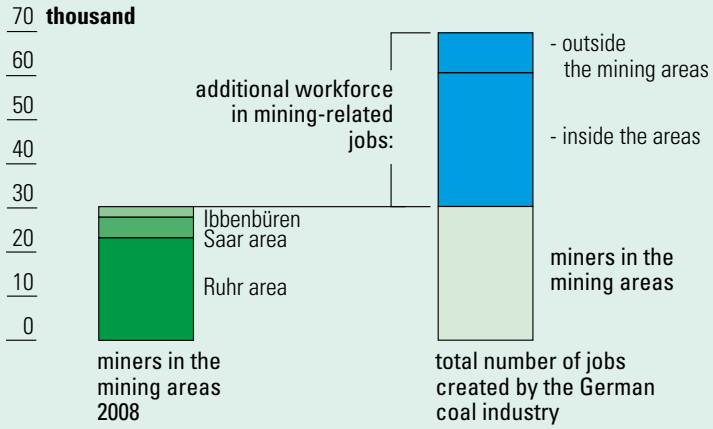
Source: IfW, Federal and State budgets

The fiscal follow-up costs are another factor to be considered. If taxes and social insurance contributions are no longer paid because mines are being closed may lead to a net burden on the public finances for many years, and this in spite of the subsidy payments saved. This in turn poses problems for the funding of structural adjustment measures at regional level. It is true that in the past numerous regional-economic support measures were provided for also by EU programmes (e.g. RECHAR or RESIDER, Objective-2 measures), but these measures were focused on the general environment and not the direct implications of job losses in the coal industry and related sectors.

Already prior to the 2007 decision to phase out subsidized coal production in Germany production was clearly reduced over years, but always in a socialy acceptable manner. At least this has prevented disruptions in the coalfield communities. The phase-out date 2018 was deliberately chosen so as to avoid major negative social and regional impact.

In summing-up the Council Regulation on State aid to the coal industry, which expires at the end of 2010, it can therefore be said that it has stood the test and has not caused any serious problems that might have prompted the need for an amendment during the lifetime of the instrument. This conclusion was also reached by the European Commission in its monitoring report on the Regulation. And this was why, when presenting its position as part of the consultation process for the monitoring report back in 2006, the German coal industry expressed its support for the Regulation to be extended, albeit in a modified form. A number of other coal producing countries share this view. In any case all existing State aid instruments should continue to be permissible within the framework of EU legislation also in the future.

Employment effects of the German coal industry by region



Consequential fiscal costs for different job replacement rates

job replacement rate p. a.	job losses in 2018 NRW	consequential fiscal costs 2007 - 2018 NRW	consequential fiscal costs 2007 - 2018 Germany
0%*	- 43,726	1.43 bn €	9.54 bn €
2,25%	- 37,390	1.30 bn €	8.57 bn €
4,5%**	- 32,963	1.18 bn €	7.71 bn €
9%	- 25,054	0.99 bn €	6.25 bn €

* status quo with normal trend ** UK reference case
Source: Prognos, 2008

„Order of work“,
Photograph & Design:
Andreas Ermert, 2009.

Innovative German mining technology leads the world

The orderly and staged downsizing of the German coal industry has not only helped cushion its regional and social impact but has also enabled to supplier industry to adapt to the changing market environment. The international standing of German mining technology owes much to the challenges an industry has to face when operating under the kind of geological and climate conditions encountered when working as much as 1,500 m below ground. The average winning depth at German collieries is currently in the region of 1,150 m. By 2012 this will have increased by an additional 100 m. What is more, the German mining industry is recognised as having the best safety record and the highest health and safety and environmental protection standards in the world. The home-based supplier sector, working in close partnership with the German coal industry, has played a significant role in this area and as well as being a competitive player on the world market is now also spearheading technological development in this field. German equipment manufacturers are currently making a major contribution in the EU, in eastern Europe and in other countries such as China and India.

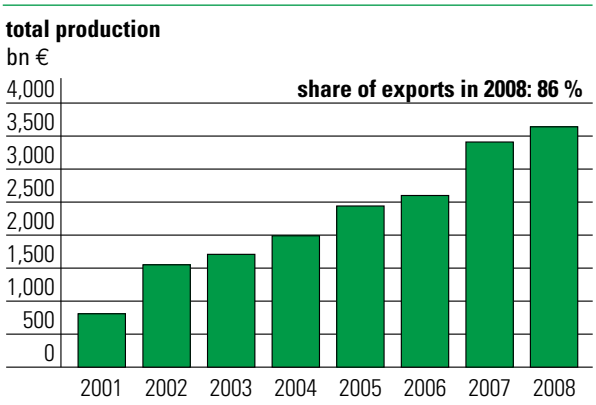
The development in Germany has now shown, however, that the decline in coal production has put some equipment manufacturers under threat and indeed individual companies have already gone out of business. What is more, when preparing their products for the marketplace some German suppliers would not have the financial resources needed to trial their equipment at collieries that are located far from the factory.

The vast majority of these companies, along with their value-added potential and employment opportunities, are established in the coalfields. In fact 80% of all Germany's mining equipment suppliers are based in North Rhine-Westphalia.

All equipment purchased by the deep-mining and opencast industries, i.e. coal and non-coal, is now supplied by 115 mainly small and medium-sized undertakings with a combined workforce of more than 13,500. This sector has been increasing its turnover year on year, a fact that more than makes up for the decline in sales to the home market, and in 2008 recorded a growth rate of 7%.

However, according to the Association of Mining Machinery Manufacturers, which is affiliated to the VDMA (German Engineering Federation), the German mining equipment industry's leading position on the world market would be threatened if the Government actually goes ahead with its decision to phase out the coal industry. The VDMA is of the opinion that a domestic coal industry is essential if German mining technology is to maintain the high technological standards it has been setting around the world. The innovative products that are required by the industry can only be developed and can only succeed if they are first tested and trialled under the challenging conditions that are present in German collieries.

Value of production of German industry equipment suppliers industry



Source: VDMA, 2009

Innovation is driving technological development

Productivity improvements and process innovation are now crucial for the economic success of any mining company. The global trend is towards increasingly efficient deep mining operations: this is because, on one hand, the deposits

The changing face of mining technology as a profession

The new profession of 'mining technologist' was introduced on 1 August 2009 to replace that of 'mining mechanic'. This new professional category will enable training policy to keep pace with the changing circumstances in the coal industry and the structural changes to the working environment of those engaged in mining and in ancillary occupations in Germany.

Young apprentices can choose between the specialisations of 'deep drilling' and 'underground mining'. Deep drilling focuses on areas such as geology, borehole construction and borehole control. As well as home-based coal mining the 'underground mining' course includes studies in potash mining, landfill construction, site reclamation and – making a welcome return – ore mining. Here the training covers the construction and support of underground workings and aspects of mine ventilation and climate control, none of which are relevant for deep-drilling engineers.

Female students will henceforth be eligible for training in this profession. This follows the decision taken by the German Bundestag on 20 January 2009 to remove the ban on women working below ground. Prior to this the European Court of Justice had compelled all EU countries to revoke the convention adopted by the International Labour Organisation in 1935 prohibiting women from taking part in any underground work, as it was in breach of a European directive.

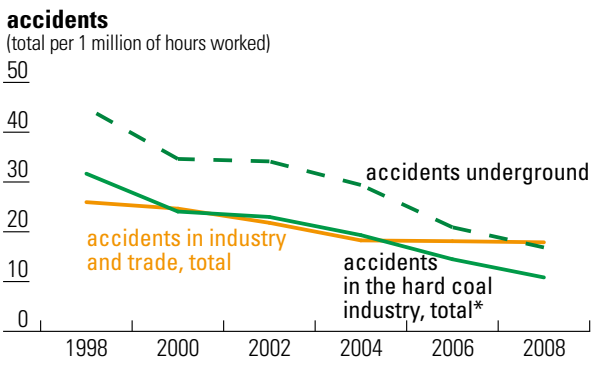
recoverable by opencast methods are slowly but surely running out and, on the other, because increasingly stringent measures are being put in place – both in Germany and elsewhere – to prevent damage to the surface environment. In areas where deep mining is already under way the working depths are gradually increasing and the miners are becoming ever more familiar with the challenges this can bring in terms of increasing rock pressures, ventilation problems and a more difficult working climate.

Health and safety and environmental sustainability have always featured highly on the German coal industry's agenda. These are not only key principles of company strategy but also important requirements for efficient production. The colliery environment will by nature always involve its own special risks and hazards for the miners. In spite of this the industry's accident figures have fallen by nearly 90% since the early 1990s and currently stand at an all-time low. The German coal industry is now setting the standard for industrial health and safety, not only within the international mining sector but also when measured against other branches of industry at home.

The German coal industry is now also identified with having a responsible attitude to environmental sustainability. This is demonstrated in particular by the fact that environmental impact assessments are carried out before any mining work commences. These surveys examine the anticipated environmental impact of the project and lay down the compensation and mitigation measures that are to be put in place, along with the procedure for ongoing monitoring and control.

Achieving further improvements in productivity will crucially depend on innovation in areas such as automation, communications and infrastructure. This includes improvements in drive systems and mining technology, logistics, plant maintenance, planning and organisation. The German coal industry is currently working closely with scientific and research establishments with a view to making further progress in these important areas, while every year the RAG

Reduced accidents in coal industry



* only corporate sectors under mining-authority supervision

Source: Stautory german Accidence Insurance, RAG

Future Mine Monitoring

presents its 'Research Award' in recognition of intra-company efforts to promote continous innovation.

Efforts aimed at automating the operating procedures feature largely in the RAG Research Award. This has included the development of a new coal plough system that not only resulted in a marked improvement in the daily face output at RAG collieries but also helped cut outlay on repair and maintenance by 50% and extended the operating life of the equipment. A new drive system was also developed for coal conveyors that significantly boosted productivity and, as a result, helped cut operating costs. And at number three, a fully-automatic system was devised for underground transport operations.

The ability to develop new technologies and the know-how and experience needed to understand strata behaviour and how to handle it are invaluable assets when it comes to competing on the world market. RAG has now developed a geotechnical valuation system, which employs the latest IT systems and structures, in order to exploit this pool of knowledge. This gives planners a much clearer picture of the different rock strata. To this effect a self-learning database has been built up to improve strata control in in-seam roadways. This reflects the experience that has been acquired over one hundred years of coal mining in Germany. This database will for the first time provide a comprehensive, networked set of figures and formula that can be used for planning and driving new roadways. What has been built up in terms of know-how and experience over the last 25 years is particularly unique and cannot be found anywhere else in the world. A similar database has also been established for the mines rescue services. As well as improving safety levels in German mines and safeguarding the existing body of knowledge this database will help promote German standards around the world and provide additional impulses in this area.

The RAG Research Award also recognises work not directly connected with underground operations. In one case a planning and control system was developed for large-scale and efficient land recycling projects and other major schemes of this kind. Another example was the 'MINEO' research project, which employs a new type of remote sensing technique for monitoring environmental change in mining areas.

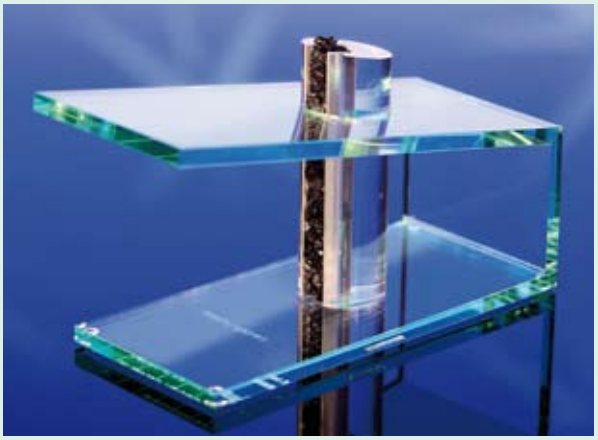
The RAG Research Award for 2008 went to a system that uses computer-assisted technology to transmit speech, images and data. Just imagine the scenario: an electrical engineer is working to repair a complex piece of equipment underground. A specialist from the equipment manufacturers has a direct visual and acoustic link to him. The problem is quickly rectified without any time lost through travelling and without several hours

The RAG Research Award

Every year since 2002 the RAG has presented a Research Award to employees for outstanding achievements in the area of research and development. The awards panel, which is chaired by RAG Board Member Jürgen Eikhoff, selects from a range of ideas and improvements that it considers will act as a stimulus and drive innovation. The particularly challenging geology and the worldbeating standards that the German coal industry has set in respect of health and safety and environmental sustainability all require the ongoing development of German mining technology if efficiency levels are to be pushed ever upwards. Great efforts are also being made to preserve and develop the industry's know-how and expertise, which is being achieved in spite of the reduction in the workforce.

The award – which is a stylised shield support made of coal and acrylic glass – is presented to the winner in front of an audience of government, industry and press and media representatives.

Previous awards ceremonies have met with a very positive response. In 2003 Hannelore Kraft, the then Minister for Science and Research in North Rhine-Westphalia, stated in her address that the Research Award underlined the strategic significance of research and development work for the German coal industry and demonstrated the innovative talents of researchers in North Rhine-Westphalia. Two years later the same message was delivered by Dr Michael Stückradt, State Secretary at the NRW Ministry for Innovation, Science, Research and Technology. Referring to the fact that German mining technology now leads the world Stückradt said: *'Holding on to this proud record will require excellence in research and development and in the way we put this into practice.'*



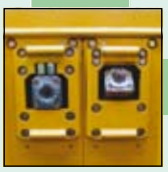
The press and media also reported these events very positively, highlighting not only the innovative energy of the workforce but the efforts that the German coal industry is making in this area at international level. And this partnership is now reaching out into space, as witnessed by the appearance at the 2004 awards ceremony of guest speaker and astronaut Dr Ulf Merbold.

of production downtime. All kinds of different requirements first had to be met before this technology could be introduced into the complex world of the modern colliery. The project was funded by the European Commission.

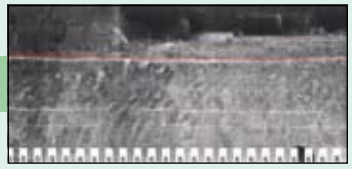
The process of consolidation now under way in the German mining industry has created a large pool of used and field-tested mining equipment. Designed to work under the challenging conditions found in German collieries these items are usually well up to coping with the job elsewhere. In order to serve this market in the years ahead RAG has recently set up another company under the Group umbrella, RAG Mining Solutions. Business connections have already been

Research Award 2009

In order to support visuality video cameras and spotlights have been installed at both arms of the shearer drums.



Part of the full automation process is the possibility of recognizing the boundary layers between rock and coal. This is enabled using two infrared cameras at the coal front. Infrared technology recognizes textures in seam which are hardly visible with bare eyes.



After 20 years of devolopment RAG succeeded to have the shearerloader – the cutting machine – intelligent. Powerful computers and communication systems as well as modern sensoric such as infrared, radar and vibration measurement are enabling that. The machine itself recognize obstacles and the bound aries between coal and rock. The result is effective and material friendly mining of coal underground. The project has been awarded with the research award by RAG in 2009.

established with mining companies in Poland, the Czech Republic and Ukraine with a view to marketing this state-of-the-art equipment – much of which is no longer deployable here at home – and the know-how that goes with it. An increasing number of enquiries of this kind are also coming from China, Turkey, Russia and Mexico.

These examples show that despite the decline in coal production at home mining technology has continued to make huge progress year on year, and this process is continuing. This owes much to the fact that mining coal from some of the deepest deposits in the world calls for the highest level of technical performance, combined with extensive expertise. The high regard that is held around the world for the innovative efforts of the German coal industry can be measured by the huge interest shown in presentations by our coal industry personnel given at international conferences and seminars.

Photographs:
Mine methane power plant of Herne community supply at location of former Mont Cenis mine

Climate and the environment

Current developments in national and international climate policy

National and European climate policy in the latter half of 2008 and through 2009 was characterised by the implementation of the EU's climate protection proposals (the 'Green Package') of January 2008. The centrepiece of the Green Package is the revision of the European emissions trading system for the period post-2012, which marks the end of the second trading period and the commitment period under the Kyoto Protocol. The key element in the European emissions trading scheme, which was adopted by the European Parliament by overwhelming majority on 17 December 2008, involves a significant reduction in emission levels under the trading system for the period 2013 to 2020. This means that by 2020 installations participating in the scheme will have to reduce their emissions by 21%, as measured against the reference year 2005. The great majority of these emission permits are allocated to the electricity generating companies. These permits are not now to be issued free of charge, as in years gone by, but will be allocated by auctioning at the bidders' expense. This will drive up the cost of electricity and the increase will have to be borne by Europe's industrial and private consumers alike.

Full auctioning of emission permits in the power generating industry will hit the two carbon-rich fuels of coal and lignite particularly hard, as the greatest increase in electricity production costs will be felt in this sector. The likely trend here will be towards 'decarbonisation', especially when it comes to the building of new power stations, as new investment in coal and lignite fired plant will only be forthcoming if the full costs can be passed on to the electricity market. The emissions trading scheme favours low-carbon energy sources like gas. Price levels and price risks have so far prevented these fuels, whose benefits have helped them become established in the heat market, from becoming baseload energy carriers in the German power generating sector. However, the emissions trading scheme threatens to shift this balance. Industrial installations operating in the non-power sector will gradually be phased into the auctioning system: 80% of the permits will still be allocated free of charge in 2013; this will be reduced to 30% in 2020 and then to zero by 2027.

The Directive adopted by the European Council in March 2009 contains a number of loopholes that the Commission has to close before the start of the third trading period in January 2013. This particularly relates to the demarcation of the 'carbon leakage sectors', which are subject to international competition, and the definition of benchmarks for these very sectors.

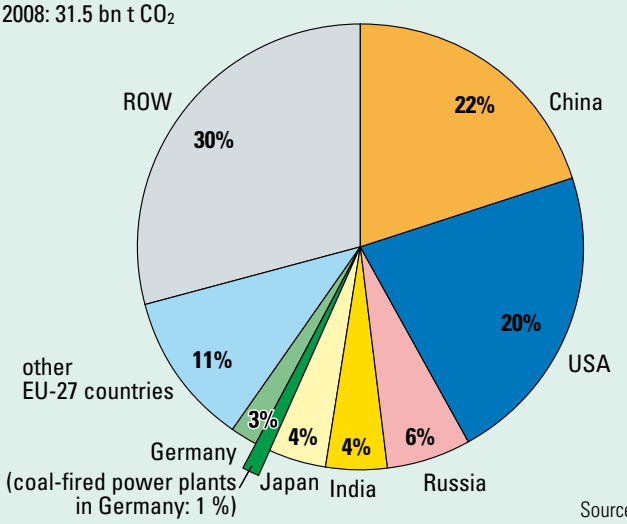
If the competitiveness of European industries is not to be excessively disadvantaged certain exemptions from the auctioning process need to be put in place for the energy-intensive sector, which would also include coking plants. These exemptions would provide for the free allocation of emission permits for the 10% most efficient installations in the sector concerned, while the rest of the operators in the carbon leakage sector would ultimately, at least in some measure, have to buy-in the emission permits allocated to them. Moreover, the number of permits allocated within the entire emissions trading scheme – whether cost-free or not – is to be reduced by 1.74% a year from 2013 to 2020, so that by the end of this period we can expect to see a significant shortage of emission allowances.

At international level the climate debate of 2009 has been conducted against the background of preparations for the 15th Conference of the Parties to the UN Framework Convention on Climate Change (COP15), which is to take place in Copenhagen in December this year. The Conference will seek to reach a follow-up agreement to the 1997 Kyoto Protocol and to adopt a set of climate targets for the period after 2012. In the run-up

to the negotiations the European Union unilaterally committed itself in January 2009 to a 20% reduction in emissions compared to 1990 levels and also expressed its readiness to cut CO_2 emissions by 30% in the event that other industrial nations undertook to make comparable cuts in their emission levels. It is also calling for the global temperature rise to be limited to 2°C and to achieve this wants to see a 50% cut in global emissions by 2050 compared to 1990 levels. The EU's final negotiating position is to be decided at a summit meeting of the European Council in October 2009.

Global energy-related CO_2 emissions

2008: 31.5 bn t CO_2



Source: BP, 2009

These European demands were taken up at the G8 L'Aquila Summit in Italy in July 2009. The G8 countries want to reduce their greenhouse-gas emissions by 80% by the year 2050 and are calling for global emissions to be cut by 50%. If this target is to be reached the developing and transitional countries would also have to reduce their emissions by at least 30% between now and 2050, this depending on the reference period selected after 1990 as the starting point for the emissions reduction process. This implicit demand by the G8 Summit will pose a new set of tough challenges for international climate policy.

If we compare this with the CO_2 reduction targets that the developing countries are demanding the industrialised nations to introduce (a 40% cut by 2020 compared to 1990 levels) it is clear that the reduction proposals announced to date fall well short of what is being called for. The UN climate negotiations are being further hampered by the fact that the developing countries are asking the industrialised nations to pay in the region of US$ 200 bn a year as reparation for 'climate damage', a demand that appears less than realistic given the current economic and financial crisis. The emerging nations themselves, and especially China and India, which have to bear a large responsibility for the dramatic increase in emission levels over the last ten years, are however not prepared to make binding emission reduction commitments of their own. Nevertheless, they have indicated that they are generally prepared, for environmental reasons, at least to work towards a significant improvement in their energy efficiency rates (i.e. energy input or CO_2 emission level per unit of GNP) and will even seek to stabilise their CO_2 emissions by about 2030. This would go against the expected trend and lead to a general reduction in greenhouse-gas emissions, including those from the developing countries, which in particular means China and India.

The election of President Barack Obama to the White House in January 2009 was immediately followed by a new policy direction on environmental emissions. This quickly resulted in a draft bill being submitted and adopted by the US Congress that, according to the World Resources Institute, would lead to an overall 28% reduction

in greenhouse-gas emissions from the USA by the year 2020, when measured against 2005 levels. This bill has still to be approved by the US Senate, whose decision certainly cannot be taken for granted. This climate protection programme is even broader in scope than the EU Green Package or Germany's Meseberg/Brandenburg climate policy decisions of August 2007. It includes all six Kyoto gases and covers comparatively much larger areas of the American economy than does the European emissions trading scheme. The Waxman-Markey bill requires in total a 17% emissions reduction from 1990 levels by 2020. This is a relatively ambitious figure, especially in the light of current emission levels, and when set against the reference year 2005 it should add up to a more demanding set of emission reduction targets that those of the European Union. Apart from Europe and the United States, however, the OECD countries in general are showing little or no sign of willingness to reduce their greenhouse-gas emissions by a comparable amount by the year 2020.

As part of the climate debate in Germany we are increasingly hearing calls for CO_2 levels to be reduced by at least 40% by 2020, with claims that climate change has been accelerating in recent years and that this is one of the reasons why we have to reduce greenhouse-gas emissions in a more significant and sustained manner than was thought necessary just a few years ago.

'The doomsday hysteria being propagated by some elements of the press and media is simply not supported by scientific estimations.'

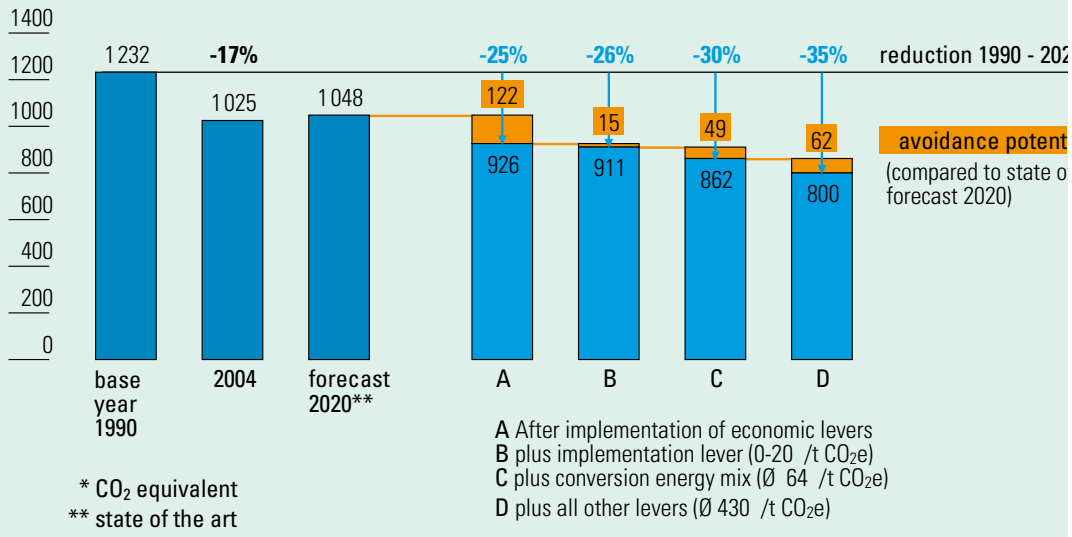
Prof. Dr. Richard S. J. Tol,
Environmental Economist and member of the Intergovernmental Panel on Climate Change (IPCC), quoted by Philip Plickert in the FAZ, 14 September 2009.

What the public does not seem to recognise is that science holds a spectrum of opinions on the extent to which anthropogenic greenhouse-gas emissions are responsible for the rise in temperature witnessed in recent decades. The press and media tend to a large extent to listen to those scientists who belong to the 'alarmist' end of this spectrum, who are calling for substantial cuts in CO_2 emissions in spite of the fact that, in the opinion of other scientific experts, climate change – as defined for example by global mean temperature, rising sea levels and hurricane frequency – has not gathered pace in recent years. Writing in the bulletin of the American Meteorological Society a number of authors (Peterson and Bariger, in a special supplement on 'State of the climate 2008', Vol. 8, August 2009) have discussed in some detail how recent global developments compare with the events of previous years. To quote from a paper by Knight et al. (ibid.), which uses data acquired up to and including December 2008, *'Observations indicate that global temperature rise has slowed in the last decade'*.

As part of a BDI-organised climate event held at the end of March 2009 the BDI initiative 'Business for climate protection' (the BDI, or Federation of German Industry, comprises some forty companies and associations, including the GVSt) published an updated version of the McKinsey study 'Costs and potential of greenhouse gas abatement in Germany', which first appeared in 2007. Germany is therefore the first country in the world to possess a detailed breakdown of all known technological levers for reducing greenhouse gases in '€ /t CO_2'. A key criterion for assessing the 'acceptability' of the investment effort in conversion and avoidance measures is whether or not this will restrict economic growth, competitiveness and quality of life.

The level of greenhouse-gas reduction that is considered acceptable by 2020 has been put at 30%. A 25% reduction could be achieved during this period by employing economic levers, while a figure of 30% is possible if the energy mix could also be adjusted to include a higher share of renewable energy. This would require political support and the levying of additional

Reduction of GHG emissions in Germany until 2020



Source: McKinsey study, 2009 (base szenario) on behalf of the BDI-Initiative „Wirtschaft für Klimaschutz".
Data account for the continued operation of nuclear power plants.

abatement costs of up to 49 €/t CO_2 equivalent (CO_2e). A 40% cut in greenhouse gases, on the other hand, is not thought to be achievable before 2030, and even then only if CCS technology makes a breakthrough after 2020.

As well as looking at energy utilisation the study also examines various other sectors such as construction, transport and industry. It assumes that Germany will stick to its intention to phase-out nuclear energy and retain the Renewable Energy Sources Act. The study concludes that the most cost effective savings are not to be found in the energy sector at all but in fact in the construction industry and in some areas of industrial manufacturing (particularly through the use of more efficient drives). Within the energy sector itself the retrofitting of coal-fired power stations is considered as being among the most cost effective options, particularly as these 'economic levers' can often pay off. The study also pointed out that in addition to the rich harvest of economic and sustainable emission reductions we can also expect to see to a relatively steep rise in the marginal abatement costs, in other words any further reductions will mean ever higher abatement costs per tonne CO_2 equivalent.

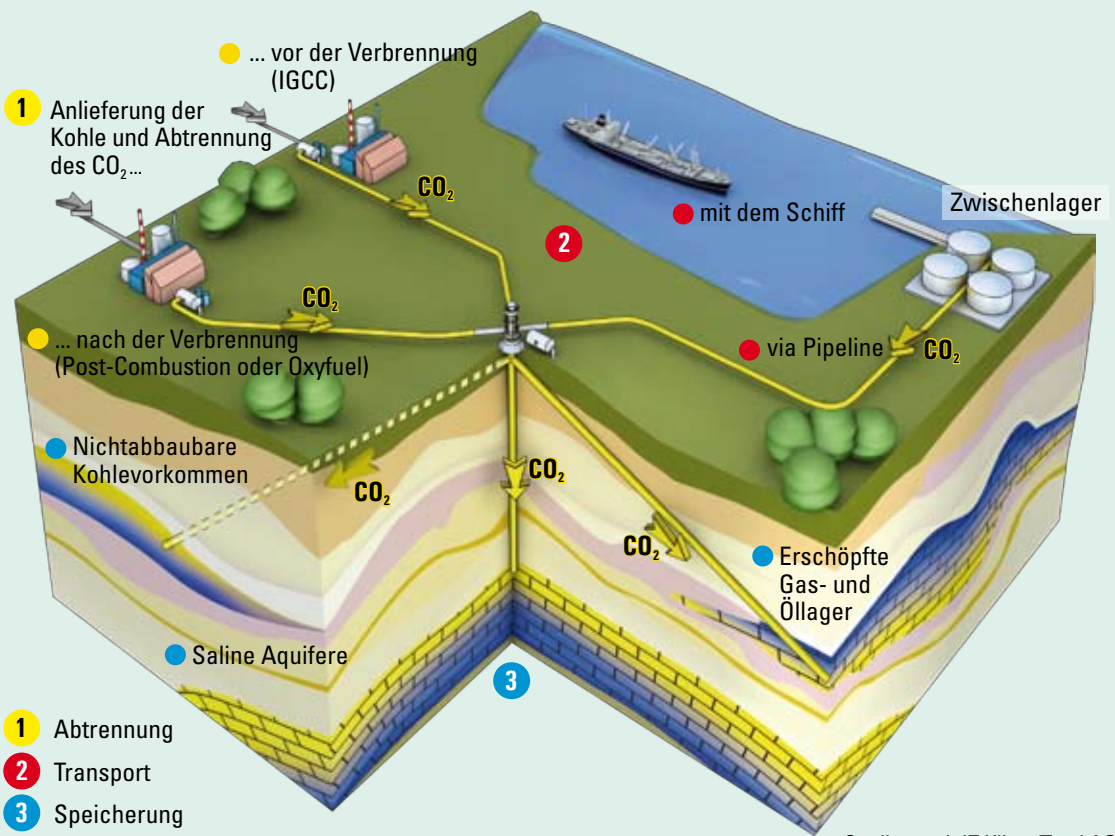
BDI President Hans-Peter Keitel regards the study as evidence that climate protection and economic growth can go hand in hand and that environmental targets can be retained even in the current economic crisis. However, he believes that climate policy has to be shaped so that it provides a stimulus for economic growth and allows fair competition. Irrespective of oil price levels, and even in the event of extreme price fluctuations, he still sees a huge potential for avoiding greenhouse gases.

CO_2capture and storage (CCS)

Climate change is a global issue and major efforts are being made to find a solution to it. Europe, and Germany in particular, wants to play a leading role in all this, but then 'saving' the climate is not something which can be done alone. A sustainable climate policy therefore has to be embedded in international climate protection strategies and agreements if the competitiveness of the national economy is not to be weakened and if jobs are to be safeguarded. New technologies for power generation, transport and the heating and cooling of buildings are currently being researched and introduced to the market. Carbon capture and storage (CCS) – the separation of CO_2 from power-station flue gas and its safe injection into underground geological deposits – is one such technology, though it is not yet ready for deployment on a large scale.

At a trilogue meeting on 13 December 2008 the Council of Ministers and the European Parliament reached a compromise agreement on the Directive on the geologi-

CCS-Technologie: Möglichkeiten der CO_2-Abtrennung und CO_2-Speicherung



Quelle: nach IZ Klima/Total AG

cal storage of carbon dioxide (the CCS Directive). This Directive was finally and formally adopted in early 2009 and was published in the Official Journal of the European Union on 5 June 2009. The amendments to the Commission proposal which were tabled by the European Parliament environment committee were again scaled back to create a workable solution. The Directive is aimed, among other things, at establishing a link between the issuing of planning approval for combustion plant in the ≥ 300 MW category and their 'capture readiness'. This means that for new installations it needs to be assessed whether enough space capacity for the capture and compression of CO_2, suitable storage sites are available and CO_2 transport facilities are technically and economically feasible and power-station retrofitting is technically and economically feasible. The CO_2 limit being called for by the European Parliament has been withdrawn, though the Directive does contain a review clause that allows the Commission to conduct a reassessment of the provisions in 2015. The requirements in respect of 'capture readiness' are not actually defined and it is therefore left up to the national authorities to draw up the specific criteria.

The Emissions Trading Directive, which was adopted at the same time, states that up to 300 million CO_2 trading allowances in the ETS (Emission Trading System) new entrants' reserve fund 2013 to 2020 shall be made available until December 2015 to help stimulate the construction of up to 12 commercial demonstration projects for CCS along with demonstration projects for renewable energy technologies. The European Commission has also allocated € 1.05 bn for CCS projects under the European Energy Programme for Recovery (EEPR).

The CCS Directive has to be transposed into national law within two years of its publication. Most of the large energy supply companies involved in coal-based electricity generation pressed for rapid action on national implementation in order to obtain legal assurances for their investments in CCS projects. The 'Draft law regulating the separation, transport and permanent storage of carbon dioxide' was approved by the German cabinet on 1 April 2009. Time was of the essence if the bill was to be approved before the end of the legislative period ending in September 2009.

With CCS technology the industry is entering new territory. As the research and development phase is likely to take many years, and in order to progress as rapidly as possible, companies such as Vattenfall Europe, RWE Power and E.ON have already started work and have launched their own pilot projects. However, the coalition bill failed to obtain majority support. It is expected that the postponement of the bill until after the Federal elections on 27 September 2009 will help resolve any outstanding issues. In a statement on the subject the Council of Environmental Experts, which is a scientific advisory body set up by the Federal Government, referred to the many technical, ecological and financial questions connected with CCS technologies that have still to be settled. There were, for example, still no reliable figures for the available storage capacity in Germany, and in fact all that was known was that this was limited. The ecological risks of storing CO_2 were said to be largely unresearched. It was still not possible at the present time to draw up a satisfactory set of regulations on the large-scale use of CCS technology. Moreover, the problems that were likely to arise in respect of how the public would accept the pipelining and underground storage of CO_2 were said to be underestimated. At the BDEW (German Energy and Water Association) conference in June 2009 Chancellor Angela Merkel spoke about the importance of CCS technologies for the German export sector and referred to the risk of Germany's industrial base being damaged if the country was not able to participate in the European CCS pilot projects. However, she also said that if the unresolved issues could not be settled *'it would be better to leave well alone than to adopt a bad infrastructure law'*.

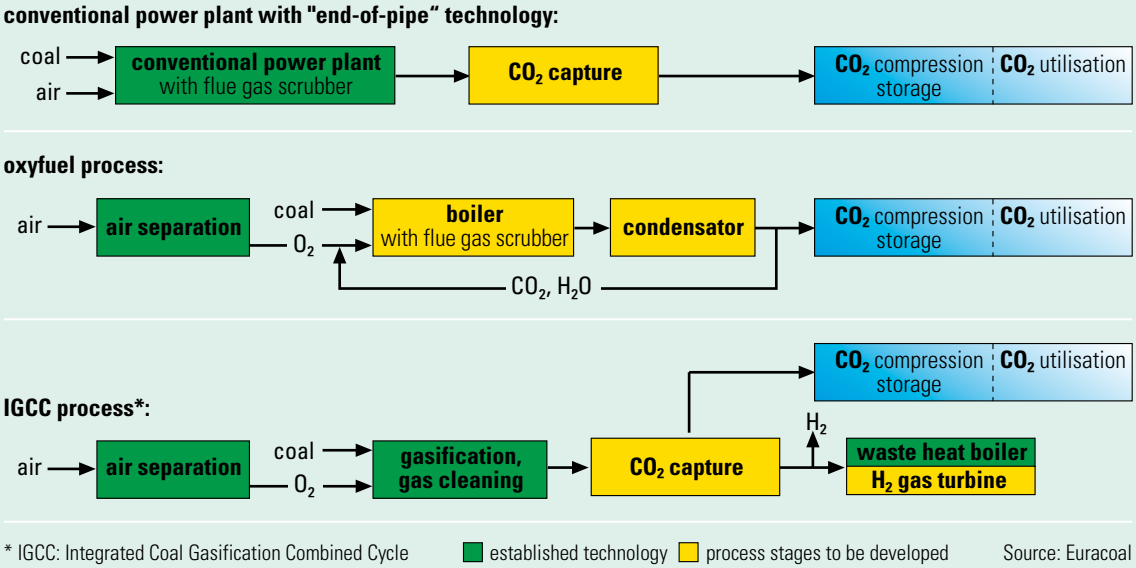
When a second attempt is made to get the CCS bill through after the elections winning the acceptance of the public at large is the biggest challenge besides effective technical solutions. This can only be done through an early, credible and factually comprehensive publicity campaign, especially at local level. If new concerns arise through lack of attention to sensitivities on the ground it will only prevent new technical options from being considered.

In its legislative programme the SPD intends to continue with the development of CO_2 sequestration technology in Germany – which will also include EU-funded demonstration projects. The CDU/CSU says in its legislative programme: *'The technology for the separation and storage of CO_2 (CCS) can make a significant contribution towards the climate-friendly use of fossil fuels.'*

To date it has only been possible to make a very rough assessment of how economically viable CCS technologies will be, as the individual process involved are still very much at the R&D stage. Nevertheless, on the basis of the calculations already carried out by various institutions we are able to undertake an economic comparison between state-of-the-art conventional coal burning technology, CCT (clean coal technologies) – i.e. with efficiency levels as they are today and as they are expected to be in 2020 – and CCS. Such a comparison of efficiency levels and electricity production costs shows that power-station efficiency rates will decline when CCS technology is introduced – which ultimately means a higher fuel input for the quantity of electricity being generated – and operating costs will nearly double.

According to a study carried out in September 2008 by consulting firm McKinsey & Company and entitled 'CCS: Assessing the Economics', CCS costs could fall in line with future – estimated – CO_2 permit costs as we enter the commercial phase some time after 2020. This is based on the expectation that permit costs for CO_2 emissions from conventional power stations will be roughly comparable with

CO_2 capture technologies



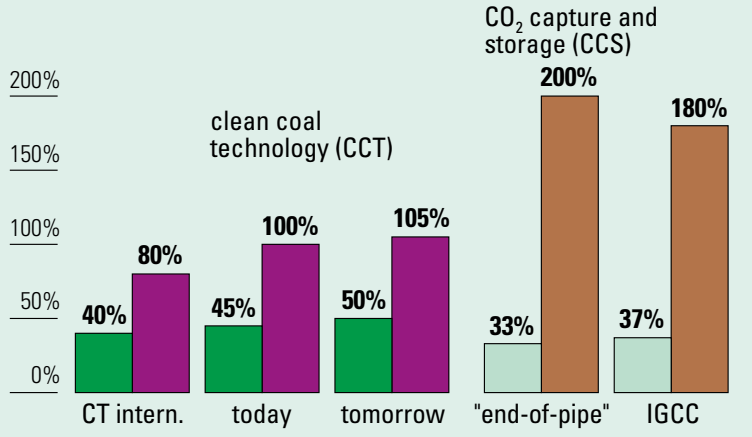
* IGCC: Integrated Coal Gasification Combined Cycle

established technology

process stages to be developed

Source: Euracoal

Efficiencies and costs of CCT and CCS



Source: STEAG/VGB PowerTech, 2007

the cost of using CCS technology per tonne of CO_2. CCS power stations would then no longer be at a disadvantage from a cost point of view. From the current perspective of the European coal industry it is generally to be concluded that CCS can make thoroughly good sense as a strategy in the context of today's environmental requirements.

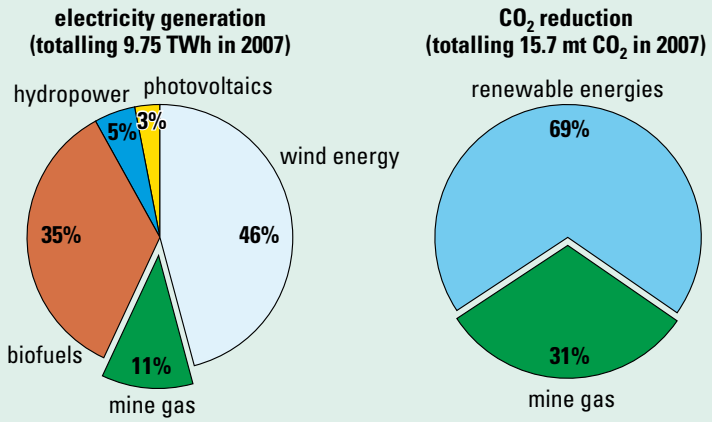
However, this assessment will depend on a number of basic conditions. Extending the remaining life of Germany's nuclear power stations is one particular measure that could have a significant influence on CO_2 permit prices – and consequently on the chances of CCS technology becoming a reality.

Renewable energies and mine gas

In August 2007 the German cabinet, meeting in Meseberg, adopted an ambitious integrated energy and climate programme with 29 key elements. A package of 21 acts and regulations were subsequently attached to this programme in December 2007 and May 2008. Most of the measures have now been implemented, including amendments to the Combined Heat and Power Act, the Renewable Energy Sources Act (EEG), the Energy Industry Act (which seeks to extend the national electricity grid), the Energy Savings Regulation and the Heating Costs Regulation. Arrangements have also been put in place to monitor the progress and impact of these measures. In November 2010, and then every two years after that, the relevant departments will present the Federal cabinet with a report detailing the impact of the integrated energy and climate package. This report is to be based on a survey carried out by independent experts.

Between 2000 and 2007 the contribution made by renewables to Germany's total energy consumption more than doubled to 9.8%. The original aim of the Federal Government was to ensure that by 2010 some 12.5% of gross electricity consumption is met from renewable energy sources. This target was more than exceeded by 2007, with a figure of 14%. On 6 June 2008 the Bundestag adopted the new Renewable Energy Resources Act (EEG) and the Renewable Energies Heat Act (EEWärmeG). Both pieces of legislation came into force on 1 January 2009. The Federal Government now wants to raise the input from renewables to at least 30% of total power supply and then to gradually increase this share year on year. In the case of new builds the EEWärmeG lays down various obligations for the use of renewable energies. The Act seeks to raise the renewables' contribution to heating requirements to 14% (from the current 7.7%) by 2020. According to preliminary estimates from the AGEE-Stat (working group for renewable energy statistics) the use of renewables will save Germany in the region

Electricity generation and CO_2 reduction through renewable energies and mine gas in North Rhine-Westfalia



Source: Bez. Reg. Arnsberg; IWR

of 115 million t of CO_2 a year – of which some 57 million t alone can be attributed to the EEG.

The EEG has been promoting the extraction and utilisation of mine gas since the year 2000. This effort, which has both mine-safety and environmental benefits, is mainly directed at using the gas as a fuel source. In the Ruhr coalfield and in Saarland a dynamic new industry has now sprung up offering job opportunities in the environmental sector. Former colliery sites still have pipework that can be employed for drainage operations, while mine plans and other data can be used to identify where new boreholes should be drilled in order to target those areas that are most likely to contain gas accumulations. At collieries still in production the mine gas is pumped to the surface through drainage pipes. Electricity produced from BHKW (co-generation) plant is fed into the regional power grid. The total amount of electricity generated using mine gas extracted from active and closed collieries now makes quite a significant contribution towards local power supplies at more than fifty locations. In 2008 more than 1.3 bn kWh was generated from some 150 co-generation plant of this kind with a combined output of 228 MW. The heat produced, which currently totals 710 GWh, is used where possible for heating the colliery buildings or is delivered to external consumers. Mine-gas marketing companies are helping to reduce greenhouse-gas emissions by 5.9 million t CO_2 equivalent and are therefore contributing significantly to protecting the environment. In North Rhine-Westphalia 11% of all renewables-based electricity is generated from mine gas and this fuel also contributes 31% to overall CO_2 reduction.

Coal's potential

Coal hydrogeneration is currently experiencing something of a global revival as countries search for possible alternatives to using mineral oil as a motor fuel. The tried and tested coal liquefaction process, which can be used for producing a range of liquid hydrocarbons such as carburetor and diesel fuels, methanol (as a petrol additive or as a raw material) and coal oil for heating, is one way in which Germany and the EU in general can reduce its reliance on crude oil in the long term. About two barrels (1 bl = 159 l) of liquid fuel can be recovered from one tonne of coal. Add to this the fact that coal is the most abundantly available of all the fossil fuels and that unlike mineral oil Germany and the EU has access to massive indigenous reserves. Of course producing motor fuel from crude oil is at present more energy efficient than using coal. What is more, coal liquefaction schemes usually raise environmental concerns as they produce more total CO_2 emissions

then conventional oil refining. Then again, coal liquefaction plant could be coupled to a CCS system. When using the Fischer-Tropsch process the CO_2 has to be separated from the synthesis gas in any case, which means that there are no additional separation costs. However, investment in coal liquefaction projects is simply not viable without political support and an adequate policy framework. International developments and stimuli, along with a proper debate on a national raw-materials strategy, could cast fresh light on the situation. This technology, which was originally developed in Germany, is now being put to use in a number of projects under way in countries such as China and the USA.

Underground coal gasification (UCG) is one way in which we can exploit deep-lying or thin coal seams that cannot be extracted using modern mining methods, or areas of coal that would simply not be economically viable to work. This involves converting the coal in situ into synthesis gas. The coal is ignited via a borehole and is then heated under controlled conditions so that no combustion takes place, before the resulting gas is extracted via a production well. This method can produce about 2,700 m^3 of gas per tonne of coal. This synthesis gas can be used for electricity generation, as a chemical feedstock or for fuel production. UCG projects are now under way in many parts of the world, notably in the USA, Russia, China and Australia. China currently operates the largest UCG programme, with 16 projects now running.

International research has also been carried out in recent years to determine whether UCG-degasified coal seams might provide suitable locations for the storage of CO_2. During the gasification process the coal swells and its plastic behaviour changes. This seals the fissures and pores around the walls of the cavity and prevents any further leakage. The wells drilled for the gasification process could also be re-used for the storage operation. This saves money, as drilling makes up the largest component of the total cost of the storage project. The RWTH (Rhine-Westphalia Technical University) in Aachen and the DMT GmbH & Co. KG in Essen are now working together on the CO_2SINUS project that involves an innovative concept for storing CO_2 in post-gasification coal seams. This will seek to examine the environmental impact of such an operation and analyse the potential cost efficiency of UCG-CCS technology. The scientific findings will then be used to develop an industrial-scale pilot project.

It has been calculated that there are some 70 bn t of coal reserves worldwide that cannot be mined by conventional means but would be suitable for the UCG process. Underground coal gasification in combination with CCS therefore seems to be a future technology of real interest.

Whether or not Europe decides to invest again in coal liquefaction

Coal liquefaction plant and projects worldwide

The South African company Sasol is the world's leading exponent of coal liquefaction. This state-owned enterprise, which was founded in the 1950s, currently produces some 150,000 barrels a day (bl/d).

China's largest coal company, the Shenhua Group, has active liquefaction projects in Shaanxi, Inner Mongolia, Ningxia and Xinjiang. The country's first direct coal liquefaction project was started up in Inner Mongolia in 2004. The target is to produce 5 million t of petrol, kerosene, diesel fuel etc. from about 9.7 million t of coal (for an investment of around US$ 3 bn). By 2020 the Shenhua Group will have built up some 30 million t of coal liquefaction capacity in China's four northern provinces.

The US Pentagon has now launched a research programme for the production of coal-based jet fuel. Eleven such projects with a combined capacity of more than 230,000 bl/d are currently at the planning or implementation stage.

and gasification will depend on more than just economic viability. If the infrastructure is missing and the know-how has gone elsewhere then additional incentives will be required if we are to make up for lost ground. All the more reason, therefore, that Germany should revive R&D efforts in this field and not completely squander the opportunities that our coal reserves can provide.

Energy efficiency and industrial emissions

Energy efficiency is a term that now crops up repeatedly in connection with climate protection. Studies have been quoted to show that billions of kilowatt-hours of electricity could be saved through efficiency improvements. For private households this makes real sense, provided that they can afford to switch to a more efficient system. Industrial undertakings already have a fair amount of self-interest in minimising their operating expenses, which includes their energy costs. This is why they are developing and introducing custom-made energy management systems that are designed to cut energy costs; and coal mining and coal utilisation companies are doing this, too. As conditions tend to differ from one branch of industry to another each company tends to adopt its own individual approach when it comes to reducing energy usage. In this respect there would be no real purpose in seeking to regulate these specially-tailored energy management systems. The same applies to the Federal Government's attempt to transpose into national law the European directive on energy end-use efficiency and energy services. It is certainly true that under the terms of the Meseberg Package an agreement has been reached with German industry that by 2013 at the latest moves will be made to link tax allowances/exemptions to the introduction of an energy management system. However, this does not imply any general commitment on the part of industry to introduce an energy management system; and it certainly does not signal the early adoption of such a programme. As a quid pro quo for the undertaking to cut CO_2 emissions, which German industry gave under the Climate Protection Agreement of November 2001, the Government has agreed not to introduce a binding energy audit. A fact-based environmental strategy has to weigh-up costs and benefits. Nevertheless, it should be left to the competitive market to find ways of achieving environmental protection targets.

When it comes to climate protection we have to be aware of the global dimension. Germany taking a leading role in this area will not be enough to reduce the global increase in emissions. It is much more important to act as a role model by developing and providing new technologies.

On 25 June 2009 the Council of Environment Ministers agreed on the Industrial Emissions Directive that combines the existing Directive on Integrated Pollution Prevention and Control (the IPPC Directive) with six other sectoral directives, including the Large Combustion Plant Directive and the Waste Incineration Directive. The new Directive affects about 52,000 industrial installations in the European Union, including coal-fired power stations. Combustion plant, for example, now have to meet stricter emission limit values for SO_2, NO_x and dust. Greater attention will henceforth be focused on the BAT (Best Available Techniques) documents, which are in future to be translated into all the official languages of the European Union. National approval bodies will in future have less scope for issuing exemptions for installations with unfavourable emission limit values. According to the latest BAT document operating permits have to be brought up-to-date within five years. As before, however, geographical, technical and ecological considerations have to be taken into account when laying down the approval conditions. Inadequate use of the BAT documents and failure to implement and abide by the legal provisions can impede environmental efforts at Community level. In Germany industrial undertakings have cut their SO_2 emissions by more than 80% over the last ten years. Industry is now only responsible for about 15% of total No_x emissions.

In its Green Paper published at the end of March 2007 the European Commission announced its intention to take further steps to introduce market-based instruments. To quote Environment Commissioner Stavros Dimas: *'Market-based instruments such as emissions trading, environmental taxes and targeted subsidies harness the power of market forces to protect the environment. This more flexible and cost-effective approach has proved its value but it is still under-utilised.'* This means that a NO_x/SO_2 emissions trading system could be introduced within the next few years. The Netherlands and Slovakia already have such a scheme in operation. The Environment Directorate-General takes the view that employing 'best available techniques' to achieve emission reductions is the long way round and that emissions trading is a much quicker way to achieve this. The above figures for SO_2 and NO_x emissions in Germany show that we do not need a trading system provided that the legal provisions are strictly adhered to. What is more, regulatory legislation creates planning certainty, while an emissions trading system constitutes a massive interference into company planning. A number of EU member states are clearly lacking a resolute and strict environmental policy. This fundamental problem will not be resolved by a change of instruments.

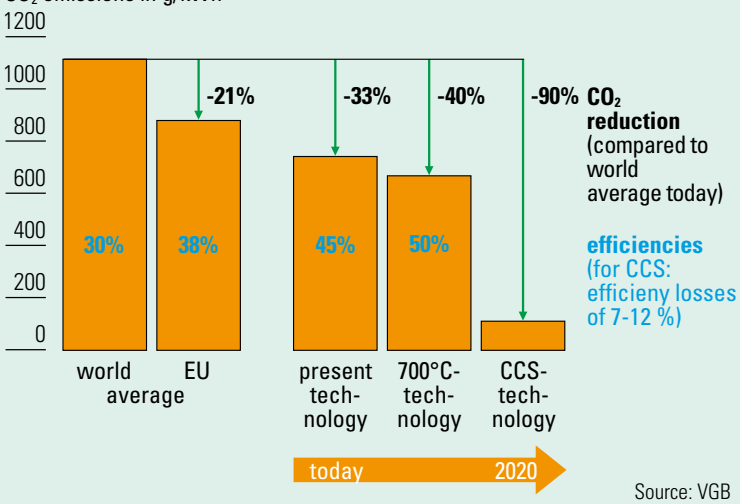
As part of the competency network 'power station technology NRW' experts are currently working on a cross-company basis along the entire supply chain to develop strategies and solutions for innovative power generation. This includes 700-degree technology and the low-CO_2 power station. It is up to the politicians to ensure that the framework conditions are in place to support these developments, although the NRW Ministry for Commerce, Trade and Energy has indicated that European decisions on emissions trading have hit North Rhine-Westphalia particularly hard.

Power plant Walsum

New power stations are now usually designed to operate at efficiency levels of between 40 and 45%. This is likely to increase to 50% in the years ahead. The new 'Walsum Unit 10' installation currently being built by Evonik Steag GmbH, which is the perfect example of an efficient coal-fired power station, will operate at around 46% efficiency and will have a rated output of 750 MW. This will be enough, for example, to supply electricity to more than 1.3 million homes. The new unit is setting international standards for power-plant efficiency and no comparable coal-fired power installation anywhere in Europe has yet achieved figures of this kind. The global average for power station efficiency currently stands are around 30%, while in Germany the average efficiency level for this sector is 38%.

Higher efficiency means that the power station needs less coal to generate the same amount of electricity: this not only helps conserve resources but also means fewer emissions, particularly CO_2. In the case of Walsum 10 this is achieved through higher steam temperatures, higher steam pressures and

Reducing CO_2 emissions of hard coal-fired power plants through efficiency increases / CCS technology



Source: VGB

an efficient, 181 m-high cooling tower. This serves to maximize the steam-energy potential in the turbine. The most expensive single component in the power station is the 106 m-high steam generator (boiler). The new series of steam generators will be able to produce steam at very high temperatures (over 600°C) and under extremely high pressures (about 270 bar). The steam then passes through the turbine unit and an attached generator converts the kinetic energy into electricity.

German Environment Minister Sigmar Gabriel, speaking at the Walsum 10 stone-laying ceremony on 20 November 2006, was full of praise for the project: 'This investment in high-efficiency, low-CO_2 power generation has come at just the right time. What we have here is a technology that can help protect the environment.' And it could do even more for the world's climate if it were to be taken up at international level – especially in China, where more than 550 new coal-fired power stations are to be built by 2015. If power-station efficiency could be increased from 30 to 45% worldwide we could cut global CO_2 emissions by nearly 2 bn t. Speaking at the boiler pressure test on 2 July 2009 NRW Economic Affairs Minister Christa Thoben said: *'The greatest contribution that any country or region can make to climate protection is to renew its coal-fired power stations. There is no alternative to highly-efficient, up-to-date coal-fired power plant like Walsum 10.'* The NRW Government was backing modern power station technologies because they could make a significant contribution to reducing CO_2 emissions in North Rhine-Westphalia by 2020.

International trends in the energy and coal markets

Photograph design:
Stock exchange

The crisis has also affected the energy sector

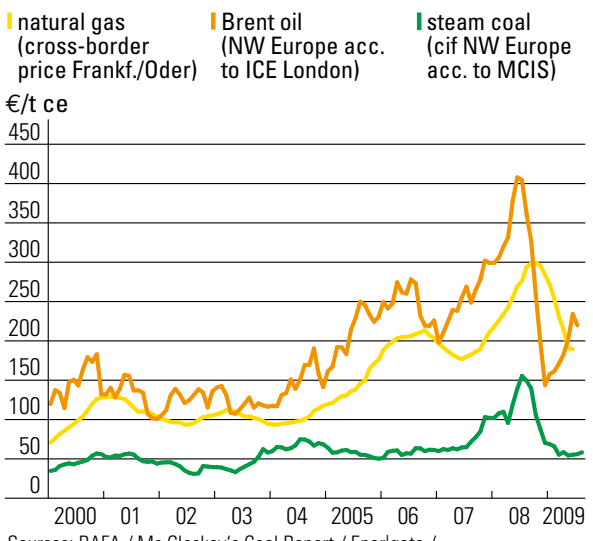
Since the turn of the year 2008/2009 the global economic and financial crisis has also caused huge disruption in the energy sector. In a new study that was used as a background paper for the G8 meeting in May 2009 the International Energy Agency (IEA) has now analysed the effects of the global crisis over the course of the year. This shows that investment in all supply and demand-side areas of the energy sector has dropped off enormously. Global electricity consumption fell by more than 3% in 2009, which was the first time this had happened since the Second World War. Investment in the power-plant sector in particular was on the verge of collapse and the IEA was especially concerned about new investment in energy efficiency and clean energy projects.

According to the IEA study the world's coal industry will be particularly affected and will see investment fall by some 40% compared with the previous year. In the summer of 2008 spot prices for steam coal climbed above US$ 200/t while the contract price for coking coal rose to more than US$ 300/t. This temporarily generated huge increases in profitability and – as demand remained high – led to an enormous upturn in investment volume. Admittedly this could be attributed in part to the need to catch up on previous years' underinvestment in mining production facilities and infrastructure capacity. Under the effects of the global economic crisis and the fall in prices as a result of the dwindling demand we then saw a collapse of planned investment all along the coal supply chain. This came as a severe blow to the medium and long-term development of production capacity in the international coal mining sector. The international oil companies also cut their investments by a quarter after oil prices – which had stood at record levels in mid-July 2008 – fell by nearly two thirds. Moreover, at the beginning of August 2009 the IEA's Chief Economist, Fatih Birol, announced that on the basis of an international survey of more than 800 oilfields it could be assumed that most of the world's major oil production sites had already passed their peak and would run dry in about five years.

The low level of investment in the energy sector, and not just in the oil and coal industries, will – according to the IEA – again have a very negative impact on the global economy in a few years time. The IEA therefore believes that around 2013 the world could well go through another energy crisis, and possibly also a global economic crisis, as a result of dwindling oil reserves and related supply shortfalls.

A look back: just one year before much of the world's economy, and this included the mining sector and the industries that depended on it, appeared to be in a very good shape. Even though the financial crisis had already burst on the scene its impact on the non-monetary world was still being underestimated. And it was not just the industrial undertakings that were enjoying record turnover and profits. Energy and raw-materials prices rose to levels that no-one would ever have thought possible. Supply could no longer keep pace with the surge in demand, especially from the emerging nations. There were supply shortfalls as production capacity and infrastructure was found wanting. There had simply been too little investment in the years preceding the crisis. In some cases these markets also attracted the attention of speculators. As a result the day rate for

Import price development of oil, gas and coal



Sources: BAFA / Mc Closkey's Coal Report / Ener|gate / Intercontinental Exchange (ICE), London / own calculations

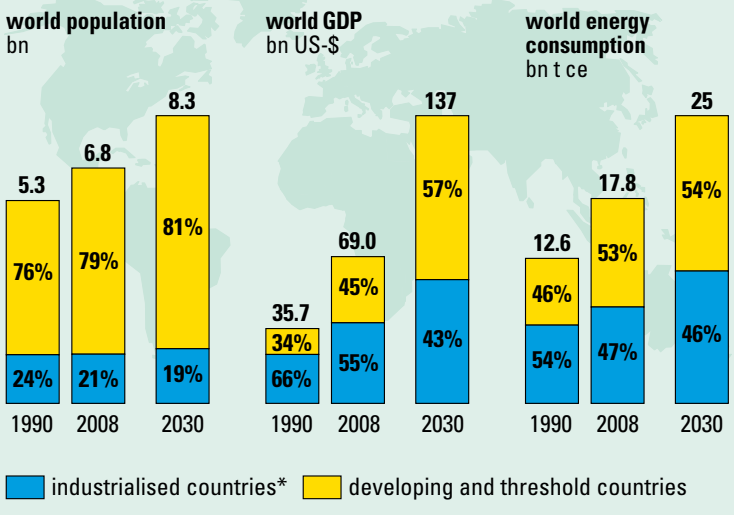
North Sea Brent crude soared to more than US$ 145 a barrel (US$/bl) at the beginning of July 2008. At the same time steam coal was selling at a spot price cif ARA of nearly US$ 220/t.

But this record boom in the energy and commodities markets was not to last long. The non-monetary effects of the global crisis led to a massive slump in demand in the steel market, which then rippled through to related markets for steel scrap, coking coal, coke and raw materials. The developing crisis spread to almost all the commodities and energy markets, often leading to a dramatic slump in demand and rapidly falling prices. The price boom of the previous year was followed by a sudden collapse on an unforeseen scale, bringing with it capacity adjustments and even a number of market exits. In the energy and raw-materials sector the crisis has brought about huge structural changes that will probably transform the business landscape completely in the years to come.

Global megatrends are set to continue

In spite of the initial effects of the crisis world primary energy consumption rose to 17.8 bn tce in 2008, which was 1.7% up on the previous year. Fossil fuels accounted for some 80% of total global PEC. Both the US Department of Energy (DOE) and the IEA have predicted that fossil energy sources will maintain their dominant position in the years ahead.

Energy consumption in comparison to world population and GDP



* OECD countries

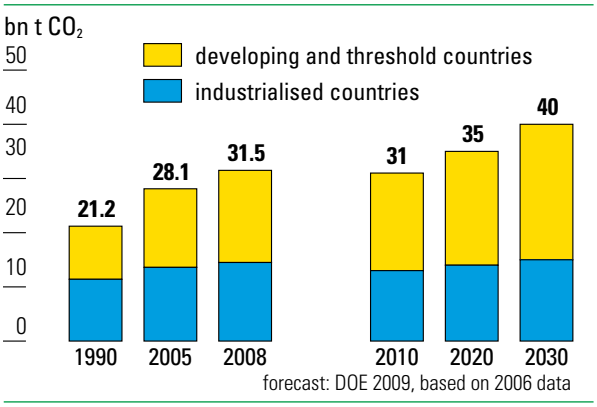
Sources: UN, IWF, DOE, 2009

While the developments depicted above were quick to cause an upset to the international energy sector there are, nevertheless, global megatrends that will continue to exert a major influence both during and after the crisis. The most important of these is the rising demand for energy and raw materials worldwide that will further intensify the international competition for increasingly scarce fuels and other commodities. This trend can in turn be attributed to much deeper underlying causes.

World population growth continues apace. According to UN figures the global population, which currently stands at 6.8 bn (2008), will exceed the 7 bn mark by 2012. The UN predicts that this will increase to about 9.1 bn by 2050, with most of this growth taking place in the developing and transitional countries. By contrast, the population of the industrialised nations will hardly change at all during this period.

The increased population growth and the economic catch-up process under way in the developing world are at the same time causing a shift in the world's economic balance.

Most of the world's GDP is still being generated in the industrialised countries. Yet within a few years their input will fall to below 50%



forecast: DOE 2009, based on 2006 data

Energy related global CO_2 emissions

and will go on decreasing. This will also result in a relocation of the world's production and demand centres. This development is taking place at an even faster rate in the energy sector. According to an assessment published in the current 'BP Statistical Review of World Energy' countries that are not part of the OECD group last year accounted for at least 53% of world energy consumption, thereby overtaking the OECD states in this respect.

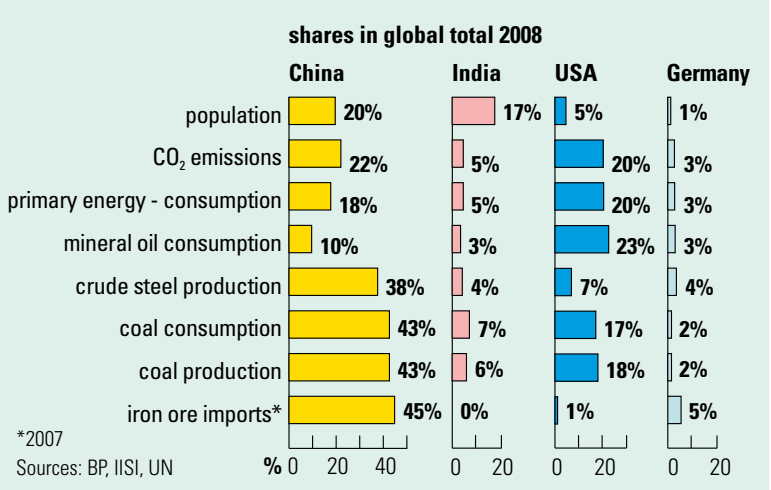
There are also major regional translocations taking place, most particularly towards China and the Asian zone. In 2008 some 87% of the growth in global energy consumption was attributable to the Asian-Pacific region, which as well as China included India, Indonesia, Thailand, South Korea and the other so-called 'tiger economies'. Similar trends are also discernible in the non-energy commodity markets.

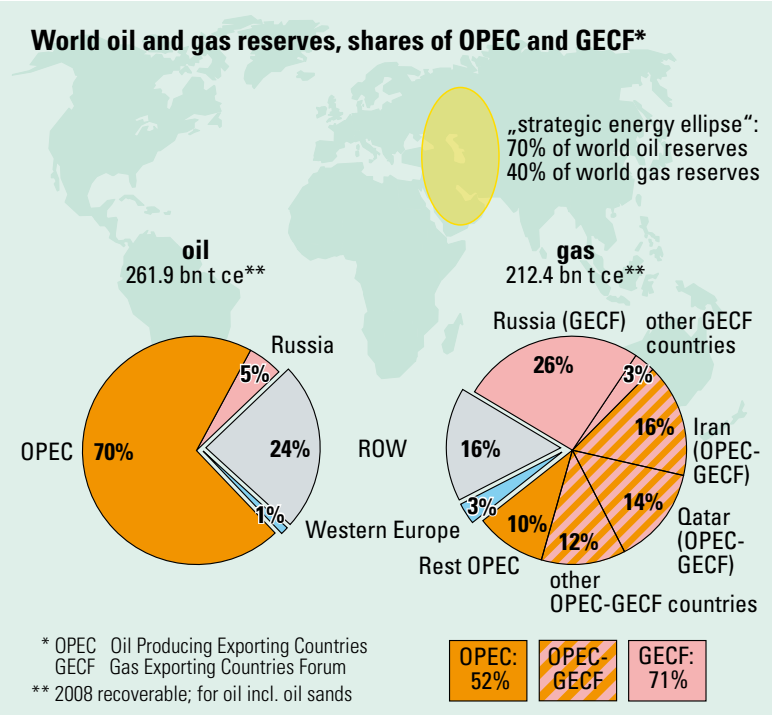
Increasing urbanisation is another ongoing global megatrend. Since 2007, and for the first time in the history of the world, there are now more people living in towns and cities than in the countryside. The UN is predicting that in 25 years time nearly two-thirds of the world's population will be residing in urban areas. And the cities will also become more densely populated. These so-called 'megacities' with more than 10 million inhabitants – for example Tokyo with nearly 36 million and New York and Mexico City with some 19 million each – will become even larger and there will be more of them. And as they expand they will also experience growing problems when it comes to energy supply.

Electrification remains a major challenge, not only for towns and cities but in the countryside too. According to figures supplied by the Federal Ministry for Economic Cooperation and Development some 1.6 bn people around the world still have no direct access to electricity.

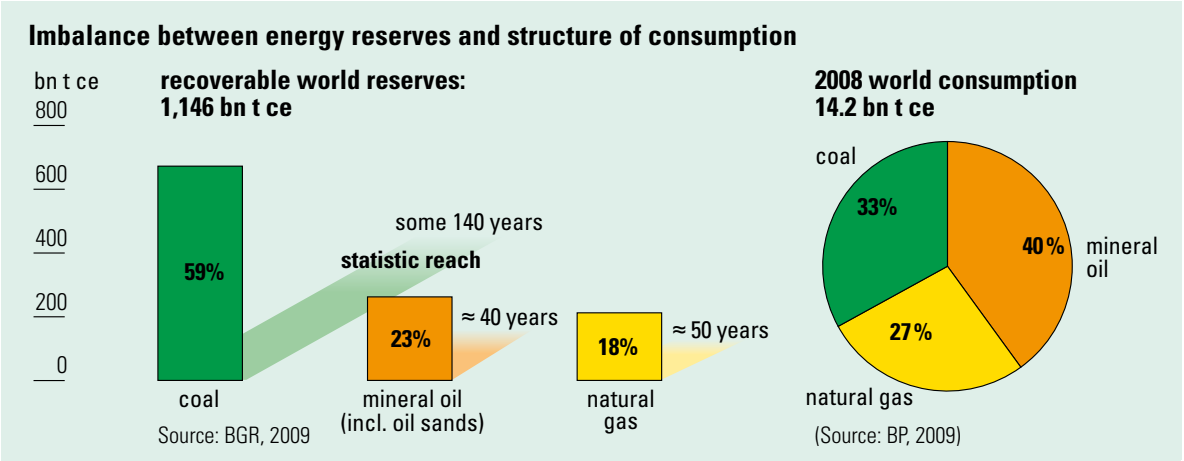
A growing environmental awareness and the increasing use of political measures to limit climate change are another two global megatrends. These efforts are still mainly focused on reducing CO_2 emissions. According to data from BP the world produced about 31.5 bn t CO_2 in 2008, which represented a global increase of 49% from 1990.

In the energy sector the global megatrends are mainly associated with world energy reserves and resources and their availability. Based on current primary energy consumption levels, and according to recent figures from the Federal Institute for Geosciences and Natural Resources (BGR), the world's recoverable oil reserves will last for another 40 years while gas reserves are expected to run out in 50 years time. Coal and lignite, on the other hand, will last for another





140 years: solid fuel is the most abundantly available of all energy resources, accounting for nearly 60% of the world's total recoverable reserves. In the case of oil and gas we also need to take account of the fact that these fuels tend to be concentrated in geopolitically unstable regions. The strategic risks involved here are described in more detail in the guest contribution to this year's Annual Report. It is clear to everyone that the geographical concentration of the world's oil and gas deposits has aroused considerable economic interest. The Energy Ministers of the 12 most important gas exporting nations met together in Moscow at the end of December 2008 as part of the Gas Exporting Countries Forum (GECF). The stated aim of this meeting was 'to build greater cooperation' and also organise things on a stronger institutional basis so as to stabilise supply and prices in an increasingly globalised market. The GECF includes many of the OPEC countries, as well as Russia. Many industry watchers believe that the aim of the Forum is to create an OPEC-style alliance (a 'gas OPEC'). In fact Russia had already agreed an international troika with Iran and Qatar on market leadership and was the driving force behind the Moscow meeting.



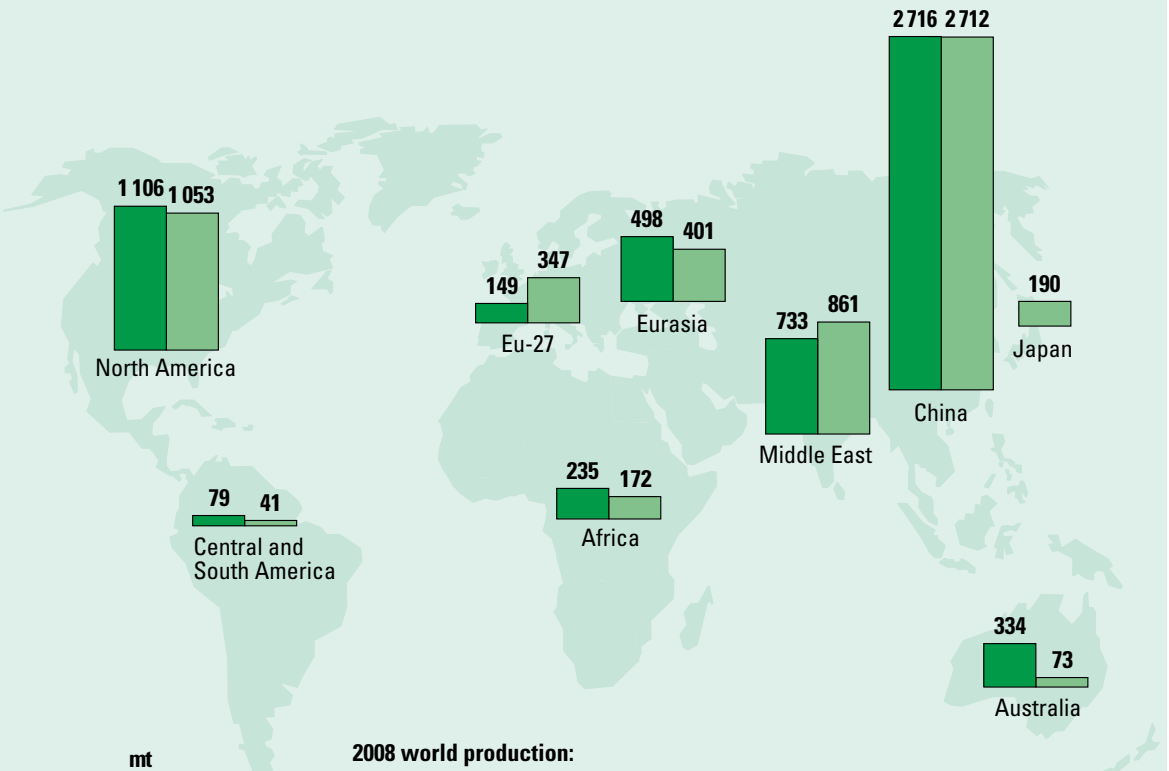
Developments in the international coal markets 2008/2009

World coal production rose by about 550 million t to a figure of 5.9 bn t in 2008, which represented an 11% increase on the previous year's output. The two largest producers were China (2.7 bn t) and the USA (1.1 bn t), while Australia (261 million t) remains the world's largest coal exporter.

Only 16% of world production was traded internationally (by land and waterway), with about 14% being marketed overseas. In total some 839 million t was traded by seaborne routes, of which 25% was coking coal and 75% steam coal.

In 2009 the full impact of the global economic crisis fell on the world's coal market. According to figures published by EURACOAL the world's maritime coal market shrank considerably in the first half-year (-8%). This decline mainly affected coke and coking coal, which were particularly hard hit by the collapse in the international demand for steel.

World hard coal production and consumption



2008 world production:

hard coal	5 850 m t	= 4 797 Mio. mt ce
lignite	951 m t	= 333 Mio. mt ce
coal total		5 130 mt ce

Sources: VDKI, WCI, 2009

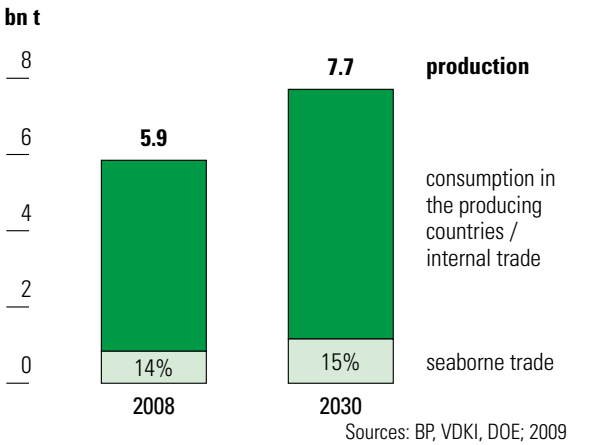
What is more, the individual coal markets behaved differently from geographic region to region and there was a more pronounced shift from the Atlantic to the Pacific market. While exports to the Atlantic steam-coal market declined significantly the Pacific market was able to show a slight upturn, especially as a result of the renewed growth in demand from China. This owed a lot to the increased volume of exports from Australia. All other exporters to this sub-market delivered much less than in the previous year. In the Atlantic steam-coal market the growth in exports from Russia and South Africa was not enough to compensate for the downturn in supplies from the other providers. The low volumes traded on the north-west European steam-coal market can mainly be attributed to relatively weak demand in Europe. Coal-based power generation in northern Europe has also slackened-off because of the recession, while demand for coking coal and coke from the steel industry practically collapsed in 2009. The situation is not expected to improve in the short term as coal stockyard facilities in north-west Europe have already exceeded the limit of their capacity.

The international market for coking coal also declined significantly in 2009. In the first quarter of the year alone demand fell by about 30%. This was a direct consequence of the slow-down in steel production, especially in the industrialised nations of Asia, America and Europe.

Australia, the USA and Canada recorded all-time lows in their coking coal exports. China became a net importer not just of steam coal but of coking coal too. For the Chinese steel makers, who are mainly based close to the coastal ports, it proved economically more viable to import coking coal than to obtain it from indigenous sources, which usually meant transporting it long distances by land. The world coking-coal market is expected to decline by 40 to 50 million t over 2009 as a whole.

In recent years China has been the dominant supplier to the coke sector with a market share of nearly 50%. However, in the first few months of 2009 the market for Chinese coke almost collapsed completely. Even though practically as many export licences were approved as in the previous year there was no international market for Chinese coke, at least not prior to August 2009. Because of the high tax of 40% imposed on coke exports – a politically deliberate measure – Chinese products were much too expensive for the world market. This has currently left Canada and the USA as the principal suppliers.

In spite of the global economic crisis China's economy has shown itself to be comparatively robust. According to OECD estimates China and India too will again record a relatively high growth rate. This is already becoming apparent not just in the coke sector but in the international steam coal and coking coal markets too. This year China's huge demand for

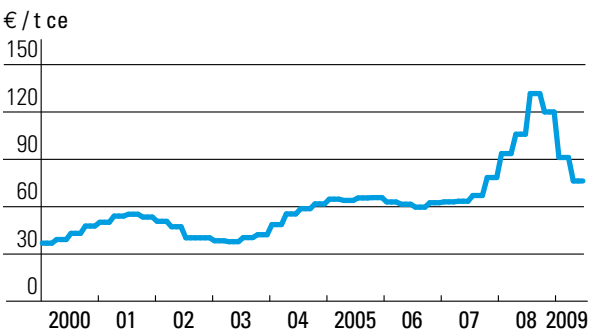


Sources: BP, VDKI, DOE; 2009

Intensity of global coal trade

commodities like coal and ore has already been causing long tailbacks of bulk carriers as they await clearance outside Australian loading ports and Chinese unloading terminals. This all ties up shipping capacity that could be used elsewhere and has at times driven up cargo rates in the Atlantic market, for one. The collapse in the global demand for bulk commodities has meant that since the end of 2008/early 2009 ocean freight charges, which had been at an all-

Price of steam coal

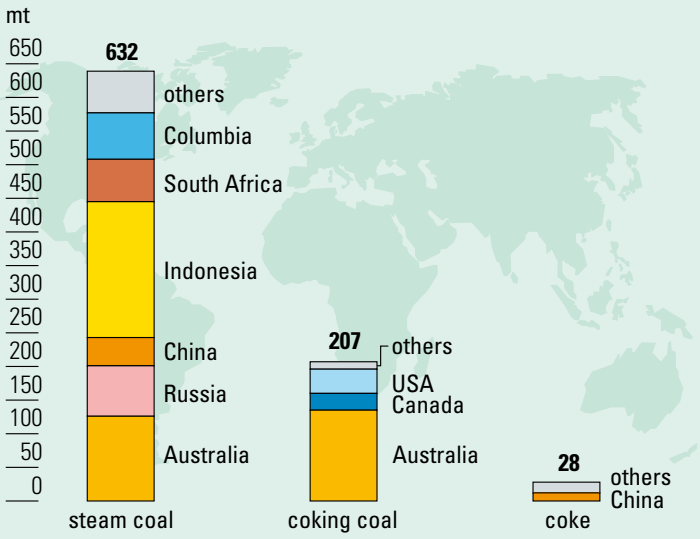


Source: BAFA, quarterly steam coal prices

time high, have in many cases fallen to ruinous levels. This has resulted in many market exits. With export capacity and facilities being decommissioned or converted to other uses there is every likelihood of shortages occurring in the international coal market in the years ahead.

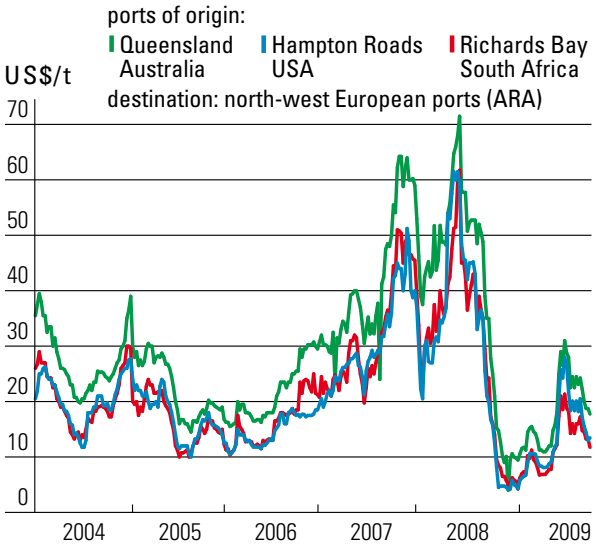
What is more, there are now real signs that the struggle for control of the world's raw materials is generally becoming much tougher. In mid-2009 Chinese state security authorities arrested several employees of the Australian mining company Rio Tinto under charges of industrial espionage. This had followed a failed attempt by the State-controlled Aluminium Corporation of China (Chinalco) to build up its majority holding in Rio Tinto – the main target being the iron ore deposits in Western Australia. This move was blocked by intervention from the Australian Government, media protests and objections from the other shareholders. This led to serious diplomatic differences between the two countries. Prior to this, in late 2007, a takeover attempt by BHP, which along with Rio Tinto is one of the 'big four' in the international raw-materials sector, also seemed to have failed. In mid-2009 the two companies teamed up even more closely in a different format by arranging joint ventures in the iron-ore and coal sectors. Since early 2009 China has again been increasingly active in the international commodities markets. During the year, for example, it has been busy buying up most of the international market for industrial metals and is striving to acquire interests in and take control of mining companies in Australia and other countries – which includes access to production capacity in the coal sector (Felix Resources). This indicates that as well as increasing corporate concentration in the international coal markets we are now beginning to see here, as in other raw-materials sectors, the growing influence of national strategies for securing raw-materials procurement.

Hard coal and coke exports worldwide (2008)



Source: VDKI, 2009

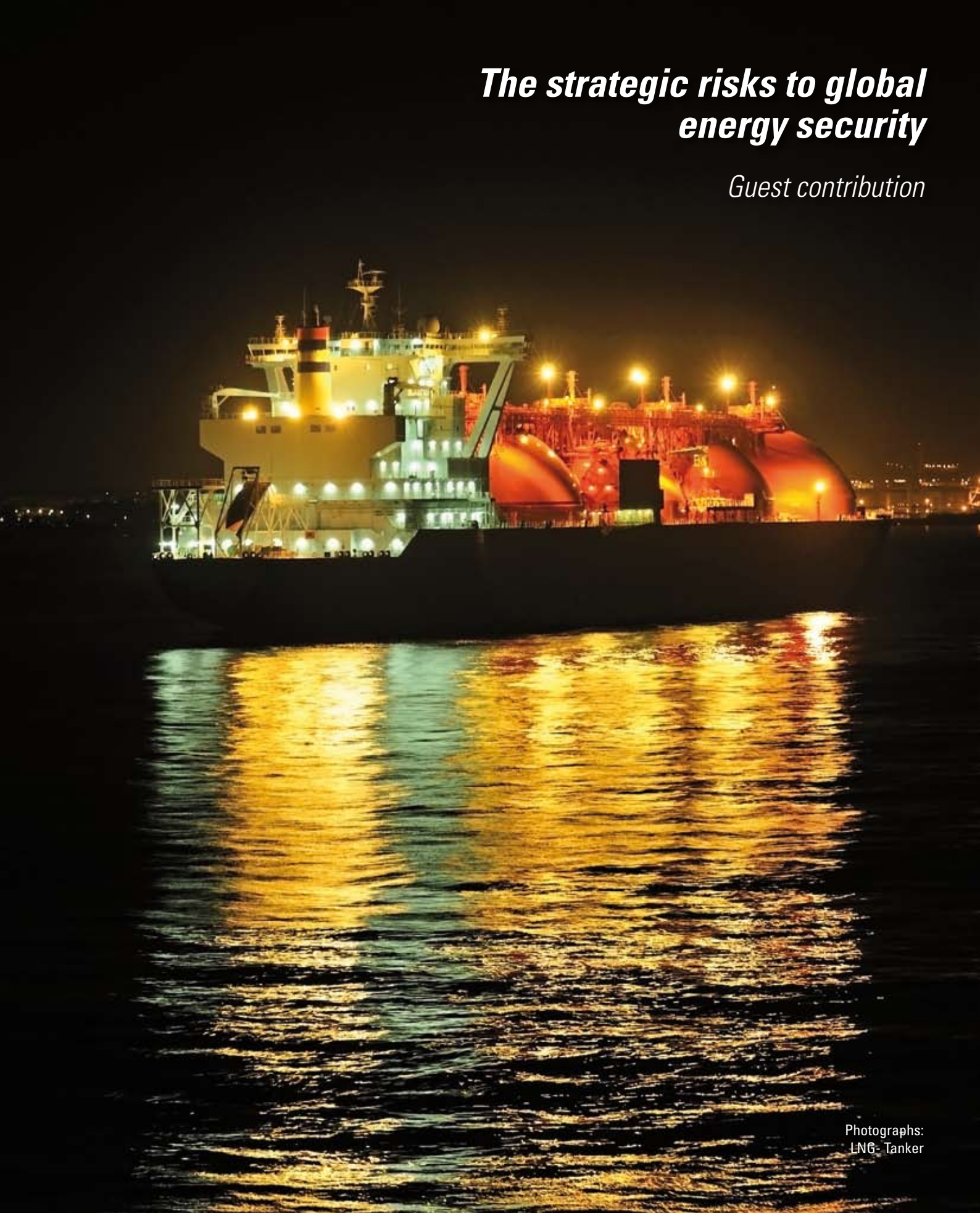
Freight rates to Europe



Source: McCloskey Coal Report, weekly sea freight rate averages

The strategic risks to global energy security

Guest contribution



Photographs:
LNG- Tanker

Guest contribution

Dr Frank Umbach, *Senior Associate for International Energy Security at the Centre for European Security Strategies (CESS), Munich/Berlin*

The energy market is a 'seller's market'

The slump in international oil and gas prices since the summer of 2008 would appear, for the moment at least, to have put an end to any major concerns we might have had about global energy supplies and the effects of the raw-materials boom on the stability of international relations. However, low energy prices will only be a passing phase and should not be allowed to influence the long-term strategic trends of international energy policy in respect of high and volatile oil and gas prices and supply shortages. In fact, in the medium term a further postponement of time-critical investment in new exploration projects and other energy infrastructure could well pose an even greater threat to global energy supplies. What is more, the geopolitical risks will still be with us, along with the consequences this will have for the global regulatory structures. This is now truer than ever as the world market for fossil fuels, namely oil, gas and coal, is facing a period of dramatic structural change. In 2008, for the first time ever, the developing countries – led by China – overtook the OECD states as primary energy consumers. At present 79% of the world's population generates 45% of global GDP and needs 53% of the world's energy to do so. As this trend intensifies in the years ahead it will have a significant impact on prices and will pose fresh challenges for international energy security and for the efforts that the world community is making as it attempts at least to slow down global climate change.

The world is therefore facing two challenges: on one hand to provide energy security at an affordable price, and on the other to prevent global climate change by switching over to higher energy efficiency and lower CO_2 emissions, especially in the non-OECD countries.

In the late 1990s the balance of power between energy producers and energy consumers started to turn gradually in favour of the producers and the development of a global 'seller's market'. This international power shift towards the Asiatic and Arabic emerging nations, and towards Russia and other energy exporting countries too, and the international expansion of their wealth funds in the USA and Europe, can be explained to a large degree by the high oil and gas prices and the raw-materials boom in non-energy resources. Since 2002 we have seen a fivefold increase in oil prices to a high of US$ 147 a barrel in July 2008, while between 2003 and 2006 the price of iron ore and steel scrap practically doubled. Moreover, non-ferrous metals have increased in price by 128% and other metals by more than 500%. The question of security of supply in energy and other raw materials therefore moved on to the political agenda of western governments, as energy and resources security is a key prerequisite for the stability of the entire economic value chain.

In the course of a process that has seen a global boom in raw materials and a rapid surge in prices, greater concentration of supply based on increasingly fewer countries and companies, ever greater distortion of trade and competition as a result of politically induced restrictions to raw-materials availability, the subsidisation of energy consumption and greater use of strategies for state-forced backward integration through increasing investment in overseas mining companies (direct access to and control of deposits in other countries), questions have increasingly arisen as to the supply capabilities of the raw-materials exporters – and this raised issues that had not been discussed by the EU for more than twenty years. This 'resource curse' reflected not only the close link between high oil prices and 'revenue economies' but also the connection between high oil prices and the unwillingness shown by many of the richer producer nations to introduce reforms and democracy at home, while adopting a more confrontational foreign policy.

All this poses major questions not just for international energy policy but also for the global and regional regulatory policy and foreign, security and development policy of the West, which of course includes the CFSP (Common Foreign and Security Policy) and the EU's Neighbourhood Policy. As energy resources and raw materials go through

periods of boom and shortage there will be a real likelihood of violent confrontations and wars breaking out over increasingly scarce commodities (especially oil, gas and water) in future. Such events will in turn create mass migration and refugee problems. This will be compounded by the consequences of global climate change, which could give rise to new disputes and, more particularly, seriously worsen existing conflict situations.

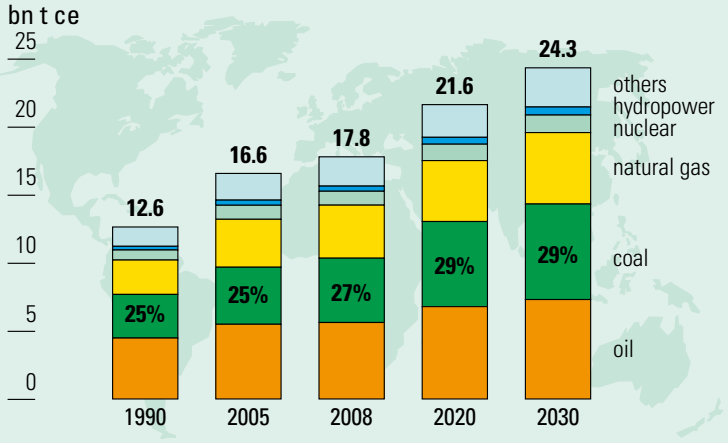
It is against this complex background that we have to analyse the global energy trends and predictions of the International Energy Agency (IEA), the Energy Information Administration (EIA) and the World Energy Council (WEC), before moving on to an examination of the medium- and long-term geopolitical risks with a view to reaching qualified conclusions on medium-term energy supply security for Germany and the EU.

International energy demand to 2030 and the question of global security of supply

The uncertainty surrounding global energy supply security prior to the outbreak of the present financial and economic crisis in the summer of 2008 was tied up, on one hand, with the rapid increase in energy demand, especially from China and India, and the fivefold increase in oil prices between 2002 to 2008 to a figure of US$ 147 a barrel, and on the other with the growing insecurity as to how much longer our oil and gas reserves will last and the volume of resources that will actually be made available on the world market in the years to come. This is precisely why this particular crisis in global energy prices and energy supplies is fundamentally different from any that has gone before. Decisive developments in the energy sector in recent years, along with the latest predictions from the IEA, EIA and WEC on fossil energy resources up to 2020, have confirmed these assumptions:

- Global energy demand will increase by 37-45% by the year 2030. The growth in world energy consumption will mainly be attributable to the non-OECD countries, who will account for 73% of it, while the increase in energy use by the OECD nations – even accepting the EIA's reference scenario – is only expected to be around 15%.
- In spite of worldwide efforts to develop the renewable energy sector, with the annual growth rate predicted at about 7%, fossil fuels (oil, gas and coal) will in the medium term continue to make by far the largest contribution to the energy market and will represent about 80% of the global rise in demand up to 2030.
- Up to 2030 oil will remain the most important fuel in the global energy mix with a share of about 30-32% (currently 34%). Average oil consumption worldwide is set to increase by 37% between

World energy consumption



Source: BP Statistical Review of World Energy 2009 / World Energy Outlook 2009, IEA
Forecast: IEA reference scenario based on 2006 data

Oil remains the most important fuel on the planet – with coal in second place

2006 and 2030 – from the current figure of just over 85 million barrels a day (bl/d) to some 106 million bl/d (IEA reference scenario). China will be responsible for 43% of the growth in global oil demand, while the Middle East will account for 20% and India 19%. Given the certainty of a growth in oil demand and the need to replace many depleted oilfields we are faced with the fact that oil production will have to rise by 64 million bl/d by 2030 – which is six times the total oil output of Saudi Arabia, the world's largest producer. According to the more optimistic alternative scenario proposed by the IEA in 2007 the world is well capable of saving 14 million bl/d, though even then oil will remain the most important fuel on the planet. While there are at present more than 182 bn t of proven oil reserves worldwide (not including Canadian oil sands) it has to be accepted that since 1986 the discovery of new oil resources has failed to keep pace with the rapidly accelerating demand.

- Because of the link to oil prices, which are now rising again, the global demand for more climate-friendly gas is only expected to increase marginally by 1.8%, which means that this fuel's share of the global energy mix will only grow from 21% to 22% by 2030. The interregional gas trade is set to double from 441 bn m^3 to more than 1 bn m^3; most of this fuel is transported as liquefied natural gas (LNG), whose share will increase from 52% in 2006 to 69% in 2030. At the same time 46% of the global rise in gas production will be based in the Middle East – precisely the region on which we have to depend for our oil supplies. In fact 56% of the world's natural gas reserves are concentrated in just three countries, namely Russia, Iran and Qatar, and more than half of the global reserves are fed from just 25 gas fields. The natural gas market is now beginning to ease somewhat with the increasing exploitation of unconventional gas reserves in the USA, which until recently were considered to be unprofitable. These deposits can now be developed economically due to the higher oil prices and the use of new drilling techniques and the output can be used to replace much of the anticipated increase in imported LNG. The production of unconventional gas from shale and coal beds and so-called 'tight gas' from sandstone formations is expected to increase from 47% of total gas production in 2006 to 56% in 2030. In its latest reference scenario the EIA has even suggested that the USA will virtually become self-sufficient in natural gas.

- In marked contrast to domestic efforts aimed at protecting the climate we have since 2000 witnessed global demand for coal growing by an average of 4.9% a year, which is more than that of any other fossil fuel and greater than the total world demand for primary energy. According to IEA forecasts coal consumption will increase by between 1 and 2% a year until 2030 and could therefore outstrip the growth in demand for natural gas. World coal demand is expected to grow by 32% between 2006 and 2015 and by as much as 61% during the period 2006 to 2030, increasing from 3,053 million tonnes oil equivalent (Mtoe) to 4,908 Mtoe. Even if the more optimistic alternative scenario were to apply, coal will still have a 23-29% share of the energy market in 2030, making it the world's second most important fuel ahead of gas.

- According to the latest EIA study global electricity demand will rise by 77% in the reference scenario between 2006 and 2030. Up to 2025 nuclear power's global contribution to electricity production will in fact be higher in absolute terms than in the comparable projection for 2004, even though nuclear energy's share of the market will fall from 15% in 2006 to 10% in 2030. By contrast, coal's contribution to global electricity production will increase from 41% to 44% by 2030, while the input from renewables will increase from 18% to 23% over the same period – thereby replacing gas as the second most important global source of electricity production soon after 2010.

The IEA estimates that some US$ 26 bn in investments will be needed by 2030 in order to satisfy the worldwide demand for energy and provide global energy security. At the same time subsidies for energy resources and energy consumption in the twenty largest non-OECD countries alone currently stand at US$ 310 bn a year. Energy consumption in these states is therefore largely disconnected from real market prices with the result that there is little or no incentive to cut energy consumption through energy saving measures and to improve energy efficiency. The investment in the global energy industry that will be required to maintain international energy security will therefore only be forthcoming if and when there is a marked improvement in the framework conditions for foreign investors, and provided that there is much greater political stability in many of the producing countries. However the really decisive question – namely as to the quantity of oil and gas resources actually available on the market at any one time, as opposed to merely existing on paper – will depend not only on narrowly defined economic factors like supply and demand or global climate policy but also and even more decisively on the dramatically altered political framework since the end of the 1990s.

Geopolitical risks and structural supply shortfalls

Since the terrorist attacks on the World Trade Center and the Pentagon on 11 September 2001, and the military intervention in Afghanistan and the Iraq war, international attention has been drawn more than ever not only to the Middle East and to the regions of southern and central Asia, along with the countries forming the so-called 'arc of instability', but also to the connection between future conflicts and the global competition for resources. This 'larger Middle East' (or 'strategic ellipse' as it is also known) is of immense strategic significance for the stability and security of the world's energy supplies in the 21st century, as most of the planet's remaining oil and gas reserves are concentrated in this part of the world:

- 90% of the oil reserves are located in the Islamic world;
- 70% of the world's oil reserves and 40% of the gas reserves are to be found in the so-called 'strategic ellipse';
- 62% of all the world's oil reserves and 34% of all global gas reserves are concentrated in the Persian Gulf region.

Add to this the fact that since the end of the 1990s between ten and fourteen of the leading oil exporting states are considered to be politically unstable. Internal political conflict could lead at any moment to major disruptions to oil and gas exports from these countries. At the present time 50% of the world's energy demand is met by oil producing states in which internal political tension poses a major threat. In the years to come the world will be reliant on an increasingly smaller number of oil and gas producing countries that, while frequently undergoing periods of political instability, will also have to ensure ever higher levels of production to maintain global security of supply in oil and gas.

Energy shortages will be increasingly difficult to prevent

Energy shortfalls with dramatic price hikes, or even major supply crises, will therefore be increasingly difficult to prevent in the medium term between now and 2020.

Unlike the oil crisis of the 1970s or the impact of the Iran-Iraq War after 1980 the high prices prior to August 2008 were therefore not the result of an individual political crisis that led to a temporary shortage of supply in the Middle East but were in fact mainly caused by global demand combined with structural problems on the supply side (shortfalls in production, refinery and transport capacity).

The pivotal role that Saudi-Arabia – the 'central bank for oil' – now plays for global energy security

has mainly resulted from the fact that Riyadh is the only oil supplier that still has access to significant unused production capacity (US experts refer to the 'energy equivalent of nuclear weapons'). Having said that (and with a production level totalling some 10 million bl/d) the world's largest oil producer could, by the summer of last year, only manage to mobilise an additional 1.5 to 2 million bl/d to help resolve the crisis. This meant that the proportion of free oil production capacity compared with global demand fell from 15% to just 2-3%. By mid-2008 almost 99% of OPEC's production capacity was being taken up – compared with 90% in 2001 and only 80% in 1990. Against this background the International Monetary Fund (IMF) called on the OPEC states in early 2005 to provide an additional free production capacity of at least 5 million bl/d over the next few years, as otherwise global oil supplies could no longer be kept at a steady level. With the exception of Saudi-Arabia, however, no other OPEC state has been prepared, on both political as well as economic grounds, to comply with this request.

Energy dependence is a foreign and security policy issue

As global oil demand shifts from the western industrialised countries towards the most populous emerging nations such as China and India we shall also see, during the course of the 21st century, most of the oil refineries being relocated away from the USA and Europe and towards Asia and other parts of the world. This means that not only most of the oil production sources but also 60% of the world's refinery capacity will eventually be located in the politically more unstable countries and regions.

The energy importing states are therefore seeking, as far as possible, both to reduce their dependence and, at the same time, to build up good relations with the oil and gas exporting nations as part of their foreign and security policy. The question of energy security in the industrialised countries was therefore never just an overseas trade issue that could be dealt with using exclusively market-based instruments.

Implications for European energy supply security

The problem of security of supply for the EU and Germany initially appeared on the political agenda after the first Russia-Ukraine gas dispute of January 2006. Since then this topic has become a high-priority issue, as confirmed by the latest contemps between these two countries in January 2009 – which has turned out to be Europe's most serious energy crisis for over thirty years. Security of European gas supplies is now proving to be the Achilles' heel of Europe's energy policy, as this issue is fundamentally different from that of oil supply security. For one thing there is no global gas market and, for another, security of supply in Europe is dependent on steady deliveries via pipeline systems that are inflexible in times of crisis.

There is now unanimous agreement between the international experts, the various energy organisations, which includes the IEA, the EIA and the WEC, and the European Commission, that a balanced and broad-based energy mix that does not exclude any resource is the only way in which we can sustainably guarantee global, regional and national energy security. From the medium-term perspective up to 2030, as the world comes to grips with the enormous challenges of energy security and global climate change, we certainly cannot afford to abandon either nuclear power or coal. This applies most particularly to Germany where, ever since the oil price crises and the huge rise in oil and gas imports from Russia, the supply risk has increased significantly as a result of the proposed 'double pull-out' from both nuclear energy and home-produced coal.

With its March 2007 resolutions on an integrated, sustainable climate and energy policy and the

'20-20-20 targets' (see below) the EU has set out its intention to escape at least partly from the spiral of escalating energy consumption and growing reliance on energy imports, or at any rate slow this trend down as far as possible. The EU energy policy concept is quite rightly built around energy saving measures and increased energy efficiency, along with diversification of the fuel mix and imports. The proclamation of an active European and German energy foreign policy that takes account of geopolitical risks has also been an important and appropriate move.

Even before the recent gas dispute of November 2008 the European Commission, acting under the French Presidency, published its 'Second strategic EU energy review' presenting a far-reaching package of measures aimed at strengthening security of energy supply and supporting the climate protection proposals. The 'Action plan for energy supply security and solidarity', which has been far too frequently disregarded by the public and in some respects by German policy-makers too, has highlighted for the first time that the successful implementation of the energy resolutions of March 2007 could cut the EU's predicted energy requirements to 2020 by up to 15% and would reduce the Community's import needs by as much as 26% compared with previous energy projections. Without the March resolutions, on the other hand, net energy imports would increase by about 41% between 2005 and 2030. The EU Action Plan of November 2008, with its latest projections, in fact shows for the first time that by implementing the '20-20-20 programme' (depending on international oil price levels) our gas import needs could be frozen at today's figure of some 300 bn m^3, instead of rising to 452 bn m^3. Depending on the scenario, the gas import requirements of the EU could even stay below 300 bn m^3 if oil prices were to climb back up to US$ 100 a barrel (see table in annex).

The Energy Infrastructure Programme proposed by the Commission and agreed by the European Council on 20 March 2009, which provides some € 4 bn worth of financial aid, is aimed at improving energy supply security and strengthening the physical infrastructure of the EU's crisis reaction mechanisms. Since the beginning of 2008 measures aimed at developing the South European gas transport corridor and access to the Caspian Sea have also been pushed forward with Nabucco Pipeline Project.

Even though Russia and Ukraine came together on 23 March 2009 to sign a new agreement on resolving the gas dispute, along with an energy memorandum on modernising Ukraine's gas infrastructure, the EU still cannot make any medium or long term assumptions about the reliability of gas supplies from Russia. Such security would depend not only on

1) the economic stabilisation and extensive reform of Ukraine's energy sector but also on
2) the complete normalisation of bilateral relations between Moscow and Kiev,
3) the elimination of all middlemen,
4) the assurance of much greater transparency in the agreements and gas operations on both sides, and
5) the decoupling of the bilateral gas trade from geopolitical motivation, and would also hinge on whether
6) the current financial and economic crisis forces the Russian gas industry to delay and cut back on the investment that is urgently needed in the exploration and development of new and much more expensive gas fields.

A broad-based fuel mix will guarantee stable and secure energy supplies

From a European and German perspective, therefore, the best guarantee for energy supply stability and security in the long term still remains – alongside new measures for saving energy and increasing energy efficiency – a broad diversification of fuel mix and fuel imports. As far as gas is concerned supply security will depend on a new combination of long-term delivery contracts, liquid trading systems, a demand-based and reliable infrastructure and the strengthening of cross-border cooperation between gas companies acting in conjunction with national governments and the EU, with its various crisis management and cooperation instruments.

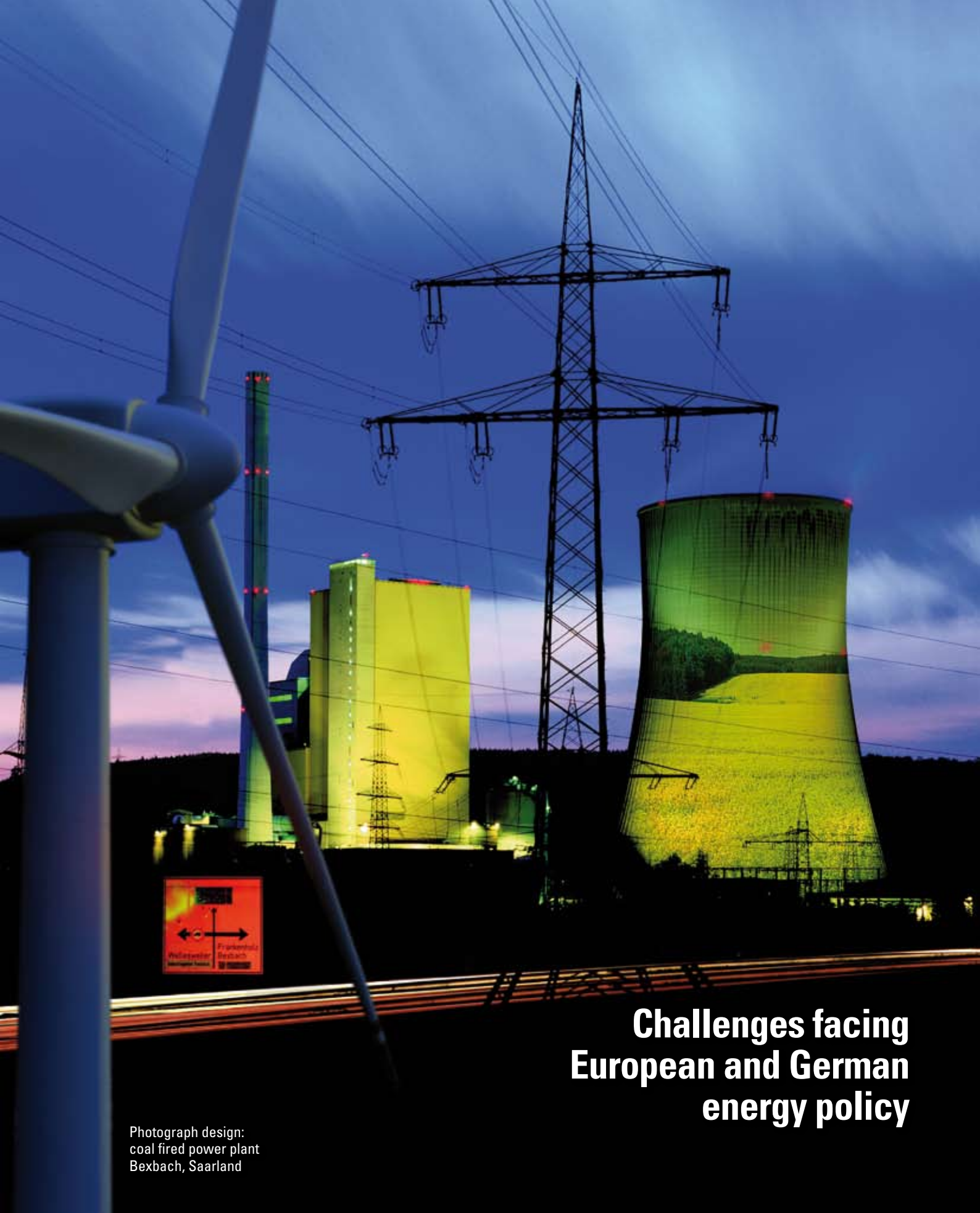
Projects like DESERTEC will require a huge investment in security measures

The much discussed DESERTEC solar and desert power project, which is currently the subject of a feasibility study, is also aimed at strengthening security of supply through diversification of fuels, imports and electricity production. This scheme, which is being backed by a consortium of twelve mainly German companies, will seek to generate electricity by solar-thermal means. An array of giant parabolic mirrors will be used to focus the sun's rays on to circuits of water that will be heated to 400°C and then passed through steam turbines to generate electricity. The € 400 bn venture is expected to send 15-20% of its output to Europe via high-voltage DC transmission lines. While there are still various technological difficulties to be resolved, particularly as regards transporting the electricity to Europe, the biggest obstacles to such a project are the financial problems and, more especially, the security issues, which have still not been properly studied. Even if we just add up the stand-by capacity for the countless infrastructure installations and the control centres serving the decentralised generator structures it is clear that massive investment would be needed to develop the physical and electronic safety systems required for the politically unstable regions of North Africa and the Middle East. It is obvious that this expenditure has not yet been adequately taken into account in the operational project costs.

Moreover, serious political disagreements still have to be resolved between the regional states and arrangements will have to be put in place for the cross-border transport of electricity between the EU countries. It is also questionable whether Spain and Italy will wish to become even more dependent on such a politically unstable region and will be prepared to further endanger their supply security, the reason being that the EU's Mediterranean states are already highly reliant on oil and gas imports from this unstable part of the world.

Add to this the fact that solar-thermal power stations require millions of cubic metres of cooling water, much of which will have to be delivered safely across national borders and into the desert regions. This will in turn represent a substantial cost factor. Nor should we overlook the risks that this will present for the security of EU energy supplies. Admittedly, solar-thermal power stations have the great advantage over conventional photovoltaics of being able to store electricity in molten salts, but nevertheless the loss of 15 -20% of electricity imports as a consequence of terrorist or electronic attacks against the high-voltage transmission lines or power control centres in North Africa would have a catastrophic impact on the EU, since Europe cannot as yet store up electricity in a strategic stockpile the way it can with oil and gas. For Arabic terrorists the solar infrastructure would be an especially attractive proposition, not least because attacks against it would enable them to strike against and put political pressure on both their own hated regimes and on the European Union too. This could be one of the reasons why decentralised photovoltaic projects could, given real advances in storage technology, actually turn out in the long run to be the more cost-effective of the solar systems. And yet all these reservations do not fundamentally militate against such a project, which would in fact be of huge benefit to the regional states concerned, provided that their political and economic elite recognise the enormous advantage to be gained from solar power plant of this type in terms of the role that their state energy companies would play and the political influence they would be able to exert on governments.

However, this 'desert electricity' is unlikely to be a factor in reducing the strategic risks to German energy supplies in the medium term to 2030. Because of the technical and – more significantly – the economic and political problems that will have to be overcome it is only in the longer perspective from 2030 to 2050 that we can expect the DESERTEC project to assume significant strategic importance for the regional states in North Africa, the Middle East and perhaps Europe too.



Challenges facing European and German energy policy

Photograph design:
coal fired power plant
Bexbach, Saarland

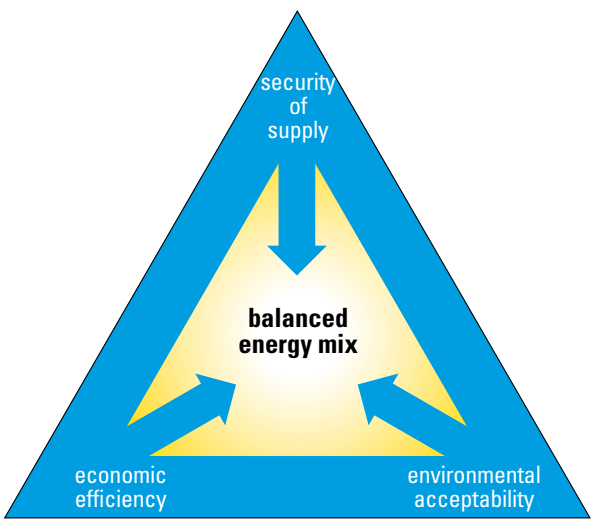
The domestic coal industry caught in the triangle of energy policy objectives

Indigenous coal and the contribution it makes to German energy supplies has always been the subject of energy policy decisions and framework policy making. In 2007 a major political initiative was taken with the decision to press ahead with the socially acceptable closure of the subsidised coal industry by the end of 2018 and the adoption of the Coal Industry Financing Act on 20 December 2007. The 'Review Clause', as it is now termed, gives the Bundestag the option of reviewing the closure decision by 2012. In this context specific mention is made of the objectives of economic sustainability and safeguarding energy supplies, which have to be seen from a macroeconomic perspective. The clause also refers to 'other energy-policy objectives, which essentially means environmental sustainability and climate compatibility. What is in fact being addressed here is the third key component of the classical triangle of energy policy objectives of competitiveness, security of supply and environmental sustainability, which are still a fundamental part of national and European policy making.

'The Federal Government shall, by 30 June 2012 at the latest, provide the Bundestag with a report on the basis of which the Bundestag will examine whether the coal industry will continue to be financially supported under consideration of the aspects of economic viability, energy-supply security and other energy-policy objectives. The coal industry and the Mining, Chemical and Energy Industrial Union (IG BCE) will be heard. The report has to be based on expert opinions of acknowledged economic research institutes, which have to be attached.'

§1 paragraph 2 of the Coal Industry Financing Act ('Revision Clause') of 20 December 2007

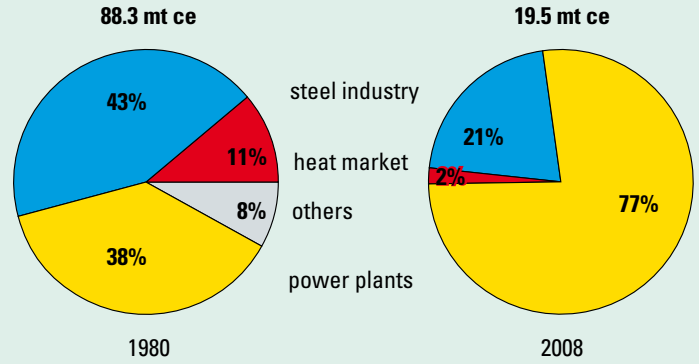
Energy-policy objectives



It would be difficult to overestimate the important role this triangle of objectives plays as a reference framework for energy policy decision making. At its 'Shaping the future' conference in June 2009 the German Energy and Water Industry Association (BDEW) cited these objectives as the 'cornerstones of the German energy industry' and went so far as to refer to a *'fundamental law of energy policy'* and *'the basis for a future-proof energy policy for years to come'*. Of course the three objectives would have to be kept in mutual balance so that *'in the years ahead we will also have an energy supply … that is protective of our climate and environment, that is permanently available or even renewable and that remains affordable'*. Playing the three central objectives off against each other, the BDEW warns, would only lead to an 'energy policy cul-de-sac'. The energy objectives are closely interlinked and require an even-handed approach, something that *'has to be carefully considered in all decision making and also honestly communicated'*.

If this is not done the balance would be lost and this would inevitably have negative consequences not only for the other objectives but also for the entire national economy. To quote a BDEW source: *'Any inequality of treatment would result in a dangerous imbalance that would ultimately jeopardise the other objectives and could even*

Sales structure for German hard coal



destroy the entire underlying energy and economic structure'. The Association particularly deplores the fact that the 'equilateral' aspect of the triangle of objectives has been absent from German energy policy in recent years and that events seem to have shifted in favour of the environmental and climate targets. This disequilibrium could also end up by dominating future energy policy. As a result, economic viability and security of supply could start to fall behind.

The triangle of objectives outlined here can clearly be used to produce a more differentiated diagnosis, especially as far as the indigenous coal and its future are concerned. The energy policy debate surrounding coal has recently come to be dominated increasingly by climate issues. However, the extent to which coal utilisation can be made compatible with environmental targets is a question that cannot be related directly to indigenous coal. It has to be answered – irrespective of the source of the fuel – by examining the energy technology being used in the combustion process, which essentially means plant efficiency, and by taking account of specific climate targets. The CO_2 emissions trading system that was introduced in 2005, with its maximum total allocation of emission permits, includes practically all the coal now being consumed in Germany – and hence covers the entire output of the indigenous coal industry. The coal sector, for one, is therefore obliged to operate in a manner that is fully compatible with the climate protection targets.

It is a matter of regret that the environmental sustainability of coal has recently been called into question, at least by some sections of the public. In actual fact, the environmental impact of the German coal industry has been declining year on year as a result of the ongoing restructuring process that has been underway for decades – though this is not to deny the particular local and regional problems that have affected those living in or close to the coalfields. At the same time, what remains of the German mining industry is now operating in full compliance with the country's strict environmental standards and principles of sustainability in the extraction of natural resources.

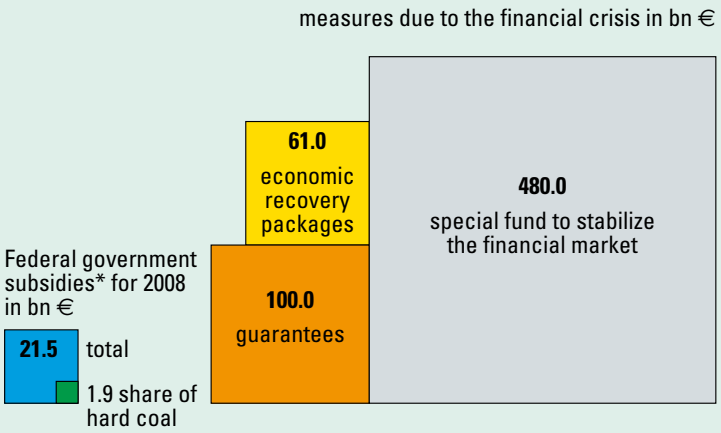
The main problem for the domestic coal industry is its economic viability. Geological conditions and other operating parameters make the production costs for German-mined coal higher than the world market price, hence the need for ongoing subsidisation. Yet the high market prices of 2008 demonstrated that this situation can change at any moment. This development brought German-mined coal close to the profitability threshold and for a while resulted in significant cuts in the subsidy requirement. However, when discussing the German subsidy system we have to bear in mind that production costs also have to cover exceptional expenses such as inherited liabilities and spending on mine closures. It should also be remembered that a vital and working mining industry is essential if we are to retain the option of being able to produce coal economically, whether as a marginal seller or

otherwise, in the event that market prices reach a certain threshold. And any macroeconomic analysis also has other factors to consider:

- for example there is the positive technological 'spill-over' effect on other sectors,
- the regional-economic importance of coalmining for the coalfield communities
- or conversely the fiscal follow-up costs of a complete shut-down of the mining industry
- and the increase in regional unemployment that this would cause.

Closing down the coal industry could therefore prove to be more costly to the public sector than keeping it going. The subsidy issue also falls into perspective when bearing in mind the fact that since the 1990s the amount of subsidy paid to the coal industry has been reduced year on year on a scale that is unprecedented in any other sector of the west-German economy (and in 2009 is now less than half the original level). According to studies carried out by the Kiel-based Institute for World Economics (IfW) the amount of subsidy granted to the coal industry in 2007 represented less than 2% of the total volume of state aid paid out in Germany that year. In fact the aid that the Government handed out in 2008 and 2009 to cushion the impact of the economic and financial crisis has now put subsidies into a completely new ballpark: nearly € 500 bn for the special bank-rescue fund, € 100 bn as security for rescue measures in the real economy and € 60 bn or more as additional financial aid in the form of economic stimulus packages.

Federal government subsidies



*) subsidy report of the Federal government

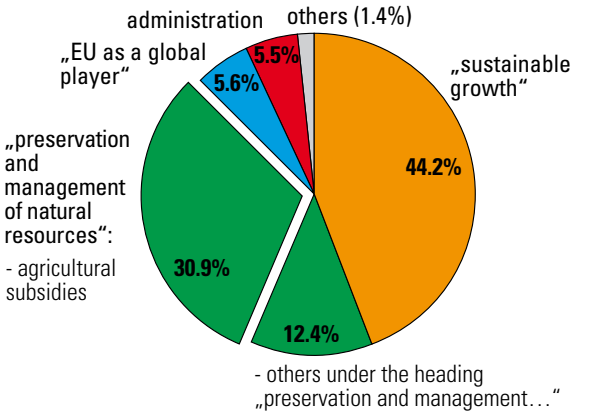
Source: "Der Spiegel" 9/2009

And coal-industry subsidies can also be seen in a new light when measured on an EU scale. Aid totalling more than € 3 trillion has already been allocated Europe-wide in an attempt to stabilise the financial markets. The EU budget is dominated by the € 55 bn paid out in aid to agriculture, much of which comes from Germany as the largest net contributor (€ 8.8 bn in 2008). The main recipient is France at € 10 bn, followed by Spain at € 7.1 bn and Germany at € 6.6 bn.

In view of Germany's high and growing dependence on imported energy home-produced coal, as an indigenous source of energy, has a lot going for it when it comes to safeguarding security of supply. While downsizing has obviously left the coal industry with only a limited capacity to contribute to

EU budget 2008

expenditure* by heading



Source: EU budget 2008 – Financial report of the European Commisson, 2009

* committment appropriations

the national energy supply, it has to be said nevertheless that coal's contribution is still on a par with that of wind energy and indigenous gas production. Home-produced coal still accounts for a significant section of the German coal market and in combination with cheaper imported coal provides a measurably greater degree of supply security than Germany's oil or gas supplies (see the RWI risk index below). Add to this the fact that coal mining maintains access to the country's huge coal deposits: these will still last for several hundred years at current production levels and could be preserved for coming generations as a hedge against global market risks.

It is now up to the political decision-makers to weigh up all the benefits and drawbacks of indigenous coal and allocate it a position in the energy-policy triangle of objectives. Of course this task is complicated by the fact that Germany still has no overall energy plan – or at least not one that takes all three objectives fully into account.

The search for an overall energy-policy concept

As Germany has no overall energy-policy concept it is hardly surprising that in this 'year of elections' it was not just the experts who were calling for a new energy concept and a national energy strategy. Practically every election manifesto contained some demand or other of this kind, while the Government departments responsible for energy matters also submitted individual proposals of their own.

In 2006 Chancellor Merkel and her 'grand coalition' announced the development of an overall energy-policy concept that was debated in 2006 and 2007 in the course of an energy summit comprising three rounds of talks.

The energy summit included representatives from the Government, the energy supply industry, the renewables sector, industrial and private electricity consumers, trades unions, energy research establishments and environmental organisations. The summit was supported by an extensive inventory of energy-related economic and political data and by scenario calculations that had been prepared by the relevant ministries and institutes. The summit conference ultimately produced a set of fundamental concepts that met with varying degrees of agreement. The Federal Government responded the same year by introducing an Integrated Climate and Energy Programme known as the Meseberg Package – which is discussed above in the section headed 'Climate and the environment'.

The Package contains numerous individual measures that have now been gradually implemented by the grand coalition. The designation 'Climate and Energy Programme' aptly expresses the fact that the focus lies with environment-oriented measures in the energy sector. This essentially means a series of steps aimed at saving on energy and CO_2 emissions and increasing energy efficiency, as well as developing renewables usage. However, many other important energy questions remain as yet unresolved – including the provisions for future energy security. It would appear that the call for an overall energy-policy concept has still not been heeded.

The plan's shortcomings were soon highlighted by the mixed response it received from the business community. In early 2009 the Chambers of Industry and Commerce in North Rhine-Westphalia submitted their 'Energy positions for 2009', which were prepared in close consultation with the trade and industry sector and with the support of the scientific community. This was an attempt to provide well-founded answers to a number of as-yet unresolved questions on German energy policy. The Chambers of Industry and Commerce in NRW have put forward the following proposals as a means to create a cost-effective and future-proof energy supply structure for North Rhine-Westphalia: rapid expansion of grid and power-station capacity, greater competition in the power-line supply sector and easier market access, reduction of the additional financial burden on German businesses in the form of electric-

Energy-policy concepts 1973 to 2001

Germany has been trying for years to develop an overall energy-policy concept. However any national energy policy also has to take appropriate account of European and international conditions and the challenges they pose. The first national energy programme was developed by the Federal Government of the day back in 1973. This was subsequently revised and updated several times in the wake of the first global oil crisis and the far-reaching changes that were to follow for the world energy markets. In the 1980s however, with the change of government and the effects of a general relaxation on the global energy markets, this programme was to fade from the scene as a guiding principle for German energy policy.

This was followed by a period of twenty-five years during which the Federal Government was to produce a number of different energy reports: this included the 1991 report 'An energy policy for a united Germany' that called for the introduction of an overall energy-policy concept. However this document essentially restricted itself to setting in context the energy policy measures that already existed or had been introduced and to drawing up general guidelines without tangible objectives. Political talks were also held during the 1990s (and in the event were to prove largely unsuccessful) with a view to reaching a cross-party and cross-regional consensus on energy policy.

In 2000 the then Red-Green coalition Government held an energy dialogue with a number of relevant social groups and set up a Bundestag Committee of Inquiry with a remit to examine the future of national energy supply. But this attempt to develop a consensual energy programme was once again doomed to failure. Nevertheless, the Red-Green Government pressed ahead with a whole range of new energy policy initiatives, which included the introduction of the ecotax, the Renewable Energy Sources Act (EEG) and the Nuclear Phase-Out Act. In 2001 the Federal Economic Ministry submitted another energy report ('Sustainable energy policy for a future-proof energy supply') that highlighted various programmatic options and made a number of recommendations. However a comprehensive new Government energy programme could not be achieved, due mainly to internal political wrangling between the Economic Ministry and the Environment Ministry as to the direction that national energy policy should take. This dispute has continued ever since and still remains unresolved in the grand coalition Government that was formed in 2005.

ity and other energy prices as a consequence of climate and energy policy regulations, the systematic dissemination of information on energy efficiency measures and broader-based and more diversified energy research. A modern energy policy should also be based around a broad energy mix and in this respect the Chambers of Industry and Commerce (CICs) called for the nuclear power option to be retained and included. The CICs wanted greater use made of indigenous fuels, which they see as the first 'milestone' in the implementation of the 'Energy positions for 2009', as this would help reduce the energy supply sector's dependence on imports. This means keeping all options open for using indigenous energy sources and in this respect the CIC document makes particular reference to home-produced coal: *'Coal too must be retained as a serious option, as it is a NRW resource and will provide a hedge against rising energy prices.'*

The Federation of German Industries (BDI) has taken up a similar position in its 'key energy policy demands', which were put forward at the beginning of 2009. According to the BDI *'There is still no sign of the overall energy-policy concept announced in the coalition agreement (the Grand Coalition Manifesto)'*, even though some crucial decisions have now been taken for German and European climate and energy policy. This will henceforth have to be structured economically in a more balanced way if

Germany as an industrial centre, and its employment base, are to be safeguarded in the long term. Climate protection, as one of the key targets, has to be put into *'a proper and fair balance'* with the other objectives of supply security and competitiveness. And this applies to much more than just the cost effectiveness of the climate protection measures. Equal consideration should also be given to energy cost levels and their impact on the competitive ability of the German manufacturing industry, the overdue modernisation of the energy infrastructure and the safeguarding of energy supplies. And this would require a broad-based energy mix for Germany, particularly in the light of the global rise in energy needs and the resulting increase in demand-driven competition in the international energy markets. The BDI also puts this requirement at the top of its list and takes the view that all energy resources – fossil, renewable and nuclear – will be still be needed.
This would mean using indigenous energy resources, diversifying imports and developing new energy sources. In its position paper 'Strengthening Germany's industrial base' of July 2009 the BDI once again calls on the powers that be *'to develop an integrated energy plan'*, to place the three central energy policy objectives *'on an equal footing'* and *'to improve security of supply by making use of indigenous energy resources'*.

Meanwhile the grand coalition has been intensively seeking answers to the question of how to tackle the conceptual shortcomings in the country's energy policy. The Federal Economics Ministry set up an 'Energy programme' working group (PEPP), whose experts were able to discuss and then lay down a set of practical guidelines for Germany's future energy policy. The first proposals were published in the autumn of 2008. These examined the requirements for an energy programme and also focused on the challenges of raw-materials security. In February 2009 the PEPP then submitted its 'ten long-term action guidelines for future energy supply in Germany'. These guidelines essentially recommended a *'technology-neutral energy policy … with a fixed link between energy policy objectives, an appropriate regulatory framework and a suitable incentive structure'*. Special emphasis was put on achieving the

three key energy policy objectives: competitiveness, security of supply and environmental sustainability. It was also vital to maintain the long-term reliability of the strategic guidelines.

The PEPP analysis anticipates a major change in the energy supply structures of Germany, Europe and the world in the coming decades. It indicates that the globalised energy markets *'will have a growing influence on import energy-dependent Germany and that special efforts will be needed to ensure that Germany, as a base for economic activity, continues to receive competitive energy supplies'*. According to the PEPP these changes were being driven by *'rising energy prices, climate change and growing competition for increasingly scarce and increasingly expensive energy resources'*, along with technological developments and the natural competitive process, especially in the electricity sector. However, the basic elements of any future energy supply system could be determined here and now, and a set of specific guidelines defined, irrespective of whatever technology and market scenarios applied.

It has to be said, nevertheless, that the PEPP has drawn up these guidelines in a fairly abstract way and that even the factual explanations provide no more than very general guidance for a future energy policy. Quite a few of the points that were squarely addressed by the NRW Chambers of Industry and Commerce, for example, were overlooked. However, the PEPP proposals do generally point to the *'limited time window available for making our entire energy system future-proof'*. This will require not only a massive increase in energy efficiency but also a more effective use of fossil fuels and recourse to nuclear power as a 'transition technology'. And all the other conventional fuels (such as coal) will also serve as transition technologies by acting as cornerstones of energy supply for decades to come. Renewables will only be able to assume this key role in the very long term. By then fossil fuels will gradually have been 'decarbonised' by way of an increased efficiency factor and/or better conversion rates, along with the development and widespread introduction of CCS technology.

The PEPP further recommends that energy and climate policy should be part of 'a single package' and calls for an 'integrative approach' in order to *'pool responsibility for energy policy and distil all the different energy policy scenarios and idealistic conceptions down into just a few guidelines for action'*. Special efforts were also needed to combine and streamline all the various forms of state financial intervention in the energy sector (which should, for example, include aid to the coal industry ranging

Principles underlying the BMU roadmap for energy policy 2020

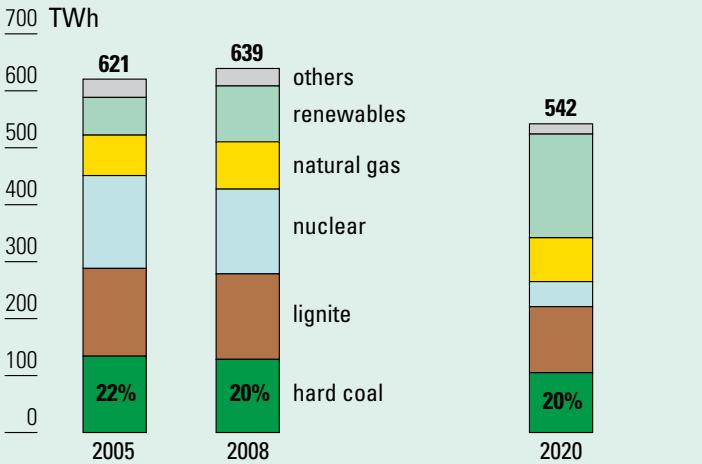
1. *We shall safeguard energy supplies in the long term.*
2. *We shall reduce our energy costs and create 500,000 new jobs.*
3. *We shall produce more than 30% of our electricity from renewable sources.*
4. *We shall phase out nuclear power by 2022.*
5. *We shall produce 40% of electricity from high-efficiency coal fired power stations.*
6. *We shall set up a nationwide grid operating company and extend our electricity grid in an environmentally sustainable and efficient manner.*
7. *We shall reduce our electricity consumption by 11%.*
8. *We shall reduce fossil-based heat requirements by at least 25% and double our combined heat and power (CHP) output to 25%.*
9. *We shall reduce our traffic emissions by at least 20%.*
10. *We shall take international climate negotiations to a successful conclusion.*

from the ecotax through to the EEG). While the term 'Energy Ministry' does not occur in the PEPP recommendations, nevertheless proposals made openly in public and from members of the expert body itself have been interpreted as suggesting that a (Federal) Energy Ministry should be set up. This would take over and unify the energy responsibilities of the existing Economics Ministry, along with those of the Environment Ministry and other departments (research, construction, etc.). The initial response from political and economic circles has been divided on this issue and the proposal is to be the focus of some lively debate in the new parliamentary session.

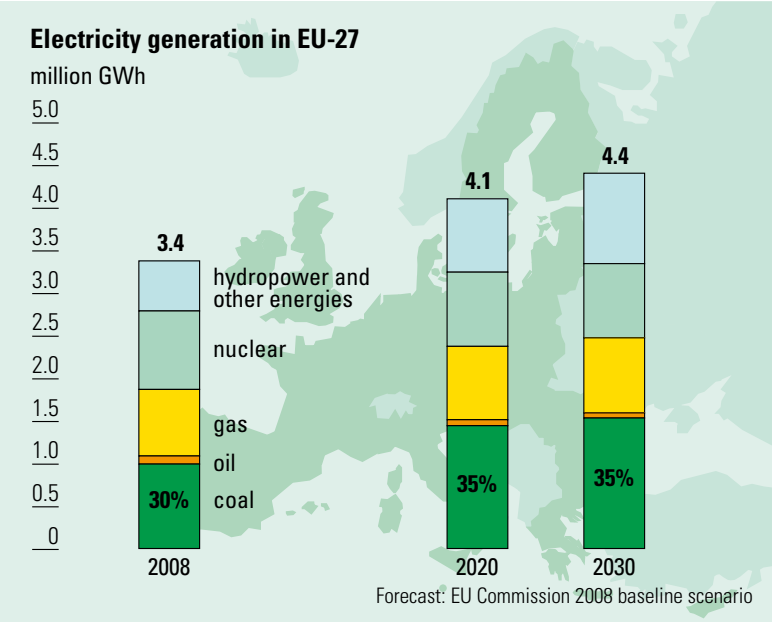
The Federal Ministry of Economics and Technology (BMWi), acting through the PEPP, has therefore submitted for discussion a number of general guidelines for an energy programme, along with a proposal for institutional reform. At almost the same time the Federal Environment Ministry (BMU) put forward ten energy policy guidelines and submitted a specific scenario on how these could be implemented by the electricity production sector by 2020. This 'Roadmap for Energy Policy 2020', which was presented by the BMU at the February 2009 conference 'New thinking – new energy', was described as a *'well thought-out set of instructions for the energy challenges that lie ahead'*. The aim of the Roadmap is to develop a concept for an *'environment-friendly, reliable and cost-effective energy supply without nuclear power'*. These guidelines essentially bring together all the part-objectives that have been proposed to date. At the heart of the Roadmap is the 'twin strategy' of extending renewables use and further increasing energy efficiency. In the area of renewables development much has clearly already been achieved or set in motion. However, as we move towards 2020 there is a much greater need for action to be taken in respect of energy efficiency. Solid fuel (coal and lignite) still has and will retain its position within this great plan. The Roadmap continues to rate solid fuel as being 'important' for electricity production and has quantified its 2020 contribution at 40% (with 19% coming from coal). This would only represent a slight reduction from today's figure (2008: 44%), though this has to be seen against the planned cut-back in total electricity production. It was therefore essential that coal, like all fossil fuels, should be used as efficiently as possible.

The building and commissioning of 'highly efficient coal fired power stations' is therefore seen as a prerequisite for electricity generation. The efficiency rates of these installations are to be increased by the general introduction of state-of-the-art technology (with 45% efficiency) and by further research and development (post-2010 efficiency targets of more than 50%). Co-generation (CHP) should also be extended to include coal, so that optimum use can be made of this fuel source. If we are to achieve this, however, we need to exploit

Development of electricity generation in Germany according to the "Roadmap 2020" scenario of the Federal Ministry for the Environment



Sources: AGEB, 2009; Forecast: BMU, 2009, "Roadmap 2020" scenario



all existing 'heatsinks' as much as possible. CCS technologies, on the other hand, were an 'important carbon reduction option', especially for the period 'after 2020'. And as a *'vision for 2030'* it is proposed that *'half of all coal fired power stations be operated with CCS technology'*.

Unlike the PEPP guidelines, therefore, the Roadmap being put forward by the BMU also lays down various quantified goals and objectives, though only presents selective information on the overall economic costs and price burden. Little mention is made of how, given the difficult framework conditions that are anticipated in the economic, energy supply and climate sectors, coal's target contribution can actually be secured for 2020 and any increased fuel switch to gas, for example, effectively prevented. Neither is anything said about indigenous coal. Reference is merely made to the fact that the emissions trading system and final confirmation of the withdrawal from nuclear energy should send out a clear message for the modernisation of the current fleet of coal fired installations.

Real efforts have therefore been made within government in recent years to develop an overall energy-policy concept that seeks to do more than merely give priority to environmental objectives. However there have been few resilient answers to date and those that have been forthcoming seem to point in different directions.

In the European corridors of power energy policy has also been very much the focus of debate in recent years, though this has so far failed to produce an overall plan. In early 2007 the European Commission presented for discussion a comprehensive package of proposals for an 'Energy policy for Europe'. At about the same time the European Council reached agreement on the '20-20-20 targets', which have now been adopted as energy policy guidelines: CO_2 emissions and energy consumption levels in the EU are to be cut by 20% by the year 2020, while the share of renewables in energy use is to be increased to 20%. The EU's new Climate Package was therefore adopted at the end of 2008 with the implementation of the Council's targets. As its name suggests the Package is mainly concerned with environmental measures, such as the amendment of the CO_2 Emissions Trading System after 2013, a new EU Directive on Renewable Energies and the new CCS Directive. For this reason it is also known simply as the 'Green Package'. However, the Climate Package only deals superficially with (and if anything partly magnifies) the challenges facing Europe's competitiveness and security of energy supply – and so does little or nothing to come up with an effective solution.

This has also been recognised by the European Commission, whose 'Second Strategic Energy Review'

of November 2008 has already referred to some of the challenges facing energy security. The situation is depicted in the Commission's own projections, such as the 'New Energy Policy Scenario' that caters for even tougher environmental targets: a purely environmentally oriented change of course for electricity production would relegate coal and nuclear power to the sidelines. On the other hand renewables, and indeed gas too, would simply take top billing in the power generation sector as a result of a massive expansion in capacity Europe-wide. Any upturn in gas-based electricity production would however inevitably increase Europe's already high level of dependence on supplies from third countries – and in particular Russia. For this reason the Commission has launched a series of initiatives designed to take better account of the problem of Europe's growing reliance on energy imports from outside the EU.

In this context the Commission has also proposed that the available indigenous energy resources should in future be used as efficiently as possible – an aim that has also been supported by the Council. This would initially involve an accurate stock-check of the EU's own energy reserves and resources – including its 'substantial' coal deposits. The current and predicted significance of indigenous energy sources will then be determined and examined in appropriate detail. Only on such a carefully investigated basis will it be possible, before the end of 2010, to draw up a comprehensive new European energy policy with a time horizon to 2030 and to underpin this with action plans and tie it into an energy policy 'vision' for 2050. Any European energy strategy must also incorporate the aspects of security of supply and competitiveness and should not neglect the strategic importance of the EU's own reserves. The renewed outbreak of the gas dispute between Russia and Ukraine at the turn of 2008/2009 demonstrated just how important this is. This dispute practically led to a two-week embargo on most Russian gas supplies to the EU and other neighbouring states, and this in the middle of a freezing cold winter. Some parts of Germany were also affected, while the incident led to an energy crisis in a number of European countries. The emergency generally created an 'extremely serious situation' for energy supplies (EU Commission). The gas dispute emphatically illustrated the potential consequences of Europe's massive reliance on energy imports from Russia. And this applies no less to Germany. Against this backdrop the management consultants A. T. Kearney produced a study of the gas supply situation in the EU surtitled: 'Russia turns off the gas tap – Europe freezes'. In spite of intense diplomatic efforts the dispute has still not be fully resolved. Gas-industry experts therefore believe that supplies could also be interrupted in the winter of 2009/2010. For this reason contingency plans are already being discussed at EU level.

Even if this very real threat did not exist any future European energy policy still has to do more to ensure security of supply and see that appropriate precautionary measures are put in place. Once the EU Reform Treaty (the Treaty of Lisbon) takes effect then so will its new Energy Chapter (Article 194 of the Treaty on the Functioning of the European Union). Paragraph 1 of this particular chapter states that, *'in a spirit of solidarity between Member States'* and in the context of the internal market and with regard for the need to preserve and improve the environment, the Union policy on energy shall seek to:

- ensure the functioning of the energy market;
- ensure security of energy supply in the Union;
- promote energy efficiency and energy saving and
- the development of new and renewable forms of energy and
- promote the interconnection of energy networks.

Under the terms of the Treaty any decisions taken on energy matters have to be adopted by qualified majority, while resolutions in the area of taxation can only be passed by unanimous consent. If *'severe difficulties arise in the supply of certain products, notably in the area*

of energy', the Council of Ministers acting in the spirit of solidarity between Member states may decide upon the measures appropriate to the economic situation (Article 122 TFEU). All this rekindles memories of the European Coal and Steel Community. However the principle of shared competences will continue to apply. While the Member States clearly remain bound by the common energy objectives, Article 194 paragraph 2 of the TFEU specifically states that each Member State shall in future still have the right *'to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply'*. Responsibility for ensuring primary-energy supplies within the EU will therefore continue to lie with the Member States, who are in this respect committed to this objective. They are, accordingly, responsible to the entire European Union for achieving this objective and are bound by a duty of solidarity in respect of their various energy resources, which includes their coal deposits.

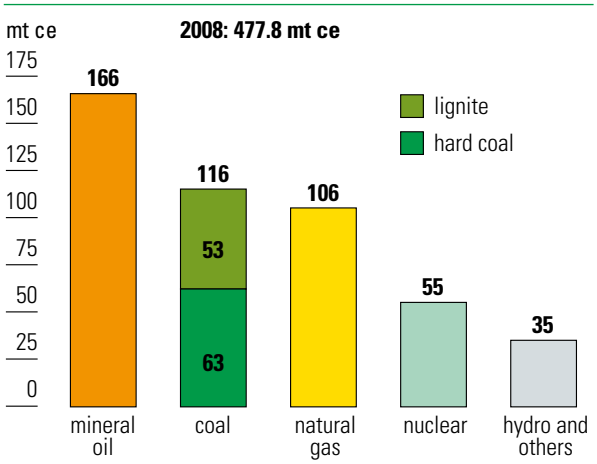
Current situation and trends in the German energy supply sector

Germany's primary-energy supplies continue to be based around a relatively broad mix of fuels with a high and growing reliance on imports. Imported energy now meets about 70% of overall primary-energy consumption – this mainly comprising oil and gas imports, though imported coal is becoming increasingly important. If imported uranium-based nuclear energy is included as a quasi-indigenous energy source then the import dependence falls to around 60%. In 2008 home-produced solid fuel made up 15% of the energy supply market (lignite 11% and coal 4%), while renewables provided 7% and indigenous oil and gas and other fuels about 5%.

If we examine Germany's overall primary-energy supply structure and set this in the context of the current energy debate it will be apparent that the two energy sources that are now the main centre of public attention – namely nuclear power and renewables – together make up less than 20% of total primary-energy consumption. While most primary-energy supplies, more than 80% of the total, continue to be based around oil, gas, coal and lignite, the public at large increasingly seems to disregard this fact. Instead these 'fossil' fuels are under fire from the environmental lobby.

Some of the media occasionally give the impression that energy is not being used efficiently in Germany, or even that it is being unscrupulously squandered. It is claimed that coal consumption in particular is not being reduced and that CO_2 emissions are not being curbed. None of this is true. Germany's primary-energy consumption (PEC) has for a number of years only been growing at a moderate level as measured against economic growth. The process of 'decoupling' economic growth from electricity consumption is continuing and the advances made in macroeconomic energy productivity will be a crucial factor here. According to the 'Arbeitsgemeinschaft Energiebilanzen' (AGEB) energy productivity in Germany rose by about 3% in 2008, adjusted for temperature and stock levels, against a 1% increase in PEC. This was clearly above the average 2% growth rate recorded since 1990, which means that energy productivity has been rising faster than economic performance. Put another way: 2008 has been yet

German primary energy consumption

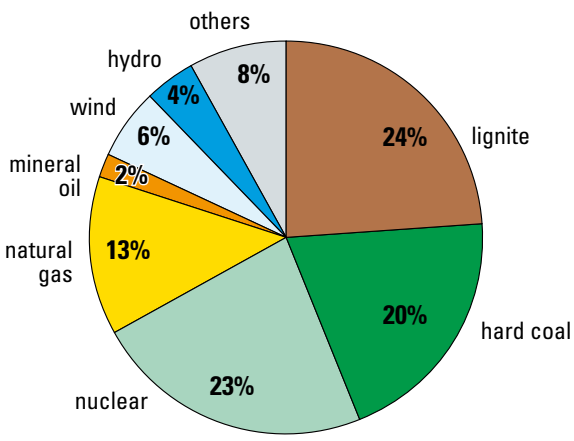


another year of significant improvements in German energy efficiency rates. While this does not mean that we have now exhausted all potential for efficiency in energy use, it is nevertheless questionable at the very least whether we shall be able to meet the huge expectations for a further increase in energy efficiency, to say nothing of an 'efficiency revolution', in the years and decades to come. A more realistic outlook would be to accept incremental advances and aim for an evolution in energy efficiency.

Primary-energy consumption is expected to decline significantly in 2009 in the wake of the current recession. In fact PEC was 6% down in the first six months of the year. Almost all energy sources were affected, with coal hardest hit as consumption levels fell by 22%. The exception was oil, which recorded a 1% increase due mainly to the fall in the price of heating fuel. This shows just how much energy consumption trends are influenced not only by exogenous factors such as economic developments and temperature levels but also by relative changes in energy prices, which since 2008 have been through some very turbulent times.

In spite of the slight increase in PEC 2008 also saw CO_2 emissions in Germany fall to their lowest level since 1990 (down 22% overall). CO_2 emissions from coal use have for many years been falling disproportionally when compared with emissions from other energy sources (39% decline since 1990). Oil-based emissions, for their part, have only decreased by 19%, while emissions from gas installations are in fact up 43%.

The German electricity generating sector is now being affected much more by structural changes than by variations in output levels. Admittedly the downturn in the German economy and the massive drop in electricity consumption by German industry during the first half of the year have also had an impact on power output – but this will only be a temporary setback. Things will be back on course again after the next economic upswing and longer-term developments on the consumption side will, if anything, drive electricity use upwards. This includes the expansion of electronic information and communication technologies, the trend towards decentralised generation structures, the increase in heat generation from CHP plant, advances in the usability of hydrogen technology and, more recently, the much-trumpeted growth potential of electromobility. And none of this is inconsistent with the ultimate objective of using energy in an even more efficient way. It is therefore now more urgent than ever that Germany's electricity production capability should be put on a secure footing for the long term.



Power generation in Germany 2008

Revisions to the environmental and energy policy agenda, on the other hand, have created a fair

amount of planning uncertainty in the electricity sector and the resulting structural changes have at the same time had a major impact on supply policy. Coal and nuclear energy, which have for many years made a pivotal and highly reliable contribution to security of supply in Germany, are now being increasingly relegated to the sidelines. In 2008 solid fuel supplied just less than 44% of the electricity production market (lignite: 24%, coal: 20%), while nuclear energy's share dropped to 23%. This contrasts with the 2000 figures of 51% for solid fuel (lignite: 26%, coal: 25%) and nearly 30% for nuclear. Coal and nuclear energy combined have therefore seen their contribution to the German electricity production sector fall by nearly a fifth since the start of this century.

Compare this with the strong progress made by renewables over the same period (most notably biomass electricity, wind power and hydroelectric power). In 2008 renewables made up 15% of the electricity market and this figure is set to go on rising. In 2000 only 6% of electricity output was generated from renewable sources. The same trend applies to gas – although the rate of growth will not be so rapid. In 2008 gas had a 13% share of the electricity market, compared with 9% in the year 2000. Renewables and gas together have therefore doubled their contribution since the start of the decade. This parallel development, which is due to continue, has not taken place completely by chance. The reason is that reserve and balancing power capacity is required in order to ensure a steady flow of output from renewable energy systems. Even though the price and supply risks of gas are higher than those of coal it is still economically more favourable to provide extra gas-fired power stations, as such projects are less capital intensive. All this adds up to a significant change in the primary-energy mix for German electricity generation, which has until now always been extremely well balanced. We could in the not too distant future therefore be confined to an increasingly narrow range of fuels and fuel sources – and that is not a positive development for the security of primary-energy supplies and electricity production.

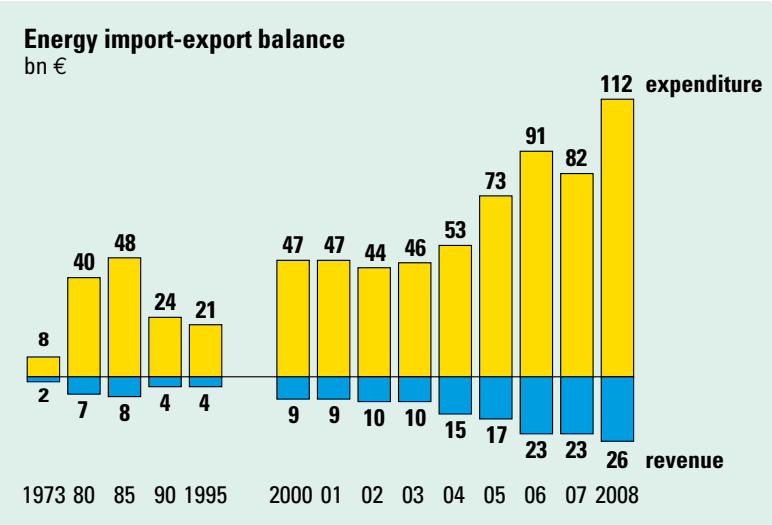
State-initiated and market-driven developments in energy prices

Surprisingly, little public attention is still given in Germany to the huge impact that Government measures have on energy prices. The same also goes for the political burdens and restrictions that have, for many years now, been imposed on fossil-fuel consumption. These are reflected in a corresponding increase in energy prices. The tax on mineral oil, for example, yields more than € 39 bn a year, which makes it one of the most productive of all the revenue raisers. About 70% of the cost of each litre of petrol is made up of Government levied taxes and duties. In Germany coal too has for a number of years been subject to a specific coal tax of about € 10/t under the terms of the EU Energy Taxation Directive. This applies to coal consumption outside of power generation and steel production, which means that it mainly affects the sale of anthracite to the heat market. The European Commission is now examining concrete proposals for extending this coal tax and other energy taxes to include a CO_2 component, which will further raise the tax burden. However the Council of Ministers will have to give their unanimous approval before this can be done. As is the case with other fossil fuels intended for the energy and manufacturing sectors all coal that is destined for electricity generation and steel production is already subject to the provisions of the current European Emissions Trading Scheme. This requires the purchase of appropriate permits, whose cost in turn results in a mark-up in electricity, steel and other product prices. Depending on CO_2 prices and the extent to which this is passed on to consumers this cost factor can exceed double digit billion amounts.

Moreover, this additional price burden, as imposed by the Emissions Trading Scheme, does not even include all those long-established taxation charges that already make up more than 40% of the cost of our electricity (electricity tax, concession fees, EEG levy and CHP levy). In 2008 this amounted to an additional cost burden for electricity consumers of some € 16 bn. In 2008 the energy infeed payments for renewables, as imposed under the EEG (Renewable Energy Sources Act), alone came to nearly € 10 bn. About half of this is classified as differential costs set against the lower exchange price for electricity: this therefore represents a form of subsidy that is paid not by the State but by the electricity consumers themselves. In the power generation sector alone renewables therefore benefit from a level of subsidy that is more than twice that of the aid paid to the coal industry, which also includes finance to cover the cost of inherited liabilities and colliery closures. In 2008 well over € 7 bn was spent on promoting renewables in this sector, which was in addition to the other tax-funded programmes (such as the Market Incentive Programme, the 100,000 Solar-panel Roofs Programme, the Bank for Reconstruction and Development (BRD) Environment Programme, the BRD-CO_2 Savings Programme for Buildings, the ERP Environment and Energy Programme, etc.).

The high financial burden that the State has imposed on energy consumption and on some individual fuels too has long been cushioned by low market prices. The world market offered cheap energy imports that were assumed to be reasonably easy to plan for. However, world market prices for energy have now generally become unpredictable right across the board. This was highlighted by last year's price explosions and by the subsequent price collapse at the end of 2008, which has now been followed by another upturn in energy prices even in this crisis year 2009. Rising energy costs have also become a social issue, with some politicians now pointedly referring to this as 'the price of bread for the twenty-first century'.

Our growing dependence on imported energy, combined with last year's record high prices on the international energy markets, also meant that Germany's overseas fuel bill for 2008 reached an all-time high. The German economy has never had to raise as much for its energy imports, in this case € 112 bn, as it did that year. And the balance of imports and exports in the energy sector also reached a new peak of € 86 bn. Studies have however confirmed that part of this overspend flows back to Germany by way of an increased level of buying by the supplier countries. This situation can be attributed to a large degree to the increase in oil imports, which rose to an import value of nearly € 75 bn. This represented an increase of 37% within a year (although in quantitative terms the figure was only about 5% up). In 2008 we also paid out € 29 bn for imported gas, € 5.5 bn for imported coal (an increase of 49% on the previous year) and € 1.2 bn for uranium imports. This not only constituted a massive



increase in the fuel import bill from the previous year but also represented all-time peaks for each and every form of imported energy and a four- to fivefold rise in spending on energy imports by Germany since the turn of the millennium.

These record figures were set in spite of the fact that towards the end of 2008 energy prices were on the slide because of the impact of the recession. This serves to illustrate the scale of the price explosion that occurred during the course of the previous year. Given the ongoing economic recession and the current low level of energy prices compared with last year it is now expected that the fuel import bill for 2009 will be well down on that of 2008. This should help relieve Germany's very poor economic situation by removing the energy-price factor, at least as far as the first six months of 2009 are concerned. Of course when viewed in the long term the sharp fall in energy prices has not in fact been on such a dramatic scale that we can now look forward to record low spending on energy imports. In reality the crisis has confirmed that the trend in world market prices for energy has been ever upwards. While the global recession has obviously interrupted this basic tendency it has not reversed it. As the economy recovers many experts are anticipating a strong resurgence in energy prices. The fuel import bill will then rise again, especially as Germany's reliance on outsourced energy, in terms of import volume, is likely to increase in the years ahead.

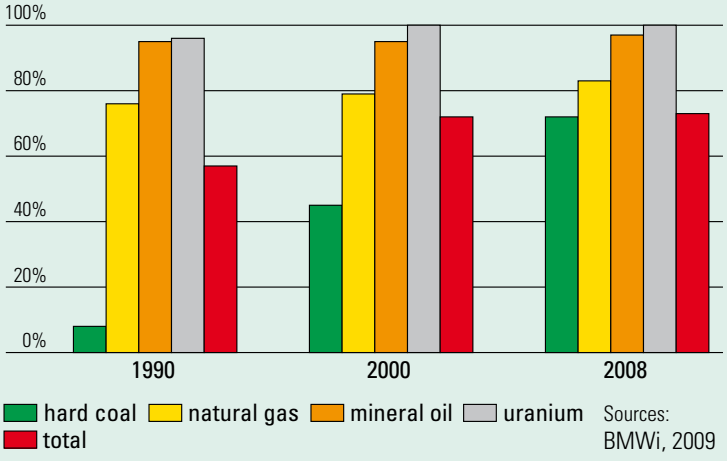
Import dependence, indigenous primary-energy production and supply risks

In 2008 Germany was on average 73% reliant on imported fuels for its primary-energy supplies. The highest dependence was on oil, with 97%, followed by gas at 84% and coal at 72% – still just below the average.

What is worrying is not only the level of dependence on energy imports but also their concentration on certain supplier regions and source countries. While a sizeable proportion of these imports is still supplied from EU member states or from countries that are associated with the European Union, a significant quantity now also comes from politically and economically risk-prone sources. Russia is now the dominant supplier of Germany's oil imports (31% of total oil consumption) and gas imports (37% of consumption). What is more, it is also the main source of imported coal (14% of the country's total consumption), and not just for Germany but for the EU as a whole.

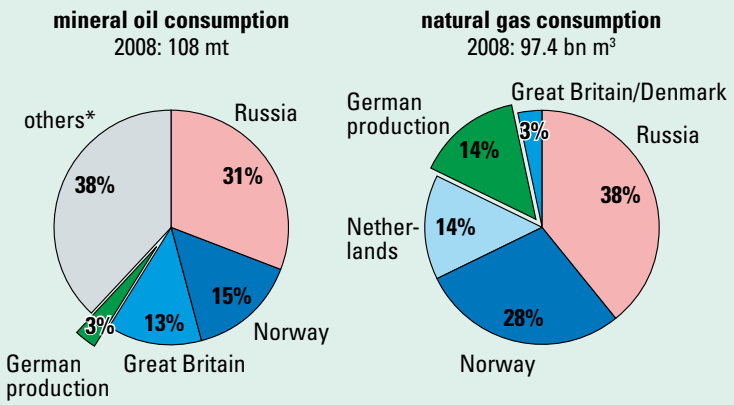
The German public generally perceives Russia to be the nation's main supplier of gas. It is true that about 20% of Germany's total primary-energy needs come from that country alone, a fact that seems to have alarmed a number of once liberal-minded commentators. Russia actually makes about the same contribution to Germany's energy requirements as does the indigenous primary-energy production sector, which in 2008 provided 27% of the country's energy needs.

Germany's reliance on energy imports increases
shares of German net imports



Sources: BMWi, 2009

Mineral oil and natural gas consumption in Germany



* (of those OPEC countries: 21 %)

In spite of the growing contribution from (primarily home-produced) renewable energies, indigenous primary-energy production in 2008, which amounted to 131 million tce, was 4% or more down – in absolute terms – on the previous year's figure. The main source of indigenous energy in 2008 was lignite, which supplied 41% of the primary-energy market.

Coal too plays an important role, with a 14% share of the energy market. This input was larger than that of German-produced gas (13%) and more than three times that of wind power (4%). Mine gas extracted from both active and disused collieries, which usually comes under the general heading 'Others', is another source of energy that should not be overlooked.

In 2008 all renewables combined contributed some 27% to indigenous primary-energy output (see page 16). Contrary to the commonly-held perception this sector is not in fact dominated by the much publicised wind power or the highly subsidised solar energy but rather by the bio-energies (biomass, biogas and biofuel), which account for three quarters of all renewables production.

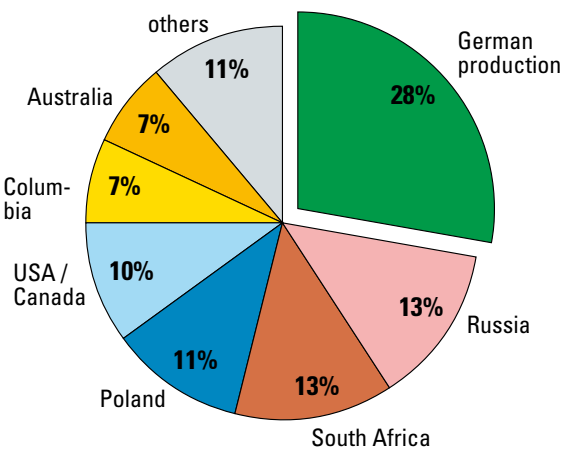
Conclusion: Germany's reliance on energy imports has to date not been reduced by developing the renewables industry, although increased renewables' use has to some extent slowed down the rate at which this dependence is growing.

The high and increasing reliance on imported energy has at the same time measurably raised Germany's energy supply risk. A number of studies have already been carried out in an attempt to quantify energy-supply sensitivity and vulnerability. The findings not only provide qualitative data on the situation but also clearly document developments in quantitative-empirical terms.

Let us take coal as an example: In 2009 the Austrian Economics Ministry produced an updated version of its 'World Mining Data', according to which nearly two thirds of the coal producing countries worldwide can be classified as being politically unstable. The World Mining Data publication adopts the following approach: a World Bank rating system is used to weigh the 'political stability' factor against the production quantities of all recorded raw materials from the different producer countries

German coal sources

2008: 63.6 mt ce share of imports: 72 %



Shares of „stable“ and „unstable“ producer countries for steam coal and coking coal

	steam coal		coking coal	
	2003	2007	2003	2007
politically stable countries („stable“ - „fair“)	34.6 %	35.0 %	45.6 %	39.3 %
politically unstable countries („critical“- „extremely critical“)	65.4 %	65.0%	54.4 %	63.7 %

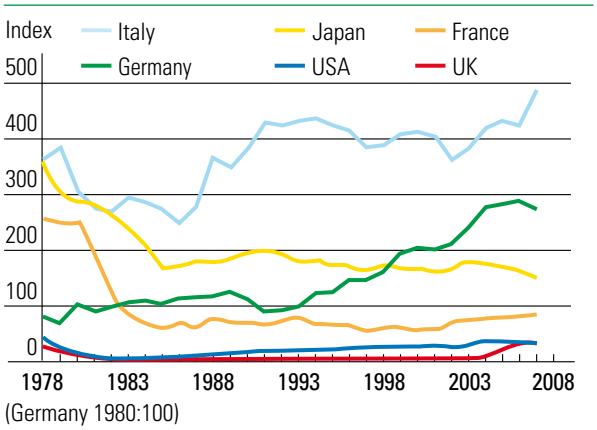
Source: „World Mining Data 2009“, Austrian Ministry of Economy

– including steam coal and coking coal. Fairly stable countries are classified as ‘stable’ or ‘fair’, while unstable countries are categorised as ‘critical’ to ‘extremely critical’. The publication indicates that in 2007 (the last year that processable data were available) about 65% of steam-coal producer countries, and nearly as many of the coking-coal supplier countries (64%), could be classified as tending to be unstable. By comparing the World Mining Data for 2009 with the findings for the period since 2003 it is evident that things have hardly improved in terms of the number of ‘unstable’ suppliers of steam coal, while the situation as regards coking-coal producers has in fact markedly worsened. This means that in the coal supply sector too our growing import dependence has almost inevitably resulted in an increased supply risk – even though the volume here is lower than in the case of oil and gas and unlike the latter two fuels the solid-fuel sector has the option of mixing imports with indigenous production.

The RWI (Rhine-Westphalia Institute for Economic Research) has been involved in analysing national energy security since 2007 as part of an ongoing remit that was first instigated on behalf of the Federal Government. These studies enable comparisons to be drawn over time and between the different countries. The RWI has focused on the degree of energy import dependence on the various supplier countries and to this effect has developed a risk index that presents the concentration and diversification of supplier countries and their political reliability on the basis of the rating system for the Government’s Hermes overseas securities, or according to the OECD classification. These investigations confirm the following: since the 1980s Germany’s energy security has decreased as a result of the country’s growing reliance on energy imports; it is much lower than that of many other industrialised nations (such as the USA for example) and in spite of the development of ‘quasi-indigenous’ renewable sources it could well decline even further. The RWI attributes this to the growing influence of Russia and to the dwindling contribution that indigenous coal is making to energy supplies. In early 2009 the RWI published a study entitled: ‘Drip fed by Russia? A concept for the empirical measurement of energy supply security’. In this investigation the RWI largely confirms what is being suggested in the title.

When comparing the different fuel sources it is clear that the increased supply risk posed by oil and gas is even more pronounced than that presented by coal. In coal’s case, however, indigenous production has until now always made up by far the largest share of this market. We are now finding that the effect of growing import dependence, which tends to increase the supply risk, is also being felt here too.

Energy supply risks
G7 states



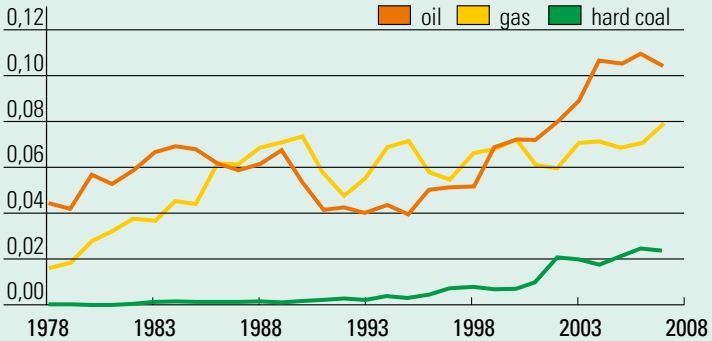
(Germany 1980:100)
Source: Frondel, Ritter u. Schmidt, ZfE 1/2009, p. 42 ff

The RWI comments as follows on the long-term prospects facing the international coal markets: nearly three quarters of the planet's coal reserves are located in just four countries – namely the four great world powers of the USA, China, Russia and India. This could well add a new dimension to the political risks existing in this area in the long term. However, the country-specific risk for coal imports is not just restricted to the huge influence that Russia and the other aforementioned powers will have on supply availability in the long term.

In another study into 'Germany's energy supply risk yesterday, today and tomorrow' the RWI has used the RWI indicator to quantify the supply risk for Germany's energy mix over a comparative period from 1980 to 2007 and has even supplemented this with a projection for the year 2020 (see: *Zeitschrift für Energiewirtschaft* 1/2009, pp. 42 - 48). This shows that the supply risk has not only risen significantly in recent years but has in fact more than doubled since 1990. And there is a very real threat of a further dramatic increase in the not too distant future.

This assessment of a growing threat to Germany's primary-energy supplies, which is supported by scientific and quantitative methods, is also confirmed by the latest broad-based survey that the prestigious EEFA Institute has conducted into the vulnerability of energy supplies to the German economy.

Supply risks for oil, gas and hard coal 1978 to 2007 according to RWI



Sources: RWI, 2008

Perspectives for energy supply to 2020 – energy security under threat

There is no doubt that energy security depends on more than merely reducing the risks to primary-energy supplies. Germany also suffers from serious deficiencies in energy generation, processing and distribution capacity. What is more, the power supply companies are being deterred from new investment projects because of climate and environment policy-related planning uncertainty in conjunction with the comprehensive deregulation of the energy markets and the overall economic instability that has recently taken hold. The German Energy Agency (dena) has repeatedly warned of an electricity shortfall in Germany: according to existing plans drawn up by the German electricity industry for the construction and replacement of 'conventional' power station capacity in response to the proposed nuclear phase-out and the extension of renewables usage we will have a 12,000 megawatt deficit in generating capacity by the year 2020. This represents about 15% of the projected electricity demand, which means that we could well experience interruptions to supply at peak-load times.

Admittedly, integration into the European single market for electricity will help alleviate the peak-load problem somewhat. However this will not resolve the capacity shortfall. Studies carried out by the European electricity grid operators (UCPTE) show that given the increase in electricity demand we are more likely to experience capacity shortages than capacity surpluses on a Europe-wide basis. And if the

Power plant Datteln

national and transboundary transmission networks are not developed and extended quickly enough shortages in supplies to consumers could arise even when there is sufficient production capacity. This applies equally well to other parts of the energy infrastructure. The need for major action in the energy supply sector has now been confirmed by the Energy Transmission Line Extension Law and other Government measures.

Nevertheless, the shortfall in electricity generating capacity that dena has predicted remains a distinct threat. One of the biggest problems is the shortage of new-build coal-fired capacity, which can be attributed to the additional expense and planning uncertainty created by environmental policies and also to local and national opposition – which has been extremely strong in some cases – to projects of this kind. We are now seeing a growing number of coal-fired power station projects being delayed, put on hold or even abandoned completely – stretching from Berlin to Kiel, to Herne in the Ruhr and down to Ensdorf in Saarland. This opposition has been directed of all things at new coal-fired plant, which are now much more efficient and environmentally sustainable. Work on the ultramodern coal-fired Datteln power station, for example, which was well advanced, was subsequently halted by the Higher Administrative Court in Münster.

We now need to look very closely at why the Court was able to object to the scheme under the planning approval process. While this case should not be taken as heralding the end of new coal-fired projects, it would seem – in spite of everything – that there is now increasingly less planning security for major investment projects in Germany.

The climate issue is a global problem that will never be solved by national action alone. Germany's coal-fired power stations – which are among the most environment-friendly in the world – produce about 1% of global CO_2 emissions. However, the problems for security of energy supply – which stem from the lack of sufficient coal-fired generating capacity – will hit the German economy full on. The opportunities offered by modern coal combustion technologies, and the impact of the environmental measures already put in place, seem to go largely unnoticed. The European emissions trading system automatically imposes full compliance with environmental targets in those sectors that are coal's main market. New power stations would find it hard to defy these provisions. The aforementioned BMU roadmap has established that if coal is to have a 40% share of the German electricity production market in 2020 this will have to be reconciled with ambitious environmental objectives just as much as with the withdrawal from nuclear power.

Increased capital costs have now led to a further decline in planned investment throughout the European power station sector. In early

2009 the consultancy firm A. T. Kearney published a study presenting the projected downturn in investment levels to 2020. The result was an estimated capacity deficit of 20 - 25%. The building programme for new coal-fired power stations, which in any case has now been revised, is less affected by this than the planned extension of power generation capacity based on renewable energies, especially the proposed building of large new offshore wind power generators. The study therefore posed the question 'Will the financial crisis be followed by an energy crisis?'

But the threat to the security of Germany's primary-energy supplies still remains all the same. According to many of the predictions and most of the experts – and in spite of the temporary downturn caused by the global economic crisis – the trend reversal that set in a few years ago on the international energy and raw-materials markets is likely to continue. And this is also borne out by appraisals that are made in this year's Annual Report.

Energy resources will gradually become scarcer and more expensive as the twenty-first century progresses. There have been a plenty of warnings of a forthcoming oil crisis. And there is now also talk of an impending gas shortage and the threat of an international gas cartel. When it comes to coal the problem is not so much an issue of quantity – global reserves and Germany's too will last for well over a hundred years – but their regional availability, which has become a critical factor. The next economic upturn will bring with it renewed growth, with demand on the world coal markets tending to shift further towards Asia. Under these circumstances the BGR (Federal Institute for Geosciences and Natural Resources) has expressed real concerns for the EU situation in its report 'Energy resources 2009': *'Against the background of a further reduction in coal output in Europe and the resulting increased reliance on imports any shortage of supply would hit the European zone particularly hard.'* These economic risks as they affect the international energy markets would then be joined by various geopolitical risks, which are discussed in some detail in the guest contribution to this year's Annual Report.

What then can the policy makers do to reduce the growing threat to supplies on the international energy and raw-materials markets? The conventional response is usually diversification – in other words systematically spreading the source of supply. However, diversification strategies always come up against the limits that are imposed by the concentration of deposits and market supply. This usually conflicts with the principles of cost effectiveness, for otherwise the price and cost signals of the market would of themselves ensure an adequate degree of diversification. Similar conflicts of interest can exist with respect to environmental targets. And finally, a market economy-oriented energy policy at national or at supranational level can do no more than create an extended framework for the efforts and endeavours of the businesses involved. Cross-border power line schemes for instance, which would come under the category of supranational projects, would pose additional coordination problems. There would be no guarantee that the undertakings in question would make use of the new system; they might well decide to set other priorities for individual economic reasons or may even be faced with conflicting strategies from other countries.

Another common response to the challenges of security of supply is the forced introduction of energy efficiency and energy saving measures. This is also compatible with the other central energy policy objectives of competitiveness and environmental sustainability. There is no doubt that this approach is fully justified. Energy efficiency is quite possibly the 'sleeping giant' of energy policy, though its real potential lies not so much in energy production but rather in energy utilisation – and this applies less to the energy supply industry and more to the construction and transport sectors and to some branches of the manufacturing industry too. The question that has to be asked of course is to what extent and at what pace can energy efficiency be driven forwards without causing a loss of prosperity in other areas. The reason for this is that the best conditions from an (energy) technical point of view are still a long way from being the best conditions

in economic terms. It would therefore be more than irresponsible to assume that energy conservation is the equivalent of having a reliable energy source or to argue on the basis of energy saving measures that will be imposed years from now that we can dispense with the sources of supply currently available to us.

The prospects for primary-energy supplies in 2020, for example, will pose huge challenges for German energy policy.

If the withdrawal from nuclear power is completed according to plan, as proposed by the current Atomic Energy Act, the last German nuclear plant is scheduled for closure in 2022. Of the 17 nuclear power stations still operating in Germany today only three will still be in service in 2020. The nuclear industry will by then only be supplying about 8% of Germany's electricity output, which means that at best nuclear power will account for just 3% of national primary-energy consumption. This small contribution will fall away to zero in the years thereafter.

Owing to the depletion of our known indigenous reserves Germany will no longer be producing its own oil and gas by 2019/2020. The gradual exhaustion of production sources in the North Sea will also reduce oil and gas output in the rest of the EU to a very low level. After 2020 we shall be 100% dependent on imported oil and gas, which will soon be supplied completely from countries outside the EU. This will be unavoidable because of the paucity of indigenous sources.

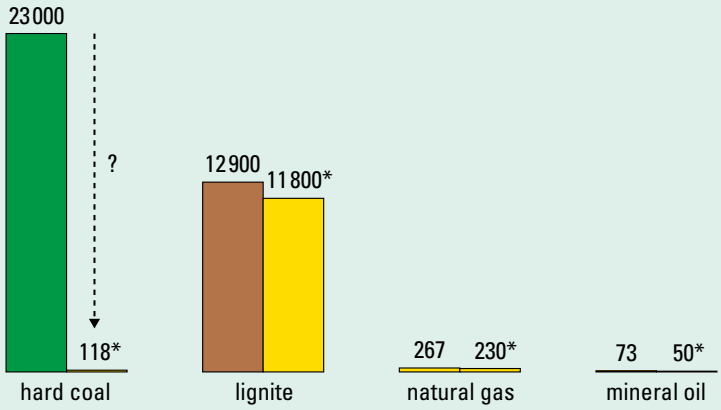
In the case of indigenous coal, of which Germany still has substantial deposits, future availability will depend not on any limitations to the resources but on economic developments and political decisions. If the Coal Industry Financing Act – which proposes to terminate subsidised coal mining in Germany at the end of 2018 – is implemented without revision the German coal industry will no longer be able to contribute to the nation's energy supply after 2020, as all the remaining collieries will have been closed. Access to indigenous coal deposits will then be lost and the German coal market would henceforth be completely dependent on imported fuel. Our indigenous coal 'reserves' are already being referred-to in minimised terms, in accordance with Government presets, even though the huge deposits still available have not physically disappeared.

The future of the domestic lignite industry is also very much dependent on political parameters. Of all the energy sources this is the one that is most in the firing line of environmental policy. The successful implementation of CCS technology will therefore be crucial for the development of an environmentally sustainable lignite-based generating sector after 2020.

Renewables, backed up as they are by massive political support, will continue to make a growing contribution to security of energy supply and in doing so will eventually break through the profitability threshold, though for the most part they are still a long way from this. In the long term, that is to say by the mid-point of the century, the German Government even expects about 50% of our energy requirements to be met from renewable

Domestic coal: Auguste Victoria mine, shaft 8

Energy raw material reserves in Germany
technically and economically recoverable reserves according to BGR
in mt ce



Source: BGR 2002 and BGR 2008 (*)

sources. Germany's stated energy policy objective is that renewables should provide at least 30% of total gross electricity consumption by 2020, and that this should then be increased year on year. Renewables will by then have a 14% share of the heat supply market, while the contribution from biofuels will have increased to 12%. The BMU's 2008 Lead Study into the development of renewable energies indicates that by 2020 renewables will make up about 16% of total primary-energy consumption – still lagging behind coal (19%) and far behind both natural gas (27%) and mineral oil (35%).

It is mainly environmental policy making that is driving the development of renewable energies. Here the Government's development targets do not actually fit in with the economic principles of the established CO_2 emissions trading system and the fiscal measures associated with environmental policy. This is because in principle they do not specify the type of energy mix to be used in meeting the environmental targets. The extended use of renewables as a replacement for coal and nuclear energy in the electricity production sector seems to be much less convincing from an energy and raw-materials policy point of view. Yet this is the very area in which renewables' development has being most actively pursued to date.

The heat and transport sectors, which rely on finite reserves of oil and gas that will have to be replaced within the next few decades, would appear to be far more important areas to focus on. Looking ahead to 2020 it is also foreseeable that even if renewables are developed so as to provide 30% of our electricity output this could not, from a purely mathematical point of view, completely replace the dwindling contribution made by nuclear power and indigenous coal. Additional energy imports will therefore be required.

Renewables certainly do not contribute towards increased security of energy supply if they supplant indigenous or other quasi-indigenous energy sources. Besides, their availability will continue to be subject to natural disruptions as long as no adequate storage technology can be developed and deployed. It is still too early to say whether or not this will change after 2020.

Neither should the development targets for renewable energies be regarded as confirmed, for there are still quite a number of major obstacles to be overcome. For one thing this sector still faces huge economic hurdles in the form of the differential and/or additional costs that will have to be offset through state or government-imposed subsidies. The BMU Lead Study indicates that by 2020 the heat market will be the only sector in which renewables can move into profitability. All the other areas will continue to rely on subsidies. According to the Lead Study the electricity production industry will still see differential costs of around € 3 bn in 2020. The study also predicts that by 2020 the cumulative development costs for the renewables sector will total some € 80 bn. One basic reason for the high

additional costs that still have to be paid for renewables-based energy is that the production systems have a larger raw-materials requirement per unit of energy than conventional energy generating installations. Renewables also present certain drawbacks when it comes to conserving non-energy resources, all the advantages of climate protection and other environmental targets notwithstanding: they consume large quantities of metallic resources – such as iron and copper ores, bauxite and special metal ores like gallium – as well as rare earths and silicon, which is extracted from silica sands. They are therefore not a cure-all solution from a sustainability viewpoint. The same can be said about the large amount of space taken up by renewables-based generating plant. This not only stands in direct conflict with the principles of nature and landscape conservation, as demonstrated by many wind-power and hydro-electric projects, but also frequently creates competition for land use with agriculture and other land development schemes – which is in fact always the case when setting up bioenergy projects. Neither should we forget the increased emission of the greenhouse gas nitrous oxide, which is released when applying fertilisers.

Some of the research findings published in early 2009 by the European research project NEEDS (New Energy Externalities Development for Sustainability) do not therefore come as much of a surprise when viewed objectively. The NEEDS project, which includes a sustainability-oriented examination of all relevant externalities in the area of energy production, gives a quite diverse picture of the sustainable environmental impact – even for renewables. There are for example only a few renewable energy technologies that clearly outperform coal in this respect – particularly given the future introduction of the CCS process. One of these is wave and tidal power, a system that of course can only be used in coastal areas. Other renewable technologies, such as biomass and photovoltaics, present no general sustainability advantages whatsoever over coal. The energy debate should not therefore be so one-sided in its approach, even when it comes to environmental protection and sustainability. And in this respect one of the most important tasks for the future will be to help CCS technology gain wider public acceptance.

Germany's energy security will therefore be increasingly threatened in the years ahead – even by the expansion of the renewables sector. A study entitled 'Security of energy supply' (by J. Eekhoff et al.), which was carried out by the Institute for Economic Policy at Cologne University in October 2008, comes to the sobering conclusion that if Germany is to improve its security of supply by reducing its dependence on politically unstable third countries, even allowing for all the efforts being made to promote renewables and their long-term contribution to energy supply, there are in effect only two logical starting points: for one thing we need to extend the operating life of our nuclear power stations, which will at the same time benefit climate protection efforts, though admittedly this does present other serious environmental problems. Here it will be necessary, according to the study, 'to weigh security of supply against the dangers posed by using nuclear power'. And for another *'the second relevant quantitative step that can be taken towards security of supply would be to increase coal utilisation. If security of energy supply is to be improved by promoting indigenous energy production then this must evidently benefit the coal industry'*. As indigenous lignite has only limited potential this plea for greater use to be made of home-produced fuel can only apply to German-mined coal.

What is more, in adopting a strategy whereby imported gas destined for the electricity market is partly replaced by indigenous coal the Cologne economists point out that there is more to be gained than just increasing our security of energy supply. They also highlight the fact that such a strategy would be completely 'carbon neutral' if the gas in question were to be used in the source country itself, such as Russia for example, as a replacement for coal (which is now being burnt in power stations whose environmental standards are lower then in Germany). Energy policy is very much about taking the overall view, which means having an overall concept.

Photographs:
Prosper-Haniel mine,
shaft 10

World primary energy consumption

year	nuclear energy	non-renewable energies: coal and lignite	non-renewable energies: mineral oil	non-renewable energies: natural gas	renewable energies: hydro	renewable energies: other fuels	total
	Mt ce						
1970	28	2,277	3,262	1,326	146	827	7,866
1980	247	2,724	4,320	1,853	206	1,066	10,416
1990	738	3,205	4,477	2,525	271	1,420	12,636
2000	955	3,123	5,005	3,091	329	1,535	14,038
2005	1,031	4,191	5,488	3,522	379	1,960	16,571
2006	1,047	4,418	5,575	3,682	387	2,030	17,139
2007	1,024	4,544	5,653	3,772	375	2,120	17,493
2008	1,020	4,724	5,619	3,898	380	2,150	17,791
2020	1,204	6,255	6,784	4,476	505	2,402	21,626
2030	1,288	7,018	7,306	5,248	592	2,878	24,330

nuclear energy and renewables evaluated by efficiency method
Source of forecasts: International Energy Agency, 2008

World reserves of coal, lignite, mineral oil and natural gas

regions	coal and lignite	mineral oil	natural gas	total
	Bn t ce			
EU-27	52.2	1.2	2.6	56.0
Eurasia*	139.4	21.0	69.2	229.6
Africa	26.8	22.4	17.5	66.7
Middle East	0.4	145.2	88.2	233.8
North America	206.4	40.6	10.7	257.7
Central and South America	9.2	25.0	9.7	43.9
China	151.9	3.1	2.7	157.7
Far East	75.3	3.2	10.8	89.3
Australia	48.4	0.3	1.0	49.7
World	710.0 59.9%	262.0 22.2%	212.4 17.9%	1,184.4 100.0%

recoverable reserves, * former SU and rest of Europe
Sources: BGR, 2009 / Oil and Gas Journal, 2008

World reserves and production of coal in 2008

regions	reserves Bn t ce	production Mt ce
EU-27	34	149
Eurasia	102	498
Africa	27	235
North America	195	1,106
Central and South America	7	79
China	148	2,716
Far East	70	733
Australia	33	334
World	617	5,850

Sources: BGR, 2009 / VDKI 2009

World reserves and consumption of coal, lignite, mineral oil and natural gas in 2009

energy sources	reserves: Bn t ce	reserves: shares in %	consumption: Bn t ce	consumption: shares in %
coal and lignite	710	60	4.7	33
mineral oil*	262	22	5.6	39
natural gas	212	18	3.9	28
total	1,184	100	14.2	100

recoverable reserves, * oil sands included
Sources: BGR, 2009 / Oil and Gas Journal, 2008

Global electricity generation

year	coal and lignite	nuclear energy	oil	gas	hydro and others	total
	TWh					
1970	2,075	80	1,625	–	1,175	4,955
1980	3,163	714	1,661	976	1,802	8,316
1990	4,286	1,989	1,216	1,632	2,212	11,335
2000	5,759	2,407	1,402	2,664	2,968	15,200
2005	7,040	2,640	1,240	3,750	3,550	18,220
2006	7,370	2,670	1,280	3,950	3,650	18,920
2007	7,950	2,580	1,120	4,290	3,955	19,895
2008	8,160	2,620	950	4,380	4,090	20,200
2010	8,668	2,761	926	4,157	4,043	20,555
2020	10,401	3,385	901	5,678	5,638	26,003
2030	13,579	3,844	866	6,769	6,696	31,754

Source of forecasts: US Department of Energy (DOE), 2009

Global CO_2 Emissions

regions / countries	1990 (base year)	2000	2005	2008	growth 1990 - 2008 %
	CO_2 Emissions in Mt				
Annex I Countries	14,930.1	14,338.2	14,858.3	14,788.6	- 0.9
EU-27	4,404.2	4,112.0	4,238.4	4,149.6	- 5.8
*thereof EU-15**	*3,364.9*	*3,359.7*	*3,465.7*	*3,348.5*	- *0.5*
thereof Germany	*1,215.2*	*1,008.2*	*968.9*	*944.6*	- *22.3*
Australia*	277.8	349.8	382.7	378.2	+ 36.1
Canada*	455.8	559.9	569.1	569.9	+ 30.9
USA*	5,068.6	5,964.4	6,081.9	5,909.3	+ 16.6
Russia*	2,499.1	1,471.1	1,525.7	1,610.9	- 35.5
Ukraine*	715.6	289.1	320.7	332.8	- 53.5
Japan*	1,143.2	1,226.6	1,267.3	1,301.1	+ 13.8
Korea	229.2	431.3	468.9	511.6	+ 123.1
India	589.3	976.5	1,160.7	1,449.6	+ 146.0
China	2,244.0	3,077.6	5,100.5	6,496.2	+ 189.5
rest of Far East	685.3	1,143.5	1,437.0	1,552.1	+ 126.5
Middle East	587.9	971.5	1,227.2	1,428.5	+ 143.0
Africa	549.3	694.4	831.8	925.4	+ 68.5
Latin America	603.1	859.8	931.9	1,068.9	+ 77.1
Other States	1,958.1	1,992.4	2,262.3	2,467.8	+ 26.0
World	22,010.5	24,119.9	27,826.1	30,178.0	+ 37.1

* Annex I Countries according to United Nations Framework Convention on Climate Change (see also http://unfcc.int) / Source: Ziesing in ET, 9/2009

Primary Energy Consumption in EU-27

year	coal and lignite	mineral oil	gas	nuclear energy	hydro and others	total
	Mt					
2005	431	1,003	606	367	123	2,530
2006	458	1,032	627	371	132	2,620
2007	455	1,006	615	347	144	2,567
2008	431	1,005	631	350	138	2,554
2020	488	1,003	721	317	283	2,812
2030	480	1,012	738	295	340	2,865

nuclear energy and renewables evaluated by efficiency method
Source of forecasts: EC, 2008, Baseline Scenario

Power Generation in EU-27

year	coal and lignite	oil	gas	nuclear energy	hydro and others	total
	TWh					
2005	990	160	660	930	440	3,180
2006	995	140	710	966	474	3,285
2007	1,040	110	710	935	515	3,310
2008	990	95	780	920	587	3,372
2020	1,440	70	860	870	860	4,100
2030	1,530	60	880	870	1,060	4,400

Source of forecasts: EC, 2008, Baseline Scenario

Coal and Lignite Production in EU-27 in 2008

country	hard coal	lignite
	Mt ce	
Germany	17.7	52.3
United Kingdom	14.5	–
France	–	–
Greece	–	11.8
Ireland	–	0.9
Italy	–	–
Spain	6.5	1.5
Finland	–	1.2
Austria	–	–
Poland	67.0	17.5
Hungary	–	2.8
Czech Republic	7.6	20.3
Slovakia	–	1.0
Slovenia	–	1.4
Estonia	–	5.2
Bulgaria	–	6.7
Romania	2.1	8.6
EU-27	115.4	131.2

Forecasts* of EU Energy and Natural Gas Demand and Imports

EU-27 Mt oe	2005	2020 Baseline Projection		2020 New Energy Policy Projection	
		oil price at 61 US-$/bbl	oil price at 100 US-$/bbl	oil price at 61 US-$/bbl	oil price at 100 US-$/bbl
Primary Energy Consumption	1,811	1,986	1,903	1,712	1,672
oil	666	702	648	608	567
gas	445	505	443	399	345
coal and lignite	320	342	340	216	253
renewables	123	197	221	270	274
nuclear energy	257	221	249	218	233
EU Energy Production	896	725	774	733	763
oil	133	53	53	53	52
gas	188	115	113	107	100
coal and lignite	196	142	146	108	129
renewables	122	193	213	247	250
nuclear energy	257	221	249	218	233
Net Imports	975	1301	1184	1033	962
oil	590	707	651	610	569
gas	257	390	330	291	245
(gas in trillion m^3)	(298)	(452)	(383)	(337)	(284)
coal and lignite	127	200	194	108	124
Final Energy Consumption Power	238	303	302	257	260

* from November 2008 under consideration of implementation of the March 2007 resolutions

Source: EC, an EU Energy Security and Solidarity Action Plan. Second Strategic Energy Review. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee of the Regions, Brussels, November 2008, Annex 1, p. 19 f.

Primary Energy Consumption in Germany

year	mineral oil	coal	lignite	natural gas	nuclear energy	wind power	hydro and others	total
	Mt ce							
1980	206.7	85.2	115.7	73.9	20.7	0.0	5.9	508.1
1990	178.7	78.7	109.2	78.2	56.9	0.0	7.2	508.9
1995	194.1	70.3	59.2	95.5	57.4	0.2	10.2	486.9
2000	187.6	69.0	52.9	101.9	63.2	1.2	15.6	491.4
2005	176.3	61.7	54.4	110.2	60.7	3.3	26.9	493.5
2006	174.7	67.0	53.8	111.3	62.3	3.8	30.6	503.5
2007[1)]	157.9	67.4	55.0	106.6	52.3	4.9	28.3	472.4
2008[1)]	166.1	62.5	53.0	105.5	55.4	4.9	30.4	477.8

[1)] preliminary
nuclear energy and renewables evaluated by efficiency method

Power generation in Germany

year	coal	lignite	nuclear energy	mineral oil	natural gas	wind power	hydro and others	total
	TWh							
1980	111.5	172.7	55.6	27.0	61.0	0.0	39.8	467.6
1990	140.8	170.9	152.5	10.8	35.9	0.1	38.9	549.9
1995	147.1	142.6	154.1	9.1	41.1	1.5	41.3	536.8
2000	143.1	148.3	169.6	5.9	49.2	9.5	50.9	576.5
2005	134.1	154.1	163.0	11.6	71.0	27.2	59.6	620.6
2006	137.9	151.1	167.4	10.5	73.4	30.7	65.9	636.8
2007[1]	142.0	155.1	140.5	9.6	75.9	39.7	74.8	637.6
2008[1]	128.5	150.0	148.8	10.5	83.0	40.2	78.1	639.1

[1] preliminary

German Coal Sales

year	domestic			EU countries		third countries	total sales
	heat market	power stations	steel industry	steel industry	others		
	Mt ce						
1960	61.3	22.1	31.3	27.0		5.3	147.0
1970	28.5	31.8	27.9	19.8	5.7	3.2	116.9
1980	9.4	34.1	24.9	13.0	4.8	2.1	88.3
1990	4.1	39.3	19.8	5.2	2.2	0.4	71.0
2000	0.7	27.6	10.0	0.0	0.3	0.0	38.6
2005	0.3	20.3	6.1	0.0	0.1	0.0	26.8
2006	0.3	18.3	3.7	0.0	0.1	0.0	22.4
2007	0.3	18.8	4.1	0.0	0.1	0.0	23.3
2008	0.3	15.0	4.1	0.0	0.1	0.0	19.5

Rationalisation Efforts in German Coal Industry

year	output per manshift underground	output[1] per working face	mines[2]	working faces
	kg saleable[3]	t saleable[3]	number	
1960	2,057	310	146	1,631
1970	3,755	868	69	476
1980	3,948	1,408	39	229
1990	5,008	1,803	27	147
2000	6,685	3,431	12	37
2005	6,735	3,888	9	24
2006	6,409	3,686	8	21
2007	7,071	3,680	8	22
2008	6,309	3,740	7	18

[1] daily face output
[2] data status: end of year excl. small mines
[3] until 1996: Saar figures in t=t

German Coal Industry Workforce[1]

by end of year	workers		white-collar employees		staff (workers and white-collar employees)	
	underground	surface	underground	surface	total	thereof apprentices
	in 1,000					
1957	384.3	169.3	16.3	37.4	607.3	48.2
1960	297.0	140.2	16.8	36.2	490.2	22.7
1965	216.8	110.5	15.6	34.1	377.0	15.2
1970	138.3	75.6	13.0	25.8	252.7	11.5
1975	107.9	60.9	11.5	22.0	202.3	14.1
1980	99.7	55.8	10.6	20.7	186.8	16.4
1985	90.1	47.4	10.2	18.5	166.2	15.7
1990	69.6	35.9	8.9	15.9	130.3	8.3
1995	47.2	25.7	6.1	13.6	92.6	2.9
2000	25.6	18.2	3.8	10.5	58.1	2.3
2001	23.0	16.2	3.4	10.0	52.6	2.2
2002	21.6	14.4	3.1	9.6	48.7	2.4
2003	20.0	13.6	2.8	9.2	45.6	2.7
2004	19.6	11.6	2.8	8.0	42.0	2.9
2005	17.7	10.9	2.6	7.3	38.5	3.2
2006	16.2	9.9	2.4	6.9	35.4	3.0
2007	15.1	9.1	2.3	6.3	32.8	2.4
2008	13.6	8.5	2.0	6.3	30.4	1.8

[1] workforce including short-time workers and trainees

Coal Production in Germany

year	area				Germany
	Ruhr	Saar	Aachen	Ibbenbüren	
	Mt saleable				
1957	123.2	16.3	7.6	2.3	149.4
1960	115.5	16.2	8.2	2.4	142.3
1965	110.9	14.2	7.8	2.2	135.1
1970	91.1	10.5	6.9	2.8	111.3
1975	75.9	9.0	5.7	1.8	92.4
1980	69.2	10.1	5.1	2.2	86.6
1985	64.0	10.7	4.7	2.4	81.8
1990	54.6	9.7	3.4	2.1	69.8
1995	41.6	8.2	1.6	1.7	53.1
2000	25.9	5.7	–	1.7	33.3
2001	20.0	5.3	–	1.8	27.1
2002	18.9	5.4	–	1.8	26.1
2003	18.2	5.6	–	1.9	25.7
2004	17.8	6.0	–	1.9	25.7
2005	18.1	4.7	–	1.9	24.7
2006	15.2	3.6	–	1.9	20.7
2007	15.9	3.5	–	1.9	21.3
2008	14.2	1.0	–	1.9	17.1

until 1996: Saar figures in t=t

Mining and Culture:
German mining museum, Bochum

Extention building „black diamond"
will be opened (draft: Benthem Crouwel)
with extraordinary exhibition „Glückauf …"
at 4th December 2009

Organisation of GVSt

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RAG Aktiengesellschaft

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Coal industry data 2008

Mines[1]	**7**	(Jan. 2009: 6)
coking plant* (owned by mining company)	1	
Workforce total[1]	**30,384**	**employees**
- Ruhr coalfield	23,286	employees
- Saar coalfield	4,690	employees
- Ibbenbueren coalfield	2,408	employees
Coal production total	**17.1**	**M t saleable**[3]
	= 17.7	M t ce[2]
- Ruhr coalfield	14.2	M t saleable
- Saar coalfield	1.0	M t saleable
- Ibbenbueren coalfield	1.9	M t saleable
coke production	2.0	M t
Technical characteristics		
production at working face	3,740	t (saleable) per day
mean thickness of coal seam	146	cm
mean face length	338	m
mean depth of extraction	1,145	m
maximum depth of shafts	1,750	m
Sales total	**19.5**	**M t ce**
- power plants	15.0	M t ce
- steel industry	4.1	M t ce
- heat market	0.4	M t ce
Portion of German coal (2008)		
- in primary energy consumption in Germany	4	%
- in electricity production in Germany	7	%
- in consumption of coal	30	%
- in electricity power generation by coal	34	%

[1] End of the year; man power inclusive those with status structural short times and qualification

[2] ce = coal equivalent; 1 Kg ce = 29,308 K Joule

[3] saleable = production excluding moisture and ash content