

COAL 2008

ANNUAL REPORT

'Competence in all things coal'

German Hard Coal Association

Foreword

The theme of this year's annual coal convention, and of the German Hard Coal Associations' Annual Report for 2008, is 'Competence in all things coal'. We ourselves are confident in the knowledge that our domestic industry has real expertise when it comes to all things coal and that this competence is of special value and stands comparison with the best in the world. While the outside perception is often held that the German coal industry is on the way out, anyone who is seriously involved in this business will have a completely different picture of events. Our high-tech skills are held in high regard and are very much sought after around the world. This ranges from coal winning and production through to fuel processing and utilisation and includes the drafting of important international standards for health, safety and environmental protection. One of the coal industry's strong points, and an aptitude that has for years been highly prized by the national Government, is the skill that it has shown in implementing the corporate programme of far-reaching restructuring – and doing it in a socially acceptable way, in other words without compulsory redundancies.

What has to be accepted however is that a political decision was taken last year to phase out subsidised coal mining in Germany until the end of 2018, unless this objective is altered as part of the Government review process scheduled to take place in 2012. The legal basis for this action, and in particular the new Coal Industry Financing Act, came into force in late 2007 and will henceforth provide the policy framework for coal production in the years ahead. In June 2008 RAG Aktiengesellschaft responded by drawing up a new coal planning programme that will initially run until 2012. The proposed separation of the company into its 'white' operations and 'black' operations was completed on 1st January 2008. The 'white' part has been trading as Evonik Industries since September 2007. Both companies belong to the RAG Foundation. This means that RAG has gone 'black' again and has reverted to its core business of coal mining and coal-related activities. In early 2008 one turning-point were the extraordinary tremors in the Saarland leaving the coalfield with just a remnant mining industry as a consequence and resulting in the closure of Saar colliery in 2012.

There have also been great changes in the global environment within which the German coal industry has to operate. In 2008 we saw new records being set for coal prices on the world market. Only time will tell whether the structural developments currently taking place in the raw-materials sector will result in the industry's specific skills as a domestic coal producer being seen in a different political and economic light.

Essen, October 2008
Bernd Tönjes

Chairman of the Management Board
of the German Hard Coal Association

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Competence in all things coal

2008 was a significant milestone for the German coal industry. This was the year when the new legal and contractual provisions of the 2007 coal agreements came into effect. A period when a new course was set for the further development of the national coal industry and concrete measures were put in place for the restructuring and adjustments that this will entail.

The year 2008 was marked by a crisis in the financial markets along with massive increases in the price of energy and raw materials. While the first of these events will cost the state hundreds of billions to offset the risk to the general public, energy policy – by comparison – protects the community from risk and provides a technological stimulus.

The Act to Finance the Termination of Subsidised Coal Mining by 2018, or the Coal Financing Act for short, came into force on 28 December 2007. This Act and the new coal-policy framework were to provide the basis for the new mine planning decisions of mid-2008 that identify the production sites, extraction capacities and manpower that will be required for the socially-responsible process of restructuring the mining companies up to the year 2012. This included the history-making event of 2007/2008 whereby the former RAG Group was split into two separate parts: the new 'black RAG' is now fully devoted to the German coal mining industry, while the new stand-alone company Evonik Industries AG has been totally freed from mining operations and now incorporates the former 'white' part of RAG with its chemicals, energy and real estate interests. Both RAG Aktiengesellschaft (100%) and for the time being a large part of Evonik Industries AG (now 75%) are owned by the RAG Foundation, which was set up last year. This body took up its full statutory duties and responsibilities in 2008 and has already been very successful in positioning an initial tranche of Evonik Industries AG on the capital market. Its role also includes steering the German coal industry through the socially responsible restructuring process that will run until 2018, along with the financing of ongoing liabilities.

In February 2008 the Saar coalfield experienced a series of underground tremors of unexpected magnitude even by today's standards. This ultimately led to the transfer of mining activities to non-critical production districts, along with the immediate closure of those parts of Saar colliery affected by the tremor. This has had a serious impact on coal production. An agreement was also reached with the Government of the Saarland that subsidised coal mining in the Saar coalfield would be completely phased out by 2012 – significantly earlier than had been previously planned.

The events in the Saar coalfield have had major repercussions on mine planning decisions elsewhere. The year also saw a decision to bring forward the closure of Lippe colliery in Gelsenkirchen to 1 January 2009 and that of Ost colliery in

Hamm to 30 September 2010, along with the intention to cease coal production at West colliery in Kamp-Lintfort by the turn of 2012/ 2013. No decisions have been taken as regards the period 2013 to 2018. These measures will have predetermined the outcome of the review procedure scheduled for 2012 as far as the decision to completely phase-out Germany's subsidised coal mining industry is concerned. Walsum colliery closed on 1 July 2008, in line with earlier decisions.

The new coal-policy direction and the resulting plans for the mining industry mean that production from the German coal industry will be cut to below 12 million tonnes by 2012, while the workforce will have to be reduced by about 50% to a figure of some 15,000. This will only be possible by continuing with existing measures and introducing new initiatives for manpower reduction. Wage policies must also play a role in the socially compatible process of downsizing. The new arrangements for the German coal industry that were agreed between the social partners in April 2008 take this premise into account. The present Annual Report describes all these developments along with the various social and personnel-related instruments that have been put in place to achieve them.

In this context a mention should also be made of the coal industry's training programme. RAG continues to be one of Germany's largest providers of training places and has for a number of years now been producing qualified workers for other sectors: as part of the company's corporate, social and regional responsibility – and in spite of the pressure to downsize – RAG continues to operate apprenticeship schemes for various skilled trades and industry in general. The quality of the courses organised by the German coal industry has been held in high regard for many years, as witnessed by the many awards that RAG apprentices receive every year from Chambers of Industry and Commerce. This training curriculum has now been updated to include, for example, the new qualification of 'mining technologist', which is of relevance to a wide variety of careers in the mining industry at large.

There is of course a relationship between the quality of the training provided and the coal industry's continuing and well recognised technological expertise. One factor underlying the German coal industry's special know-how is the leading position enjoyed by home-grown technology on the world market for mining machinery. The difficult conditions prevailing in German collieries, with their deep workings and high-stress tectonics, have led to the development of quite exceptional mining skills. The equipment and machines built as a result of this competence have provided the industry with the capacity to overcome all manner of challenges. German know-how now sets the standard for deep coal mining technology and is also at the forefront in areas such as health and safety and environmental protection. The high priority given to work safety in the domestic coal industry can well be demonstrated not only by the very low number of accidents recorded per million hours worked but also by the fact that accident figures for coal mining are below the average for German industry as a whole.

This also bears out the fact that health and safety at the workplace has long been part of the company's protocol and ranks highly on the agenda alongside production and efficiency.

Given the continuous restructuring process and the resulting departure of many experienced workers from all departments at every level the industry is now faced with the particular challenge of finding a way to preserve and continue this encyclopaedic spread of knowledge. To this effect RAG has developed a competence management system that has already won many awards for innovation, including one from the Federal Government as part of its 'Partners for Innovation' initiative. This includes the ongoing research and development activities that traditionally and in tried and tested fashion have for decades been undertaken in close collaboration with mining suppliers, technical colleges and other research establishments. This work helps to maintain and promote Germany's position as an international standard setter for mining technology.

In spite of the restructuring measures that have been rendered inevitable by economic and political circumstances the coal industry continues to be a source of considerable technical progress. Technological expertise developed by the German coal industry is in great demand around the world. This means that in technical terms the mining industry is not standing still but is in fact moving ahead – and our Annual Report acknowledges this in a special section devoted to technical achievements.

The year 2008 also saw major developments in the economic environment, particularly with regard to the world market price of coal and other resources. This situation is also discussed in this year's Report.

The decline of the domestic mining industry has meant that coal imports continue to be on the increase and this trade reached a new all-time high in 2007. Since mid-2007 this situation has been accompanied by increases in the spot price of imported coal: by the middle of 2008 steam coal was more than 130 €/t and coking coal over 160 €/t, while customers were paying as much as 800 €/t for coke. These are all record price levels that until recently would have been considered an impossibility. Price trends in the coal sector are following a similar course to that seen in the gas and oil market. As oil and gas prices have in many cases increased even more steeply since 2007 we can state that coal as a fuel has lost none of its competitive edge. The energy price situation in 2008 has now become a major economic issue and our Annual Report examines this development from a number of different perspectives.

As well as increasing price risks we are also experiencing a greater uncertainty in energy procurement and supply as a result of our growing reliance on imports. This also applies to coal, as has been acknowledged in two studies on energy supply risks in Germany that were carried out in Essen in 2007 and 2008 by the RWI (Rhine-Westphalia Institute for Economic Research) – a body that in other

respects has tended to be critical of the German coal industry. According to an assessment by the World Bank, moreover, the majority of the world's coal producing countries can be considered as lacking political stability.

The significance of reliable energy and raw-material supplies appears, however, to have been scarcely – or at the very least belatedly – recognized in Germany, a situation deplored by the *Frankfurter Allgemeine Zeitung* in an article entitled 'A land without a raw-materials strategy' that appeared in its 11 August 2008 edition. To quote directly: *'Those in political and business circles have neglected to safeguard access to primary energy sources and raw materials that the world's leading goods' exporter requires for its manufacturing base. Germany's coal and lignite deposits are to be abandoned for cost and environmental reasons. The political decision has been taken to phase out nuclear power even though the highly subsidised and fluctuation-prone renewable energies cannot replace the base-load nuclear stations. The natural-resources situation is hardly any better. German industry has to import, among other things, huge quantities of metallic raw materials, reliance on a few global mining concerns is growing daily and prices have multiplied in just a few years... globalisation has altered the international balance of power – and not in the West's favour. With China, India and Russia all playing economic catch-up we now find that a number of states are crowding-in at the top of the global economic league. They have their own concept of political domination and the West will by necessity have to enter into strategic partnerships with them. Germany is for the time being reliant on Russian energy supplies. Such countries are not fussy in the means they choose to enforce their interests, as witnessed yet again by events in the Caucasus. Given the present challenges Germany must waste no time in drawing up a strategy for long-term energy and raw-materials supply. Yet the (energy) debate is still being dominated by concerns about the climate.'*

The troubling developments on the world energy market, as described in the FAZ, continue to be driven by the high level of demand for raw materials of all kinds from China, but the situation is now being aggravated by the growing needs of other newly industrialising countries such as India, Indonesia and Brazil. Unlike Germany, however, China for one is anxious to meet its growing demand for resources by fully exploiting its own raw-materials deposits and by purchasing its additional needs all over the world. And the multinational corporation Arcelor-Mittal shows us exactly how a company can build up its strength on the basis of a long-term feedstock supply strategy.

Developments on the world energy market show beyond question that coal has been the fastest growing consumption sector in recent years. Coal remains the world's 'number one' fuel for power generation. As well as the aforementioned threshold countries economically developed nations like the US are placing increasing reliance on solid fuel. Many other countries are intensively engaged in research into alternative uses for coal, for example hydrogenation (the coal-to-

liquids process), in order to forearm themselves against an increasing dependence on oil and gas imports.

The fact is, however, that most of the coal traded around the world is sourced from just a handful of countries. What is more, a mere 15% of total coal production is made available to the global market – the rest is used directly by the producer countries. Add to this the fact that the world coal trade is controlled by just a few multinational companies.

As well as this concentration on just a few supplier countries and companies, along with the increase in demand-driven competition, the world coal trade in 2008 was further complicated by a number of additional factors. Early in the year Australia's most important coal loading port, Newcastle, was the scene of dozens of coal freighters lying offshore for weeks on end. Stormy weather had interrupted deliveries from the mines. South Africa, which is a major coal exporter, was itself affected by a shortage of electricity. This caused the Government there to consider whether more of the high-quality steam coal normally sent for export should not be retained for domestic consumption. China, by far the world's largest producer of coal, has now become a net importer of solid fuel. Yet that country still suffers from power shortages: in the winter because of the heavy frost and in summer because of all the air-conditioning systems that are being used to control the heat. The Chinese were especially concerned about the possibility of power cuts during the Peking Olympic Games in the summer of 2008. And finally, the maritime trade in raw materials continues to be affected by an extreme shortage of freight capacity, aggravated by cases of regional disparity – and at the same time the world's shipyards have full order books and will continue to have for years to come.

Within EU-27 the increasing reliance on imports is therefore being regarded with scepticism and the Member States are being advised to make greater use of their indigenous raw materials once more. In some places this is already being done, as demonstrated by the development and/or re-opening of coal mines in France and in the UK. In Germany too projects are being examined for re-opening long-abandoned ore mines and other production sites, and the prospect of success is extremely good. The country is even experiencing a boom in exploration for oil and gas deposits.

The fact that the indigenous coal industry is still in difficulties can be attributed to Germany's politically-driven lead role in environmental protection and to the fact that the national climate debate has focused far too heavily on the use of fossil fuels for power generation. As in previous years, climate policy in 2008 continues to be driven by the national and international energy and climate debate. Here it has become clear that when the Kyoto agreements expire in 2012 the Federal Government and the vast majority of the European Council essentially want to see a tightening of the protocol arrangements. The EU-27 countries themselves want to reduce greenhouse-gas emissions by at least 20% between now and

2020. The Western industrialised nations have agreed on a long-term target of a substantial cut in CO₂ emissions. Even the G8 Summit has been talking of a 50% reduction by 2050 compared with current emission levels.

The European Commission has bound its climate-policy objectives up into a complex legislative package – the so-called ‘Green Package’ of 23 January 2008. This is primarily intended to follow-on from the European emissions trading system by shaping the future climate policy of the European Union up to the year 2020 as well as by laying down a series of even more demanding emission reduction targets for the period up to 2050. The Green Package will affect, either directly or indirectly, practically every sector of the economy and society that emits CO₂ and other greenhouse gases, and particularly the power generators and energy-intensive industries. This whole legislative package is currently being discussed by the European Council and European Parliament.

In this context the Commission has also presented a proposal for a directive laying down the framework for a Carbon Capture and Storage system (CCS). The intention is to demonstrate the feasibility of CCS technology and to develop it to commercial status by 2020.

CCS is seen as an eco-friendly way to burn fossil fuels as part of the power-station process – which primarily means coal – followed by the safe transport and storage of the captured CO₂ in deep geological formations. However it is often forgotten that the CO₂ separation process is currently only at the pilot-plant stage and the technology is still a long way from being available on an industrial scale. Neither do we yet know which process or processes will win out. Yet apart from a number of detail improvements here and there the EU Directive on CCS can be considered as appropriate: provided it avoids overhasty and compulsory restrictions on existing and planned power stations and effectively contributes to the planning certainty that is needed when it comes to open questions such as disposal. The sustainable introduction of this technology will ultimately depend not only on the economic aspects of such an operation but also on the extent to which the population is generally prepared to accept CO₂ transport and storage.

However, CCS cannot be the only climate protection strategy for coal. CO₂ reduction can be achieved more readily and at calculable investment of capital by increasing the efficiency of modern coal-fired power stations. With efficiency rates of 43% for lignite-fired plant and 46% for coal burning installations German power stations are now among the cleanest and most efficient in the world. Like their counterparts in the mining supplier sector German power plant builders therefore have a technological lead in this field, at least for the moment.

The Federal Government continues to pursue its pioneering role in climate protection and has now implemented a series of measures based on the Cabinet’s 2007 Meseberg decisions. This essentially involves amendments to the Renewable Energy Sources Act (EEG) and Renewable Energies Heat Act, which

are to come into force either in early 2009 or at the latest by the summer of that year.

The Federal Government's climate strategy also includes building new coal-fired power stations, whereby the older and less-efficient coal burning installations are to be replaced by new, high-efficiency plant. This is expected to produce a 30% reduction in CO₂ emissions. However this does not seem to have gone down very well with much of the public at large and ballots and public protests have already delayed and even blocked the construction of new coal-fired stations at various locations.

Most energy experts agree that an industrial country like Germany would be well advised to retain the well-proven mix of various power generation options – including a large proportion of indigenous and quasi-indigenous resources – in order to safeguard its energy supplies. This means that renewables have a role to play alongside home-produced fossil fuels – while the option of nuclear power should also be retained in the opinion of quite a few people.

The increase in the world market price of coal has now seen the domestic coal industry return to borderline competitiveness to a degree that has not existed for decades – a scenario that many would have considered to be well nigh impossible. And yet this situation has become a reality just six months after the implementation of the new coal policy agreements. We shall have to wait and see whether the high price of coal on the world market is a long-term phenomenon, although very few experts expect a return to the low prices of earlier years. The critical factor will be whether the German coal industry is capable of producing at world market prices after it has fulfilled its restructuring commitments. If so, the Bundestag will have to change its current political strategy, which is based on a 2012 revision of the 'phase-out decision' as provided for by the review clause contained in the Coal Industry Financing Act. Access to the country's largest indigenous energy resources, namely German coal, would thus be safeguarded. It is up to the politicians to decide.

But whatever happens we can say for certain that this country has extensive specialist know-how when it comes to coal, the world's most abundantly available energy resource – beginning with extraction and production through to product processing and upgrading. This expertise has been acquired over many years with the constructive help and support of the various mining associations and organisations.

The mining associations are among the oldest of all the industrial federations and 2008 has seen two such bodies celebrate important anniversaries: GVSt (German Hard Coal Association) has now been in existence for forty years, while VbI (Association of Mining Interests) can now trace its history back 150 years. Founded in November 1858 VbI is one of Germany's oldest trade federations. As part of its efforts to further the economic development of the mining industry

through technical progress, for example, Vbl set up the Boiler Inspection Association in 1896, which was the forerunner of today's TÜV, the German Technical Monitoring Association. This was followed in the early 1900s by the Central Mines Rescue Station. After the Second World War, and along with other bodies too numerous to mention here, came the West German Coal Producers' Association as the central institute for joint mining research activities, and the forerunner of DMT (Deutsche Montan Technologie). These initiatives played a key role in laying the foundations for the high standards of German mining technology today and for the wide-ranging expertise displayed by the coal industry and its workers.

As well describing how this body of know-how is being preserved and expanded the GVSt Annual Report also contains a guest contribution from the historian Prof. Dr Klaus Tenfelde, who acknowledges the contribution made over a period of 150 years by Vbl and by the Mining Industry Library (now the Library of the Ruhr Foundation).

Guest contribution

150 years of VbI (Association for Mining Interests)

by Prof. Dr Klaus Tenfelde*

There is an anniversary to be celebrated and it is one that we are possibly hesitant about acknowledging: on 17 December 1858, exactly 150 years ago, the 'Association for Mining Interests in the Mines Inspectorate District of Dortmund' was founded in an Essen hotel – an organisation that was to be known for decades thereafter as the 'Bergbauverein' (Mining Association). While at first only 51 mining unions and companies were represented in the Association, many more were soon to join and by the beginning of the twentieth century the Bergbauverein was *the* representative of the coal mining industry in what was then generally referred-to as the 'Rhine-Westphalia industrial area'. In fact this was not the first time that the pioneers among the mining industrialists had attempted to form an association of some kind. Various efforts had been made in this direction since the 1830s, including the establishment of the Markisch Mining Association, which was then dissolved a few years after the emergence of the Essen-based organisation so as not to weaken the power of the Ruhr coalfield interest group.

The Bergbauverein was to become one of the most powerful associations in the whole of German industry during the days of the German Empire and indeed remained so at least until 1933, and in some respects well beyond this. The fiftieth anniversary was cause for great celebration and the Association marked the event by publishing a 12-volume compilation of the history and economic development of coal mining in the Lower Rhine-Westphalia region – which even today remains an important reference work for historians of Germany's industrial past. The hundredth anniversary in 1958 was marked by a very appropriate centenary edition produced by Friedrich Schunder and entitled 'Tradition and progress'. Twenty-five years later, in 1983, the Association brought out a much smaller informative brochure that was penned by Hans-Joachim Rummert. As might be expected, the various anniversaries therefore reflect the 'historical importance' of the Association over the years.

The Bergbauverein board – whose first long-serving president was the lawyer and parliamentary member Friedrich Hammacher, a man destined to be a key figure in the future development of the Ruhr – was quick to build up its own reference library and this was to form the beginnings of the soon-famous Mining Industry Library, which still exists today in the Ruhr Historical Centre under the

* Director of the Institute for Social Movements at the Ruhr University Bochum and Chairman of the Board of the Library of the Ruhr Foundation

aegis of the Library of the Ruhr Foundation in Bochum. Even the earliest budget reports of the Association included the headings 'library' and 'newspapers' and over successive years this was to develop into a formidable stock of books that by the beginning of the twentieth century totalled more than 20,000 volumes. There was no shortage of funds and as a result the library was to acquire older and in some cases expensive antiquarian works, including a copy of the Agricola masterwork *De re metallica libri XII (1556)*, many old Mining Orders and mining publications, some of the oldest works of mining and metallurgical literature and even individual hand-written documents relating to the technical and legal history of mining in Germany. And so the Mining Industry Library, now the Library of the Ruhr, is also celebrating its 150th anniversary at the end of 2008. With more than 250,000 individual works on mining and metallurgy alone the library now has a total stock of some 450,000 volumes, making it the largest technical library of its kind in Germany.

The generally very conservative and highly disciplined Bergbauverein was to display astonishing organisational continuity right up to the National-Socialist period. Yet its beginnings were not at all conservative, in fact quite the opposite, for when the Association was founded the old Mining Law – which deprived the management of essential rights of disposition over the deployment of invested capital – still had to be opposed and it was this factor, along with the economic crisis of 1857, that provided the main stimulus for setting-up the Bergbauverein. The Association then began to send a stream of petitions and memos to the Trade Ministry in Berlin and by 1861 the Prussian Trade Minister von der Heydt agreed to grant its representatives a hearing on mining affairs. The entrepreneurs that were to take control of mining in the Ruhr coalfield, along with much of the emergent iron and steel industry, were liberally disposed and increasingly national-liberal in their outlook; the mining and steel barons were only to emerge later with the growing economic and political power of the industrialists during the latter period of the German Reich. For the time being there were quite different obstacles to tackle. These included the continuing barriers to exports in the form of customs tariffs, and particularly the railway fees that any industry engaged in transporting a much sought-after bulk product would naturally want to see reduced as far as possible. The Bergbauverein defended its interests in the Association's journal *Glückauf*, an organ that developed from the *Essener Zeitung*. The *Glückauf* publication remains to this day one of the most important sources of information on the Association and on the history of the mining industry. The Ruhr Bergbauverein played a pioneering role in many respects and in the years thereafter various other Mining Associations were to be established in other mining regions of Germany.

In its early years the Association therefore focused on political agitation that was primarily directed at seeing Prussia complete its programme of liberal-economic reforms. This was in fact achieved in 1865 with the enactment of the General Mining Law that henceforth was to lay down the legal framework for the Prussian coalfields, and soon thereafter for all mining regions of Germany, in a form that

was to last until the second half of the twentieth century. While in its early years the Association still frequently took a stand on social-policy issues, after the foundation of the German Reich, and especially following the Ruhr's first major miners' strike in 1872, its activities became more focused on the technical development of the German mining industry. *Glückauf* magazine also became the leading source of information on the latest advances in mining technology. Social matters were also regulated by the mineworkers' reforms introduced by the state and even if the Association was not completely satisfied with these arrangements it did try to make the best of them, especially following Bismarck's social policy of the 1880s which was to result in a reform of the miners' guilds and in the codification of employers' rights. A significant development at this time was the setting-up of the Technical Commission in 1885, a body that became responsible for general matters affecting the region as a whole, such as mine drainage and dewatering. The extension of the inland waterway system, taxation and freight tariffs in general were still to figure largely on the Association's agenda, but much organisational work was also completed, including support for establishing the important Boiler Inspection Association at the turn of the century – which was to provide the nucleus for the modern-day TÜV. Another significant newcomer was the Central Mines Rescue Station, which was founded in 1910. The Association had already acquired the status of a legal entity, which meant it could acquire assets, and it also had the right to demand a hearing – normally reserved for Chambers of Industry and Commerce – a privilege that it was to use consistently. Neither should we underestimate the efforts the Association made in the area of cartel and syndication policy, which ultimately led to the establishment of the celebrated Rhine-Westphalia Coal Syndicate in 1893. As a result – and until the National-Socialists seized power in 1933 – the Bergbauverein was to remain a focal point for all the pressure-group activities of the Ruhr mining industry and the more it gained a dominant position in comparison with other mining regions of Germany the stronger it became in political circles. This was also acknowledged and recognised – at first hesitantly and then later consentingly – by the mining authorities, which included the District Inspectorates and the Chief Mining Inspectorate in Dortmund. A coal and steel elite was formed with, at its heart, the Bergbauverein and the many different organisations that were linked to it by ties that were sometimes visible and sometimes tenuous. It became a great honour to belong to the Association or to one of its affiliated organisations, which included the important WBK (Westfaelische Berggewerkschaftskasse) in Bochum. Responsibility for the Association's policy in general, and for the management of the various affiliated organisations, was increasingly taken over by mining academics and former mining inspectors. Social policy activities were to reach a peak in 1908 with the setting-up of the 'Zechenverband', or Mines Association, which had developed from the much older 'Strike Protection Society': the aim of this body was nothing less than the complete control of the labour market in the Ruhr area, which would at the same time protect its member companies from the threat of industrial action by the workers. Up until 1918 the Bergbauverein remained vehemently opposed to any collective labour agreements with the mining unions and

continued to defend this now obsolete position quite openly under the protection of the monarchical constitution of the German Empire at that time.

All this of course changed in 1918, although the conditions that prevailed under the Weimar Republic were not really conducive to establishing a secure and permanent framework for the labour conditions needed to establish a cooperative system of production. The Association was far too concerned with the ongoing crisis to develop a farsighted, consent-based business plan. This policy persisted throughout the years of inflation and up until the occupation of the Ruhr in 1923. It applied even more during the subsequent rationalisation crisis and it went on throughout the period of mass redundancies that followed the Great Depression of 1929: by 1932 only about one third of the miners that had been in work during the Ruhr coalfield's peak employment year of 1922 still had jobs to go to.

As we all know, the National-Socialists brutally suppressed the unions within a few months of seizing power, but were less hasty in abolishing the employers' associations as they were keen not to lose their support for the rebuilding of the economy and, more particularly, for the arms manufacturing effort that would be needed in preparation for the Second World War. The legislation therefore strengthened the employers by introducing, in 1934, the Law on the National Organisation of Work, which also introduced the 'Führer principle' to the management of the mining companies. As the armaments industry expanded the influence of trade associations was increasingly suppressed and was further weakened when the wartime economy came into force.

After Germany's surrender the British Military Government took over the administration of the Ruhr coal mines. The Bergbauverein was suspended and remained so until 1958; it was replaced by the Ruhr Mining Federation, which was established in 1952. In 1958 the then Bergbauverein (the Vbl of today) took over the trusteeship of the assets that had been built up by the various coal-industry organisations and associations over the years. This in some ways heralded the upheavals that were to affect the Ruhr mining associations when the industry began the long process of contraction that began in 1957/1958. After 1968 the general interests of the mining industry were mainly represented by the German Coal Producers' Association, which was renamed the 'German Hard Coal Association' (GVSt) in 2007.

The Mining Industry Library has, until the present day, also survived these structural changes undamaged. It was for the Ruhr an invaluable piece of luck that this incomparable stock of books came through the bombing unscathed. In fact the library was significantly expanded in the 1950s and 1960s and, incidentally, served as a collection point for all press releases relating to the mining industry. These documents are still very well preserved and are available for scientific reference. Custodianship then passed to Deutsche Montan Technologie (Resources, Energy and Environment), which was founded in 1990, and then on to DMT (Science and Training). The current custodian of this

valuable collection is the Library of the Ruhr Foundation, which was set up in 1998. The Mining Industry Library today has to be considered as an important centre for scientific research, especially since the Ruhr area did not really have another academic library until the 1960s. There are very few libraries in Germany – let alone in the Ruhr – where readers can for example consult the proceedings of the Upper Chamber of the Prussian Parliament.

A subject still to be fully researched is that which deals with the many transformations that the mining associations had to live through in the post-War era, especially as the structural crisis deepened. The story of the mining industry in these years, in other words its recent history, has still to be told in all its detail. One of the most pressing themes concerns the events that affected the association system and indeed the mining unions too. The Library of the Ruhr Foundation has already been working on such a project and between 2000 and 2007 carried out research into the development of forced labour in German mines and in those European countries that were occupied during the Second World War. With the support of GVSt the Foundation has recently been involved in the publication of an extensive, four-volume guide entitled 'The history of the German mining industry'. The various conventions and traditions of the mining industry, including the history of the different lobby groups and trade associations, are documented here in all their detail.

The German coal industry

A new framework for the German mining industry

The turn of the year 2007/2008 saw a fundamental change to the legal and institutional framework within which the German coal industry has to operate. The new Coal Industry Financing Act, which was drawn up in 2007 and subsequently adopted by the Bundestag, came into force on 28 December of that year.

A new chapter in the history of RAG Aktiengesellschaft (RAG), the company that now encompasses the entire German coal mining industry, therefore opened on 1 January 2008. The Coal Industry Financing Act, along with its various agreements, provides for the 'black' part of the industry – which remains with RAG – to be separated, as planned, from the now stand-alone 'white' part and for the severance of any bonds of liability between the two. The 'white' part, which comprises RAG's former subsidiary interests in chemicals, energy and real estate, has been trading independently since September 2007 as the integrated company Evonik Industries AG. For the new 'black RAG' the core business is now the production of German coal, just as it was when the former Ruhrkohle AG was founded 40 years ago. RAG Deutsche Steinkohle AG (formerly Deutsche Steinkohle AG – DSK) and RAG Anthrazit Ibbenbüren GmbH are now united under the parent company RAG, which also comprises RAG Bildung GmbH (training) and RAG Montan Immobilien GmbH (real estate), formerly Montan-Grundstücksgesellschaft (MGG).

The RAG Foundation, which was established in 2007, is the sole proprietor of both Evonik Industries AG (of which it currently owns 74.99%) and RAG. Its remit is to take Evonik Industries AG into the capital market step by step and to manage and build up the assets accruing from this revenue so that the coal industry's inherited liabilities can be funded after mining has ceased. The RAG Foundation will, until the end of 2018, also be responsible for *'adapting, controlling and supporting the coal mining activities of RAG Aktiengesellschaft in compliance with the legal framework and other underlying conditions'*. The day-to-day management of coal mining operations and the implementation of the new policy guidelines will be left to RAG. The RAG Foundation and RAG are party to a control and profit-transfer agreement. The stated objective of the new Coal Industry Financing Act (Section 1) is *'to terminate subsidised coal mining in Germany by the end of 2018'*. Until that date sales of German coal to power stations and steel-industry blast furnaces are to be supported by public funding, whose limit is to be scaled back year on year. As far as the workforce is concerned the Act also guarantees that manpower downsizing will continue in a socially responsible way. Although third-country coal prices will still be used as a reference for calculating the amount of aid to disposals received by each sales segment, the coal industry will no longer be subject to a policy-derived supply contract.

The financial aid will also be used to help the mining companies meet the cost of ongoing colliery closures, along with other obligations that will continue after the end of the subsidised mining industry. The Coal Industry Financing Act will in addition provide a legal basis for the continued provision of adaptation benefits to older employees taking early retirement. What this means is that after 2008 a total sum of about € 24 billion is to be provided to support the gradual phasing-out of the subsidised coal mining industry.

Section 2 of the Coal Industry Financing Act, the so-called 'review clause', states that the German Bundestag, acting on the basis of a Government report to be presented by 30 June 2012 at the latest, will then examine '*whether coal production is to continue*' and shall do this '*in consideration of economic conditions, security of energy supply and other energy policy objectives*'. This means that at national level the final decision as to whether, from an energy policy viewpoint, the subsidised German coal industry is to be phased out entirely or retained as a core production base will not be taken until 2012. Coal subsidies will be scaled back significantly until that date. Since the mid-1990s the mining industry has experienced unprecedented cutbacks in subsidy levels. Only in 2006 and 2007 was there a slight, short-term increase in public subsidy, which was due to the payout of the financial aid originally intended for 2006, which had been deferred until 2007, and various other payments held over from previous years. As a result the industry received a higher level of subsidy in 2007 – and in that year only – than in the previous period. The degressive trend then resumed in 2008.

The entry into force of the Coal Industry Financing Act constitutes the full implementation of the Coal Agreement that was signed on 7 February 2007 by the Federal Government, the Land Governments of North Rhine-Westphalia and Saarland, RAG and IG BCE (the mining, chemical and energy industrial union). This also means that the Framework Agreement negotiated the previous year by the same parties to the Coal Agreement, which is entitled '*Socially acceptable termination of subsidised coal mining in Germany*', has now also come into effect. This lays down the future financial contributions to be made by the Land North Rhine-Westphalia, along with RAG's own contribution, for the funding of the coal industry. The Coal Industry Financing Act and the Framework Agreement therefore constitute the basis for the statutory activities of the RAG Foundation. 2007 and 2008 have been momentous years for coal policy making. In referring to the Coal Industry Financing Act the German Economy Minister, Michael Glos, said that it represented '*one of the most significant economic policy decisions of recent years*'.

However, the new policy arrangements are also clearly something of a trade-off. The 2012 review, which was specified as one of the cornerstones of the February 2007 Coal Agreement and subsequently enshrined in the Coal Industry Financing Act, is regarded by some of the parties as no more than a theoretical

possibility. Yet a number of influential political figures are calling for the review clause to be taken seriously and for the option of a domestic core production base to be retained. In an interview published in the July edition of the RAG monthly magazine 'Steinkohle' IG BCE chairman Hubertus Schmoldt stated that *'abandoning the coal industry is and will remain a big mistake.'* Members of the FDP and ALLIANCE 90/THE GREENS, however, want to see the run-down process accelerated. For the time being, therefore, the German coal industry remains caught in a political crossfire.

Nevertheless, the new targets have given both the coal industry and RAG a degree of legal security and planning certainty that has not existed for years. On the day the Coal Industry Financing Act came into force the Federal Office of Economics and Export Control (BAFA), acting under the terms of the Framework Agreement and the Coal Financing Act, issued RAG with notices of approval for coal industry aid for 2009 to 2012 and – as a financial safeguard – for the period to 2019 after the end of subsidised mining. The Federal Economics Ministry has at the same time issued new coal guidelines that provide for extra funding up to 2012, retroactive to 2007, to compensate for the structural underfinancing resulting from commitments to tie-up aid to disposals over previous years. The notice of approval for the years 2006 to 2008, as granted in late 2004 by the then Federal Government, still applies in 2008.

However, the aid granted at national level still requires the approval of the European Commission. The Federal Government has already notified the Commission, on schedule, of its entire coal-industry financing package, along with a specific restructuring plan for the period to 2018. The approval process is still under way. The period of validity of the current European Regulation on State Aid to the Coal Industry ends in 2010. For this reason the German Government has already submitted an application for the entire 'package' to be approved as part of the general contract conditions for the period post-2008. The authorities in Brussels are still discussing the details of how this plan is to be implemented.

The Saar tremor and a new mine planning framework

The resilience of the new coal policy framework was severely tested a few weeks later. On 23 February mining induced tremors of a magnitude that could not have been predicted struck the Primsmulde workings in the Saarlouis district. This was caused by an unfortunate combination of factors that included the relative depth of the worked-out seams (1,400 metres), which are overlain by a high quota of strong rock beds running up towards the surface, and a quite specific set of tectonic conditions. Independent experts are in agreement that such a combination of circumstances is not to be found in the North Rhine-Westphalia region.

The future of mining in the Saar was already the subject of a heated debate among some parts of the population and Saar Government after a series of much weaker tremors that had affected the area before the February occurrence. Tempers now threatened to boil over and RAG Deutsche Steinkohle reacted spontaneously to the extraordinary circumstances by immediately ceasing all coal mining activities in the Saar even before the mining authorities acted. This decision was designed to eliminate any threat to residents or mineworkers, even though the tremor itself had only caused damage to property. The critical hazard areas were immediately made safe, a damages centre was set up and local claims processing began almost immediately so that any losses incurred could be settled quickly and with the minimum of bureaucracy.

As similar tremors in the affected workings could not be ruled out, and since trials with new prevention techniques did not prove sufficiently reliable, coal production at Saar colliery was suspended for several weeks. As a result much of the Saar workforce was put on shorter hours, a move that also had repercussions for the entire regional economy. Supplies to the local power generators were also threatened, especially since the Saar power stations are almost totally reliant on locally-mined coal. As a result as many as 10,000 jobs were threatened in the Saar area as a whole. Intensive talks were held with the Saarland Government and mining authorities with a view to finding a way out of the crisis. An agreement was subsequently reached in mid-March for a new and much reduced mining concept and as a result Saar colliery resumed production on 2 April 2008.

The new plan allows for residual extraction in the Saar coalfield until 2012 and imposes tight restrictions on the way in which mining is to be transferred to other production districts. Coal mining has now ceased completely in the Primsmulde workings and in other adjoining sections affected by the specific geological conditions. Production has now been transferred to the Grangeleisen seams and will in future move into the Wahlschied measures. Surveys have shown that mining in these seams poses no risk as defined by the Federal Mining Act. However, Saar colliery's production capacity will have to be reduced to about one third of its former output, in other words to between 1 and 1.5 million tonnes a year. The small Merchweiler mine ceased production in mid-2008 for reasons unconnected with the February tremor. This means that Saar-mined coal can only provide base-load cover for the Saarland's coal fired power stations.

As a result the Saar mining industry will only be able to retain about two-thirds of the normal workforce, and even this will only be possible initially because of the large amount of development work required to access the new production districts. The physical relocation of the coal faces will demand much greater operating flexibility. Socially acceptable options will therefore have to be provided elsewhere for the remaining third of the workforce, including the possibility of transferring to collieries in North Rhine-Westphalia. The coal reserves in the remaining production districts are so limited in scope that there is little or no chance of production continuing beyond 2012. An agreement has therefore been

reached with the Land Government to bring subsidised mining in the Saar coalfield to a close by 2012 and to collaborate in the Saar Solidarity Pact that has been initiated by the Saarland Government. For its part the Land Government has agreed to provide support for additional social measures aimed at avoiding compulsory redundancies in the Saar coalfield. A job placement service has for example already been set up to help Saar mineworkers find employment in other sectors.

A separate wages agreement has been concluded in order to provide socially compatible assistance for all those affected by the pressure of having to adjust to the changes. After intense talks between the co-determination committee and the works council the pay-agreement parties, the German Hard Coal Association and the IG BCE decided on 31 July 2008 to accept the 'collective agreement for the shaping of socially compatible measures as a response to the phasing out of the Saar mining industry on 1 July 2012'.

The parties to the agreement are convinced that reasonable solutions have thereby been found for those working in the Saar mining industry. The agreement contains arrangements that provide financial security and promote employment opportunities and in return for this demands a high measure of flexibility from all those involved in it.

The new concept being put forward by RAG Deutsche Steinkohle for the Saar coalfield has produced a very positive response at both local and national level, as it has been recognised that the mining industry – faced as it is by a very tough challenge made more difficult by various conflicting demands – has sought and found a solution that takes everyone's interests into account. From a mining viewpoint it has to be accepted with great regret that the Saar coal industry, which is steeped in tradition, is to come to a premature end in just a few years time. This means that after 2012 all coal mining in Germany will be concentrated exclusively on North Rhine-Westphalia. In Saarland the effects of the mining crisis will continue to be hotly debated in political circles. All political parties have been involved in this discussion and it is possible that this topic will feature largely in the region's elections in 2009.

For the German coal industry the new concept for the Saar coalfield will also have an impact on future planning at national level. Before the February tremor Saar colliery was one of the most cost effective of RAG Deutsche Steinkohle's eight remaining pits. The loss of production, combined with the new extraction concept for the Saar coalfield, has completely altered this situation and the plans laid down for the NRW collieries have had to be quickly reassessed to a certain extent. This is because – as the Federal Government has reaffirmed – the coal industry's new financial framework must remain unchanged.

The closure of Walsum colliery in Duisburg (the 'Walsum understanding'), which had been decided-on back in 2005, went ahead as planned on 1 July 2008. In

April 2008 the RAG Board of Directors then took the decision to bring forward the closure of Lippe colliery, which had originally been set for early 2010, to 1 January 2009. In June 2008 the RAG Board decided to implement a number of further closures that outline the restructuring roadmap for the years ahead: this retroactively confirms the partial closure of Saar colliery on 1 May 2008. 1 July 2012 has now been set as the deadline for the final closure of the colliery along with all Saar central offices and service sectors, insofar as these are not required for follow-up operations. At the same time the RAG Board decided that Ost colliery in Hamm will close on 30 September 2010 and announced the company's intention to close West colliery in Kamp-Lintfort at the turn of the year 2012/2013. Mining under the Rheinberg-Annaberg district will in fact cease in late 2010/early 2011. No further closure dates have been announced as yet for the period 2013 to 2018. According to this plan RAG Deutsche Steinkohle will still comprise three operating collieries after 2013, namely Auguste Victoria in Marl, Prosper-Haniel in Bottrop and RAG Anthrazit Ibbenbüren in Ibbenbüren.

The new coal-policy roadmap and the mine planning actions that result from it mean that Germany's annual coal production is to be reduced from its 2007 level of 21.3 million tonnes to a figure of less than 12 million tonnes. At the same time the workforce will be cut by about 50% to some 15,000.

A factor that is still largely disregarded is that the decision to phase out the German coal industry will not only have a negative impact on the mining equipment sector but will also have serious implications for the regional economy of North Rhine-Westphalia. Downsizing will place an additional burden on the job market in the mining regions for many years to come. Each coal-industry job is on average linked to 1.3 jobs in the wider economy, including quite specifically one additional workplace in the Ruhr area. Unless we can accelerate the pace of structural change in the mining areas significantly and exceptionally by creating new and sustainable job opportunities we will be faced with fiscal follow-up costs as a result of net job losses, additional expenditure on unemployment benefits and a revenue shortfall from taxation and welfare contributions. The additional burden that this will place on the public purse could for years exceed the money saved on aid to the coal industry. This was the categorical conclusion of the Pronos study 'Regional and economic impact of coal mining in North Rhine-Westphalia', which was published in February 2008. The 2007 GVSt Annual Report has already presented the main findings of this particular study (see *ibidem* pp. 33 et seq.). An unpublished report drawn up by Prognos in early 2008 reaches similar conclusions as far as the regional-economic importance of the Saar mining industry is concerned.

Personnel and social restructuring instruments

The industry now faces the huge challenge of applying Government agreed measures for the socially acceptable adaptation of the workforce in the years up

to 2018. If the restructuring programme is to continue as planned, while at the same time avoiding compulsory redundancies, the industry will have to deploy all available instruments for personnel adaptation and social adjustment by way of the new coal policy framework outlined above. In this context the adaptation benefits that are available for coal-industry workers, an instrument that has been in existence since 1972, will have a key role to play.

However, unlike in previous years, the manpower reductions required can no longer be achieved solely by making full use of the 'early retirement potential'. Various in-house programmes have therefore been devised and adapted so that, for example, younger workers can be offered alternative career prospects both inside and outside the RAG Group and incentives are provided to promote and encourage greater flexibility. This includes various professional qualification courses and other programmes aimed at encouraging staff to take up alternative posts within the Group and elsewhere, for example the 'personnel development pool' or 'employability pool', the RAG transitional aid scheme, flexibilisation support for employees, business start-up assistance, job departures with a reemployment agreement and compensation for a change of status or employment with external companies. More than 50,000 people left RAG Deutsche Steinkohle between 1997 and the end of 2007. As well as age-related retirements (about 21,000), outsourcing (1,300) and other self-motivated departures (turnover of about 7,000) many employees have opted to take advantage of the company's own personnel schemes. These in-house programmes have now given some 23,000 members of staff the motivation to take up employment outside the coal industry.

Over the years instruments of this kind have helped reduce the number of active employees from the 280,000 that existed at the time Ruhrkohle AG was first set up to a figure of some 30,000 at the end of 2007 and this has been achieved without the need for compulsory redundancies. Nevertheless, because of the coal agreements of February 2007 the company continues to face a huge challenge as far as personnel policy is concerned. Even if all the provisions of the Coal Industry Financing Act are put into effect it will not be possible for many members of staff to take early retirement by way of the coal industry's own adaptation and severance schemes. These employees will have to leave the company by 2012 with a view to taking up posts with other employers. Those involved have been kept fully informed of events through roadshows and personal letters. For them new career options will have to be found as a matter of some urgency. A similar number of temporary employees and coal-industry trainees will also have to be found places in the job market.

The company and the union-oriented organisations will be providing these members with the help and support they require en route to finding new employment – and this will be done using the schemes outlined above and other dedicated instruments. Unwavering Government support will continue to be a key factor in implementing these measures in a socially responsible way.

Limited placement opportunities for mineworkers

We must not overlook the fact that the opportunities that exist for the socially responsible adjustment of coal-industry workforce by transferring staff into other employment sectors are and will remain limited. There have been various assertions from political circles that the downsizing of the German coal industry could be pursued at an even faster pace and that mining operations could be phased out completely, and in a socially acceptable manner, even before 2018. It has been claimed that the labour market is generally fairly healthy and that for example there is a serious shortage of skilled workers in the industrial trades. A 'job placement offensive' could therefore be launched so that large numbers of trained mineworkers could be transferred to other industries, especially the craft professions. It has been suggested that this would give an added impetus to the process of structural change in the 'withdrawal areas'. However such claims have little or no basis in reality.

In actual fact the 'job placement offensive' proposal is something that has been in operation for years. The 'craftsman's initiative' has long been one of the methods used to achieve socially acceptable manpower reductions in the coal industry and this process has already been exploited to maximum effect. Since 1997 collaboration with job agencies, trade corporations, chambers of industry and commerce and the undertakings concerned has resulted in more than 6,000 mineworkers being placed in the various craft professions. This was the maximum that could have been achieved and the potential for future transferrals of this kind will remain limited. At the North Rhine-Westphalia Trades and Crafts Day in early 2008, for example, it was stressed that while this sector had achieved some really excellent results over the years in taking on workers from the steel and mining industries – and that this link was still there – *'we must not exaggerate the employment potential that exists in the trades and crafts sector for former mineworkers'*. In fact the sector's capacity has declined again in 2008 *'because of the rather gloomy economic forecasts'*. Neither should the employment potential of the crafts sector be seen *'on a one-to-one scale as an assembly area for miners threatened by unemployment as a result of imminent pit closures'*. This is because the trades and crafts profession includes a very wide spread of occupations and there is only a slight overlap between this array of activities and the skills and qualifications obtained in the mining industry. What is more, the age structure of the mineworkers of today does not really meet the needs of the crafts sector and, in any case, vacancies tend to be filled by those who have been specifically trained for the job. Unless the applicant's professional qualification is the key factor former mineworkers would at the same time have to compete with all the other jobseekers. Miners that overcome the competition and find new employment will of course be able to carve out new careers for themselves, but this naturally crowds out other job hunters. This process does not therefore change the total number of posts available. Furthermore, a new job

for a former coal-industry employee in the crafts sector or in any other branch merely balances out the loss of a job in mining.

The other side of the coin is that many of the mineworkers are still needed by the coal industry itself and cannot simply be transferred at will. The socially responsible run-down of the mining industry by the end of 2018, with the proviso of a review by the Bundestag in 2012, calls for an orderly and controllable process of downsizing. Uncontrolled restructuring could well threaten the continued existence of the company in the run-up to 2018 and as a result the industry would no longer be able to guarantee its commitment to manage its affairs in a socially responsible way.

An uncontrolled and accelerated departure of qualified workers would result in a shortfall in those areas where skills are essential. After all, a colliery cannot function without its electricians. If all the coal industry's electricians were to transfer to the electrical trade overnight it would of course constitute a socially acceptable solution for several hundred former mineworkers. However, it would also make it impossible to continue employing the remaining 30,000 or so (as at the end of 2007) coal industry employees. This would in turn threaten coal production to which the mining industry is committed under the coal policy arrangements and on which customers, e.g. in the power generation sector, rely.

The model calculations that were accepted by all the parties in the run-up to the new Coal Industry Financing Act, including the Federal Government, the Land Governments of North Rhine-Westphalia and Saarland, the RAG and the IG BCE, have shown that if compulsory redundancies are to be avoided it will not be possible to shut down the coal industry before the end of 2018. By the same token this means that only by retaining the 2018 deadline will we be able to find socially responsible solutions for all our employees.

Health and safety in the coal industry

For the coal industry having a good mix of skills and age groups is important not only to maintain production levels but also from a health and safety point of view. Working below ground does of course present particular hazards and the mining industry has always made great efforts to minimise these risks as much as possible. With technical standards at a very high level much of the safety focus is now on organisational measures and individual accident prevention. The German coal industry leads the way as far as health and safety is concerned and major accidents of the kind that used to occur in the German coalfields – and which are still happening in other mining countries – are now effectively a thing of the past. The investment needed to maintain these high standards does of course constitute a cost factor that does not have to be borne by those coal producing nations whose health and safety standards are much lower.

World-beating safety technology combined with RAG Deutsche Steinkohle's broad-based health and safety strategy has meant that as productivity improves the number of accidents at the workplace has fallen considerably in all areas and departments. This applies not only in absolute terms but also in relation to the declining production figures, as well as in comparison with other branches of industry. In 1997 the accident figures for the German coal industry were still above the average for the wider industrial sector. Since then the number of accidents recorded per million hours worked has fallen by about 62% such that by 2007 the figure was 13.2% below the average for German industry (17.4 accidents per million hours worked). This success can be attributed not only to individual accident prevention efforts but also to systematic investment in improved working conditions, greater specific know-how and operational priority setting in health and safety matters. Since 1991 the company's mission statement has specified that workers' health and safety must be rated alongside production and efficiency.

Continuous improvements in working conditions, and especially more effective dust control methods, have also meant that new silicosis cases– which were once the scourge of the mining industry – have now practically disappeared.

Today's complex mine ventilation systems, the stringent technical provisions in place to prevent water ingress and rockbursts and the huge range of safety instruments backed up by the latest information and communication technology all require a massive level of investment. These systems represent a financial cost that is several times greater than the expenditure on individual accident prevention measures. The challenge for the German coal industry is now to continue this success story against a background of further restructuring and to preserve the safety expertise that has been acquired so that it can be made available to other coal producing countries.

Pragmatic pay settlement for 2008

Wage policy also has a key role to play when it comes to the socially responsible downsizing of the coal industry and this has been recognised by both pay-agreement partners. The new wages settlement for the period 1 January 2008 to 31 December 2010, which was agreed in April 2008 between GVSt and the IG BCE, has specifically incorporated the fact that the adaptation process has to be continued in a socially acceptable way while at the same time respecting the financial and cost framework laid down under the terms of the new coal policy agreements. The scope available to the parties for agreeing an increase in wages was therefore fairly limited from the outset. The planning arrangements that underlie the Coal Industry Financing Act have been observed under the terms of the new wage settlement.

The respective bargaining parties for the coal industry also signed up to a basic wage-policy agreement in 2008 whereby both sides affirmed that the framework laid down by the Coal Industry Financing Act and corresponding mine planning actions calls for the personnel adaptation and cost objectives to be firmly retained so that the downsizing process can continue in a socially responsible manner. This will only be achievable by making effective use of existing measures combined with the application of new manpower policy instruments. It is therefore essential that the existing labour contract and operating conditions should in future be shaped in such a way that all sectors concerned have flexible access to the manpower they require, both at the right time and of the correct quality and quantity, without overstepping the available financial framework. All appropriate operational measures should be effectively targeted so as to offset manpower surpluses and shortfalls. The coal industry's two bargaining parties have therefore promised to create the conditions under which such operational measures can be applied. Where necessary these will be supported by collective pay arrangements. Provision has also been made so that the measures in question can be implemented without delay as soon as operating conditions dictate.

Key aspects of the 2008 pay settlement

For the agreed period of 36 months, and after being held constant for four months, standard wages and salaries will be increased by 3.4% from 1 May 2008. This will be followed by an increase of 2.0% on 1 May 2009. (Plus a one-off payment in May 2008 of € 300 for industrial and administrative/managerial staff and € 120 for trainees.) Christmas bonuses, which were reduced by agreement in previous years, will continue to be paid in the period 2008 to 2012. After years of pay restraint some measure of inflationary adjustment could, after all, be granted to the coal industry employees.

Competence management: securing knowledge, preserving know-how, shaping the future

There is a saying that 'Mining is not a one-man operation' – and this is particularly appropriate when applied to technical developments in the coal industry during 2008. As a branch of industry that relies on continuous technical developments coal mining has had to focus on one key factor: how to preserve the intrinsic expertise of a rapidly dwindling workforce. Johan Mathesius said in 1562 '*He who would build himself a mine must have either money or industrious hands ...*' and to this we could certainly add '*...and most of all a wise head.*'

The task before us is clearly defined: during the period between the coal agreements of 1997 and 2005 the former DSK lost about 48,000 employees – almost 60% of its entire workforce. Under the terms of the 2007 agreements only

about half of the industry's current labour force of 30,000 will still be working in Germany's coal mines by 2012. However, as the industry sheds its workers so it will also lose the knowledge, experience, skills and problem solving abilities that have been built up over many decades – unless measures are taken to halt this process.

This is exactly what the coal industry is now doing. Since 2001 the current RAG has been engaged in the targeted and systematic organisation of a 'know-how backup scheme' (KHS) – a skills management system that seeks to offset the loss of knowledge caused by the massive reduction in personnel by directing and regulating the manner in which existing skills are deployed and developed. The KHS is based around a comprehensive 'knowledge management' structure that has been built around the core question: who can do what?

In order to acquire this information systematically a catalogue of mining-relevant skills and competencies was built up along with an EDP system that would allow this know-how list to be reproduced and managed in a user friendly way. At the end of the two-year trial phase the result was a matrix of some 5,000 individual qualifications for industrial and technical activities and 1,200 professional competences and method skills for specialised and managerial personnel. Seven years after it was launched the KHS now constitutes the skills and knowledge base of 95% of the workforce.

This wide-ranging qualifications catalogue was then used to build up a detailed skills profile for each employee and the files have been continuously maintained and updated ever since. The pool of know-how that can be accessed via the workforce can therefore be realistically surveyed at any time. The essential aim of the exercise is to deploy each worker in a role that best befits their skills and capabilities.

And there is more to it: as well as reviewing who can do what, it is also important to know which skills and professional abilities have been lost, and exactly when this happened, each time someone leaves the industry. The consequences of coal industry restructuring – namely the loss of knowledge – can therefore be recorded. This matrix, which records and maps the array of qualifications, also includes a computation component whereby personnel planning teams are able to simulate future developments, such as manpower downsizing, the restructuring of the production faces and other factors, and predict how these will impact on the workforce structure. Predictions can therefore be made of the future knowledge and skills requirements, managerial errors can be avoided and know-how losses can be minimised or fully compensated for.

Knowing and managing what each individual can contribute to the company is one thing. Knowing what he or she could contribute is another. Where is the hidden potential and how can the company stimulate and encourage its

employees to maximise their capabilities so that manpower requirements can continue to be met in the best and most effective way?

A new field of activity: mining technologist

The coal industry's new operating parameters and the structural changes that have taken place in the mining and related professions in Germany also have to be taken into account when drawing up training policy. As a result, the training qualification of 'mining mechanic' is currently being reassigned to the new grade of 'mining technologist'. The previous training category, which dates back to 1989, no longer meets current requirements. The new designation of 'mining technologist' is designed to signify that the profession involves the mastery of complex technical processes. The rudimentary principles of metalworking, for example, no longer feature as part of the training. The old designation of 'mining mechanic' was no longer tenable as an equivalent training qualification to that of 'industrial mechanic'. At the same time new economic and technological developments have created new fields of activity that have to be exploited for professional training purposes (particularly geothermal heat recovery). It has yet to be decided whether the job description of 'mining technologist' should be geared towards a single profession or whether training should be provided in two fields. The debate is currently focused on two specialities: 'deep drilling' and 'underground engineering'. Deep drilling would include the core themes of geology and borehole construction and control. As well as indigenous coal mining, underground engineering would also include potash mining, underground waste disposal, mine rehabilitation and – something of a revival – ore mining. This speciality would therefore have to focus its training content on aspects such as the stability of the mine workings and underground ventilation and air conditioning – which are of little or no relevance for students of deep drilling. It is hoped that the new training category will be in place by the second half of 2009.

The manpower planners and developers – both on-site and in the central department for human resources – therefore make frequent use of KHS not only to search out employees whose professional knowledge is urgently required but also to predict where the specialists will be needed in the medium term. The demand for qualifications and skills enhancement measures can therefore be assessed and planned-for on an individual basis.

In addition to the specific employee profiles there are also target profiles for individual positions and even complete departments. It has therefore become possible to encourage individual employees more effectively and purposefully to develop the knowledge and potential that may have gone unused for years and to enable them to acquire the skills and qualifications needed for other, more demanding activities and fields of operation. This in turn helps employees to be more flexible and in this way to be better equipped to face the continuous

demands of industry realignment. Managers and manpower specialists have a reliable overview of the type of knowledge losses to be expected as a result of the downsizing process, and when and where they will occur, and are able to react as necessary by offsetting these losses through restructuring and strategic manpower planning. The KHS system therefore enables the German coal industry to operate in an orderly way and to make the most efficient use of the available know-how and expertise even as the workforce continues to shrink as a result of the ongoing adaptation process.

This successful competence management system also provided RAG with an entry to the Government-launched initiative 'Partners for innovation' and the company was subsequently nominated as an example of best practice in the 'knowledge carrier' category.

Skills and knowledge management is also being used in another vitally important area of the German coal industry: mines rescue. As part of an initiative with DMT the experience and know-how built up over many years has now been input to a database that currently contains more than 3,000 sources in hard copy and some 7,000 files and pictures. It is indeed no coincidence that the German coal industry can now claim to be far and away the safest in the world.

At the centre of this database is a specific pool of knowledge relating to the risks and hazards associated with working underground and ways whereby these can be controlled safely and reliably. Colliery managers and ventilation engineers on site are able to access this information so that in an emergency situation they can act quickly and decisively by using the knowledge acquired over many years. This special know-how backup scheme has now received the Deutsche Steinkohle research award. RAG is also employing this kind of knowledge management system in other specialist areas, including rock mechanics. This initiative has now been documented in two books published by VGE-Verlag.

Competence in all things coal – this naturally also implies continuous research and development. R&D in the German coal industry has traditionally taken the form of a tried and tested process of close collaboration with mining suppliers, technical universities and other research establishments. This ensures that the resulting machines and equipment are developed to world-beating standards. A good example of this collaborative effort is the GH42 'gleithobel' plough and the history of its technical development.

The gleithobel has been the standard technology in RAG mines for some 15 years. However until now its scope has been limited in that it cannot be used on coal faces affected by poor geology. Unlike cutting winning installations the performance of stripping winning machines is very much affected by the strength of the coal and dirt beds present in the seam. The decision to install a stripping (coal plough) winning system will therefore depend on the 'cuttability' of the floor and roof beds. As a result of further developments in stripping winning

technology, combined with improved drives, advancing systems and controls, sensor devices, mechanical components and haulage chains, the coal plough system is now making inroads into geologically challenging seams.

AIMS – successful collaboration with science and research

The German coal industry is now active in many areas, including involvement in the activities of the Aachen International Mining Symposia (AIMS), which are coordinated by the Institute of Mining Science I of the RWTH Aachen (Rhine Westphalia Technical University of Aachen). In May 2008 AIMS organised the 6th International Colloquium 'Rockbolting in the mining industry, injection technology and roadway support systems'.

The chronology of the various colloquia and papers presented between 1987 and 2008 shows how rockbolting has developed to become the primary support system in the German coal industry. Up until the end of the twentieth century there was still much scepticism about the future dominance of this particular roadway support technique. It has always been considered that rockbolting would become less viable as workings moved to deeper levels and as the proportion of worked-out measures increased. More recently, as rockbolting technology developed, it has in fact been shown that it is hard to imagine roadway support systems without rockbolting in combination with steel arch and porch-set systems for roadway support.

Reference has been made to various technical milestones in the development of the roadway support system, which plays such a key role in RAG collieries. Technical advances and refinements of the different support components – yielding arch supports, pack wall backfilling, rockbolts and strata injection – have now been combined to create a state-of-the-art support system for gate roads. There is now no disputing the fact that these combination support systems are suitable for deep workings of 1,000 metres and more. As the geomechanical conditions become increasingly challenging the range of application of the combination support system has continued to grow. While in 2000 the coverage was 12%, this increased to a level of 57% in 2007 and the trend is still upwards.

The many stages in the successful development of the combination support technique would not have been possible without continuous and innovative engineering involvement in a whole series of research projects, the transfer of these findings into operating practice and the gradual improvement and refinement of the results. RAG's technical strategy for ongoing standardisation, combined with the high support requirements for gate roads, then created the environment in which the combination support method could be defined as the standard system for future development drivages.

The latest development for roadway support systems, namely a polymer-based sprayable lagging material, is currently the focus of a research project. This product is designed to be spray applied to the roadhead area in parallel with the cutting operation and actually allows the 'one-step' rockbolts to be installed as it sets. The face can therefore be secured without any of the heading team having to enter the roadhead zone.

This new spray-on lagging therefore constitutes another tool with which the roadheading operation can be mechanised and part automated in conjunction with the support setting work.

The introduction of the GH 42 plough has improved winning performance by more than 100%. One of the results of the R&D work was an increase in the speed-controlled drive output, which was confirmed during initial prototype trials below ground. This system makes for a smoother start-up, which helps prolong the life of the plough chain. This R&D project has enabled the engineering team to standardise the design of the improved plough installation to give a much better operating performance under difficult conditions and with much less wear and tear on the components – or to put it succinctly 'competence in all things coal'. RAG currently has eight of the new-generation ploughs in operation and further installations are on order.

The new GH 42 coal plough

The GH 42 gleithobel (plough with 42-mm chain) is a new, high-performance winning machine that has been developed for hard coal conditions. It features a special steering and guidance system that enables it to glide through the coal. The plough body and chain operate with a face-side guidance device and a special jib steering arrangement allows the plough to dive or climb as it moves along the face – and as a result the machine always stays 'in the zone'.

The first underground trials with the GH 42 prototype were conducted four years ago in seam H at Prosper-Haniel colliery in Bottrop where the face geology was extremely challenging. The development team was able to acquire a great deal of experience and information that was to help develop the installation further. The new plough technology more than lived up to expectations and over a combined trial period of ten months the prototype GH 42 was able to deliver 6,100 tonnes of coal a day – a total of some 1.1 million tonnes.

Working in another seam the new plough subsequently produced peak outputs of 10,322 tonnes saleable a day at a daily rate of advance of 10.5 metres and an area increment of face advance of 12.46 m² a minute. This installation is still in operation and has to date produced about five million tonnes of run-of-mine product. The wear resistant design has meant that the new machine has already been transferred directly to several new faces without the need for lengthy and expensive interim maintenance.

Competence in all things coal – this also includes the close collaboration and ongoing cooperation with scientific and research establishments referred to above. ‘Mining is not a one-man operation’ – and the same goes for competence in all things coal. The latter is in fact the complex result of deploying the entire workforce and exploiting their respective skills. This involves everyone working closely together – from the mineworker at the face to the university professor – and the incentive to continue to develop and improve every aspect of the industry’s operations. This is the only way in which the German mining industry will be able to keep pole position: ‘competence in all things coal – made in Germany’.

2007 was an incredibly successful year for German mining equipment manufacturers and the results for the first six months of 2008 have also been satisfactory. According to the Mining Machinery Association, which is affiliated to the German Engineering Federation (VDMA), the raw-materials boom and the development of national economies, especially in China, Russia and India, have resulted in full order books at the German mining equipment suppliers.

In 2007 the Association’s 120 or so companies, with a combined workforce of about 16,500, achieved a turnover of almost €3.5 billion. Output in fact almost doubled from €1.78 billion in 2002 to €3.41 billion in 2007. During this period the export share of the business rose from 70 to 86%. The sector’s most important marketing areas are the US, Russia and China. German mining equipment manufacturers supply a wide range of products – from machines for extracting coal, industrial minerals and ore to product preparation and processing equipment. While previous years have seen a massive jump in new orders and business turnover this sector expects that 2008 will provide some breathing space before things take off again in 2009.

The great strength of Germany’s mining technology companies lies in their flexibility and capacity for innovation. German suppliers have used the latest frequency converter technology on pumps and winning machines, for example, to move ahead of the competition. With operating requirements and geological conditions changing all the time this modification has made the equipment in question more flexible and at the same time has greatly improved its performance. The real strong point of the ‘Made in Germany’ label is the creativity and flexibility of German suppliers and their capacity to adjust to and anticipate the changing demands of customers. With German collieries and their tough working conditions serving as a reference basis this brand has now developed into an internationally competitive and strong-selling industry. Moreover, the firms involved are constantly extending their client base. In sub-Saharan Africa (the Congo, Namibia, Zambia), in Yakutia in the far east of the Russian Federation and Mongolia too we are currently witnessing the development of major mining industries that are being equipped with the latest

technology. At the same time countries like China – for years a reliable purchaser of German mining equipment - are now beginning to supply products of their own and so are starting to compete with German mining machinery manufacturers. It is therefore vital for this sector of German industry to stay ahead of the field in its technology and expertise and to extend this lead as and when possible. In this respect research and development – supported by close collaboration between scientific establishments, the coal industry and the mining equipment providers – is just as important as technology transfer and knowledge management.

The German coal market

In 2007 coal consumption in Germany increased to just short of 68 million tce (tonnes of coal equivalent), which was 1.3% up on the 2006 figure. With a 14% share of the primary energy market coal therefore continues to be the third-largest contributor to national energy generation, after oil (34%) and gas (22%), but ahead of lignite (12%), nuclear power (11%) and all renewables combined (7%).

Coal consumption in 2008 is expected to be slightly down on the previous year. Coal's principal markets continue to be the electricity generators (2007: 72%) and the steelmaking sector (26%), which buys in coke for its smelting plant. In the generation market at least the demand for coal is expected to remain stable in the short term because of its improved price competitiveness – especially when compared with gas. The requirements of the steel industry are more susceptible to major economic trends, though demand from this sector has been fairly stable in recent years. The remaining disposals (2%) are destined mainly for the heat market where anthracite coals – which in previous years have only been sold in relatively low quantities – are now increasingly in demand (2007: 14% up on 2006). This can be attributed to their higher calorific value and to the fact that anthracite is now more cost effective than oil and gas, which have recently become much more expensive. Coal could well be playing a much larger role in the German heat sector in the years ahead. Indigenous anthracite is now able to hold its own in this market segment without the need for subsidies.

Against this, however, the future of coal-based fuel production in Germany remains uncertain. One potential starting point is coal hydrogenation, a technology that once was highly developed in Germany and which has now spawned a number of significant projects in other countries, including China and the US. Coal hydrogenation, as an alternative to mineral oil, is now being increasingly discussed because of the high prices and uncertainties affecting the oil sector. However no concrete plans exist for such an operation to be set up in Germany and therefore no coal has yet been used for this purpose. Moreover there are considerable environmental reservations about such a project as the coal hydrogenation process emits more CO₂ than burning oil. Of course both the direct and the indirect coal liquefaction process can be linked to a CO₂

separation system, but without an adequate political framework and without support there is little or no chance of investment in CTL (coal to liquids). Sales of German coal to the liquefaction market therefore remain a pipedream for the moment, though international developments and incentives, along with reflections on a national strategy for raw materials, could put a different complexion on such a project.

The decline in the domestic mining industry has meant that imported fuel has dominated the German coal market for several years. In 2007 some 67% of domestic requirements were met by imports, while in the coking coal and coke markets the share of imports has practically reached 80%.

In spite of the ongoing process of restructuring and contraction domestic coal production actually increased slightly in 2007 to a figure of 22 million tce – not least because of the improvement in the average output per man-shift. However this is an exception when seen in the long term and is unlikely to be repeated. In 2008 annual production is to be cut by around a quarter to a figure of about 17 million tce as a result of scheduled capacity adjustments and the unexpected losses in production from the Saar coalfield. Output will also be reduced according to plan in the years thereafter.

Nevertheless, in 2007 indigenous coal still made a significant contribution of 33% to the domestic coal market. Further restructuring is likely to reduce this share to between 15 and 20% by the year 2012. However, deliveries to German coal-fired power stations in 2007 were still holding up and represented 39% of the fuel supplied to this sector.

In 2007 coal accounted for 16% of domestic primary energy production, thus surpassing indigenous gas (13%) and easily eclipsing wind power (4%), hydroelectric power (2%) and solar energy (< 1%). The public perception of the situation is often confused. While the current role played by indigenous coal – and especially its contribution towards energy production and consumption in Germany – is frequently undervalued, the actual input from renewable energy sources is overrated. Another common misconception is the amount of subsidy that would be required if more indigenous coal were to be replaced by renewables. In kilowatt-hour terms the average payment for the feed-in of electricity from renewable sources, as based on the Renewable Energy Sources Act (EEG), is just under 11 cents. According to scientific calculations undertaken by the Aachen University of Applied Sciences in 2007 electricity from renewables benefits from a subsidy of at least 7 ct/kWh. This is 2.8 times the calculated amount of subsidy per kWh paid for electricity generated using German coal. It is likely that this gap will have widened further in 2008.

When it comes to Germany's indigenous energy reserves coal remains by far and away the largest domestic resource. It is even more abundantly available than lignite, even though the question of the extent to which indigenous coal

deposits can be considered as economically recoverable 'reserves' depends very much on the Government's financial framework and will fluctuate according to production costs and world market prices. Irrespective of economic recoverability, however, there are still huge, technically recoverable geological deposits of coal – amounting to more than 20 billion tce – beneath the soil of Germany. These will continue to be available as long as there is an active coal industry with the know-how needed to extract the nation's coal deposits.

The new framework conditions and changed market circumstances have seen Germany's coal imports rise to a figure of some 50 million tce in 2007, a new record high. Most of this fuel arrives via inland waterway and rail routes from other European countries and only about 30% of the total is imported directly by sea-going vessels. With the exception of Poland the main supplier countries are not EU member states and most of the imported coal now comes from Russia and from overseas.

As imports reached record levels the prices being paid for imported coal have now also gone through the roof. While the world market price for steam coal increased only slightly in 2007 (the yearly average cross-border price in Germany rose from 62 to 68 €/tce) there has since then been a veritable explosion to match that of international oil and gas prices. One record high followed another, although there has been some easing of prices in the interim. The cross-border price for steam coal is expected to reach an annual average of some 110 €/tce in 2008. In mid-July 2008, however, imports to northwest Europe had to be bought on the spot market at a time when prices had temporarily peaked at well above 200 \$/t. This corresponded to an import price of up to 160 €/tce. According to press reports the new year-contract prices agreed in mid-2008 for high quality coking coal, especially that sourced from Australia, have increased threefold in relation to the previous period. As far as imported coke is concerned, where China is now setting the pace on the world market, 2008 has again seen prices going into an upward spiral. By the summer of 2008 price levels in this market were more than twice that of the previous year.

Such increases in world-market and import prices have also enabled indigenous coal and other home-produced natural resources to edge closer to the break-even point in competitive terms in a way that has not existed for years. German coking coal is also part of this picture and there have now been calls from political circles for a resumption of the planning and approval process for the Donar mining scheme, which had been put on a temporary hold. The Donar project involves the construction of a new, subsidy-free colliery to extract coking coal from an undeveloped area of deposits close to the town of Hamm, where reserves have been estimated at some 100 million tonnes of high quality fuel.

All this has given fresh impetus to the debate on the future of the domestic coal industry. Just six months after the entry into force of the Coal Industry Financing Act the media, including the television programme *ARD-Morgenmagazin*, held a

debate on the future of the mining industry with the theme 'Opting out of the opt-out'. In March 2008 a representative poll carried out by Forsa found that when faced with the statement 'Germany should continue to mine coal in the future' a clear majority of 55% of respondents answered 'yes' (in NRW the figure was 63%), with only 31% against (27% in NRW). As similar surveys also found in previous years a broad majority of the population is opposed to the policy of closing down the coal industry and completely abandoning the nation's natural resources.

Of course these are merely snapshots of public opinion. The Government is still set on its 2012 review of the decision to cease coal production and will wait until then to assess developments as they affect the world market and the energy situation. For the coal industry the political decisions have therefore been taken and will not be challenged.

Import reliance poses a threat to supplies

In addition to the risks posed by rising prices there is also an increasing threat to security of supply in the form of a growing – and possibly total – reliance on imported fuel. Germany is admittedly still in a fairly comfortable position as far as coal availability is concerned. This is certainly true when compared with the supply situation for oil and gas, where the level of vulnerability to energy crises is now much higher than ever. By resorting to a mix of lignite, indigenous coal and fuel imports from various supplier countries any threats to supply can be effectively limited and price risks can be controlled. While the introduction of new and more-efficient coal fired power stations will also make coal utilisation a cleaner and more environmentally friendly process, growing environmental restrictions and the proposed phasing out of the domestic mining industry are now threatening to reduce the core production base even further. This is clearly having a negative impact on security of energy supplies, a fact also borne out by the Essen-based Rhine Westphalia Economic Research Institution (RWI), which was commissioned by the Federal Finance Ministry in 2007 and 2008 to carry out an empirical analysis of 'Security of energy supply in Germany' (see *Zeitschrift für Energiewirtschaft* 2/2007, pp. 117 et seq. and *Energiewirtschaftliche Tagesfragen* no. 4/2008, issue 54, pp. 8-14). The RWI does not at present foresee any absolute shortage of energy supplies in terms of an inadequate physical availability of global energy resources and raw materials. However, import-dependent consumer countries like Germany live under the constant threat of relative shortages caused by supply bottlenecks and the unreliability of the vendors. In order to quantify the supply risks as they exist in this sector the RWI has examined how Germany's energy imports are concentrated according to the different supplier countries (using the Herfindahl index). It then went on to assess the risk factor as based on the Hermes classification, which is the German Government's official system for rating the political and economic stability of its trading partners.

The study found that the risk to oil and gas supplies in Germany has risen considerably since the oil price crisis – with a major factor being the massive growth in imports of oil and gas from Russia – ‘*whereas the supply risk for coal has only increased slightly*’. The reason for the relatively positive findings as far as coal is concerned lies in the large and ‘*still significant contribution*’ being made by reliably available indigenous coal, even though it has not been competitive without subsidies. As the RWI figures clearly prove, the downsizing of the domestic coal industry and the relentless growth in imports is also increasing the perceived supply risk in this sector too. However, with indigenous coal still having a share of the fuel market – albeit this is declining – and with the diversification of imports, the situation as it affects the coal market is still well below the risk threshold that applies to oil and gas. Of course this could well change in the future and for the long term.

In another study on the same theme (‘Measuring energy security: a conceptual note’) dated July 2008 the RWI draws attention to the fact that in the coming decades the threat to Germany’s energy supply security will grow considerably as a result of the proposed shutdown of the nuclear energy (around 2022) and domestic coal (2018) industries. This is threatening to be an even bigger problem than that facing the US and the planned extension of renewable energy capacity will not be able to close the gap. However, the RWI has not specifically calculated the extent to which security of supply would be affected if Germany were to shut down its mining industry and become completely reliant on imports, including coal. The RWI study is a retrospective assessment, not a forecast. A status quo prediction based on the RWI quantification method shows that the risk to coal supplies will increase significantly in the event of a further reduction in the market share of reliable German-mined coal. This applies especially to steam coal, where the risk factor would then be on a level with that of gas. While there is admittedly less of a national risk to coking coal imports, two thirds of the world market supply of coking coal now comes from just one source – Australia. This constitutes in statistical terms a ‘cluster risk’, in other words the concentration of much of the total risk on a single risk bearer, a category that is currently the subject of intense debate in the world of banking and finance. The astonishing price surges in the coking coal market as a result of weather-related production stoppages in Australia in early 2008 have shown exactly where such a situation can lead.

The RWI study also established that global coal reserves are even more concentrated than those of oil and gas. Nearly three quarters of the world’s reserves are located in the four main coal producing countries (US, China, India and Russia), a fact that could well give the political risk a very special dimension in the long term. As far as Germany is concerned the increased threat to coal supplies as quantified by RWI ‘*can to a large degree be attributed to imports from Russia*’. As well as being a major provider of oil and gas Russia has now also

become one of Germany's most important suppliers of coal. The public debate on future coal supplies has so far failed to appreciate this fact.

However, the problem of an increased national risk to coal supplies – as our reliance on imports continues to grow – is by no means restricted to deliveries from Russia. 'World Mining Data', as published in 2008 by the Austrian Ministry for Economics and Labour, contains for example a classification of the political stability – as rated up to the year 2006 – of the countries that produce the world's raw materials, including energy resources. This also includes those that supply the world market with steam coal and coking coal. The classification of a country's political stability is based on the 'worldwide governance indicators' drawn up by the World Bank. According to this grading system the political stability of nearly 64% coking-coal producing countries and some 71% of steam-coal producers is rated as 'critical' (and in some cases 'extremely critical'). Between 2002 and the end of the assessment period the proportion of countries rated as 'critical' has in fact increased considerably. It is hardly surprising that a growing reliance on imported coal will increase the national threat to security of supply.

Climate and energy

New developments in international climate policy

In 2007 and 2008, as in previous years, climate policy dominated the energy and climate debate at both national and international level. On the international stage the decisions taken at the G8 Summit held in Heiligendamm in June 2007 helped pave the way for the Bali Climate Change Conference of December that year. It was agreed in Bali that a follow-up agreement for the 1997 Kyoto Protocol would be negotiated by the time of the 15th conference of Signatory States to be held in Copenhagen in December 2009. The current provisions of the Kyoto Agreement are due to expire at the end of 2012. The EU in particular considers that the provisions of the Kyoto Agreement for the post-2012 period should be fundamentally toughened up. It is now generally being discussed that the industrialised countries should be required to cut emission levels by 50 to 80% by the year 2050, as measured against the reference year 1990. At the Bali conference, surprisingly, even large emergent nations like China and India expressed a willingness to introduce emission reduction and limitation measures, though these were not elaborated on further. Given the huge growth in emissions from these two nations it is particularly important that China and India be included in the Kyoto follow-up agreement. In 2007 China in fact took over from the US as the world's largest emitter of CO₂ and emission levels from that source are now growing at the rate of about 10% a year. The Western industrialised countries (United States/North America and the European Union), along with Japan, have recorded little or no change in emission levels since 2000 in spite of the significant industrial growth that has taken place in these regions. There has in recent years evidently been a marked decoupling between economic growth and CO₂ emissions.

The G8 Summit held in the Japanese city of Toyako in July 2008 again underlined that the Western industrialised nations were at one in achieving significant cuts in CO₂ emissions in the long term. The objective is a 50% reduction by 2050. This target will also be the blueprint for the next round of negotiations at the conference of Signatory States, which is to be held in Poznan (Poland) in December.

Debate on the European Commission 'Green Package'

In January 2008 the European Commission presented the details of its climate policy plans of January 2007, this taking the form of a complex legislative package – the so-called 'Green Package' – which was endorsed and enlarged upon by the European Council in March 2007. This Green Package should help shape EU climate policy until 2020 and also map out the emission reduction targets that the Commission considers necessary for the period to 2050. The

Package will cover almost every sector of the economy and society that emits CO₂ and other greenhouse gases, and as such will have a massive impact on the prospects for the European coal industry.

The Green Package is built around the further development of the European Emissions Trading System (EU-ETS) for the period after 2012. The Commission has now laid down extremely demanding emissions-trading targets for 2013 to 2020, according to which CO₂ emissions in the EU are to be reduced by 21% between 2005 and 2020 within the EU-ETS zone. After 2013 emission permits are no longer to be allocated to the energy utility companies free of charge but will be 100% auctioned. The auctionable allocation will then be reduced by a certain percentage each year in order to achieve the required reduction quota by 2020. A wave of cost increases can therefore be expected to hit the power generation sector and this is likely to force electricity customers, and especially industrial consumers, to make some painful adjustments. The emission permits for the manufacturing sector, which in total make up a smaller proportion than those assigned to the power generators, are initially to be allocated free of charge after 2013. They will then be progressively auctioned until full auctioning is achieved in 2020. However the Commission wants to assess which of the branches of industry concerned are competing on the international stage and could therefore be put at a considerable competitive disadvantage by the compulsory auctioning process – a situation that could threaten their economic existence. Such businesses could then be excluded from the compulsory auctioning system. Air travel is also to be included in the EU-ETS from 2011. In some European countries, including Germany, moves are now being made to keep industry out of the full auctioning process.

Acting through the BDI, as well as by individual representation, German industrial operators have been openly critical of the Commission's proposals for an EU emissions trading directive. As well as denouncing the fact that the emissions trading sector is being overburdened compared with other areas of business where the potential for reducing emissions has still not been used to the full, and raising other points such as the limitations imposed on using JI (Joint Implementation) and CDM (Clean Development Mechanisms) emission credits, this criticism has mainly been directed at the full auctioning system that is to be introduced in 2013. An expert report commissioned by the Association of the Industrial Power Industry (VIK) has calculated that German consumers in all areas will have to pay an extra € 122.4 billion between 2013 and 2020 as industry passes on the cost increases. Only € 10 billion of this will in fact be recouped costs for industry and the power generators. The remaining € 112.4 billion constitutes the cost of the auction itself. These proceeds would then go to the national budget and would be mainly be used for fiscal purposes, for the intended emission reduction objectives could in fact be achieved at a lower cost. The VIK for its part wants to propose a fuel-specific benchmark system that makes the need to purchase emission permits dependent on the deviation from a technical reference mark. The quantity of emission permits that would have to be

purchased – and hence the cost burden – would be significantly reduced as total emissions continue to be further restricted. Power stations that achieve their benchmark would not have to purchase any additional emission permits and investment in new power plant would not be additionally compromised in an environment where normal competitive risks continue to apply. The additional costs of €2.4 billion that are really essential from an ecological viewpoint would then contrast with the €112.4 billion in incremental charges resulting from the full auctioning process, in other words almost fifty times as much for the same environmental effect. As the number of emission permits is defined and limited by way of the savings target, or 'cap', the environmental objectives of the EU-ETS could essentially be achieved even without full auctioning. This is not the most effective way for a national economy to attain its emission reduction targets. During the autumn of 2008 this issue was the subject of intensive negotiations at European level. For each EU member state the Commission has set minimum reduction targets for 2020 that apply to those parts of the national economy not included in the emissions trading scheme. Under these provisions Germany is required to reduce its CO₂ emissions by 14% from the 2005 levels (the so-called 'effort sharing' commitment).

The Commission has also put forward a proposal for a directive laying down the legislative framework for CO₂ storage. Other directives are also being drawn up that will extend renewables' contribution to total primary energy input to 20% by 2020. This whole complex legislative programme is currently the subject of a fairly contentious debate in the European Council and Parliament and it can be assumed that modifications will be made in a number of individual areas. Various member states and the European Parliament itself seem to be sending out signals that in some points at least they wish to make some clear changes to this package. The Commission is keen to see this entire body of legislation adopted by Parliament by mid-2009 at the latest. This will coincide with the end of the current term of office of both the Commission and the European Parliament and consequently efforts are now being made to conclude this whole dossier by that date.

CCS – a future option caught between policy issues and R&D

Primary energy demand is growing worldwide and in the long term this inevitably means an increase in the consumption of the fossil fuels – oil, gas and coal. One possible way in which the climate can be protected is to use large-scale CO₂ separation when burning fossil fuels under power station conditions, followed by safe transport and storage in geological formations. This whole process is known in its abbreviated form as CCS (Carbon Capture and Storage). Current proposals for introducing CCS technology tend to be associated with coal because of the relatively high specific CO₂ content of this fuel.

There are basically three different processes for separating CO₂ from the power generation process: treating the fuel before combustion (the pre-combustion process), treating the waste gases after combustion (the post-combustion process) or burning the coal in an oxygen atmosphere by using an air separation plant (the oxyfuel process). All three processes still need a lot of development work and any large-scale commercial application will depend on the experience acquired from pilot projects. The first installation of this type – at Schwarze Pumpe – has recently been put into operation. The energy used for the CO₂ separation process results in an 8 to 15% loss in operating efficiency. In the case of a modern combined-cycle power station operating at about 45% efficiency this would therefore reduce the total efficiency rate to somewhere between 37 and 30%. The quantity of fuel required to produce the same amount of electricity would therefore have to be increased by 22 to 50%. Climate protection and resource conservation are therefore clearly in contradiction when it comes to efficiency losses in respect of fuel input. The various research projects currently under way to reduce energy consumption during CO₂ separation are therefore of critical importance.

The creation of an extensive transport infrastructure between the power station and the storage site is a key element in the CCS technology chain. Given the large quantities of gas to be transported the only effective solution here would be to use pipelines and possibly tanker vessels. An environmental impact assessment will have to be carried out on pipeline systems in order to examine the process of transporting CO₂ destined for geological storage.

While practical success has already been achieved with the storage system there is still a need for further research into the geological storage of CO₂. Such an operation will require fairly dense geological formations so that the CO₂ can be kept permanently separated from the outside atmosphere. The pressure and temperature conditions that prevail below 800 to 1,000 metres can be classified as being safe for gas storage purposes. Depleted oil and gas deposits and even abandoned coal workings can potentially provide storage capacity. As is known, CO₂ is already used to improve oil production rates by way of CO₂ enhanced oil recovery. However, as Europe's on-shore oil deposits are relatively small – and this applies especially to Germany – these formations could not be considered for CO₂ storage. There are currently no projects anywhere in the world that use CO₂ enhanced gas recovery. However, there is a CO₂ enhanced coal-bed methane recovery process that injects CO₂ into the coal seam to recover gas (methane) from production boreholes. Here the CO₂ is absorbed by the coal surfaces in the newly exposed pore space. European coal seams are located at greater depth and tend to be thinner than in other countries. They therefore present less favourable conditions for CO₂ storage than those in the US, for example. The German Government has ruled out ocean storage of CO₂ on ecological grounds.

The most promising storage option appears to be to use deep saline aquifers. These are water-bearing formations with good porosity and permeability characteristics for the transport and storage of liquids and gases. As the deep-lying aquifers have never been of any economic significance there is little or no reliable geological information available on them. The EU-funded CO₂SINK project, which is headed by the Geo Research Centre Potsdam based in the Brandenburg town of Ketzin, is now attempting to store CO₂ in an on-shore saline aquifer – the first time this has ever been tried in Europe. The first injection of gas took place in June 2008. This test facility will also be studying and monitoring the behaviour of the CO₂ and the operators are hoping to inject a total of 60,000 tonnes of gas into the porous sandstone beds by 2009. The findings from this trial will provide some of the first answers to the question of how CO₂ behaves when stored in an underground aquifer. A total of 18 institutions and nine European countries are participating in the CO₂SINK project.

It is still too early to give a definitive statement on the feasibility of CO₂ storage on a large scale. This applies both to the assessment of the storage capacity as well to the controllability of the safety issues. The Federal Institute for Geosciences and Natural Resources (BGR) estimates that Germany has a total CO₂ storage capacity of between 24 and 33 Gt of CO₂, with the greatest potential being located in the saline aquifers. The technical and economic potential of the process can however only be assessed when sufficient information has been collected on parameters such as storage capacity, the identification of well-defined, enclosed deposits and long-term behaviour. The storage volume actually available will also be restricted by economic and legal factors and so will in fact be much less than the BGR's figure.

CCS appears to be developing a momentum of its own in political circles. In March 2007, for example, the European Council announced that it supported the building of twelve CCS demonstration facilities as the next step towards the introduction of this technology. On 7 and 8 June 2008 the G8 Energy Ministers meeting in Japan voiced their intention to build twenty CCS commercial-scale demonstration plants by 2010. In 2007 the European Commission expressed the view that by 2020 all new coal fired power stations should be fitted with CCS technology during their construction. In the meantime it will probably forego the need for regulations on the mandatory introduction of CCS technology.

The Commission directive on CCS is designed to ensure that CO₂ is effectively retained in such a way that any negative impact on the environment, and the threat this would pose for human health, is prevented or reduced as far as possible. The directive includes, for example, regulations governing the selection of the storage site, exploration and storage permits, reservoir monitoring and closure, and post-closure obligations. Potential users will also be required to provide open access to the CO₂ transport network and to the reservoir itself. While there are still some detail improvements to be made, this directive can be seen as an adequate and reasonable document. The critical factor will be the

level of public acceptance of the whole CO₂ transport and storage process. This is the only way in which CCS will be implemented on a sustainable basis, if need be with the demonstration of the commercial, large-scale feasibility of CO₂ separation and storage. Industry and Government are now therefore developing a publicity campaign targeted at this specific area.

The current proposal for a directive contains requirements for retrofitting existing power stations with CO₂ separation technology. However, if the emissions trading system is to be the mechanism for achieving the CO₂ reduction targets then a mandatory ruling on CO₂ separation would constitute a double regulation. The introduction of mandatory provisions for tomorrow should be avoided at all costs. The commercial feasibility of the process has still not even been demonstrated and it is not possible to assess the prospects of success and the time that will be needed to produce the evidence required.

The German Government views the new CCS technologies as a future option. Its objective is to create a suitable framework for the development and testing of the CCS process so that this technology can be market-ready by 2020. The Government has made it clear that it will give serious consideration to the Commission's proposal for the mandatory EU-wide introduction of CCS at all new power stations from 2020. However it has also pointed out that CCS can only be introduced as a mandatory requirement when the technical, economic and environmental feasibility of the entire CCS technology package has been proven by way of demonstration power stations and projects aimed at the long-term safe storage of CO₂ below ground.

What is more, CCS cannot be the coal industry's only environmental strategy. CO₂ reduction can also be successfully achieved more quickly and at a calculable level of investment by improving efficiency levels at conventional coal fired installations (CCT). The 2007 McKinsey study on cutting greenhouse-gas emissions has even identified negative CO₂ avoidance costs/cost savings of 50 €/t of CO₂ for an efficiency increase of 38 to 43%. Moreover, the cost of future power generation with CCS will be much higher than that of a state-of-the-art CCT power station. Germany's newest coal fired power stations operate at efficiency levels of 45% and are among the cleanest and most efficient in the world. If the average efficiency of the world's power stations (currently 30%) could also be improved to this level of 45% it would eliminate 30% of the global CO₂ emissions from coal fired plant. Industry experts believe that future-generation coal fired power stations will achieve efficiency rates of over 50%.

Implementing the Meseberg decisions: Germany leading the way in climate protection

The Federal Government is keen to maintain its leading role in the area of climate protection and the Meseberg Integrated Energy and Climate Programme

(IKEP), which was agreed in August 2007, comprises an extensive and far-reaching package of measures that is aimed at limiting the direct and indirect use of fossil fuels, including coal. The first part of the package was submitted as draft legislation by a Cabinet decision of 5 December 2007 and was subsequently adopted by the Bundestag on 6 June 2008. This bill is essentially a modified version of the Renewable Energy Sources Act (EEG) and the Renewable Energies Heat Act (EEWärmeG) and in fact is only to apply to new buildings – and not, as originally intended, to older properties. On 18 June 2008 the Cabinet agreed on the second phase of the Meseberg package and a decision on the third and final part of the programme is expected in the autumn of the same year. The parliamentary stage of the legislative process for both the second and the third part of the IKEP is to be completed by late 2008/early 2009. This means that the actual legislation could enter into force sometime between early and mid-2009.

The German Government estimates that by 2020 the Meseberg Energy and Climate Package will have reduced national CO₂ emissions by 33 to 35% from their 1990 levels, which is somewhat less than the 40% originally proposed. Furthermore, it has had to cut back on the ambitious targets set for the renovation of the residential building stock, while the very demanding proposals for extending biofuel usage in the transport sector have also proved to be unrealisable. The contribution made by biofuels in this area is therefore to be increased to between 12 and 15%, as opposed to the 17 to 20% initially proposed.

By early 2008 the Government was coming under increasing criticism. For one thing it appeared that the existing vehicle fleet was not capable of running on fuel containing more than 5% of biofuels. For another, turning over increased areas of agricultural land to biofuel production was disrupting the growing of foodstuffs. In recent months this has clearly contributed to the marked rise in food prices both nationally and internationally (the 'fill the tank or the plate' dilemma).

Renewable energies – climate protection versus economics

In 2007 renewable energies accounted for 14.1% of Germany's electricity production and 6.6% of primary energy consumption. This is clearly a modest input as far as meeting the nation's primary energy needs is concerned. And yet the development effort that has been directed at renewables has been substantial to say the least. Since the introduction of the Electricity Feed-in Act in 1991 the extended use of renewables for power generation has been promoted by way of the commitment to produce electricity from renewable sources (water, wind, solar, gas from landfill sites and purification plant, and biomass) and the feed-in compensation scheme. Wind power in particular experienced an early boom due to the fact that it was producing electricity at almost break-even cost. The introduction of the EEG in the year 2000, with amended versions of the Act

following in 2004 and 2008, has given an added impetus to the renewables sector.

The application of renewables is not limited to electricity generation. They also have a presence in the heat market (e.g. solarthermics, geothermics and wood pellets) and in the transport sector (e.g. biofuel admixtures). However, the ongoing development of renewable energies will have the greatest impact on coal and its largest commercial market – the power generators.

The aim of the EEG as it is at the moment is to increase renewables' share of the power generation market to 12.5% by 2010. This is then to be raised further to at least 20% by the year 2020. Germany has already achieved its target for 2010. The European Council decision of early 2007 wants to see renewables' share of total energy consumption Europe-wide increased to 20% by 2020. In Germany the Meseberg Package is aimed at giving renewables a 25 to 30% share of the electricity generation market by 2020 and this is to be increased further by 2030. The revised EEG, which comes into force in 2009, even specifies this target corridor by setting a minimum objective of 30% for 2020. The development goals for renewable energy sources are therefore becoming increasingly demanding. However, a lot of ambition and a great deal of additional expenditure will be needed if this increased input from renewable sources is to compensate for the phasing-out of nuclear power for electricity generation in Germany (in 2007 this accounted for about 24% of the market), which according to the Atomic Energy Act is to be completed by 2022. The compensation balance that has been calculated for the input quotas is fairly unspecific about the relevant load periods – nuclear power operates in base load while renewables generally do not – and about the displacement effect all this will have on the load structure of the electricity generation system.

The main aims of the EEG are to achieve sustainable development of energy supplies in a manner that benefits the climate and the environment, to reduce the financial impact on the economy by taking externalities into account, to conserve natural resources and to promote new technologies.

In the views of the Government however, as revealed by a question raised in the Bundestag on 23 July 2008, current knowledge of some of the basic methodical points still does not provide sufficient understanding of how to undertake a macro-economic calculation of external costs. The Government has therefore backed away from carrying out a quantification of its own. Indeed such a calculation is likely to be extremely complex. As well as the cost of the electricity generation process itself any assessment has to take account of additional factors such as the impact on employment and the opportunity costs of other CO₂ avoidance strategies. From an environmental point of view too, as far as external costs are concerned, the extended use of renewables across the board will certainly not be without its problems, particularly as this frequently involves much greater land use than is required for 'conventional' energy recovery. This

can lead to serious clashes with landscape protection and nature preservation groups, as already witnessed in a number of wind-power and hydro-electric projects. What is more, generating fuel from biomass, biogas or biodiesel cannot by any stretch of the imagination be described as a CO₂-neutral process.

From a CO₂ point of view there are also further factors to be considered: because of the upper limits for CO₂ emissions from the sectors that come under the emissions trading scheme (which includes the entire electricity generating industry) no specific development targets are in fact required as far as renewable energy sources are concerned. The quota of emission permits available to the electricity sector has been fixed by the climate policy makers and cannot in sum be exceeded, irrespective of whether – and to what extent – renewables are used for power generation or not.

It is beyond dispute that the rate of remuneration paid for electricity produced from renewable sources is significantly higher than the cost of conventional power generation. These differential costs, which amounted to some € 900 million in 2000, have increased continuously and by 2007 totalled some € 4.3 billion. They are set to grow further in the years ahead as more electricity is produced under the provisions of the EEG and the Federal Environment Ministry (BMU) expects them to be in the region of € 5 billion by 2008. These differential costs will then slowly decline at some point in the future as the degressive rates of remuneration begin to take effect. The subsidy-like contributions that electricity consumers have to make for renewable energies therefore amount to much more than the € 2.6 billion paid to the coal industry in 2007 – aid that has been progressively reduced for many years and is set to decline further.

In economic terms there are distinct differences between the various forms of renewable energy. The funding of photovoltaic installations, which currently receive compensation payments of nearly 47 cents/kWh (for new plant of up to 30 kW), is for example considered by the RWI to be a technological misjudgement, while following the compromise arrangement for solar-energy payments that was adopted by the Bundestag as part of the 2008 EEG amendment the total cost of using renewable energies – according to the RWI – is expected to grow to € 100 billion and more by 2015.

However the prospects for wind generated power, which currently receives less than 9 cents/kWh, appear to be more favourable. Moreover, as suitable on-shore sites become used up the development of offshore wind farms can provide a real alternative for taking this technology further. The EEG progress report published by the BMU in 2007 estimates that during the first 12 years of operation offshore wind generators with a rated capacity of 3 to 5 MW and installed in water 20 to 30 metres in depth will produce electricity at between 12.67 and 14.09 cents/kWh. By way of comparison the prime cost of conventional electricity in 2008, according to BMU figures published the same year, is put at about 5.5 cents/kWh. It still remains to be seen whether the cost estimates for offshore

wind power, a technology that has so far only partly been tested on a commercial scale, will stand up to the reality test and how the expansion of fluctuation-prone wind generated electricity can be made compatible with network availability and network stability.

Add to this the fact that the EEG costs for renewables do not include the additional expenditure on conventional balancing power and reserve power. Wind energy and solar power are subject to widely fluctuating availability both during the course of the day and as a function of weather conditions. The feed-in process for renewables means that conventional coal and gas fired power stations sometimes have to increase their plant utilisation rate or hook up to the grid in order to compensate for load deficits from renewable sources. According to the BMU this operation alone costs an extra € 300 to 600 million a year.

It is debatable whether by promoting renewable energies for environmental reasons – and this means reducing CO₂ emissions – we are really heading in the best direction from a cost point of view. The 2007 McKinsey study, which was commissioned by BDI, looked at the cost and potential of avoiding greenhouse-gas emissions in Germany up to the year 2020 in terms of using renewables for electricity generation and calculated that the average CO₂ avoidance costs would be 32 €/t CO₂. This analysis, from the perspective of the private decision-maker, already includes the EEG support factor. Without EEG funding the avoidance costs would be close to 80 €/t CO₂. On-shore wind power, when seen from the decision-makers viewpoint, would for example cost 34 €/t CO₂ with EEG support and 55 €/t CO₂ without. By way of comparison the McKinsey Study estimates for example that the CO₂ avoidance costs for lignite-CCS would be 30 €/t CO₂ or more, while for coal-CCS the figure would be 50 €/t CO₂. By using power station technology of the future, which will be superior to that available today, McKinsey reckons that coal will cost less than 50 €/t CO₂ and coal-based combined heat and power (CHP) less than 20 €/t CO₂. The modernisation/retrofitting of older lignite and coal fired power stations then even becomes economically viable and can produce cost savings, in other words negative avoidance costs – which in economic terms makes it a much more favourable option from a climate protection viewpoint, a fact often overlooked in the public debate.

Life after the 2007 IPCC Report: the work of the climate scientist goes on

After the publication of the fourth Interim Report of the International Panel on Climate Change (IPCC) in February 2007 some calm was restored to the scientific debate on global warming in 2008. This return to tranquillity has been due in part to the fact that there has been no further increase in global mean temperatures over the last ten years. In mid-2008, as a reaction to natural parameter fluctuations in the world's climate system, temperature levels actually cooled down by about 0.5 degrees from the figure measured in early 2007. It is

becoming increasingly obvious that the extreme scenarios painted by the IPCC are quite implausible. Any climate changes triggered by the greenhouse effect tend to have taken place, or will take place, at the lower end of the IPCC range.

Coal fired power stations are portrayed in the media as having a detrimental impact on the world's climate, but the criticism goes further than this in that they are also charged with emitting traditional air pollutants such as SO₂, NO_x and particulates. A series of legislative measures introduced since the 1980s has imposed strict emission controls not only on existing coal fired plant in Germany but on new installations too. As a result emissions have been reduced by more than 90% compared with previous levels. The German Government has reacted to publically expressed fears by introducing new legislation (Federal Immission Control Act No. 37) that imposes even tougher limits on emissions from coal fired power stations.

The European Commission too is anxious to reduce the environmental impact of industrial installations by introducing increasingly stringent air quality standards. To this effect it is planning to toughen-up the provisions of the various air quality directives, including those of the National Emission Ceilings Directive (NECD).

The success of this clean air policy has been reflected in a continuous improvement in air quality in recent years. The air in the Ruhr of today is in fact of better quality than it was in the central uplands of Germany 25 years ago, an area that at that time was classified as a 'clean air zone'.

The environmental debate as a factor in investment decisions – the fear of an energy gap

The state-run German Energy Agency (dena) has carried out an investigation into how the German electricity market will develop to 2020, with projections for the period to 2030, in terms of power-station and network planning. This has concluded that even by 2012 current power station capacity may no longer be sufficient to meet Germany's annual peak load requirements. By applying the findings of the German Government's Energy Study as presented at the 2007 energy summit, which point to a decline in electricity consumption, the difference between annual peak load and secure power plant output would amount to about 11,700 MW by 2020. If electricity demand remains unchanged this difference will increase to as much as 15,800 MW. Depending on the scenario, extending the lifetime of the nuclear power stations by 20 years would delay this widening gap by between 10 and 15 years. There are therefore calls for existing power plant (and not just the nuclear installations) to be retained beyond their scheduled run-time. This may well be the only way to guarantee security of supply, even in the knowledge that the extended use of today's inefficient plant will continue to mean high CO₂ emission levels.

The Study is based on 15 power stations that are currently under construction and on six planned projects that have a good chance of getting off the ground. It also looks at another 60 power plant projects whose future is very uncertain. The Hamburg-Moorburg power station, for example, is included in the survey as one of the 15 'definites' now under construction. The Study lists the following reasons for the large amount of uncertainty surrounding projects of this kind:

- lack of public acceptance, particularly in the vicinity of the proposed plant
- the high cost of power station technology and plant components
- uncertainty over the future cost of CO₂ allowances under the emissions-trading framework that will apply after 2013, and in connection with the unpredictable nature of global energy prices (coal and gas).

The Study calls on politicians and energy suppliers to act together quickly in order to create suitable conditions for building the new fossil fuel-based power generation capacity that is so urgently needed. If energy supplies are to be made secure, risk-free and sustainable then society has to come to a broad agreement on the need for renewing the nation's power generating installations and extending Germany's power supply network.

The NRW energy and climate programme: climate protection hand in hand with coal

North Rhine-Westphalia is one area that has recognised the specific challenge posed by the need for greater climate protection and May 2008 saw the publication of the NRW energy and climate protection strategy 'Facing the future with energy – climate protection as an opportunity'. As the industrial heartland of Europe NRW produces 30% of Germany's total electricity requirements and consumes 40% of all the power supplied to industry. However as it is located relatively far from the coast North Rhine-Westphalia is not a particularly good site for wind parks and is therefore something of an underachiever when it comes to the ambitious expansion targets that have been set for renewable energies, especially wind power. NRW is finding it difficult to achieve the local target of 36% laid down by the Meseberg Package for CO₂ reductions nationwide. The NRW strategy is currently focussed on a 33% reduction target for 2020, which means cutting CO₂ output by some 98 million tonnes from the 1990 level. About 17 million tonnes of this reduction have already been realised. In fact only 36 million tonnes of the remaining savings of 81 million tonnes of CO₂ are attributable to the Meseberg programme – a further saving of 45 million tonnes will have to be made by NRW's own efforts.

Inevitably, the most important aspect of the package as far as achieving the climate targets is concerned is the rapid renewal of the existing stock of conventional power stations by a process of replacing older installations with new plant of similar output. Of the anticipated annual savings of 30 million tonnes of

CO₂ some 18 million tonnes will be due to plant renewal measures up to 2012 and a further 12 million tonnes to actions taken during the period thereafter. Replacing the nine coal fired power stations in NRW that have been identified in the programme will deliver 50% of the CO₂ reductions to be achieved by 2012. NRW is now showing by example how climate protection can be made to work *with* coal rather than against it.

International market developments in energy and raw materials

International energy prices in 2008 – setting all-time records

The price of energy resources has risen dramatically and 2008 broke all previous records. In July 2008 the monthly average prices quoted for oil, gas and coal were the highest ever. Brent crude for example reached more than 133 USD a barrel (1 barrel = 159 litres), steam coal f.o.b. northwest European ports was more than 210 USD a tonne and Chinese coke f.o.b. China was costing up to 760 USD a tonne. As the Paris-based International Energy Agency (IEA) put it: *'the alarm bells are ringing'*. In the media the talk is all about the global battle to secure increasingly scarce energy resources and industrial raw materials. The global catch-up process and the spectacular economic growth under way in a number of 'newly emergent nations' have created a boom-time for the world's commodities markets and brought international mining companies record profits. Admittedly there has been some relaxation on the energy resource markets during the last third of 2008 as a result of a slowdown in the global economy and hence a lower rate of growth in demand. In September 2008 the UK price of Brent crude fell below the 100 USD a barrel mark. Nevertheless, 2008 will go down as a year of historic significance for the world's energy industry.

Prices are expected to continue to spiral upwards in the medium and long term. The Royal Institute of Foreign Affairs, based at Chatham House in the UK, has for example stated that the crisis in the price of oil and energy resources – which in mid-2008 showed some signs of easing – is but a foretaste of the impending high price levels that will be with us in a few years time, especially when it comes to the benchmark energy currency that is oil. In its recent study 'The coming oil supply crunch', which was published in August 2008, the Royal Institute believes that oil prices quoted for UK Brent could well rise above 200 USD a barrel for a certain period around 2013 and attributes this primarily to the lack of investment in developing production and processing capacity. A similar pattern can be seen emerging in the other fossil-fuel markets too.

The causes of the energy price explosion

There are many reasons for the rising prices being quoted for energy resources and many other mineral products. Countless expert reports, studies and press publications have blamed this on the huge upsurge in demand from the newly industrialising countries, which seems to have taken the producers completely by surprise. Mining countries and mining companies alike appear to have been caught out by this development. They had not made sufficient provision for production and transport capacity and had failed to make the necessary investment. The markets were therefore hit by a massive surplus demand. Yet the BRIC countries (the term 'BRIC' was coined by the US investment bank

Goldman-Sachs in 2003 to denote Brazil, Russia, India and China), which have been labelled '*raw-material guzzlers*', were already buying up minerals and other resources long before the commodities crisis. They acquired mines and mining licences, took out shares in mining companies, formed joint ventures and signed bilateral agreements with a number of resource-rich but financially poor countries, especially in Africa. In some cases – coal being one – China changed from being a net exporter of raw materials to being a net importer. These former developing nations now have huge financial muscle and their enormous and as yet not fully developed purchasing potential makes them the markets of the future. Moreover they still offer relatively attractive conditions for setting up new production facilities. China especially has in many ways already taken over from the traditional industrialised nations as a major industrial base. The economic centres of power are therefore shifting.

Add to this the fact that the international financial crisis first impacted on the price of raw-materials derivatives – which are financial operations derived from raw materials both with and without physical performance – and subsequently on the physical undertakings themselves. The main effect of this increased speculative influence was to raise price volatility and this in turn tended to drive the price dynamics on a sporadic basis.

Energy price surges hit the German economy

The German economy did not escape the impact of this dynamic upward trend in international energy prices. In June and July 2008 the inflation rate in Germany was running at 3.3%, the highest since December 1993. According to calculations produced by the Federal Statistical Office this was mainly attributable to the increase in the price of energy and foodstuffs, which together were held responsible for two thirds of the rise in costs. If the increased energy prices are completely left out of the equation Germany's inflation rate in July 2008 would have been a mere 1.9%. In the run-up to July 2008 the world market prices for many energy resources were setting new record highs month on month. When compared against the previous July figures, for example, the index-linked import prices, free German border, were about 76% up for coal, 61% up for oil and nearly 53% up for gas.

In 2007 the energy import bill, which totalled some € 80 billion, was down on the previous year's figure. There are now plenty of indications that energy imports in 2008 will surpass the record level of € 91 billion set in 2006. By the end of the first six months of 2008 expenditure on energy imports had already totalled € 49 billion.

Higher energy prices are also placing a huge burden on German industry and companies whose energy bill represents a major component of the operating costs are now facing financial difficulty.

Private consumers too have felt the direct impact of rising energy prices in a number of ways, especially when paying heating and electricity bills and filling up the car, and the debate about the commuting allowance and about subsidised gas and electricity rates for low-income households has now gained momentum as a result of this sudden movement in prices.

There is also uncertainty surrounding future economic developments. In their autumn prognoses both the Kiel-based Institute for World Economics and the RWI in Essen have indicated that the global economy is showing real signs of a marked slowdown both this year and in 2009 – this situation being aggravated by the growing property and financial crisis that originated in the US and by the high rise in energy prices. After showing 6% growth in 2007 world trade is expected to increase by less than 4% in 2008 because of the slowdown in the global economy and the expectations for 2009 are even gloomier. The German economy will not escape the impact of these developments and the Institute is now predicting almost zero growth for Germany in 2009.

Security of supply and competitiveness have become indispensable

Germany is largely dependent on supplies of reliable and affordable energy and industrial raw materials for ensuring sustainable economic growth in the years ahead. Even now the country is 97% reliant on imported oil, 84% reliant on imported gas and 68% dependent on imported coal. These figures are set to increase further as national production is scaled back. In the case of oil and gas this will be due to the depletion of indigenous resources, while coal's decline has been the result of political decision-making.

We are made painfully aware of these relationships not only during energy-price crises but also at times of international conflict. The West's reaction to the Caucasus conflict in 2008 was also affected by concerns about security of energy supplies from Russia and the Caspian region, while EU plans to impose sanctions on Russia were also rejected partly because of Europe's reliance on Russian energy. In Germany these critical developments even forced the Federal Economics Minister, Michael Glos, to consider setting up a national gas reserve to match the country's strategic oil reserve. In spite of the findings presented in this Report there still appears to be much less concern in this respect when it comes to coal.

Germany and indeed the rest of Europe too is now increasingly coming to realise that there is an urgent need for a balanced energy policy in which the objective of a reliable and affordable energy supply is ranked alongside that of preserving and protecting the environment. The risk that insufficient supplies of raw materials can pose for Germany as a manufacturing base has been ignored for too long. On closer inspection many of the instruments, when seen both

individually and in combination, have failed to deliver. For example the promotion and expansion of renewable energy sources were supposed to contribute in equal measure to the twin objectives of environmental protection and security of supply. Renewables can at best make a partial contribution to meeting our raw-materials needs. However they are not one-hundred percent reliable when it comes to security of supply, they are not completely without ecological issues of their own and they come for the time being with costs attached. This example shows that the policy objective of security of energy supply is still being overshadowed by environmental targets. Competitiveness is therefore getting a raw deal, even though according to the much vaunted triangle of energy policy objectives – which is recognised by the Government – equal weight should be attached to all three aims.

Security of energy and raw-materials supplies is certainly one area that has been unduly neglected for too long. This key issue is now being given much more attention by the German Government and in particular by the Federal Ministry of Economics (BMWi). The first phase of this energy action involved the publication by Federal Economics Minister Michael Glos of the findings of the 'Project Group Energy Policy Programme' (PEPP) on 3 September 2008. This extremely welcome and, with its political declarations, long overdue PEPP initiative calls for a reliable and affordable energy supply along with increased competitiveness in the electricity and gas markets and in addition advocates combining responsibility for energy and raw-materials policy under the Ministry of Economics. There have also been proposals for convening a 'Scientific advisory panel for energy and raw-materials security' and appointing a 'Government Commissioner for energy and raw-materials security' in order to strengthen Germany's energy policy. The Government will also be making an annual statement, accompanied by a report from the BMWi, on the state of energy and raw-materials supply in Germany. The BMWi report 'Energy in Germany', which was published in May 2008, is to serve as a basis for these actions.

Fossil fuel resources, reserves and availability

The fears and concerns for the world's capacity to meet its energy needs are obviously still contingent on the industrialised countries' huge appetite for energy, and that of course also applies to the emerging nations – especially in Asia. Yet political instability in the source countries is also posing a threat to supplies. Add to this the fact that most fuels are now increasingly affected by bottlenecks in the transport and delivery infrastructure, while oligopolistic situations are also developing in many of the world's energy-resource markets.

According to the IEA 'World Energy Outlook 2007' global energy demand will be 55% higher in 2030 than it was in 2005. This projection means that 82% of the world's energy needs of some 25.3 billion tce, in other words nearly 21 billion tce,

will have to be met by fossil energy sources – and nearly 30% of this will be supplied by coal.

An examination of the global situation as it affects energy reserves and resources highlights the serious problems that are developing, especially when it comes to meeting our long-term oil and gas needs. For a number of years now the physical conditions as they exist on the resources side, with repeated reports of oil and gas supplies about to 'peak' or even already having done so, have been seen as increasingly critical.

According to rough estimates based on international data the static life-span of the three main fossil energy resources is put at 50 years for oil, 60 years for gas and 160 years for coal – measured against the rate of consumption in 2007. In addition to the physical risks, which while fairly low in the short and medium term still cannot be neglected when viewed from a longer perspective, there are also political and economic factors to be taken into consideration. What is essentially needed is an overall plan.

The figures put forward by the Federal Institute for Geosciences and Natural Resources (BGR) in their recent study of conventional hydrocarbons and coal present the following situation as at year's end 2006: oil production based on conventional mineral oil should, in geological terms, 'peak' sometime around 2020 given a moderate increase in consumption. OPEC's share of world oil production is likely to continue to grow since new oil finds in non-OPEC countries will alone not be able to meet the growth in demand. The concentration of oil reserves (and gas too) in the 'strategic ellipse' that stretches from the Middle East through the Caspian Sea to Russia conceals a high risk potential due to the political instability present in many of the regions concerned. A unilateral reliance on supplies can also seriously disrupt the entire economy by exerting pressure to enforce certain political interests. This applies particularly to EU gas supplies.

The debate about security of gas supplies has highlighted the important role that liquid gas (LNG) can play in helping to diversify sources of supply and prevent a situation of over-reliance. However Germany in particular does not have the infrastructure required for an LNG industry. The options for diversification remain limited and new risks are now emerging in terms of the physical reliability of supplies and the threat posed by terror attacks. Yet the main impact of all this will be a definite upward price tendency.

According to the European Commission's latest estimates, gas consumption in the EU 27 will reach 583 billion m³ by 2030, which is 16% higher than the 2005 figure. With the Community's own gas output expected to drop to about 96 billion m³ by that time the EU's import requirement will therefore increase to 84%. There therefore appears to be relatively little scope for reducing the gas supply risk by increasing deliveries of LNG.

The world market for coal

In 2007 only 15% of the five billion tonnes of coal produced worldwide was traded on the international market – and the proportion of solid fuel coming on to the market will tend to decline between now and 2030. This means that the trading intensity for coal is much lower than for oil and gas.

The main price indices for both the Atlantic and the Pacific coal markets have been steadily increasing since 2003 and in fact rose steeply in 2007. Shielded by the strong euro and weak dollar the European price in 2007 was only 23% up on the previous year. When calculated in dollars, however, the price rise was 43%.

Industry watchers clearly see the upward movement of prices on the world coal market as being partly driven by the additional demand from the newly industrialising countries, yet they still fail to recognise in this the direct impact of production bottlenecks. But shortages have happened all the same. Prices were also pushed up by the increases in sea-freight charges that over the past 12 months have more than doubled, and in fact since mid-2008 have risen more than threefold.

Coal prices

Coal is used in the power generation and steel making industries as well as in the heat sector. It is therefore traded on separate markets and classified differently according to its place of production, consumer region and quality (e.g. calorific value, degree of hardness, water content and ash content). This means that there is essentially no world market price for coal as such – just as in the oil market with its various quotations for Brent, WTI and Arabian Light. Internationally traded coal prices, according to which German coal also has to be sold to its home customers (as based on the BAFA price – see below), essentially mean the current market prices. These are established by the current or anticipated supply and demand situation and are therefore not cost prices that can be determined by official pricing schedules or that reflect actual production costs.

As is the case in other markets coal prices can differ enormously from coal production costs. Only in a buyer's market situation, where there is intense competition on the supply side, do prices tend to follow the (average) production costs. In a seller's market on the other hand, in other words when supplies are tight or when demand is approaching the suppliers' full capacity, prices can be several times higher than the production costs. This has long been the case in the oil market and in other commodity sectors too, and the international coal markets have also witnessed a similar phenomenon – especially in 2007 and 2008. Production costs, which in the case of the coal industry can differ widely because of geological factors and on account of the national framework

conditions prevailing at the mining site, will at all events define the long-term lowest price limit below which no buyer's offer is viable. The political and legal terms of reference under which the German coal industry operates additionally mean that production costs, which are subsidised in order to make up for the BAFA price gap, also include the future cost of closing down collieries and inherited liabilities from mining operations that ceased years before. In principle the coal market distinguishes between longer-term contractual prices, spot-price quotes that are updated on a daily or weekly basis and a combination of the two.

The Federal Office of Economics and Export Control (BAFA) imposes a weighted cross-border price for steam coal, the so-called 'BAFA price', which is levied free German border on all coal imports from third countries. This applies to both contractual and spot deliveries from non-EU countries only, which means that it no longer covers supplies from Poland and the Czech Republic, countries that joined the European Community on 1 May 2004. The BAFA price is determined on a monthly basis and is published quarterly with a time lag of about two months. It is primarily used for setting a parameter for subsidising German coal intended for power generation purposes. Similar rules apply to subsidised coking coal. Disposals of coal to the heat market, where fuel oil and gas prices set the benchmark, are not subsidised. As it is based on longer-term contract prices the BAFA price tends to differ by varying degrees from the short-term spot prices.

The spot markets for coal have several price quotations in circulation and these are calculated on different price bases. For example the 'McCloskey International Steam Coal Marker Price (MCIS)' and the 'Average Price Index 2 (API 2)', which are the steam-coal price references relevant for the northwest European market, already include transport within the producer country and all insurance, shipping and freight charges (= cif, cost, insurance and freight) to the destination ports of Antwerp, Rotterdam or Amsterdam (ARA). Additional allowance therefore has to be made for sea freightage that is governed by other market rules. Prices quoted as 'f.o.b.' (free on board) only cover the cost of transporting the product to the port of loading, as in the case of the 'Average Price Index 4 (API 4)', which includes the cost f.o.b. Richards Bay (South Africa).

Over the past year the global coal market has also been seriously disrupted by extreme weather conditions – as experienced for example in Australia and Indonesia – as well as by transport problems in Russia. This resulted in delays and bottlenecks that affected production and shipping operations. At the same time there has clearly been an increase in 'resource nationalism' and in early 2008, for example, China was temporarily compelled by the severe winter to suspend its shipments of coal and coke, commodities that even in normal times are subject to export quotas. This was the only way to safeguard supplies to the home market. This decision had a huge impact on prices, particularly as China – the world's largest coke exporting nation – had been supplying nearly 50% of the market. While special circumstances such as these do not occur

every year and recessionary global trends can temporarily exert pressure on prices from time to time there is still every likelihood of a huge strain on the world coal market in the medium term. The massive upsurge in demand from the newly industrialising nations will have a much more lasting impact. This development has put the coal market under real pressure and resulted in a distributional shift from the Atlantic to the Pacific market. This meant that Indian purchasers were increasingly buying up steam coal from South Africa and generating large fluctuations in the f.o.b. prices. The general problem of massive underinvestment will also have a long-term impact. This will sooner or later result in bottlenecks throughout the entire coal supply chain – from production and preparation through inland transport and transloading to seaborne shipping and landing. It is expected that by about 2012 there will be a global supply shortage of steam coal on the world market. This projection comes from the energy company E.ON and is based on a fundamental analysis of developments in investment, capacity, production and demand on the world coal market. Such a situation of undersupply is again likely to result in dramatic price increases.

Add to this the fact that sources of supply still tend to be very much concentrated on just a few countries. In 2007 the tonnages available for export by sea were considerably up on the previous year. About 60% of the seaborne steam-coal market, which in 2007 amounted to an estimated 618 million tonnes, was that year covered by the three largest supplier countries, namely Indonesia (28%), Australia (19%) and Russia (12%), while in the case of seaborne coking coal – where some 200 million tonnes were traded internationally in 2007 – about 93% of the market was supplied by the three most important source countries Australia (68%), USA (13%) and Canada (12%).

At company level the 2007 market was still very much dominated by the four commercial giants BHP Billiton, Rio Tinto, Xstrata-Glencore and Anglo Coal. That year the 'Big Four' supplied about 30% of the global steam coal market and also dominated the international seaborne trade in coking coal by supplying some 47% of the market. The much-debated merger of Rio Tinto and BHP Billiton, which is something that still cannot be completely ruled out, would give the new company control of nearly 40% of Australia's coking-coal export capacity and about 15% of the Australian steam-coal export trade. While this business mainly supplies consumers in Asia such a development would also have ramifications for the Atlantic market.

Germany's options

In spite of all the efforts put into saving energy and extending the use of renewables Germany will for the foreseeable future still be reliant on fossil energy sources, and that includes coal. The famous triangle of energy policy objectives calls for a balanced energy mix. As well as diversifying imported energy supplies, a process that is difficult to control, the country also has to

engage in active diversification of indigenous energy resources and it must do so irrespective of whether they are cost effective, as in the case of hydro power and lignite, or whether they require state subsidies, which applies not just to German coal but also to many of the renewables. For the sake of energy security and reliability of raw-materials supplies we therefore have to keep all our options open and not abandon them.

When Germany's huge coal deposits are taken into account it can be seen that the country is certainly not lacking in energy resources. There is an estimated 35 billion tce of recoverable fuel deposits beneath German soil. According to figures published by EURACOAL, the European Association for Coal and Lignite, Germany currently has some 12.9 billion tce of lignite deposits that can be recovered using existing technology, while the equivalent figure for the nation's coal deposits is 23 billion tce. Germany's oil and gas reserves are modest by comparison.

Rising coal prices, increasing transport costs and concerns about security of supplies have meant that in some countries there is now increasing public awareness of the importance of an indigenous coal industry. Plans are already being laid in some parts of Europe to re-open coalfields that were closed many years ago. In Japan too the Government is proposing to revitalise coal production by re-opening mines that were closed some time ago because production costs were too high. However preparations are being hindered by the fact that there are now too few geologists with specialised knowledge in this area and the information held on the deposits is in many cases out-of-date. There are also problems in recruiting a workforce with the necessary skills and qualifications.

Germany could well face the same dilemma.