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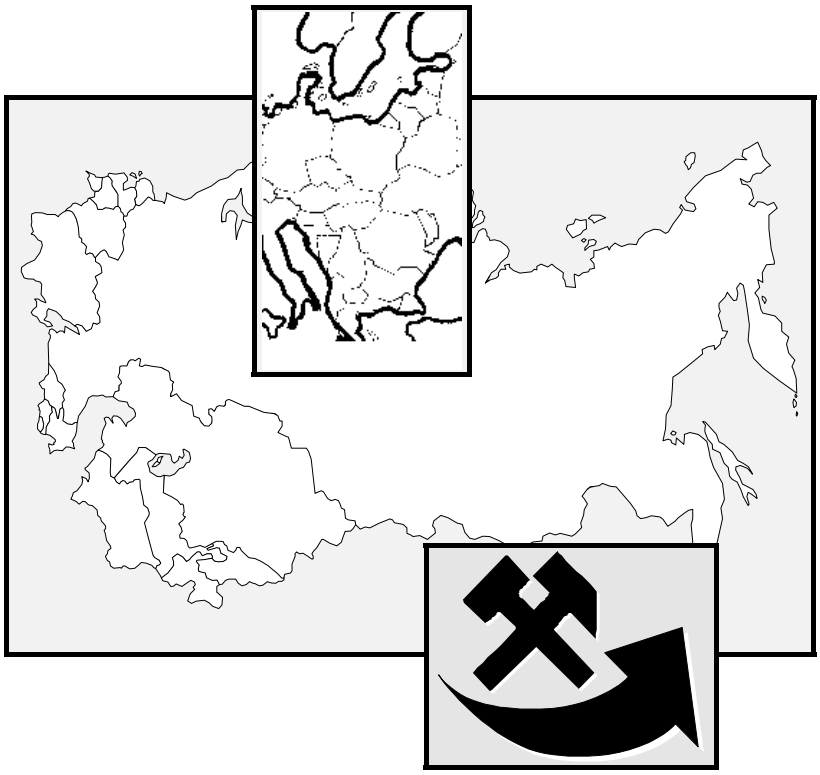
RESTRUCTURING AND PRIVATIZING THE COAL INDUSTRIES IN CENTRAL AND EASTERN EUROPE AND THE CIS



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RESTRUCTURING AND PRIVATIZING THE COAL INDUSTRIES IN CENTRAL AND EASTERN EUROPE AND THE CIS

LA RESTRUCTURATION ET LA PRIVATIZATION DE L'INDUSTRIE CHARBONNIÈRE EN EUROPE CENTRALE ET ORIENTALE ET DANS LA CEI

PREFACE

THE ISSUES

Reforming the coal industries in the economies in transition in Europe proved the most difficult task of the entire economic reforms, not least because of the heavy legacy of the past and the social and regional implications of market-oriented reforms. Yet, it had to be done to secure a balanced, environmentally sound and economically viable energy future for the region.

Since 1989 or so, when coal industry reforms began in central and eastern Europe (CEE) and the Commonwealth of Independent States (CIS), progress has been made. But what progress? Where and under what circumstances? Why did some approaches work and others fail? What road had been covered by 1999? How did energy reform affect coal compared to gas, oil and electricity? How did the coal industry evolve in terms of productivity, profitability, environmental acceptance and appeal to investors? What is now its relevance as an exporter, importer, industrial partner for power generators or steel makers? What is its record in terms of partnerships with foreign coal or power companies or investors? What are the prospects for the competitive hard core of the CEE/CIS coal industries to emerge more forcefully and for coal to become (again) a competitive regional player in a growing European energy market?

What are the prospects for the competitive hard core of the CEE/CIS coal industries to emerge more forcefully, and for coal to become (again) a competitive regional player in a growing European and world energy market?

THE APPROACH

These were the questions that the two Working Groups B "Central Europe" and A "CIS" and of the WEC East-West European Energy Programme decided to explore in a joint study. At meetings in Vienna and Cracow in April and September 1999 respectively, a common outline and working procedure were agreed upon, followed in January 2000, in Katowice, by a meeting of experts to review regional and national inputs. Guidance was provided by WEC's Programme and Studies Committees. By April 2000, the present study was completed. Responsibility for the various country reports lie with the respective authors.

THE SCOPE

The issues of restructuring and privatizing the coal industries are not exclusively or even primarily economic, but strongly intertwined with policies, be they macro-economic, budgetary, social, regional, environmental, security-of-supply or other. These volatile policies are subject to great short-term and long-term uncertainties, be they national, regional or global: speculations about the implications of rising gas prices in Europe or of a phase-out of nuclear power in Western Europe on CEE/CIS coal production are cases in point.

THE SUBJECT

The term "restructuring" is meant in its broadest sense of policies and measures that aim to render the coal industries competitive and profitable and to raise their efficiency and environmental record to good international levels. The study is, thus, not confined to ownership change and deregulation but includes productivity and profitability under enhanced environmental constraint.

The term "privatization" covers both, "mass" or voucher privatization and equity privatisation, despite the very different implications of these two approaches.

"Coal" covers hard coal (including sub-bituminous coal), brown coal and lignite. For their respective physical/chemical properties in the countries of the region, consult WEC's Survey of Energy Resources, 1998. Estonian shale has been included for the sake of covering solid fuel mining in the region as fully as possible.

THE STRUCTURE

The study attempts to capture the complexities of coal industry reforms for the region as a whole in Part I. The macro-economic and general energy policy context for coal reforms is described in chapters 1 and 2. Coal industry restructuring policies are analysed in chapter 3. Chapters 4 to 6 contrast policies with industry realities and responses, while chapter 7 highlights the international implications of national action. Chapter 8 ventures a medium- and long-term outlook and, chapter 9 draws business-relevant conclusions. Part II provides in-depth country profiles.

THE MESSAGES

The **first** message of the Study – its result – appears encouraging: much, and in some cases, most of the road to a self-sustaining, albeit streamlined, coal industry has been covered and the conceptual, legislative and institutional framework for further progress has been laid.

In a growing number of countries, the viable hard core of the industry, in local and national terms, was clearly emerging as the 20th century drew to its end.

Those other countries that have not gone as far as they may have wished might find encouragement in noting the benefits of striving for market-oriented competition in terms of diversified energy supplies, environmental protection, regional revival and ... profitability.

The **second** message is that of an extremely effective cooperation between WEC Member Committees. This testifies to WEC's capability to mobilise a body of professional expertise able to address, in a short time, a rather complex and sensitive issue. It is therefore with pleasure that I, as Project Director, thank Mr. N. Bernot, Chairman of Working Group B "Central Europe" and Mr. E. Udod, Acting Chairman of Working Group A "CIS", for their support and guidance, and the numerous national experts for their comments and country profiles.

Geneva, April 2000

EXECUTIVE SUMMARY

"The worst is over." Already at present, about 95% of brown coal/lignite and 75% of hard coal production in Central and Eastern Europe (CEE) and the Commonwealth of Independent States (CIS) is "viable" locally or at the national level, while not being profitable in international terms.

The restructuring approach of "unbundling profitable from unprofitable mines + "customerization"1 + equity privatization" proved superior to "bundling all mines + State ownership + mass or voucher privatization".

The coal industry's decline in the region during 1990-1998 was significant:

- production: - 40%
- manpower: - 50%
- mines: - 30%

However coal remained essential. In 1998, it covered 25% of primary energy demand in the region and produced 35% of electricity generation. It's 1.2M employees produced 760 Mt of solid fuel.

At present, progress in coal reforms has been significant.

- Direct State subsidies for investments and operations have been practically discontinued.
- Private investors began to commit themselves: already 20% of mining capacity is investor-owned.
- Productivity could potentially improve by more than 30%.
- Many business opportunities are being exploited:
  - equity commitments in mines + power stations/steel works
  - independent power generation on the basis of domestic and imported coal
  - methane drainage
  - ecological certification and clean-up
  - mining engineering, clean coal technologies, mine management

By about 2005, restructuring will have been completed, with privatization gaining momentum. Coal production under market conditions will be 50% of what is was under central planning. The share of coal production supplied to power stations will increase to 66% from 59% in 1998. The share of coal-based electricity generation will decrease in CEE, but increase in CIS in a reappraisal of coal versus gas as a power-generating fuel.

Projections for 2010 (compared with 1997) suggest that production in CIS will increase by between 23 and 45%, whereas it will decline by 20% in CEE. Overall in the region, production will increase by 10% over 1997 levels by 2010, and 15% by 2020.

1 "Customerization" can be defined as selling an asset to its main customer. In the case of an unprofitable mine, to the power plant or steel works it supplies, it may yet be an economical purchase.

CEE coal imports will double, exports decline. The region as a whole will see its net exports decline by more than half by 2010.

Several issues require continued attention at the policy and business levels.

- The conclusion of restructuring depends on government finance for redundancy and regional conversion programmes.
- Vast investment are needed: for mining $12-14 billion, for power generation $35-40 billion, for ecological clean-up $38 billion.
- Equity privatization requires dispensation from past (huge) ecological and financial liabilities.
- In CIS, the current payment crisis, which favors barter transactions and hence vertical and horizontal integration, is delaying investor-driven privatization and must be resolved.
- Flue gas desulphurization will only apply to 20% of coal-fired power generation capacity by 2003, and needs to be pursued/financed.
- Pollution by small coal boilers below 50 MW must still be addressed.
- For CEE countries to join the European Union, its "acquis communautaire"[2] must be adopted to avoid trade distortions; this applies primarily to (indirect and cross) subsidies.

WEC Message

The image of CEE/CIS coal has been determined by a decade of difficulties. As the industry approaches "the end of the tunnel", it is time to highlight coal's growing viability and its continued significant role in the Central and East European energy and electricity picture. The industry's productivity potential is significant, as are business opportunities. Tapping those will enhance coal's viability beyond what has been achieved to date. Reforms need to progress, though, and address the issues identified: financing redundancies and investments, proceeding with equity privatization, coping with past ecological liabilities, reducing pollution from large and - increasingly - small and medium-sized coal boilers, and preparing for European integration. As reforms progress, more businesses will feel that the time has come to take a fresh look at investment opportunities in the region.

2 The "acquis communautaire" represents the body of common rights and obligations which bind all Member States together within the EU, relating mainly to the single market and common policies that underpin it.

RÉSUMÉ

"Le pire est derrière nous": dès à présent, en Europe centrale et orientale (ECO) et dans la Communauté des États Indépendants (CEI), à peu près 95% de la production de lignite et 75% de la production de houille sont "viables", soit au niveau local ou national, tout en n'étant pas "rentables" sur le plan international.

L'approche consistant à "dissocier les mines viables de celles qui ne le sont pas, associer ces mines avec leurs clients (centrales électriques, sidérurgie) et à privatizer l'ensemble" s'est avérée supérieure au "regroupement de toutes les mines, maintien du contrôle de l'État, et privatization de masse".

Entre 1990 et 1998, le déclin de l'industrie charbonnière a été significatif:

- production: -40%
- main d'oeuvre: -50%
- nombre de mines: -30%

Cependant, le charbon reste une source d'énergie essentielle: en 1998, il a satisfait 25% de la demande d'énergie primaire de la région et produit 35% de l'électricité. Ses 1.2M employés ont produits 760 Mt de charbon.

À present, le progrès dans la mise en oeuvre des réformes à été significatif:

- Les aides directes des États aux investissements et à l'exploitation se sont pratiquement arrêtées.
- Les investisseurs privés ont commencé à s'impliquer: déjà 20% des capacités de production sont la propriété des investisseurs.
- Le potentiel de productivité - condition préalable pour de nouveaux progrès - est important: + 30%.
- Beaucoup d'opportunités commerciales sont déjà exploitées:
  - associations/fusions entre mines et centrales électriques
  - production indépendante d'électricité sur la base de charbon domestique et importé
  - drainage du méthane
  - certification et assainissement écologiques
  - production d'équipements miniers et de techniques de combustion propre du charbon, gestion minière.

À l'horizon 2005, la restructuration aura fini, accompagnée d'une montée en puissance de la privatisation. La production de charbon réalisée aux conditions du marché s'élèvera alors à 50% de celle réalisée à l'ère de la planification centralisée. La part de la production de charbon fournie aux centrales électriques s' élèvera de 59% en 1998 jusqu'à 66%. La part de l'électricité produite à partir du charbon décroîtra en ECO, mais augmentera dans la CEI (due à une réévaluation du rôle du charbon par rapport au gaz dans la production d'électricité).

Les perspectives pour 2010 suggérent (en comparaison avec 1997) que la production augmentera par 23-45% en CEI, mais sera réduite en ECO par 20%. La région entière verra une augmentation de 10% entre 1997 et 2010 et de 15% par 2020.

ECO doublera ses importations, mais la région baissera ses importations nettes à partir de 2010. Plusieurs problèmes politiques et commerciaux demandent une attention continue.

- L'achèvement de la restructuration dépend de moyens financiers des gouvernements en faveur des programmes de réduction de main d'oeuvre et de reconversion régionale.
- Les investissements requis sont estimés à $12-14 billion pour l'exploitation minière, à $35-40 billion pour la génération d'électricité et à $38 billion pour l'assainissement écologique.
- La privatization doit s'accompagner de l'exemption des charges financières et écologiques du passé, qui sont considérables.
- Dans la CEI, la crise de paiements et des trocs favorise l'intégration verticale et horizontale plutôt qu'une privatization à l'initiative des investisseurs.
- La désulfuration des gaz de combustion sera mise en oeuvre sur (seulement) 20% de la capacité des centrales électriques au charbon d'ici à 2003, et doit être poursuite.
- La pollution provoquée par les petites chaudières de moins de 50 MW doit être abordée.
- Pour s'adhérer à l'Union Européenne, les pays ECO doivent adopter son acquis communautaire, principalement en matière de subventions (indirects et croisés), afin de ne pas fausser les échanges.

Le message du CME

L'image du charbon de l'ECO/CEI a été déterminée par une décennie de difficultés. Comme l'industrie s'approche de la fin du tunnel, il est temps de mettre en valeur la viabilité du charbon et son rôle dans le panorama énergétique et électrique de l'Europe centrale et orientale. Le potentiel de productivité de l'industrie est important, comme le sont les perspectives commerciales. En faisant appel à ces potentiels, la viabilité du charbon ira au delà de ce qui a été réalisé à ce jour. Toutefois, les réformes doivent progresser et aborder les problèmes identifiés: financement de programmes sociaux et d'investissements, privatization, assainissement de l'héritage environmental, réduction de la pollution provenant des grandes–et de plus en plus–petites et moyennes chaudières, et l'intégration européenne. Dans la mesure où les réformes progressent, davantage d'investisseurs jugeront qu'il faudrait réévaluer les opportunités commerciales dans la région.

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PART II:
COAL INDUSTRY RESTRUCTURING IN VARIOUS COUNTRIES

ABBREVIATIONS

bcm	billion cubic meters
CEE	Central and Eastern Europe
CHP	combined heat and power
CIAB	International Energy Agency Coal Industry Advisory Board
CIS	Commonwealth of Independent States
CMEA	Council for Mutual Economic Assistance
CCT	clean coal technologies
CO_2	carbon dioxide
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
EU	European Union
FGD	flue gas desulphurization
ex-GDR	former German Democratic Republic, now part of Germany
GDP	gross domestic product
IBRD	International Bank for Reconstruction and Development - World Bank
IEA	International Energy Agency
IGCC	integrated coal gasification combined cycle
NO_x	nitrogen oxide
SO_2	sulphur dioxide
tce	ton of coal equivalent
toe	ton of oil equivalent
UNECE	United Nations Economic Commission for Europe
$	United States dollar
WEC	World Energy Council

PART I
COAL INDUSTRY RESTRUCTURING - THE REGIONAL PERSPECTIVE [3]

1 THE CONTEXT: MACRO-ECONOMIC AND ENERGY REFORMS

What have been the macro-economic framework conditions for energy reforms? What role was assigned to energy restructuring during this process? Have objectives been achieved? At what price?

The energy economy served as a buffer, not as a locomotive for macro-economic reform.

1.1 UNEXPLORED TERRAIN

When around 1989 all nations of CEE/CIS opted for political and economic reform, the ultimate goal of a pluralistic, democratic society and of an open-market economy was clearly perceived. Not so the road, the number of milestones and the toll to be paid in terms of individual hardship, social and ethnic fragmentation, disintegration of the Soviet Union and the Council for Mutual Economic Assistance trading system, and economic restructuring. Nor was it evident that there was not one road, but many. This had to be learned the hard way.

1.2 THE RECESSION

As a result of the change of social and economic systems, by the mid 1990s, GDP had on balance fallen by one third (see Table 1). While GDP began to rise again in CEE as of 1994, in CIS economic activity continued to fall until 1996.

1.3 NO PRIORITY FOR ENERGY REFORMS

Economic reform policies accorded priority to macro-economic, monetary, fiscal and budgetary reform, but not to the restructuring of the energy sector. Rather, energy reforms were made secondary to advance other (anti-inflationary, employment, social, budgetary) reforms. Last in

[3] K. Brendow, Regional Coordinator, WEC East-West European Energy Programme, Geneva

line, the energy economy served as a buffer, not as a locomotive for macro-economic reform. No wonder that its record of restructuring so far is less impressive than that of most other sectors of the economy and that the legal framework for a market-oriented energy economy has still not been completed or come into effect throughout CEE/CIS in 1999.

Table 1: The Great Recession: GDP growth 1989-1997 (1989 = 100)

Region	1991	1993	1995	1997
CEE, excl. Baltic States Baltic States CIS	82.5 89.7 91.2	77.9 58.4 70.9	86.1 56.8 57.5	92.1 63.6 56.1
TOTAL	88.6	72.6	65.8	66.8
ex-GDR	*68.3*	*80.4*	*92*	*96.6*
Source: UNECE Common Data Base				

1.4 CONFLICTING GOALS

Governments have further constrained the speed of energy reform by pursuing a host of (often contradictory) goals.

True, CEE/CIS governments applauded the merits of energy market liberalization. Market forces were expected to enhance energy efficiency, reduce wastage and pollution, improve the profitability and competitiveness of energy enterprises, enhance energy services to customers and reduce the need for subsidies. However, except in Hungary where the government clearly aimed at maximising revenues for energy sector privatization, energy reforms were to meet several goals at a time:

- to integrate the national energy economies into the European and world mainstream
- to protect large segments of the population from the consequences of energy reform
- to enhance the international competitiveness of the manufacturing industry by maintaining low energy costs
- to preserve integrated energy complexes, infrastructure and systems
- to maintain a steady flow of hard currency from energy exports
- to reduce import dependence
- to cater to sensitivities associated with foreign access to resources or ownership of land or with "strategic" industries
- to enhance protection against energy-related pollution and health hazards
- to temper the need for regional/industrial conversion.

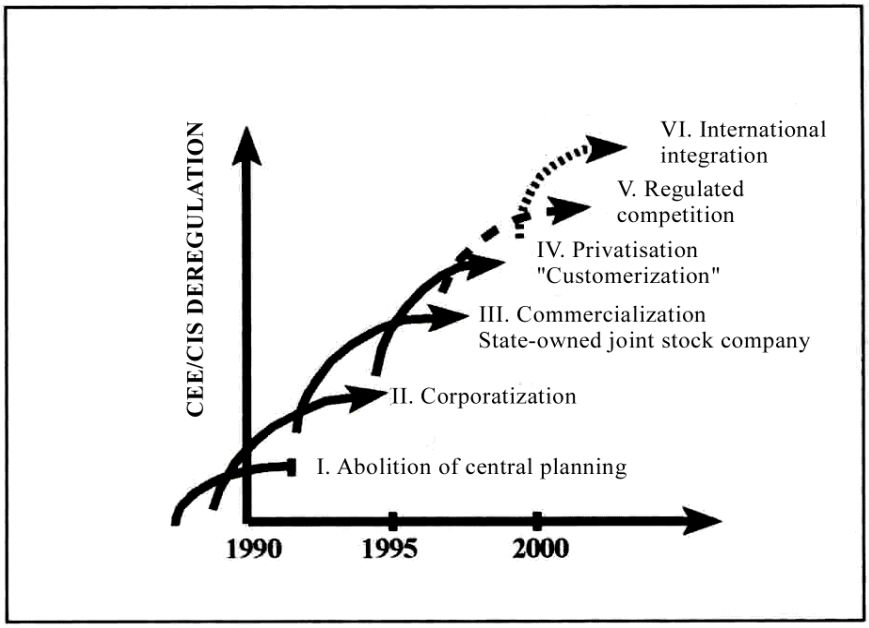
As a result, energy reforms lacked focus and had to pass through several stages or reformulation, further prolonging transition.

1.5 GRADUALISM

Such complexity calls for "gradualism" and "pragmatism" in restructuring policies rather than for shock therapy. Governments held that under the complex conditions of economic transition, the CEE/CIS energy economy could not lend itself to speedy deregulation. Moreover, the salutary power of market forces was believed to be limited as long as energy markets were imperfect, as they are in CEE/CIS (a vicious circle).

Rightly or wrongly, these arguments prevailed, thereby rationalizing the delay of energy reforms compared to general reforms. Evidently, this argumentation tended to prolong the top heaviness of the CEE/CIS energy sector, inherited supply systems, established management and workforce attitudes; and to protect vested interests.

Graph 1: Restructuring - phases and calendars



1.6 DYNAMICS

Nevertheless, progress in reform has been made since 1989 generally and with regard to energy, and even considerable progress in a growing number of CEE countries. Progress was less real in south-eastern Europe and the CIS. Countries changed constitutions and institutions, separated policy from operational functions, eliminated some foreign trade monopolies, adapted prices, reduced subsidies, encouraged foreign investors, and began to create markets.

Energy sector liberalization progressed step by step (see Graph 1 above):

- **I abolition of central planning**: change of constitutions and state governance;
- **II "corporatization"** of energy enterprises in the early 1990s, with full State ownership, controlled prices and regulated markets;
- **III commercialization** of these entities in the mid 1990s, i.e. their transformation into joint stock companies;
- **IV privatization** through "customerization" (less attractive assets such as coal mines

were bundled together with more attractive ones such as power stations, thereby combining a mine with its main or only customer) and through "mass privatization" (vouchers and auctions; foreign investors taking part in the ensuing stock trading). Domestic prices and tariffs were adapted but remained low compared to costs and international practices. Prices continued to be distorted by subsidies and cross-subsidies. Clearly, this affected the profitability of energy corporations, especially those in CIS suffering in addition from the non-payment of billions;

- **V regulated competition** developed early for exports/imports and trade of oil products and coal, whereas primary production and generation/transmission remained either monopolistic (nuclear energy) or oligopolistic (gas, oil, coal mining). Deregulation of the electricity markets in the late 1990s resulted in the establishment of regulators to oversee competition among generators. Equity privatization began to occur involving foreign investors;
- **VI international integration** in the sense of indiscriminating treatment of foreign enterprises and capital is the final objective the Energy Charter Treaty. Countries wishing to accede to the European Union actively aim to conform with the EU directives for the internal gas and electricity markets and its "acquis communautaire" (or body of common rights and obligations) in the field of energy.

Energy reforms and integration did not become a subject of intra-CEE or intra-CIS co-ordination or co-operation.

While in hindsight these developments appear evolutionary and follow a logic, realities looked more erratic and hesitant, particularly as regards the restructuring of the coal industries.

1.7 COUNTRY SPECIFICS

Progress was very country-specific. By spring 1999, most Central European countries had set the stage for energy and electricity markets to develop, while for various reasons the south-east European and all CIS countries but Kazakhstan appear more hesitant, some even reluctant.

Country specifics are outlined in Part II of this report and in each of the following chapters.

2 THE PRIORITIES: COAL REFORMS IN COMPARISON

How were coal reforms handled in comparison with reforms of the oil, gas and electricity industries? Did these reforms imply a bias in favour or to the detriment of coal versus its competitors?

Coal industry restructuring not only lagged behind reforms of the oil, gas and electricity industries, it was also very much affected by contradictory and volatile policies.

2.1 OIL: FIRST TO BE LIBERALIZED

Oil and oil products were first to be liberalized. CEE – an oil-poor region and heavily dependent on Russia – opted in favour of quick market liberalization, international integration and investor-friendly exploration concessions, whereas in the CIS, oligopolistic markets prevailed. Markets became determined by demand, deregulated prices, changes of ownership, abolition of import/export restrictions, integration into international markets and West European pipeline networks. Where crude or product pipelines are not owned by a private company, a monopoly or single buyer takes charge of the national grid and a regulator determines transmission fees and access to capacity. Remaining restructuring problems include: overcapacities in refining, third-party access to pipelines and lack of legislation on oil emergency stocks.

2.2 GAS: PRUDENTLY ADAPTING TO INTERNATIONAL PRACTICES

The CEE/CIS gas industries have been restructured into State-owned joint stock companies enjoying strong (monopolistic, single buyer) status on the grounds that only large players could operate successfully in the oligopolistic European gas market. Exports and imports remain the prerogative of the national company. Prices are controlled. Thus, domestic intra-gas competition has not generally developed, which is not to deny competition between suppliers for resources, transportation capacities and international customers. However, competition is on the horizon: large customers can increasingly negotiate gas prices. Foreign suppliers are establishing gas trading houses and concluding long-term supply contracts and back-up agreements. Investors are building underground storage facilities, interconnecting pipelines and gas-fired power stations on an independent power producer basis. Strategic investors are acquiring shares in gas distribution companies, committing fresh investments; their objective is either to protect or gain market share. Region-wide systems such as the Baltic Gas Ring are studied.

On the whole, the reform process needs new impetus. Except in the Baltic States where privatization is progressing, ownership change, unbundling and third-party access to grids are not aggressively pursued. Reforms must advance before the EU Directive on the Internal Market for Gas can be adopted (in CEE) and the Energy Charter Treaty is ratified by Russia.

2.3 ELECTRICITY: ON THE VERGE OF FUNDAMENTAL CHANGE

Rather slow so far in adopting market-oriented structures and strategies, the electric power industries are on the verge of fundamental change, domestically and internationally. Only a few countries continue to entrust their electricity sector to a State agency or company with limited autonomy as regards tariffs and investments. Most have gone a step further in establishing joint stock companies (fully State-owned or with the State a as majority shareholder in the case of "mass privatization") with a commercial mandate but without disposing of the necessary managerial freedom and means. These companies remained controlled by governments, not by investors, shareholders or financial markets. A few CEE countries have gone a step further towards "real" investor-oriented privatization and created competitive markets at the generation level. Most countries though are hesitating to take this step, as various concepts such as single buyers and direct third-party access compete with the traditional vertical integration. International electricity markets are unregulated and growing.

2.4 COAL: STRUGGLING WITH CONFLICTING POLICIES

Compared with the oil, gas or electricity industries, coal industry restructuring lagged behind. After a vigorous reduction of production capacities and manpower by one third in the early 1990s governments had to opt for a (temporary) "stop" in the mid 1990s, confronted as they were by the extraordinary size of the task of restructuring and by its budgetary, macro-economic, regional and social ramifications.

The next go was conceptualized in the mid 1990s and has mostly been initiated by now, although not everywhere. Rather than letting international coal, oil and gas markets determine the future of domestic coal, CEE/CIS governments assigned to the industry a continued role in tempering energy import dependence, softening regional conversion and stabilizing labour markets.

The issue is that these other policy goals, which require considerable finance and focus, prejudice the emergence of the competitive hard core of the coal industry.

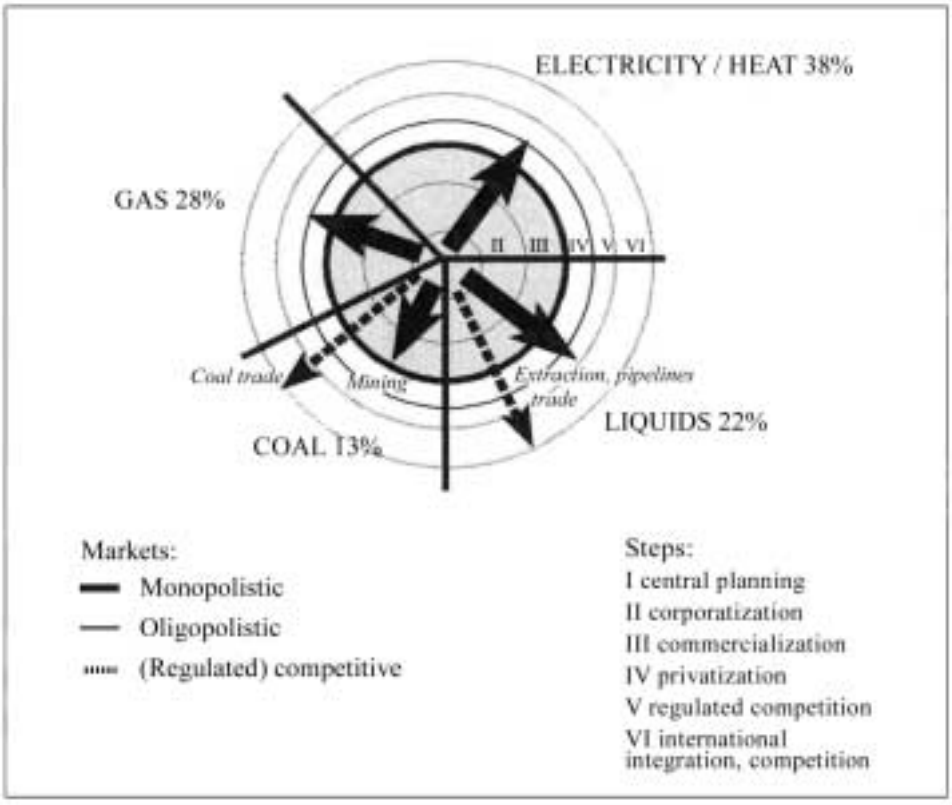
2.5 APPRAISAL

Energy reforms were not uniform, but fuel-specific, different for coal, oil, gas, nuclear, thermal and hydroelectricity. Market structures remained monopolistic for nuclear power and became oligopolistic for gas, oil and coal mining. Competitive markets developed in oil and coal trade and retail generally and, in the more advanced reforming countries of CEE, in electricity generation. Competition was dependent on the abolition of trade monopolies, price regulation and ownership change, particularly (equity) privatization. The resulting bias of competition between the various sources was not seen or was neglected in the light of the dramatic circumstances of the reform process.

In addition, the reforms of the various energy sectors did not progress simultaneously: just as energy reforms lagged behind macro-economic reforms, coal industry reforms lagged behind reforms in the oil, gas and electricity sectors, as shown below.

Graph 2: Coal as part of energy reforms, CEE/CIS 1999

Related to fuel shares in final consumption, 1995



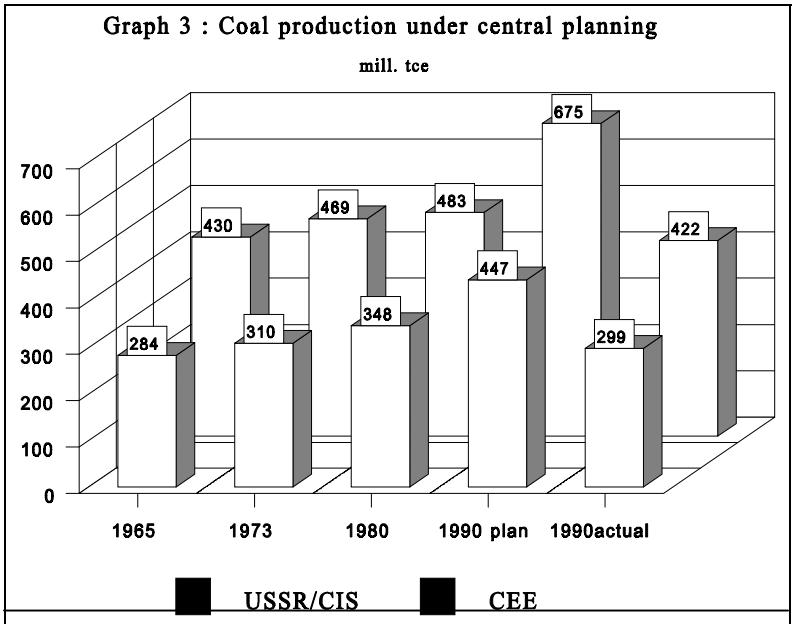
3 THE CONCEPT:
COAL INDUSTRY RESTRUCTURING UNDER MULTIPLE CONSTRAINTS

What were the goals of coal industry reform? Were the means and time frames adequate to meet the goals? What were the conditions and obstacles? What solutions were applied or rejected by the various countries? What was the attitude of the industry towards reform?

The objective of a restructured and profitable coal industry had to be attained under social and financial constraints and despite resistance. This implied a step-by-step approach on an ever-extending time scale.

3.1 GOALS: FROM QUANTITATIVE GROWTH TO VIABILITY

Quantitative growth had been the law under which the coal industries developed under centrally planned regimes. These ambitions culminated in plans to raise coal production in the USSR from 483 Mtce in 1980 to 675 Mtce in 1990 (+ 40%) and in CEE (mostly in Poland) from 348 Mtce to 447 Mtce (+ 28%).[4]



[4] United Nations Economic Commission for Europe (UNECE), "The energy economy of Europe and North America - Prospects for 1990", in Economic Bulletin for Europe, Vol. 33/2, Geneva, June 1981, p. 221; actual data for 1990: Commission of the European Union, European Energy to 2020, Spring 1996, table 1.3; CEE data for 1990 includes the ex-GDR.

However, developments **in the 1980s** were quite different (see Graph 3) and demonstrated the need for reforms: quantitative targets even more modest than those planned could no longer be financed and actually squandered precious resources of manpower, capital and environment. For the sake of fairness, it should also be mentioned that 1980 estimates of West European coal production for 1990 exceeded real output in 1990 by 16%.

During this re-assessment of the role of coal, the coal industries found themselves accused of being over-grown, structurally uneconomic, highly polluting, internationally uncompetitive and unsafe. The unavoidable clash between the new policies and traditional perceptions and realities created the impression that the coal industries were incapable or even unwilling to put their houses in order.

Nevertheless, in a first round, 119 mines were closed **by 1995** (see Box 1 and Table 4) – with significant social and regional implications. Growing social unrest in the mining regions made continued restructuring at that speed politically unacceptable. Moreover, the simple closure of mines, while it was efficient, proved to be questionable from various points of view:

- the absence of functioning markets and true prices and costs rendered it difficult to draw a line between "viable" mines (economic within their own local context) and uncompetitive mines
- medium- and long-term projections indicated a future for coal which contrasted with the signals of the (temporary) depression
- if implemented radically and fast, mine closure policies conflicted with other economic stabilization, social and security-of-supply policies.

Box 1 :

First-round mine closures to 1995

Albania	8
Bulgaria	4
Czech Republic	15
Estonia (oil shale)	1
Kazakhstan	8
Macedonia	-
Poland	16
Romania	18
Slovenia	3
Slovakia	-
Russia	37
Ukraine	9
TOTAL	119

Sources: UN/ECE, document ENERGY/ WP.1/R. 40 of 7. 8. 1995; Yuri N. Malyshev, "Restructuring of the coal mining industry of Russia", WEC 17th Congress. Sept- 1998, paper 1.4.14, p. 398; UNECE, "Restructuring the coal industry and thermal power sector in the CIS", document ENERGY/1998/15 of 30 July 1998; ditto for south-eastern Europe, doc. ENERGY/1998/ 16 of 7 July, 1998

It became evident in the **mid 1990s** that the size of the problems and their concentration in mining regions with few economic alternatives were such that restructuring policies had to be long-term and compromising in order to become acceptable and feasible. Achieving the goal of reducing coal production to its competitive core was certainly held up by budgetary constraints, long-term considerations and a host of other policies:

- macro-economic and monetary stabilization
- social protection of redundant miners
- mine area conversion
- security of energy supplies, also in a longer-term perspective
- implementation of international environmental commitments
- availability of finance.

Arbitration between these concerns and adaptation to constantly changing circumstances began to characterize coal policies – devouring plans, men and institutions.

3.2 MEANS: SMOOTHING THE UNAVOIDABLE

3.2.1 Reducing direct State subsidies

At the beginning of the reform process, there were no markets, market-driven prices or costs that could identify uneconomic mines. Under socialist regimes, coal prices were low, State-controlled and uniform over the country, whatever the distance of transportation. Mines were either subsidized or "taxed". During transition, governments continued to control coal and electricity prices thereby impeding coalmines from covering costs. Under these special circumstances, the fact that direct State subsidies were (and are) paid is not a sufficient indicator for a lack of competitiveness, until "real", internationally open and undiscriminating energy markets are put into effect.

Table 2: Direct State subsidies for the coal industries (1993 = 100)

	1993	1995	1997	1998
Bulgaria	100	62	5	18
Croatia	0	0	0	0
Czech Republic	100	118	99	105
Estonia	0	0	0	0
ex-GDR	0	0	0	0
Hungary	100	107	100	217
FY of Macedonia	100	0	0	0
Kazakhstan	100	0	0	0
Poland	0	0	0	0
Romania	100	112	25	22
Slovakia	100	41	37	43
Slovenia	100	92	0	0
Russia	100	88	71	66
Ukraine	100	0	53	46

Source: country profiles in Part II; UN/ECE: Restructuring the coal industry and thermal power sector in the CIS; document ENERGY/1998/15, Geneva, 30. July 1998; ditto: ... in south-eastern Europe; document ENERGY/1998/16, Geneva, 7 July 1998; ditto ... in central European economies in transition, document ENERGY/1998/20; for the Czech Republic: UNECE, Results of the restructuring of the Czech coal industry, document ENERGY/GE.1/7 of 16 July 1998, p. 9

Nevertheless, the degree of subsidization served to measure the relative competitiveness of mines. Pressed as they were by budgetary and International Monetary Fund constraints, governments used these relationships as a first proxy for identifying particularly uneconomic mines. Direct State subsidies were constantly and significantly reduced and even totally phased-out in Kazakhstan, Republic of Macedonia, Poland (abolished in 1993[5]), Hungary, Slovenia and in the ex-GDR, and significantly reduced in Romania.

[5] WEC, The benefits and deficiencies of energy sector liberalization, London 1998, vol. II, p. 180 ff

3.2.2 Maintaining indirect aids

This does not mean that subsidies actually disappeared, as shown in Table 2. Some subsidies (for social security, health, railway tariffs) were integrated into other chapters of the State budget or of its agencies. Cross subsidies had to be paid by the new owners of mines who had bought their suppliers by "customerization", or by power stations compelled to buy coal at government-fixed prices and quantities:

- In Croatia, the Plomin I coalmine was owned by the national electricity board - HEP - that covered its losses until the mine was closed in 1999.
- In the Czech Republic, direct subsidies will continue to be necessary and have been estimated to be $450 M in 1999-2002 compared with $563 M in 1993-1998 when 46% was used for social security, health and safety, 28% for mine closures and 26% for repair of damage resulting from mining. Hard coal mines in particular will not be able to cope without further joint financing from the State budget.[6]
- In the ex-GDR, electricity from brown coal was supposed to enjoy a certain protection until 2003 in that the deregulation of the German electricity market did not apply to them. However, because of the advanced stage of liberalization in Germany, the resulting gap in electricity prices between former east and west became too big to be sustainable
- In Hungary, power plants subsidise not only their own mines but also supplies from third party mines
- In Poland, in the absence of cost-covering prices and direct subsidies, the coal industry did not pay taxes and social security contributions;[7] losses accumulated to 16.1 billion zl ($4 billion) on 31 December, 1999 for the State's restructuring programme (see Part II.)
- In Romania, direct state subsidies declined from $338M in 1990 to $33M in 1999.
- In Russia, federal subsidies for operations and investments have been significantly reduced and are planned to be phased out;[8] between 1995 and 1999, the share of subsidies for the coal industry in the fell from 8% of Gross National Product to 1% (see country profile in Part II).
- In Slovakia, in addition to direct State subsidies for sized household coal (3$/t in 1999), lignite mines are subsidized by the electricity industry to the extent of $14M. (1996).[9]
- In Slovenia, direct subsidies for the coal industry were terminated with the closure of three mines, but the electricity industry was compelled to subsidize purchases from the remaining mines [10].
- In Ukraine, apart from receiving direct subsidies (1996: $470M as well as $70M in loans), the coalmines were exempt from paying VAT until 1999.[11]

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[6] UNECE, Results of the restructuring of the Czech coal industry, document ENERGY/GE.1/7 of 16 July 1998, p. 9, and document ENERGY/1998/20, of 1 October 1998, p. 6

[7] WEC, Emerging energy legislation in central Europe, London 1998, p. 84

[8] G. G. Olkhovsky, Coal in Russian power industry, WEC 17th Congress, Sept. 1998, paper 1.2.22

[9] WEC, Emerging energy legislation, op. cit., p. 106

[10] country profile in Part II; IEA, Energy policies of Slovenia, 1996 Survey, Paris 1996, p. 60

[11] WEC, The benefits ..., op. cit., p. 185

Remaining direct State subsidies corresponded to 37.80$/t in Ukraine (1997), 4.19 $/t in Russia (1997), 0.9 $/t (or 4.8$/t including indirect subsidies) in Slovakia (1996) and 1.24$/t (1997) in the Czech Republic. In Poland, there were no direct State subsidies, but the costs of restructuring and social plans for 1999-2001 amount to roughly 8 - 9$/t; the cumulative debt of the industry in 1998 amounted to 13.6 billion PLZ ($ 3.6 billion) or 4$/t.

To join the EU, transition countries would have to align their subsidy policy with EU directive 3632/93/ECSC of 28 December 1993 and practices.

3.2.3 Restructuring before privatization?

The weakness of a policy of mine closures based primarily on budgetary or geological grounds, prompted the question what other, complementary or alternative, gauges could be used to identify mines that were economic or offered good prospects of becoming economic. The proponents of liberal policies tended to let the markets determine the selection process: privatization would enforce a certainly painful but rapid and lasting revival of the industry. This policy was nowhere applied except temporarily in Poland, where in 1990, 70 independent coal enterprises were formed and given the right to market their output independently; however, this radical approach failed due to overcapacity, falling prices [3] and, surely, resistance from industry and trade unions.

All countries opted for the formula "restructuring first, privatization next."

In fact, all countries opted for the formula "restructuring first, privatization next", contending that an investor-driven restructuring would be socially unacceptable; that the "bad" mines would remain unsold due to "cherry picking"; and that the profit-orientation of private investors might jeopardize longer-term security-of-supply concerns. However plausible this approach was, it implied extraordinary burdens for the State budget (for details, see 4.3.2).

3.2.4 Securing a legal and institutional framework

Against the background of high costs and social concerns, systematic coal restructuring policies were designed. The related debate dominated the mid 1990s and still continues. While granting the coal industry a breathing period, governments remained determined to maintain pressure on the industry to enhance profitability, productivity, product quality and pollution control. The means employed were

- the abolition of coal import/export monopolies very early in the process
- the liberalization of coal prices, at least for industrial customers and exports/imports
- coal-to-coal competition among coal mining associations/groups (i.e. not between individual mines)
- and competitive pressure from foreign and domestic sources of energy.

Coalmines were, thus, subjected to the double pressure of competition and reduced State subsidies. This double-pronged strategy involved a bias against coal: first in the competition between coal and gas. Secondly – and perhaps more importantly – having the profitable mines lumped together with the uneconomic ones was a great handicap.

This prevented the former from strengthening their competitive position in the market and encouraged the latter to continue a battle that was likely to be lost.

These policies needed to be enshrined in laws and ordinances, and their implementation entrusted to competent institutions.

The ministries of coal in charge of implementing government policies under central planning were dissolved early in the reform process (but re-established in the Ukraine in 1994). Responsibilities were transferred first to newly created ministries of energy and recently to ministries of economy (for energy policy matters) and, in some countries, ministries of finance (as regards state property and privatization).
Legislation on coal was not among the priorities, but has been passed by now, sometimes by way of decrees. The issue now is to find the required financing and to implement these instruments, but also to amend them in the light of constantly changing legal and political circumstances and international practices.[12]

The main feature of these legislative and institutional processes was a step-by-step approach to coal industry restructuring and, hence, a constant pressure for change. The main steps in the process to privatization were "corporatization", commercialization, unbundling and "customerization".

Box 2: CEE/CIS energy legislation

Albania: petroleum 1993, concessions 1995, electricity 1995, coal 1995, gas: under preparation
Armenia: subsoil exploration 1992, energy strategy 1995, draft energy law 1996
Bulgaria: energy: under pr., efficiency: under preparation; concession law 1995
Croatia: oil 1990, electricity 1990, mining 1991/1995, heat/hot water (Communal Law) 1995, energy, electricity, gas, oil: under preparation; no law on coal
Czech Republic: energy 1994, nuclear 1997, energy: under preparation; third mine closure programme under preparation.
Estonia: long-term energy strategy, energy law 1998
Georgia: state programme for the development of the coal industry 1996
Hungary: concessions 1992, mining 1993, electricity 1994, gas 1994, privatization 1995, energy law envisaged
Kazakhstan: decree on concessions 1996
Kyrgistan: energy programme 1992, presidential decree 1993
Macedonia: energy law 1997, concessions 1997
Poland: mining, energy 1997, restruct. prog. 1998
Romania: autonomous agencies 1990 and 1997; Conservation Agency 1990, oil 1995, mining law 1998, energy under preparation.
Russia: energy strategy for Russia 1995, Guidelines 1995, presidential decrees on coal 1993, 1995, 1996, 1997.
Slovakia: energy strategy 1993, strategic enterprises 1995, energy strategy to 2005 1997
Slovenia: energy strategy 1996, gas 1996, mining law 1999, power generation law 1999, nuclear energy under preparation.
Ukraine: national energy programme to 2010 of 1996, energy law under preparation, presidential decree of 1996 on coal industry restructuring

Source: WEC, Emerging energy legislation in central Europe, London 1998, p. 4, and national sources

3.2.5 Paving the way: corporatization, commercialization and unbundling

Governments paved the way for later privatization in transforming coal production entities first into agencies ("corporatization") and next into joint stock companies (commercialization) grouping together the mines of a particular region, sometimes under the auspices of holdings:

[12] UNECE, Energy and mineral resource management and legislation in the ECE economies in transition: present status, 1997-1998, document ENERGY/1998/5, Geneva, 8 April 1998

- In Albania, all coalmines were commercialized in 1995 according to law.
- In Armenia, plans in 1996 aimed at creating one State coal enterprise.[13]
- In Bulgaria, the coal industry is organised in 11 companies under a State holding created in 1993 that operates under the authority of the Committee on Energy.[14]
- In Croatia, the only mine in operation was integrated into HEP, the national electricity board, until its closure in 1999.
- In the Czech Republic, since 1994 the coal industry has been organised in 5 joint-stock companies (two in hard coal mining, three in brown coal mining), of which one (Kladno) is in private hands and the others were privatized through vouchers. The State, municipalities and the National Property Fund hold the majority of shares. Service companies were unbundled from the mining entities.
- In the ex-GDR, the brown coal mines were either closed or sold to investors (power companies, including foreign (MIBRAG, 1993); two uncompetitive opencast mines with a production of 5.9 Mt (1998) are owned by the State property agency (ALausitzer Mitteldeutsche Bergbau-Verwaltungsgesellschaft m.b. H.) and will be closed by 2001.
- In Estonia, oil shale is mined by one fully-State-owned joint stock company - Eesti Pilevkivi
- In Poland, the hard coal sector is grouped in seven fully State-owned joint stock companies and restructured under the auspices of the State Agency for the Restructuring of the Coal Industry.
- In Kyrgistan, the coal industry consists of the State concern Kyrghyskomur and an association of smaller producers.
- In Romania, the coal industry is organised in one autonomous agency (hard coal) and two joint-stock State-owned companies (for lignite and brown coal/lignite), earmarked for partial privatisation.
- In Slovakia, three joint-stock companies operate, two of them under private ownership, the third 34% State-owned.
- In Slovenia, the two remaining brown coal and lignite companies are fully State-owned joint-stock companies.
- In Russia, the coal industry is structured in 14 regional production companies and 11 holding companies: their shares are held by the federal government, regional governments and employees. Rosugol managed the State shares and provided services and distributed subsidies, but was dissolved in 1997.
- In the Ukraine, the coal companies have been State-owned joint stock companies since 1994.

These joint stock companies were either fully State-owned or under State majority control in the case of mass privatization (vouchers, auctions). Management was controlled by governments, not by investors, shareholders or financial markets. However, already in coal trade and supplies, governments tended to admit "real", i.e. equity privatization.

These joint stock companies ... were to behave commercially, but were not always given the necessary managerial freedom and the financial means to do so.

[13] Black Sea Regional Centre, Armenia, September 1996, p. 48

[14] Black Sea Regional Energy Centre, Bulgaria, September 1996, p. 49

Privatization occurred more generally through the unbundling and outsourcing of non-core activities such as housing, power generation, agriculture, briquetting, cementing, trading, repairs, beneficiation, design and construction, recreation, canteens and community services:

- In Poland, privatization of such activities began in 1993; the privatization of the biggest coal trader – WEGLOKOKS – was planned for 1997, but has been delayed.[15]
- In Russia, since 1990 many non-core activities have been split-off as independent entities; in addition, investment, insurance and consultancy companies have been formed.[16]
- In Slovakia, as non-core mining machine production actually allowed the company to make a profit, the biggest lignite company Hornonitrianske Bane Prievidza did not unbundle these activities.[17]
- In Slovenia, restructuring of coal mining led to important spin-offs in power generation, quarrying, cementing and machine-making.[18]

3.2.6 Advancing towards privatization: customerization, partnerships

Some privatization proceeded via "customerization". As power and iron and steel companies were up for privatization prior to coalmines, a "package", mostly combining a power company and an adjacent mine, was offered to private investors. In countries with a national power generating monopoly, third party investors were welcome in joint ventures between power plants and mines:

- In Bulgaria, privatization "packages" are prepared for two thermal power stations and the adjacent mines.
- In the Czech Republic, plans are to privatize the three brown-coal mining companies, but not the hard coal mines; privatization requires the prior definition of responsibilities for inherited environmental damage, and the recognition on the part of the investors that coal mining has important social and regional implications.
- In Croatia, HEP the Croatian electric power company agreed to a 50/50 joint venture with the German RWE to complete the 210 MW coal power plant Plomin II. HEP also plans the construction of a 2 x 350 MW coal fired-plant based on 180 000 t of imported hard coal.[19]
- In Hungary, five of the remaining eight coal companies were integrated with power companies, jeopardizing momentarily the sale of these power plants to foreign investors; the other three companies, owned by a State Agency, are operated as independent coal companies and will be gradually closed.

[15] IEA/CIAB, East and central European coal industry issues: an international perspective, Paris 1997, p. 14

[16] Lee B. Clarke/IEA Clean Coal Centre, Coal prospects in Russia, London 1996, p. 23; UNECE, Transition of the European coal industry to market economy conditions: the Russian coal industry, document ENERGY/WP.1/R.40/Add. 5, of 14 July 1995, p. 4

[17] WEC Slovakia/EE Journal of Electrical and Power Engineering, special issue 1998, p. 50

[18] IEA, Energy policies of Slovenia, op. cit., p. 59

[19] HEP Annual Report 1997, p. 25 and 43

- In Kazakhstan, the 1996 sale of 15 mines to Ispat-Karmet for $193M was combined with the sale of a power plant for $2.4M and the Karmet steel works.[20]
- In Macedonia, the two major lignite mines are part of the vertically integrated National Power Company; two other (State-owned) smaller lignite mines supply industrial and household consumers.[21]
- In Poland, attempts are made to merge brown coal mines with adjacent power stations.
- In Russia, only one mine (Luchegorsky-1) has been acquired by a utility: LuTEK; the idea of "customerizing" mines is, however, debated (see country profile in Part II).
- In Slovakia, equity privatization is not intended, given the bad financial results of mining operations. At present, the three mining companies are owned predominantly by the State or employees.
- In the Ukraine, commercialization of coal enterprises is envisaged by Presidential decree 116 of February 1996 and the subsequent restructuring programme.[22]

3.2.7 Approaching equity privatization and profitability

The last step in the process of restructuring – the sale of coalmines to private investors – has so far been undertaken systematically in Kazakhstan, Hungary, Russia and the ex-GDR, and sporadically in others:

- In Macedonia lignite mining, which is profitable, is integrated into the national electricity monopoly.
- In Albania, the privatization of mines is legally possible (Law 8026 of 1995) but jeopardized by the collapse of demand, unprofitability of production and bad quality.[23]
- In Armenia, where coal production is nil, the development of a coalmine is subject only to obtaining a licence; there are no restrictions on coal trade and distribution.[24]
- In the Czech Republic, one mining company (Kladno) was sold to private investors; the completion of privatization of another (OKD) has been postponed; a programme for ending State ownership of three brown-coal companies has been prepared.[6]
- In Estonia, the oil shale mining company is up for privatization by 2000.[25]
- In the ex-GDR, in 1993 the mining-cum-power generation company MIBRAG was sold to PowerGen, NRG and Morrison-Knudson (USA).

[20] International Coal Report, 24. 2. 1997, 418/4

[21] UNECE, Restructuring of the coal industry and thermal power sector in south-eastern Europe, document ENERGY/1998/16 of 7 July 1998, p. 13

[22] UNECE, Restructuring of the coal industry and thermal power sector in the CIS, op. cit., p. 13

[23] UNECE, Restructuring ... in south-eastern Europe, op. cit., p. 2

[24] Black Sea Regional Energy Centre, Armenia, op. cit., p. 43

[25] UNECE, Restructuring of the coal industry and thermal power sector in central European economies in transition, document ENERGY/1998/20, of 1 October 1998, p. 7

- In Hungary, six underground and six opencast mines associated with power companies were sold to investors: RWE/EVS and AES acquired three power plants totalling 1281 MW and a coalmine (1996: 950,000 t) for $127M.[26]
- In Kazakhstan, after the closure of uneconomic mines, 15 underground mines in Karaganda were sold for $193M to Ispat-Karmet (a London-based steel group) in 1997. In Ekibastuz, JCC (Japan Chrome) acquired the Vostochnij opencast mine; Access Industries (USA) the Bogatir opencast mine; the Russian Sverdloenergo power company the Severnij opencast mine; Samsung of South Korea the Borli mine; the German NTD the Majkubensky opencast mine; and US Global Mineral Reserves the Choubarkolsky opencast mine. Four underground mines were sold to local companies; while three opencast mines in Karaganda remain State-owned.[27] AES acquired a 4000 MW coal-fired plant in Ekibastuz for approximately $3M.
- In Poland, the privatization of one mine (Bogdanka) was foreseen for 1999, on an experimental basis.
- In Russia, privatization by share auction continues, particularly in the profit-making mines of the Kuzbass, Krasnojarsk and Hakassia regions in Siberia; by end 1998, about 45% of coal production will be in private mines.[28]
- In Slovakia, in two of the three joint stock companies the employees hold the majority of shares, and in one the National Property Fund is the majority shareholder.
- In Slovenia, 20% of the underground lignite mine of Velenje is up for privatization as the outlets of production are secured by a mine-mouth power plant.
- In the Ukraine, the lack of political consensus, legal underpinning and finance has, so far, prevented steps towards privatization despite the fact that 71 out of the 271 underground mines with a production of 50 Mt or 62% of output were profitable (at the end 1997).[29] This did not prevent foreign investors such as the Canadian CCI Holdings from exploring the opening of a new mine or the acquisition of existing ones, particularly coking coal mines for exports.[30]

In the case of voucher privatization, ... the financial status of "privatized" mines remained as precarious as before.

Privatization did not necessarily imply that all the mines were already profitable, which was reflected in a "discount" price:

- AES acquired three Hungarian power plants with a capacity of 1281 MW and a mine (1996: 950,000 t) for $127M, and a utility with 4000 MW of capacity in Kazakhstan for $3M (but with outstanding receivables of $54M).[31]

This policy also meant that making a mine profitable was left to the investor who took his

[26] AES, 1997 Annual Report, p. 44

[27] UNECE, Restructuring of the coal industry and thermal power sector in the CIS, op. cit., p. 3

[28] UNECE, Restructuring of the coal industry and thermal power sector in the CIS, op. cit., p. 10

[29] UNECE, Restructuring of the coal industry and thermal power sector in the CIS, op. cit., p. 14

[30] International Coal Report, 2 June, 1997

[31] AES, 1997 Annual Report, p. 44

commitments in the light of his marketing and power generation strategy, and possible State aids for investments and redundancies. In case of voucher privatization, such new investments funds were not forthcoming, so that the financial status of the privatized mines remained as precarious as before. Only equity privatization provided new investments funds that were typically part of the negotiations between the governments and the bidders.

- In Kazakhstan, the bidders for the opencast mines Bogatir, Vostochnij, Severnij, Borli and for 15 deep mines in Karaganda accepted to invest during 1997-2001 $964 M[32], so as to bring production capacity to 115 Mt, approximately double the production of 1997.

3.3 TIME HORIZONS: A MOVING TARGET

3.3.1 The evolution thus far

Given the complexity of goals and the difficulties encountered, it is not surprising that the coal producing countries of CEE/CIS pursue different calendars for rendering their coal industries self-sustaining and market-driven. And that they have to review these calendars in the light of realities not once, but all too often.

As a result, by 1999, no country could claim to have achieved the double objectives of a restructured and profitable coal industry (see Graph 4). The ex-GDR, Kazakhstan, Hungary and to some extent Russia could claim to have attained the goal of restructuring, while facing continuing problems of rendering the industry profitable as a whole. In other countries, coal mining is virtually competitive and "viable" under local conditions, but the industry has not (yet) been restructured: in Poland, the Czech Republic, Romania and Macedonia, brown coal/lignite mines are profitable, but were not privatized. Also, while oil shale mining in Estonia is competitive with imported coal, privatization is foreseen for 2000.

By 1999, no country could claim to have achieved the double objectives of a restructured and profitable coal industry.

Generally, the coal industry throughout the region is waiting for the legislative and institutional environment to evolve further (should that be the desire and in the capacity of governments):

- In Albania, only the Memaliaj mine may achieve profitability by 2005-2010 if restructured. [33]
- In Bulgaria, privatization will develop gradually after 2000, 2001.[34]
- In the Czech Republic, the third "Coal Industry Restructuring Programme" of 1998 foresees bringing mine closures (or partial closures) up to 35. Progress towards privatization depends on a clarification of the legislative environment, in particular as regards the intended downsizing of the industry, the handling of long-term commitments to meeting obligatory social and health requirements and claims by coal industry employees, responsibility for past debts and liabilities, and conditions for open bidding.[6]
- In Georgia, implementation of the government plan for the development of the coal industry

[32] UNECE, Restructuring of the coal industry and thermal power sector in the CIS, op. cit., p. 4

[33] (Albanian) National Committee of Energy, op. cit., p. 18

[34] UNECE, Development of the energy sector in the transition to market economy, op. cit., p. 10

is impeded by lack of finance.[35]

- In Macedonia, the government has not determined the future structure of its national power company – owner of the lignite mines.
- In Romania, a first phase of the restructuring programme (1999-2001) aims to continue mine closures (27 unprofitable mines have been identified in the short term), reduce costs, improve product quality and environmental protection, commercialize the remaining autonomous agency, unbundle industry in mining areas, provide new mining concessions, render the entire industry competitive and privatize it[36] in a long-term programme (up to 2010).
- In Slovakia, the government has determined to maintain coal production and the industry structure till about 2005, although production and companies operate at a loss.[37]
- In Slovenia, modernizing the Trbovlje power station could produce electricity from coal from the remaining sub-bituminous coalmines of Trbovlje and Hrastnic at competitive prices, but related investments from State funds were refused by a referendum on 10 January, 1999.[38]
- In Russia and the Ukraine, coal industry restructuring plans have not been fully implemented due to lack of finance or acceptance.

3.3.2 Ambitions and perspectives: 2000-2010

All countries have set themselves time horizons for concluding the restructuring of their coal industries, rendering them profitable and "going private"; at present, the time horizon most often quoted is 2000-2010 (see Graph 4). These time horizons should be interpreted with caution: past experience has been disappointing as governments regularly underestimated the importance of conflicting interests. Time targets should also not be interpreted as implying that all mines would be competitive at that moment: mine associations will continue to include less competitive mines to the disliking and at the cost of the better ones, and mine owners (power stations, the State) may still have to subsidize some.

[35] UNECE, Clean coal programmeme in the Republic of Georgia, document ENERGY/WP.1/R.73/Add.5 of 5 August, 1997, p 2

[36] UNECE, Restructuring of the autonomous hard coal company under economic transition, document ENERGY/GE.1/1998/9 of 25 June 1998, p. 2 and 3

[37] IEA, Energy policies for the Slovak Republic, Paris 1997, p. 123

[38] IEA, Energy policies of Slovenia, op. cit., p. 61, Frankfurter Allgemeine Zeitung, 20 January, 1999

Graph 4 Coal Industry Restructuring "Paths" in CEE/CIS 1989-2010

Region/country	Reduction of subsidies, first round of mine closures	Legislative framework energy strategy, law	Corpora-tization	Commercia-lization (State-owned joint stock company)	Unbundling of non-core activities	Customeri-zation: merger with steel, power plant	Equity privatisation (* = public vouchers, employee shares)	Full "viability" see 4.1 attained, uncertain, targeted
Central Europe								
Albania	→	→	→	1995				almost phased out
Bulgaria	→	⋯	→	1997				2001 and later
Croatia								phased out 1999
Czech Republic	→	⋯	→		1993/94		1 mine 1996	largely attained
Estonia (shale)	→	→	→					
ex-GDR							1994	attained
Hungary							1997	after 2001,2002
Macedonia								attained
Poland					1997		1 mine 2000	attained Velenje
Romania	→	→	→	1998				uncertain Trebovlje
Slovakia	→	→	→	⋯	⋯	→	1993 *	
Slovenia	→	→	→		1992			
CIS								
Georgia	→	⋯	→					almost phased out
Kazakhstan	→	→	→	→	→	→	1997	largely attained
Kyrgistan	→	→	→					unknown
Russia	→	→	→	→	→	→	1995*	early 21st century
Ukraine	→	→	→	1994				undetermined

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4 THE IMPLEMENTATION: MATCHING POLICIES AND REALITIES

How did these policies affect production, employment, and productivity? Did visions and realities match? What were the costs in terms of investments? Had these investments been forthcoming? What remains to be financed?

By 1998, production had been reduced by 41%, employment by 45% and the number of mines by 26%, but productivity rose by only 8% due to disinvestment, unrest in the mining community and the lack of estimated required investments 14$/t or $12 billion.

4.1 PRODUCTION: DECLINING BY MORE THAN ONE THIRD THROUGHOUT THE REGION

4.1.1 Trends and variations

Between 1990 and 1998, total coal production in CEE/CIS declined by 41% (see Table 4 and Graph 9). The decrease was 40% in CEE and 41% in CIS. A breakdown by hard coal and brown coal for the period 1990-1997 is given in Table 3 overleaf:

- Production of lignite, brown coal and oil shale decreased by 41% and hard coal by 33% in the region as a whole.
- In CEE, production of hard coal dropped by 11% and brown coal by 43%.
- In the CIS, production declined at practically the same rate for hard coal (-41%) and brown coal (-38%).

The above numbers include coal mining in the ex-GDR as a benchmark for restructuring under best circumstances.

However, it could also reasonably be argued that coal industry restructuring in the ex-GDR took place under different political and economic conditions and that, therefore, the ex-GDR should be excluded from the tabulations. This would affect the aggregate calculations as follows (see also Table 3):

- *In CEE/CIS, total coal production declined during 1990-97 by 30% rather than 37%, including the ex-GDR, and brown coal production by (only) 25% compared with 41%*
- *In CEE, total coal production fell by 14% compared with 34% including the ex-GDR and brown coal production by 17% against 43%.*

Looking at individual countries, coal production trends varied between a 12% increase in Macedonia, to phase-out of coal production in Croatia (-98%) and Albania (- 77%). The bigger producers reduced production in the 30 to 40% range – the ex-GDR by 70%. Beyond 1997, coal production continued to decline. There are no plans to reverse this trend in CEE, but coal production should increase again in CIS.

4.1.2 International comparison

The 33% decline of hard coal production in the economies in transition compares with a 6% increase of world hard coal production during the same 1990-97 period. By contrast, the 41% decline of CEE/CIS brown coal production echoed a worldwide decline of 23%.[39]

Table 3: CEE/CIS lignite and hard coal production, 1990 and 1997

region/country	lignite Mt		hard coal Mt		total coal Mt		change in%
	1990	1997	1990	1997	1990	1997	
CEE							
Albania	2.07	0.04	-	-	2.07	0.04	-98
Bulgaria	31.50	30.00	0.14	0.10	31.64	30.01	-5
Croatia	0.12	0.01	-	-	0.12	0.01	-92
Czech Republic	76.00	55.00	22.40	16.00	98.40	71.00	-28
Estonia (oil shale)	22.50	13.57	-	-	22.50	13.57	-40
ex-GDR	249.00	74.00	-	-	249.00	74.00	-70
Hungary	15.80	15.00	1.74	1.00	17.54	16.00	-9
Macedonia (Rep.)	6.70	7.50	-	-	6.70	7.50	+12
Poland	67.60	63.00	147.70	137.00	215.30	200.00	-7
Romania	33.70	30.40	3.90	3.00	37.60	33.40	-11
Slovakia	4.80	3.90	-	-	4.80	3.90	-19
Slovenia	4.00	4.00	1.30	0.80	5.30	4.80	-10
total above	541	296	177	158	691	454	-36
1990 = 100	100	58	100	89	100	66	-
total excl. ex-GDR	*265*	*222*	-	-	*442*	*380*	*-16*
1990 = 100	*100*	*84*	-	-	*100*	*86*	-
CIS							
Georgia	-	-	0.13	0.04	0.13	0.04	-69
Kazakhstan	4.1	3.0	75.00	75.00	134.10	78.00	-42
Kyrgistan	1.1	0.3	-	-	1.10	0.30	-73
Russia	138.5	87.0	247.50	152.00	386.00	239.00	-38
Ukraine	5.8	1.0	135.00	75.00	140.80	76.00	-46
Uzbekistan	4.5	3.6	0.20	0.10	4.70	3.61	-23
total above	154	95	458	302	667	397	-40
1990 = 100	100	62	100	66	100	60	-
CEE/CIS							
total	668	391	635	460	1358	851	-37
1990 = 100	100	59	100	72	100	63	-
total excl. ex-GDR	*419*	*317*	-	-	*1109*	*777*	*-30*
1990 = 100	*100*	*76*	-	-	*100*	*70*	-

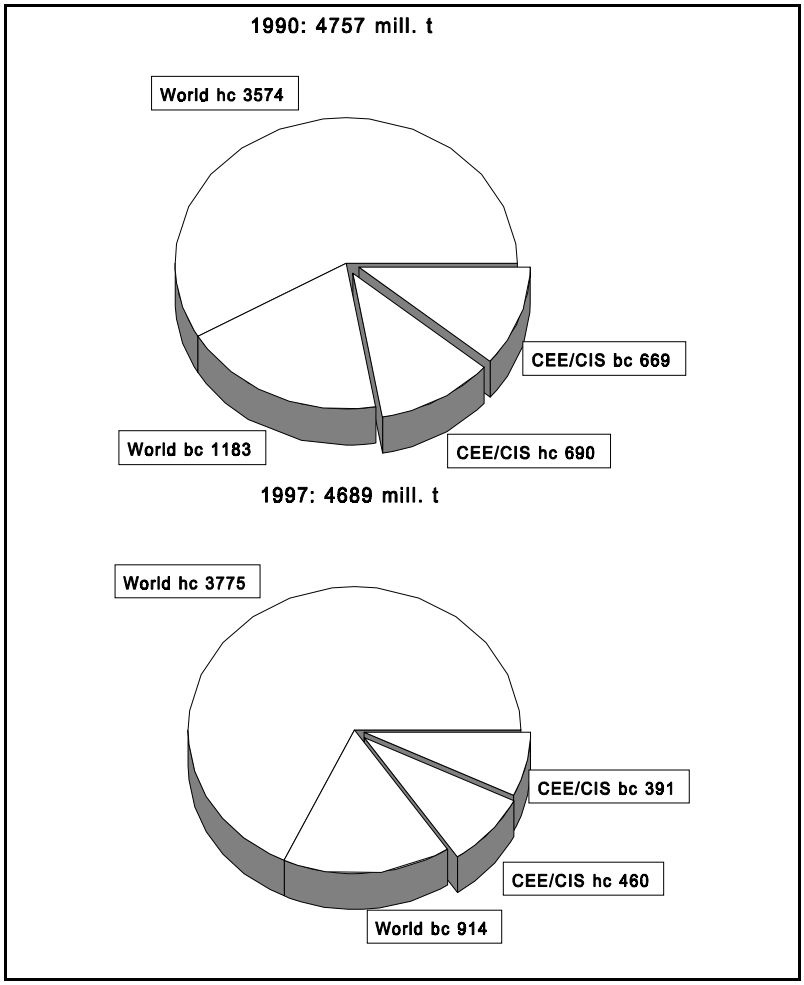
Sources: IEA, CIAB, UNECE, WEC Survey of Energy Resources 1998, Statistik der Kohlenwirtschaft, national sources

Thus, the transition economies' role in world coal mining, significant in 1990, had diminished by

[39] IEA Coal Information 1997, p. I.175, Statistik der Kohlenwirtschaft 1997, p. 88

1997 (see Graph 5).

Graph 5: CEE/CIS vs. world 1990 and 1997 brown and hard coal production



4.1.3 The drives and the brakes

The decline of coal production as described above was the result of various and opposing factors:

Box 3: Driving forces

The drives:	The brakes:
• the deep recession • budgetary and international (IMF...) constraints • actual or projected competition from other sources, particularly gas • pollution associated with coal mining and combustion • energy reforms in general • coal-specific policies	• the size of the coal industry • its inertia • its social and regional relevance • security of supply and • balance of payment considerations • technological advances • in mining and combustion • long-term energy needs

It would be interesting to quantify the relative importance of these opposing factors, so as to

better anticipate future developments and advise policy makers. However, the dynamics of their interaction are so complex that such an exercise appears impossible. Still, some exploratory consideration might be in order.

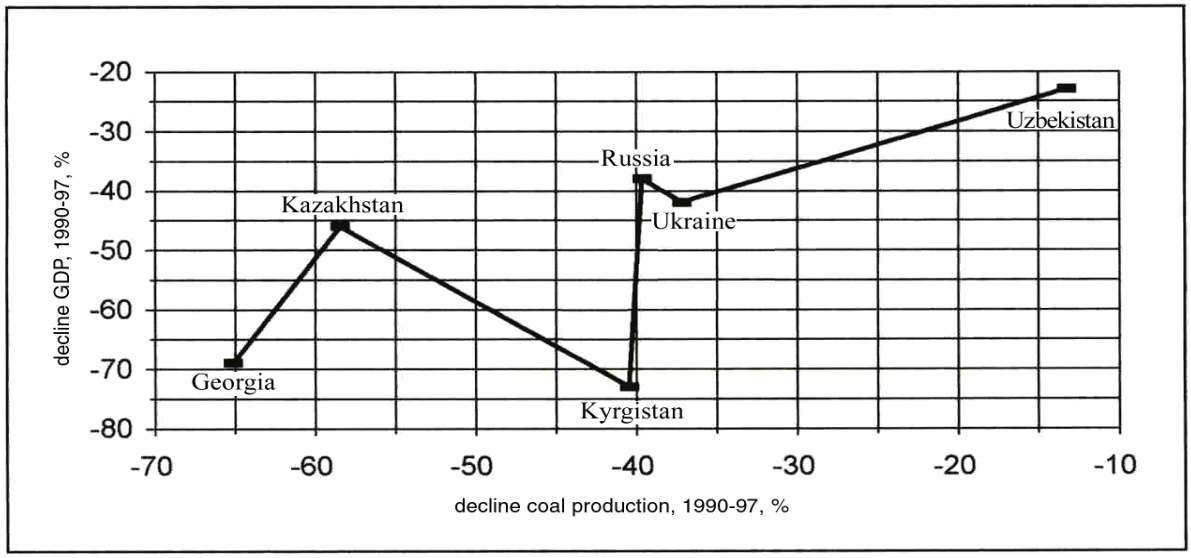
4.1.4 The relative impact of the great recession

One of the issues worth exploring is the question of to what extent the decline of coal production was attributable to the deep recession (as opposed to, say, deliberate coal policies). Were it shown that some of the decline was due to the severe economic downswing, the economic recovery (already notable in CEE) would offer more encouraging prospects for the coal industry and policy makers would be well advised to soften mine closure programmes they established under the bleak impressions of the recession.

A regression analysis correlating the dynamics of coal production and GDP 1990-1997 shows:

- a) the decline of coal production is indeed related to the decline of GDP throughout CEE/CIS, with the exception of Macedonia and Slovenia
- b) in CEE, this correlation is too weak (correlation efficient $R^2 = 0.12$) to be significant; indeed, while GDP began to rise again in 1993/94, coal production continued to decline
- c) by contrast in the CIS, the correlation is more pronounced ($R^2 = 0.46$, Spearman's: 0.77) as can also be seen from Graph 6 below.

Graph 6: The impact of the recession on CIS coal production



Whatever the shortcomings of the analysis, in CEE the coal industry declined not because of the recession, but for other structural reasons. By contrast, in the CIS the recession does explain at least part of the decline of coal production. The policy message is that an economic recovery would be significant for coal's future in the CIS but not in CEE.

The policy message is that an economic recovery would be significant for coal's future in the CIS but not in CEE

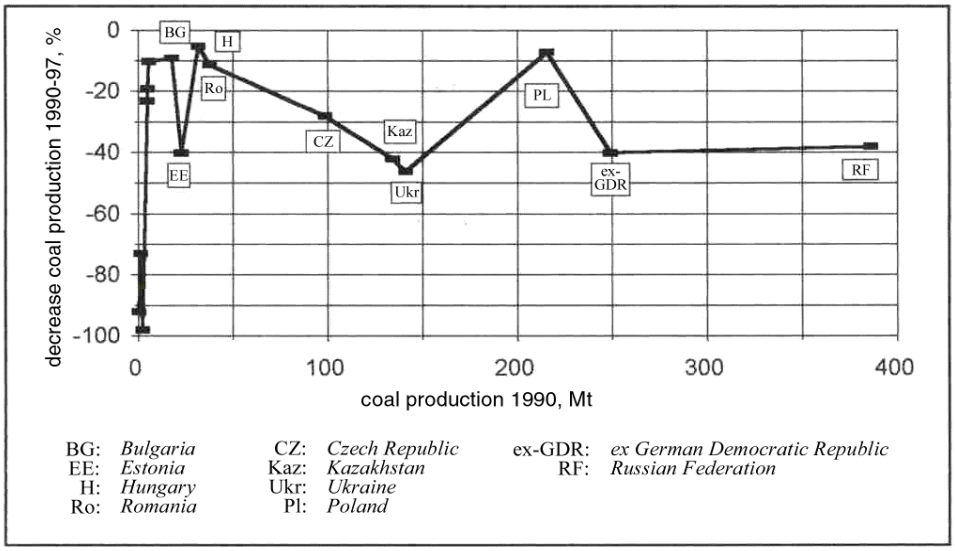
4.1.5 Size - restructuring impediment or driver?

Was size, in terms of t of coal produced, an impediment to restructuring? Was it more difficult to reduce coal production in the major coal producing countries than in the smaller ones? Or vice-versa? Or was size irrelevant?

Based on Table 3, Graph 7 plots the decline of coal production during 1990-97 against the initial (1990) size of coal production. It illustrates that

- there was no significant correlation between size and reduction of coal production throughout the region; this observation is confirmed by a correlation coefficient R^2 of 0.04;
- the decline of coal production in the four smallest coal producing countries (Croatia, Georgia, Kyrgistan, Albania) was double the decline in the four biggest coal producers (Russian Federation, ex-GDR, Poland, Ukraine): 89% compared with 51%.

Graph 7: The impact of initial size of CEE/CIS coal production, before 1990-1997



Thus, the initial size of the coal industry, in terms of tonnage, was not totally irrelevant for the speed of reducing coal production. At the lower end, size was a stimulus for reduction, at the higher end – a brake.

Interpreting this evidence is less easy. Is size associated with managerial inertia and political leverage? Poland, Romania and Bulgaria would support that theory, whereas in the ex-GDR, Ukraine, Kazakhstan or the Russian Federation, the political leverage of the mining community was less effective, despite greater size. Rather it seems that size reflects the relevance of domestic coal production for national energy policies: the smaller this role, the easier the decision to reduce production. Size also implies greater operational flexibility: it is easier for the bigger producers to shift production to better seams, mines and fields, hence to soften the overall decline:

- In Russia, new production capacity of 2.4 Mt was built in 1997 and another 41 Mt in 1998 (6 underground at 9 Mt and 9 opencast mines at 32 Mt); 11 deep and 15 opencast mines are under construction (57 Mt) so that total coal output should reach 350 Mt by 2005. [40]

[40] UNECE, Restructuring of the coal industry and thermal power sector in the CIS, op. cit., p. 10, and Y. Malyshev, op. cit., p. 394 ff

4.2 PRODUCTIVITY: INCREASING IN CEE, STAGNATING IN CIS

4.2.1 Trends and variations

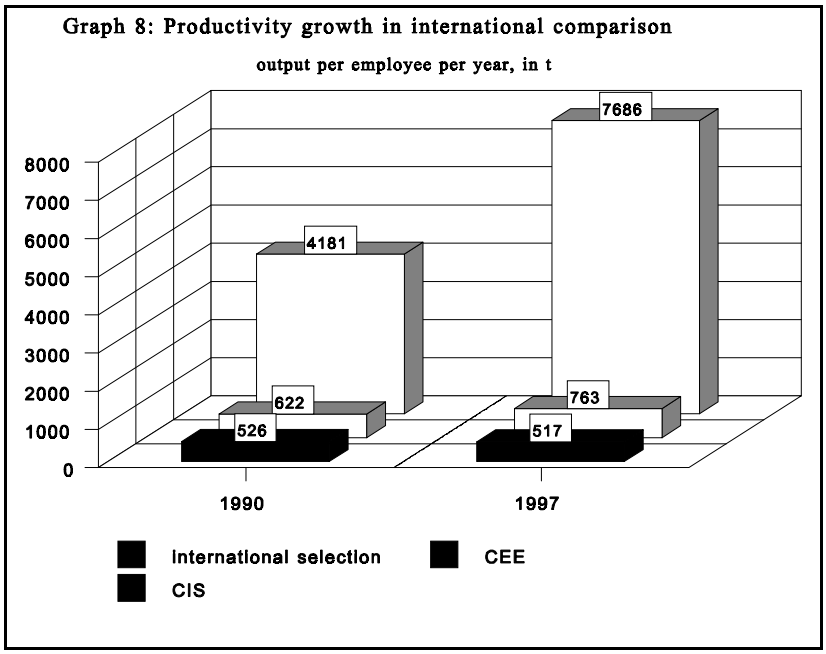
Between 1990 and 1998, productivity (output per employee and year)[41] increased in CEE by 22%, but stagnated in the CIS (- 2%). The overall improvement was only 8% (see Table 4).

As a result, a productivity gap developed between the CEE and CIS coal industries. Whereas in 1990, output per employee was almost 20% higher in CEE than in the CIS, by 1997 the gap has risen to almost 50%.

Developments varied greatly between countries:

- In Albania, productivity fell by 98% due to civil unrest and uncertainty as to the future of coal mining.
- In Bulgaria and Romania, productivity rose by over 100% despite a policy to slow the shrinking of coal production.
- In the ex-GDR, a policy of reducing production and the number of mines and employees at the same speed, resulted in a doubling of productivity.
- In Russia, during 1996-1999, productivity rose by 30% to reach 917 t/man/yr.
- In Hungary, productivity increased by 161% due to the reduction of the number of mines and employees.
- In the Ukraine, productivity fell by 13% due to a lack of determination and the means to implement a coal industry restructuring policy.

4.2.2 International comparison



[41] for a methodological note, see Table 4

How does this performance of the CEE/CIS coal industries compare with best international standards, with their international competitors (see Graph 8)? The CEE coal industries did not compare favourably with an international selection of performing coal industries [42]: productivity growth of 22% compared with 84% productivity growth in the international selection. As regards output per employee, the gap has grown and becomes desperately large: 763 t/employee in CEE against 7686 t/employee in the international selection.

The CIS coal industries lost even more ground internationally in terms of productivity growth (-2%) and output per employee (1990-1997: - 9t).

4.2.3 Redundancies: the overriding productivity driver in CEE

As seen in Table 4, output per employee increased by 22% during 1990-1998. Had employment and all other factors remained unchanged, production would have reached 760 Mt. However, employment decreased actually by 50% which, all other conditions unchanged, implies a production of 380 Mt, very close to actual production of 373 Mt. This suggests that positive influences from other factors such as the reduction of the number of pits by 30% and fresh investment, were unfortunately compensated for by negative factors (delayed restructuring, disinvestments, labour disputes). Clearly, though, lay-offs have been the dominating factor for productivity growth.

4.2.4 Inaction: the main impediment in the CIS

By contrast, in the CIS, lay-offs did not generate productivity growth: the number of employees and production declined at practically the same rate (-40%). The closure of pits (-23%) should have generated a productivity gain, but did not (actually there was a loss of 2%). Other negative factors such as legislative inaction, defensive industry and trade union attitudes, disorganisation of mining activities (social unrest, unpaid salaries, rising mortality) and disinvestments (ever-rising obsolescence of facilities and equipment) neutralized, indeed overcompensated productivity gains from lay-offs and mine closures.

Productivity growth resulted mainly from the lay-off of miners (-40%) and closure of mines (-26%). Investments could prompt a significant productivity gain quickly, as the employment surplus has been drastically reduced.

Cases in point are the Ukraine – where productivity even fell by 13% despite an outflow of labour by 34% – and in CEE, Albania. Here productivity fell by 98% while the number employees and of pits declined by only 15 and 12% respectively. The reasons: social unrest, absence of coal industry restructuring policies, lack of profitability, and hence investments.

[42] Australia, Canada, Colombia, South Africa, United Kingdom, United States; source: IEA Coal Information 1997, p. I.204 and 205; data for 1997

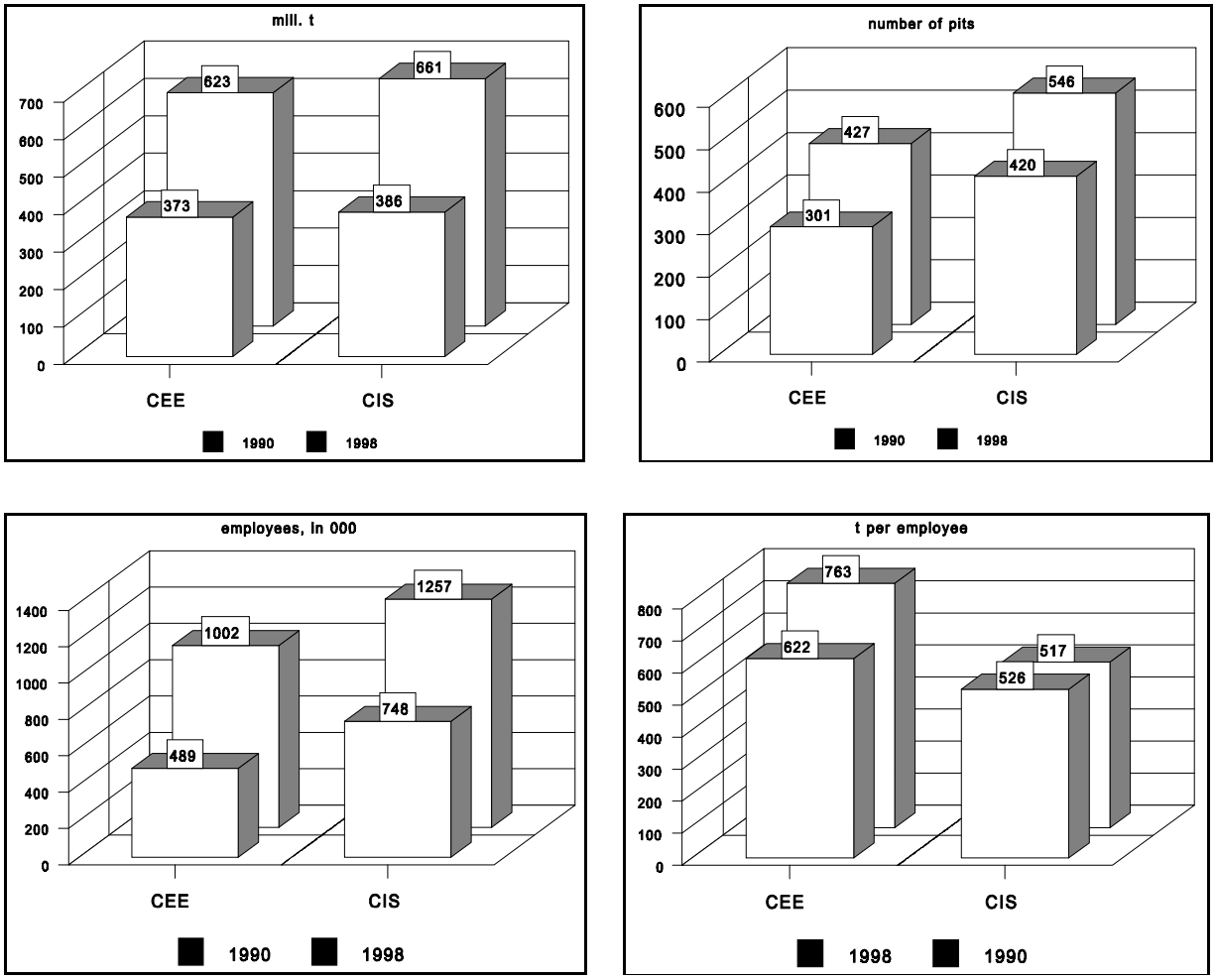
Table 4: Coal production, labour, mines and productivity in CEE/CIS, 1990 and 1998

Region/ country	Coal production, Mt			Number of pits			Number of employees, in 1000			Output per man and year, in t		
	1990	1998	%	1990	1998	%	1990	1998	%	1990	1998	%
CEE												
Albania	2.07	0.04	-98	33	29	-12	39.0	33.1	-15	53	1.2	-98
Bulgaria	31.64	30.00	-5	90	78	-13	134.0	57.0	-57	236	526.0	+123
Czech R.	98.40	67.00	-32	47	18	-62	110.0	65.5	-40	895	1023.0	+14
Estonia*	22.50	13.50	-40	7	6	-14	11.0	8.3	-25	2045	1627.0	-20
ex-GDR	249.00	74.00	-70	37	9	-76	112.2	16.4	-85	2219	4512.0	+103
Hungary	17.54	15.00	-14	41	18	-56	49.0	16.0	-67	359	938.0	+161
Mac. Rep	6.70	7.60	+13	4	4	-	2.1	1.9	-10	3190	4000.0	+25
Poland hc	147.70	121.00	-18	70	53	-24	388.0	219.0	-44	381	553.0	+45
Romania	37.60	33.40	-11	90	78	-13	134.0	57.0	-57	281	586.0	+109
Slovakia	4.80	4.00	-17	5	5	-	15.1	9.8	-35	318	408.0	+28
Slovenia	5.30	4.80	-9	3	3	-	7.6	5.2	-32	697	923.0	+32
sub-total	623	373	-40	427	301	-30	1002	489	-51	622	763	23
CIS												
Kazakh.	134.1	78.2	-42	402382	311182	-23	88.9	47.0	-47	1508	1667	10
Russia	386.0	228.0	-41	68	71	-50	559.1	300.7	-46	690	758	10
Ukraine	140.8	80.0	-43			+1	609	400	-34	231	200	-13
sub-total	661	386	-42	546	420	-23	1257	748	-40	526	517	-2
CEE/CIS	1284	759	-41	973	721	-26	2259	1237	-45	568	614	8

Methodological note: this table covers in principle all types of coal and shale, whether produced underground or opencast; definitions of production, employees, mines and pits (units of mines) differ between countries, so that comparisons between countries are to be made with caution. Due to its all-embracing coverage, this indicator does not lend itself to an in-depth analysis of the various factors impacting on productivity. **Statistical notes:** 1997 for Albania, Bulgaria, Romania; hard coal only for Poland; shale for Estonia; **Sources**: UNECE, Restructuring of the coal industry and thermal power sector in the CIS, document ENERGY/1998/15 of 30. 7. 1998; ditto ... in central European economies in transition, document ENERGY/1998/20 of 1. 10. 1998; ditto... in south-Eastern Europe, document ENERGY/1998/16 of 7. 7. 1998; for ex-GDR, Statistik der Kohlenwirtschaft 1997, p. 22 and 47.

The bad news is that a decade has been lost. The good news is that investments would prompt a significant productivity gain quickly, as the employment surplus has already been drastically reduced. What are the conditions for halting the implosion of the CIS coal industries? Focus on "organisation" (pro-active coal industry restructuring policies, market-oriented industry and trade union response) and fresh investments. Further lay-offs in an environment of legislative and institutional uncertainty would be counterproductive.

Graph 9 Production, pits, employees and productivity
in CEE/CIS coal mining, 1990 and 1998



4.3 INVESTMENTS: THE HARD CHOICES

4.3.1 Magnitude and profile of funding

Totally funded by the State under socialist regimes, the coal industries since 1990 had to rely increasingly on their own resources and on investors for investments proper. State funding remains important but is re-directed to restructuring, environmental and social projects:

- In Bulgaria, the development of coal mining until 2010 according to the government plan "Bulgaria 2001" would require investments to the extent of $437 M.[43]

[43] UNECE, Development of the energy sector in the transition to market economy: Bulgaria, document

- In the Czech Republic, during 1993-1998, the State spent CZK 18.6 billion ($560M) and the coal industry CZK 4.5 billion ($135M) on social security, health and safety (46%), mine closures (28%) and dealing with past mining damage (26%). The restructuring plan for 1999-2002 will cost an estimated $455M: 46% for social security, health and safety, 24% for mine closures and 30% to cover claims for mining damage (see Graph 12).[44]
- In Hungary, coal industry restructuring until its privatization required HUF 24 billion, $200M.[45]
- In Kazakhstan, the closure of 12 underground mines required $45M; the new owners of the privatized mines accepted to invest $964M during 1997-2000.[46]
- In Poland, the "Programme of hard coal mining adjustment to the conditions of a free market economy and international competitiveness" of May 1996 foresaw direct support of PLZ 6.372 billion ($2 billion) and indirect support (guarantees) of PLZ 1 billion ($312M) for the period 1996-2000. The direct support was to be used as follows: mining 18%, coal preparation 10%, environment 4%, purchases of investment goods 45%, other investments 10%, repayment of investment credits 14% (see Graph 12).
  A new (1998) plan to accelerate restructuring in 1999-2002 foresees PLZ 6.2 billion ($1.9 billion) for restructuring (of which PLZ 1.5 billion for mine closures, and PLZ 168M for reducing environmental damage) and a reduction of the industry's PLZ 13.6 billion ($4.2 billion) debt; in addition, there is a social package of PLZ 4.5 billion ($1.4 billion).[47] The focus of both plans on improved coal quality is notable: between 1990 and 1998, 14 preparation plants have been refurbished and another 14 plants will be modernized or commissioned in the near future.[48]
- In Romania, state funding for subsidies and investments, were $210M in 1996 and, fell drastically to $70M in 1998; $20M for investments proper and $50M for social programmes and subsidizing unprofitable mines.[49]
- In Russia, budget allocations for the coal industry have been huge (RUB 10.4 billion or $2 billion in 1996:); investments proper constantly declined from RUB 3200 billion ($200M) in 1990 to RUB 980 billion ($60M) (in 1991 prices) in 1996. Concurrently, industry's share of in investments rose from 5% in 1993 to 66% in 1996, which implies an annual availability of $100M for investments proper (see also Graph 10).[50] These investments are directed to new capacities east of the Urals, to opencast mines, coal

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ENERGY/GE.1/1998/5 of 16 July 1998, p. 6

[44] UNECE, Results of the restructuring of the Czech coal industry and the future role of coal for the national economy, op. cit., p. 4; UNECE, Restructuring of the coal industry ... in central European economies in transition, op. cit., p. 3 and 5

[45] UNECE, Restructuring of the coal industry... in central European economies in transition, op. cit. p.9

[46] UNECE, Restructuring of the coal industry ... in the CIS, op. cit., p. 3 and 4

[47] Frankfurter Allgemeine Zeitung, 9 April, 1998

[48] Ministry of Economy; Hard coal mining policy of the State and sector for 1996-2000, Warsaw 1996, table 3; UNECE, Restructuring of the coal industry ... in central European economies in transition, op. cit., p. 11

[49] UNECE, Restructuring of the coal industry ... in south-eastern Europe, op. cit., p. 12

[50] IEA Coal Research, Coal in Russia, op. cit., p. 29

preparation plants, railway infrastructure (particularly the Terentevskaya railway yard) and port facilities (Ust Luga near St. Petersburg and Novy on the Black Sea). As of 1998, State funds are exclusively used for restructuring, social programmes and subsidizing unprofitable mines, leaving investments proper to industry and investors. This concentration of State funds is not likely to suffice, however. RUB 9.2 trillion ($1.5 billion) were needed in 1998 to implement the programmes, but only RUB 5.7 trillion ($ 950M) were made available in the State budget.[51]

- In Slovenia, the cost of closing the three sub-bituminous coalmines in Senovo, Kanizarica and Zagorje was SIT 14 billion ($115M).[52]
- In the Ukraine, a programme to close unprofitable mines up would cost $1.09 billion to 2005, and a programme to soften the social and economic consequences, $1.37 billion.[53]

The above funding (actual or needed) for rendering the CEE/CIS coal industries "viable" (Table 5 on page 36) amounts to $10 billion or 14 $/t (1997): $6 billion in CEE and $4 billion in the CIS; the funding ratio of 14$/t is constant for CEE and CIS countries.

$12 billion or 14$/t of investment in coal mining is required: 72% for winding up, 28% for investments. Another $40 billion is needed for coal-based power plants.

If the countries listed above were representative of the entire region, $12 billion is required to render the CEE/CIS coal industries economically viable in a socially acceptable manner: 72% would be needed for winding up (closing/subsidizing unprofitable mines, remitting debt, securing social protection, undertaking environmental projects) and 28% for investments proper. Another $40 billion would be needed to upgrade coal-based power plants (see Chapter 6.2.2).

4.3.3 Financing sources

Is $12 billion much? Not from the perspective of a western multinational company: the development of the new high-capacity Airbus A3XX designed to compete with the Boeing 747 is at that price. Also not from a macro-economic perspective: $12 billion equals 0.9% of one year's (1995) GDP in the economies in transition ($1369 billion) [54].

On the surface, the issue is that these funding needs may not be the last word and funds may not be fully forthcoming as sources are under constraint:

- State budgets are operated under severe monetary and budgetary discipline.

[51] UNECE, Restructuring of the coal industry ... in the CIS, op. cit., p. 8, 9 and 11; conversion factor 1991 30 RUB/$, 1996 5300 RUB/$ (IEA Coal Research, Coal prospects for Russia, op. cit., table 4); 1998, 6000 r/$

[52] IEA, Energy policies of Slovenia, op. cit., p. 60

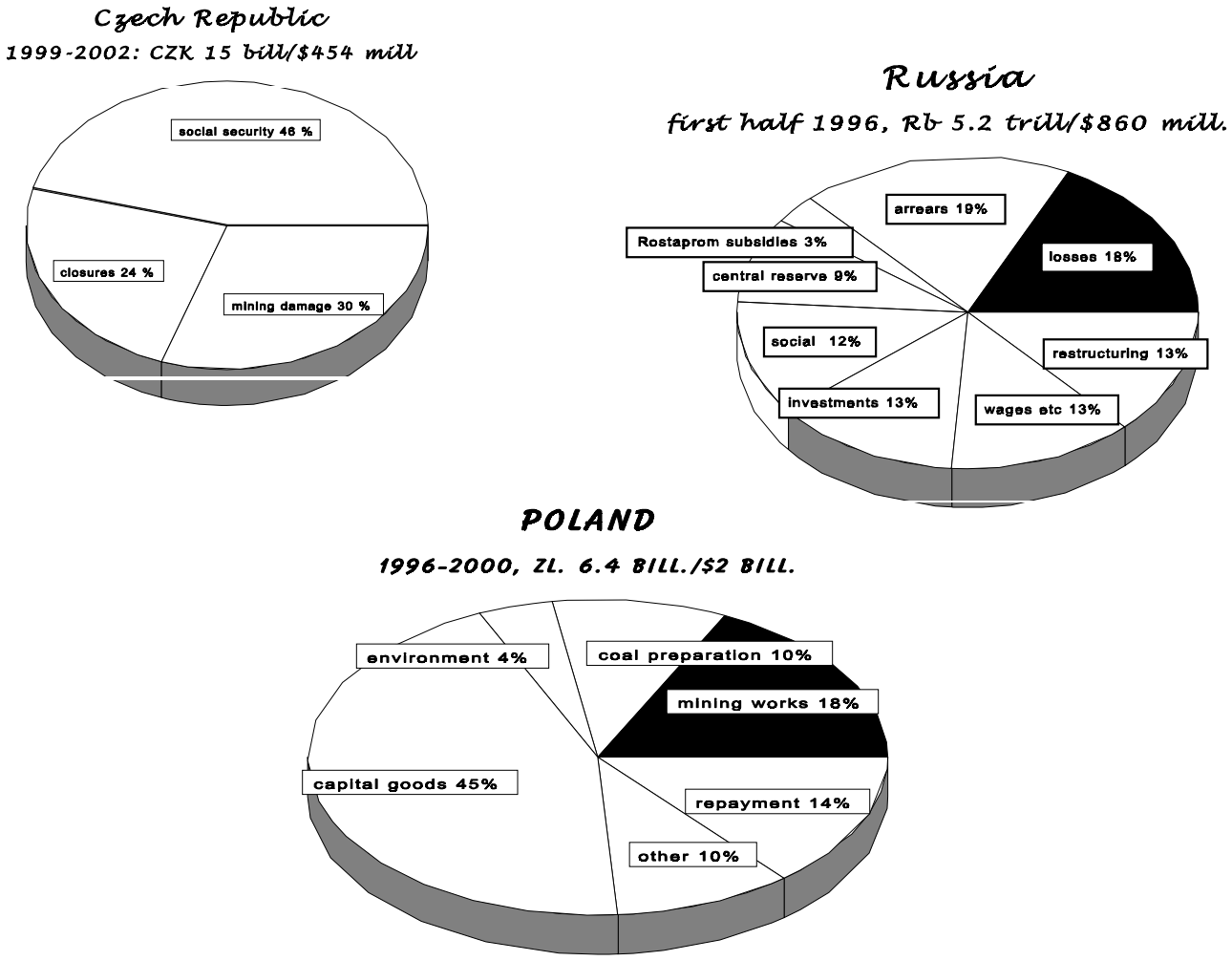
[53] UNECE, Transition to the market economy in the Ukrainian coal mining industry, document ENERGY/WP.1/R. 72 of 24 July 1997, p. 6

[54] IEA World Energy Outlook 1998, Paris 1998, p. 250

- The coal industries suffer from unpaid bills[55], "bundling" economic and uneconomic mines together, and continued price controls (Russia, Ukraine, Bulgaria, Slovakia).
- Domestic capital markets lack volume and long-term orientation.

Foreign capital markets cannot be accessed for lack of internationally tradable products or attractive risk/reward ratios. More fundamentally, the issue is that in the majority of CEE/CIS countries, delays in restructuring impede private investment from substituting for State budgets, or stimulating capital markets. In countries where restructuring and privatization are concluded, private investors have been forthcoming: power generators in the ex-GDR, Czech Republic (Kladno), Hungary, and Kazakhstan; traders in Russian port facilities (Ust-Luga).

Graph 10: Magnitude and profile of coal industry funding



[55] In mid-1998, outstanding bills of the Russian coal industry amounted to RUB 3.7-4 billion ($620-670M); Frankfurter Allgemeine Zeitung, 22 May, 1998; similar difficulties are reported from Ukraine, Romania and Bulgaria

4.3.3 Allocation procedures

Another issue is the allocation of funding. In the majority of CEE/CIS countries, where the coal industry is not restructured and privatized, the allocation of funds to the various mining regions, mines and cost items is undertaken centrally at the political level:

- In Bulgaria, the governmental Committee on Energy oversees the financing of the coal industry and proposes coal and electricity prices.[56]
- In the Czech Republic, funding is controlled by the Ministries of Industry + Trade and of Finance, directly if State money is involved, and indirectly (as majority shareholder) if industry finance is concerned. Policy is to merely replace used equipment and not to engage in new capacities as existing capacities, particularly in brown coal mining, are believed to meet future needs.[57]
- In Poland, the Ministries of Economy and of Finance control the allocation of State funds directly, and of company funds indirectly, as shareholders.
- In Russia, Rosugol assumed the function of allocating funds until its dissolution in December 1997, as of when the Ministry of Fuel and Energy took over.[58]
- In Slovakia, the Ministry of Finance oversees the allocation of funds and energy prices and tariffs.[59]
- In the Ukraine, the Ministry of Economy approves coal prices for consumers, the Ministry of Coal those for wholesalers, and the National Commission for Management Problems in the Power Generation Industry those for electricity generators.[60]

It is evident that funding determined by governments bows to different objectives than funding determined at the company level. Essentially, the former aims to attenuate the rigours of the market (thereby delaying reforms), while the latter targets efficiency, profitability and market share.

[56] UNECE, Restructuring of the coal industry ... in southern Europe, op. cit., p. 4

[57] UNECE, Results of the restructuring of the Czech coal industry ... in the CIS, op. cit., p. 2

[58] UNECE, Restructuring of the coal industry ... in the CIS, op. cit., p. 10

[59] UNECE, Energy and mineral resources management and legislation, doc. ENERGY/1998/5 of 8 April 1998, p. 33

[60] UNECE, Restructuring of the coal industry ... in the CIS, op. cit., p. 15

5 THE RESULTS: FROM VIRTUAL TO REAL VIABILITY

To what extent has restructuring so far enhanced the profitability of the coal industries in CEE/CIS? How have the various approaches performed in achieving viability?

By 1997, about 95% of the brown coal/lignite production and 75% of hard coal production were actually or virtually viable — about half 1990 production. Bundling good mines with bad and mass privatization delayed restructuring. Bundling mines with power stations, and equity privatization advanced it.

5.1 NOTIONS OF "PROFITABILITY" AND "VIABILITY" UNDER CONDITIONS OF TRANSITION

Most coal mining in CEE/CIS is still not "profitable" in the straightforward sense used in developed and integrated market economies where it implies a rate of return on investments that compares favourably with rates of return in other sectors of the economy or internationally.

Cases of such profitability exist in CEE/CIS (see 5.4 below), but in 1999 most coal production must still be qualified as "virtually profitable" or as "locally/nationally profitable" only, for which the term "viable" might be more appropriate.

Reasons for the lack of profitability lie in delays in restructuring. By imposing regulated (low) coal prices and granting insufficient compensatory subsidies, and by "bundling" economic with uneconomic mines, CEE/CIS governments on the one hand impeded the "economic" ones from gaining the "rent" that geology and management could earn which could and would have been used to invest in productivity-generating equipment, and – on the other hand – did not enable the "uneconomic" ones to turn the tide.

These policies affected profitability in several ways:

- They obscured the fact that a significant part of the industry was indeed profitable, even under the worst conditions of transition.
- They slowed the emergence of this competitive hard core – at high social and developmental cost.
- They discouraged external investors.

Table 5: Actual and viable coal production in CEE/CIS

Country/region	production 1997, in Mt		production considered "viable", Mt	
	brown coal/lignite	hard coal	brown coal/lignite	hard coal
CEE				
Albania	0.04	-	-	-
Bulgaria	30	0.1	27	-
Croatia	0.01	-	-	-
Czech Republic	55	16	49	15
Estonia (shale)	13.57	-	13.6	-
ex-GDR	74	-	50*- 75	-
Hungary	15	1	15	1
Macedonia (Rep.)	7.5	-	7.5	-
Poland	63	137	63	92
Romania	30.4	3	30.4	-
Slovakia	3.9	-	3.9	-
Slovenia	4	0.8	4	-
sub-total	296	158	263-288	108
in%	100	100	89-98	68
CIS				
Kazakhstan	3	75	...	60-65*
Russia	87	152	90*	120*
Ukraine	1	75	...	50
sub-total	91	302	90	230-235
in%	100	100	100	77
CEE/CIS				
in Mt	387	460	353-378	338-343
in%	100	100	91-98	73-75
1990, Mt	668	635	n. a.	n. a.
in% of 1990	n. a.	n. a.	53-56	53-54

- = nil; * = estimate; ... = not available; n. a. = not applicable; for sources, see section (5.4)

5.2 THE DIFFERENCES FROM INTERNATIONAL PRACTICES IN ACCOUNTING TERMS

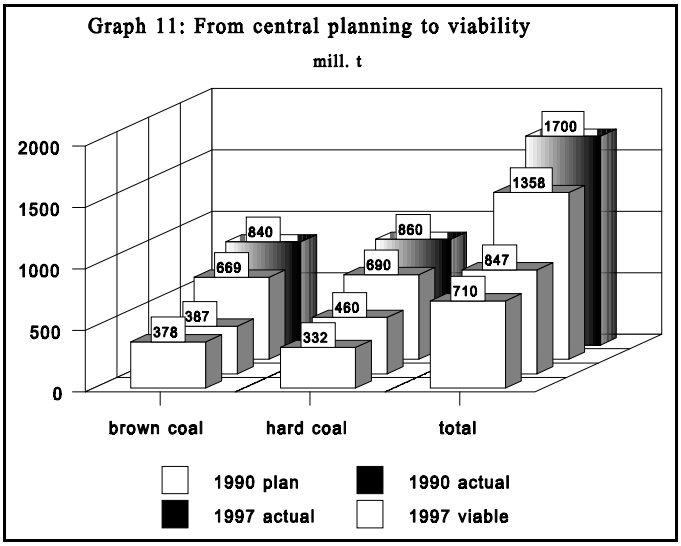
The differences between the notions of profitability and viability, under condition of transition, are detailed below.

i. Foregone revenues/accumulated debt: The basic difference results from the fact that profitability was not a target under socialist regimes. Mines "with high economic and technical indicators" were "taxed", the others subsidized. Under the subsequent regime of regulated (low) coal and electricity prices, coalmines that as such were profitable remained unprofitable. When, in the next step, coal prices were liberalized in the mid 1990s, the mines had to carry (and possibly service) accumulated debt that in part was due to the pricing policies mentioned. Accounted for as liabilities, these "debts" were in fact foregone revenues. It is therefore not

surprising that there is a continued quest to write off these debts to the extent that they had indeed been caused by government-imposed prices not compensated for by subsidies.

ii. Customerization: A coal mine may be unprofitable on its own, but "viable" as part of a power (or steel, or aluminium) company. Cross-subsidies from the latter to the former, while undesirable in theory, in practice imply that the company as a whole is profitable. The issue is whether electricity tariffs cover the higher costs of coal supplies from the integrated mine compared with costs of imported coal, gas or fuel oil, and whether the rate of return satisfies investment requirements and shareholders of the parent company. This question has been very controversial in the mid 1990s, but lost some of its urgency when more market-oriented higher tariffs were applied. In other cases, the sale price of the mine included a discount sweetening the pill of (later) cross-subsidies.

iii. Inherited environmental damage: Past environmental liabilities are not accounted for in the



books of CEE/CIS coalmines. Should they be fully charged, few mines could be considered "viable", not to mention "profitable". The preferred solution is for the State to assume these liabilities until and beyond the closure of the mine in question, or until its privatization. Indeed, new investors would hardly be forthcoming had they to shoulder the important, but largely un-quantified cost of past pollution.

iv. Government-brokered supply contracts: In cases where uneconomic mines could not be "customerized" but had to be kept in operation for some time, certain governments obliged power plants to purchase a given amount of coal at given conditions, much to their dislike as such brokered contracts jeopardized the profitability of the utility in question. However, this measure is clearly intended to be a temporary one, smoothening the process of mine closures. It appears also of limited importance in terms of coal output.

5.3 ADOPTED DEFINITION

In attempting to measure the level of "viability" of CEE/CIS coal mining, the following cost items will not be taken into account:

- accumulated debt
- past environmental liabilities
- cross-subsidies paid by parent power companies to integrated mines
- purchases of coal under government-brokered contracts

This implies that viability is virtual and restricted in cases where restructuring has not yet been concluded. It also means that when restructuring is concluded, "virtual" viability turns into "actual". This kind of approach does seem appropriate for a macro-economic analysis such as this one. This is not to suggest that a potential investor ought to ignore these possible cost items when appraising a particular project.

5.4 VIABLE COAL PRODUCTION IN THE VARIOUS COUNTRIES

Viability differs between countries:

- In Albania, only the Memaliaj mine might be viable by 2005-2010, if restructured.[61]
- In Bulgaria, 78% of coal production (mostly from the Maritza East power-mining complex) would be competitive with imported coal. In 1997, production cost in opencast mines ranged between 18 $/t and 33.5 $/t, in underground mines between 47.5 $/t and 63.7 $/t.[62]
- In Croatia, mining will be abandoned in 1999 for lack of viability.[63]
- In the Czech Republic, in particular hard coal mines, will not be able to cope without further state support, but one company - OKD - can already do without direct or indirect state subsidies.[64]
- In Estonia in 1997, the cost of shale production underground was at 7.07 $/t, in opencast mines at 5.98 $/t. Four underground mines will be closed. Shale production, at 1.04 $/GJ by 2000, is expected to remain competitive with imported coal and gas at 1.7 $/GJ, but generating cost would be affected as a result of lower combustion efficiency if fluidized bed boilers were installed.[65]
- In the ex-GDR, brown coal mining is competitive except for two state-owned opencast mines (1998: 5.9 Mt) that will be closed in 2000 or 2001; until 2003, electricity

[61] Albanian National Committee of Energy, Energy Report of Albania, Ankara, Oct. 1996, p. 17

[62] IEA Coal Research, Coal in Bulgaria, London 1999, p. 26; UNECE, Restructuring of the coal industry ... in south-eastern Europe, op. cit., p. 3 and 6

[63] communication from the Croatian Member Committee of WEC

[64] UNECE, Restructuring of the coal industry ... in central European economies ..., op. cit., p. 3 and 5; and UNECE, Results of the restructuring of the Czech coal industry and the future role of coal for the national economy", document ENERGY/GE.1/98/7 of 16 July 1998, p. 4

[65] communication by the Estonian Member Committee of WEC; UNECE, Restructuring of the coal industry ... in central European economies ..., op. cit., p. 7

generation from brown coal is exempted from electricity market liberalization in Germany; state funding is directed at the closure of mines and the recultivation of land: during 1992-2002 DM 9.2 billion ($5.2 billion) is required.[66]

- In Hungary, the liquidation of loss-making mines has almost been completed.[67]
- In Macedonia, lignite mining is competitive.
- In Kazakhstan, except for three opencast mined in state ownership, all mines remaining after the closure programme have been privatized, indeed associated with power plants and steel works.
- In Poland, brown coal mining is competitive and on the increase; average production cost of hard coal stood in December 1996 at PLZ 124.48 ($33)[68]; the government intends to render hard coal mining as a whole competitive by 2001, when production would have been reduced from 133 Mt (1996) to 110 Mt[69]; this implies the continued cross-subsidization of uneconomic mines by economic ones; assuming that exports remain loss-making and that residential markets would be largely lost to competing fuels, a range of 92 Mt of hard coal production is estimated to be "viable" by 2010.[70]
- In Romania, lignite is produced in Oltenia at ROL 42 000-111 000 (3.3-8.7 $/t), supplied at world market prices and not subsidized. Hard coal (at production costs of ROL 212 000-375 000 or 16.5-29.3 $/t) is sold at 50% above world market prices.[71]
- In Russia, with average production cost at 13 $/t, opencast mining as a whole became economically viable as of 1996; average production cost of underground mines is at $30/t. A major means of achieving profitability is the replacement of old by new and European by eastern capacities: at present 57 Mt. are under construction.[72] "By the beginning of the 21st century coal mining in Russia will be completely renovated into a profitable branch of the national economy".[73]
- In Slovakia, coal production is at loss and will be phased-out by about 2020, together with the power station Novaky that the coal is supplied to.[74]
- In Slovenia, in the absence of State support for the upgrading of the power station of

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[66] Energiewirtschaftliche Tagesfragen, vol. 9/1995, p. 536; Statistik der Kohlenwirtschaft, Der Kohlenbergbau in der Energiewirtschaft der Bundesrepublik Deutschland im Jahre 1997, Essen/Köln 1997, p. 26

[67] UNECE, Restructuring of the coal industry ... in central European economies ..., op. cit., p. 9

[68] State Hard Coal Restructuring Agency, Hard coal mining in Poland, Katowice, March 1997, table 22

[69] UNECE, Restructuring of the coal industry ... in central European economies ..., op. cit., p. 7

[70] Polish Member Committee of the WEC, Energy sector in Poland, Cracow, 1999, p. 7

[71] N. N., Restructuring of the mining sector in Romania, April, 1998, p. 2; Ion Stanciu et al., Coal mining industry restructuring in Romania, p. 4

[72] UNECE, Restructuring of the coal industry ... in the CIS, op. cit., p. 8 and 10

[73] UNECE, Restructuring of the coal industry ... in the CIS, op. cit., p. 8; Y. Malyshev, op. cit., p. 394

[74] IEA, Energy policies for the Slovak Republic, op. cit., p. 123

Trbovlje, the lignite coalmines would be closed by 2004; lignite production at Velenje (4 Mt) is viable.[75]

- In Ukraine, 71 of the 271 underground mines with a production of 50 Mt are profitable (end 1997) at average production cost of 35 $/t (with the cheapest mine at 17.7 $/t). There is "no viable option" for the remaining mines.[76]

Table 6: 1997 Production cost, in $/t

Country	brown coal	hard coal
Bulgaria	18-33.5	47.5-63.7
Estonia (shale)		
opencast	5.98	-
underground	7.07	-
Romania	3.3-8.7	16.5-29.3
Russia	13*	30**
Ukraine	-	35

* = opencast hard coal and brown coal

** = underground hard coal and brown coal

5.5 REGIONAL APPRAISAL

Whatever differences between countries and whatever the uncertainties associated with coal restructuring plans, regional trends appear very forcefully

- most of the coal production in the region is actually or potentially viable, except in Albania, Croatia and Slovakia
- in 1997, 83% of production was viable (91-98% of brown coal, 73-75% of hard coal).
- viable CEE/CIS coal production in 1997 amounts to about half the production of 1990 (54% in the case of brown coal and 49% in the case of hard coal).

There is thus still a way to go.

[75] IEA, Energy policies for Slovenia, op. cit., p. 61

[76] UNECE, Restructuring of the coal industry ... in the CIS, op. cit., p. 14

6 THE NEW RESPONSIBILITY: CLEAN COAL

Was environmental cleanup a policy objective during restructuring? What means were applied to attain this goal? What priorities emerged with regard to air and water pollution, soil contamination, recultivation? What was achieved? What would it cost to comply with international environmental standards?

Since 1990, environmental cleanup has been significant in CEE/CIS. It resulted from macro-economic restructuring rather than from clean coal technologies, whose cost proved to be a serious obstacle in all but the most advanced reforming countries.

6.1 POLLUTION CONTROL: THE PROMISE OF CLEAN COAL TECHNOLOGIES

Heavily polluted (the "black triangle" between northern Bohemia, Saxony and Upper Silesia may serve as a reminder), the economies in transition are under strong international pressures to reduce transboundary air and water pollution. Pollution control policies have been conceptualized comparatively rapidly. The necessary national legislation and institutions have been developed and international instruments such as the UNECE Convention on Long-Range Transboundary Air Pollution of 1979 and its Protocols, the Convention on the Protection and Use of Transboundary Watercourses and International Lakes of 1992, the UN Framework Convention on Climate Change of 1992 and the Kyoto Protocol of 1997 have been adhered to.

Without going into detail, suffice it to say that the CEE and CIS countries have integrated into the international mainstream in this regard. In CEE, much of this commitment can be attributed to the desire to join the EU as early as possible and to conform to various EU directives, particularly the Directive on Large Combustion Plants.[77]

These policies and instruments also particularly affected, coal mining and combustion, as coal was a major source of pollution and had no long-term future unless it became clean. Improved management and clean coal technologies (CCT) were at hand to respond to the challenge, but needed to be applied to the specific circumstances prevailing in the economies in transition. However, this proved technically more difficult, financially more demanding and more time consuming than had been anticipated.

Three "applications" of CCT need to be distinguished:

- in power generation and co-generation
- for district heating, briquetting and direct burning in small industrial/residential boilers
- in mining proper.

[77] for a survey of these agreements, see: J. Topper and A. Botting, Developments in environmental legislation and regulation relating to coal-fired plants, CRE Group Ltd, Cheltenham, UK, 1998

6.2 CLEAN COMBUSTION: POWER PLANTS AND CO-GENERATION

Policy attention focusses on coal-based power plants as their limited number and huge throughput facilitate remedial action.

Coal is a most important fuel for power generation in the economies in transition: 30% of electricity generation is based on coal[78]. Equally, power plants absorb a high and ever increasing share of coal production: 66% in CEE and 50% in CIS (1995)[79] (see Table 7). This interdependence explains the mutual interest of both industries in the successful application of clean coal technologies.

The following section on clean combustion, will focus on desulphurization. Low NO_x burners and fluidized bed boilers are increasingly installed, but not well documented.

6.2.1 the situation in the various countries

Yet, progress in applying these technologies has been slow and uneven so far. CCT has been systematically introduced only in the new German Länder, the Czech Republic and Poland. Hungary will follow by 2003/2004. The other CEE countries are either undertaking ad hoc projects or are still in the planning stage. The small and energy-importing CIS countries (Belarus, Moldova, Georgia, etc.) are not able to even begin the process of investing into environmental cleanup:

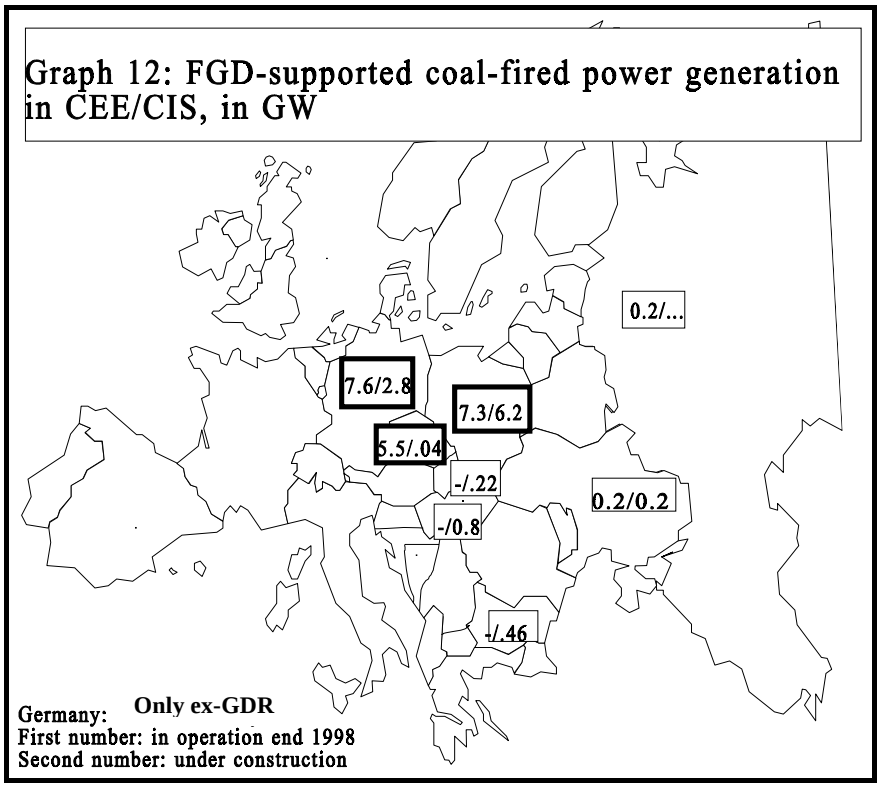
Box 4: Clean coal technology (CCT)

Definition:	Technologies designed to enhance both the efficiency and environmental acceptability of coal extraction, preparation and use
Extraction:	- geophysical and seismic exploration - selective mining techniques - mine methane drainage - reduction of ground water contamination - recultivation
Preparation:	- increased share of washed coal - improved reduction of ash and sulfur - waste water treatment
Combustion:	- sub-critical (<248 bar/560^0 C) pulverized coal combustion combined with electro-static and/or fabric filters, flue gas desulphurization, low-NO_x burners, selective catalytic NO_x reduction - advanced pulverized coal combustion with higher efficiencies due to high-strength alloy steels enabling supra-critical and ultra-supra-critical pressures (>248 bar) and temperatures (>560^0 C) - fluidized bed combustion - atmospheric or pressurized - integrated coal gasification combined cycles (IGCC) hybrid systems - IGCC co-firing coal and biomass, waste - "Power Plexes": integrated multi-solid fuel conversion into electricity, steam, fuels and chemicals with efficiencies › 60% and near zero pollution (USDOE "Vision 21")

[78] database of WEC/IIASA, Global energy perspectives, Cambridge 1998

[79] UNECE, Coal demand and supply in the ECE region in 1997 and prospects, with particular attention to thermal power generation, document ENERGY/GE.1/1998/4, table 8, CEE augmented to include the ex-GDR

- In Bulgaria, the first two flue gas desulphurization (FGD) facilities (2 x 230 MW) with wet limestone technology will be in operation in Maritza-East by 2001; by 2010a further 2 x 230 MW are planned to be in operation. There will also be a test facility using ammonia to remove sulphur and NO_x.[80]



- In the Czech Republic, law required that existing generating units be equipped with desulphurization by the end of 1998; subsequently, CEZ - the national power company - invested $2.2 billion in desulphurization, denitrification and repowering of its coal-fired plants; 5510 MW are in operation and desulphurization of another 400 MW is planned.[81] The application of CCT depends entirely on the resources of coal-using companies, even though the law requires them to use CCT. The absence of Czech-designed CCT proved a difficulty as it implied cooperation with foreign financial institutions and technology providers; also, the large size of boilers (>250 MW) and uncertainty about the long-term functioning of CCT for low-grade coal was an impediment. As a result, preference was given to low-cost, proven CCT with flue gas desulphurization and circulating fluidized bed combustion. More advanced CCT is envisaged for 2000-2010, with integrated coal gasification combined cycles using heat from nuclear reactors emerging after 2020.[82]

[80] UNECE Seminar on restructuring of the coal industry and coal-fired power sector in the economies in transition, Varna, 25-27 May 1998, document ENERGY/GE.1/Sem.1/2, p. 8

[81] IEA Coal Research, Coal in the Czech Republic, draft of September 1998, p. 23

[82] UNECE, Recent developments and preconditions for further implementation of clean coal technologies in the Czech Republic, document ENERGY/WP.1/R.73/Add. 4 of 18 August 1997

Updating is expensive: in some cases, it would have been cheaper to build a new plant.[83]

- In Hungary, coal-fired plants are not equipped with sulfur and nitrogen control, though dust control works efficiently. Plants that will not conform to stricter environmental regulations will be closed down by 2003, 2004. Plants using coal from underground mines may not be sufficiently profitable to finance CCT; by contrast opencast-supported power generation will be expanded. Thus, RWE/EVS will refurbish its 800 MW Matra plant ($253M, of which $70M for environmental protection) and build a new 2 x 500 MW plant near Miskolc ($1.48 billion, of which $0.48 billion in mine expansion).[84]
- In Poland, the government adopted in 1996 a plan entitled "SO_2 emission reduction in the Polish energy sector" implying a cost of $2 billion. By mid 1997, 4360 MW had been equipped with FDG and 2970 MW were under construction; another 6160 MW are earmarked for FDG. Various CCT approaches are used: wet limestone, semi-dry, dry absorbent SO_2 reduction and atmospheric circulating fluidized bed combustion. NO_x reduction is achieved through low-NO_x burners and staged combustion; fly ash is reduced by electrostatic and fabric filters.[85]
- In Romania, power plants use mostly pulverized coal combustion with low efficiency and without denoxification and desulphurization. A "Programme of refurbishing and modernization of power plants within the national power system" directs the refurbishment of the entire thermal power sector that relies to 44% on coal. Required investments are estimated at $2.5 billion. Due to lack of funding, low- and medium-level measures (improved burning process control, low NO_x burners, improved electrostatic precipitators, pollution measurement) have been applied to four units (1140 MW) of the lignite-fired Turceni and Rovinari power plants; CCT will be applied at a later stage for existing plants, but have to be applied from the outset to new plants.[86]
- In Russia, coals from Kuzbas, Kansk-Achinsk, eastern Siberia, the North East and Far East are low-sulphur and can be burnt with minimum or no sulphur cleaning: these mining regions accounted in 1993 for 78% of production. In other cases, CCT is required: since 1995, 200 MW have operated with FGD at the Dorogobush co-generation plant[87]. At present, desulphurization tests are run with anthracite culm and coals from Kansk-Achinsk and Ekibastuz. Demonstration projects are undertaken by:
  - Rostovenergy

  a) combustion of anthracite screenings in melted slag at the Nesvetai power plant,

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[83] UNECE Seminar on restructuring ..., op. cit., p. 8

[84] communication by the Hungarian delegation to the UNECE Group of Experts on Coal and Power Stations, Geneva, October 1998; Power Economics, nr. 8/1997

[85] UNECE, Clean coal programmemes in Poland, document ENERGY/WP.1/R. 73 of 25 July 1997

[86] UNECE, Restructuring of the coal industry ... in southern Europe, op. cit., p. 10; UNECE, Rehabilitation of coal-fired power plants strategy in Romania, ENERGY/WP.1/R. 73/Add. 2 of 22. 8. 1997

[87] G. G. Olkhovsky, Coal in Russian power industry, paper 1.2.22 of the 17th World Energy Congress, Houston, September 1998; IEA Coal Research, Air pollution control for coal-fired power stations in eastern Europe, London, 1995, p. 41

b) circulating fluidized bed combustion of anthracite screenings in large boilers in the new Rostov power plant, and

c) circulating fluidized bed combustion of coal preparation wastes in smaller boilers,

- Krasnoyarskenergo:

a) staged combustion in a traditional pulverized coal furnace with high temperature preheating,

b) fabric filters and sulphur removal from the flue gas with activated ash

c) Ryasan State District power plant, with a German partner, will undertake desulphurization of a 300 MW unit.[88]

- In Slovakia, two units of Vojany Power Plant were equipped with desulphurization/ denitrification technologies and two units of Novaky Power Plant with desulphurization facilities. Novaky was also equipped with a 97 MW fluidized bed boiler.
- In the Ukraine, only one unit (250 MW) of the Dobrotvorsk Power Plant is equipped with wet limestone FDG.[89] Boilers, turbine, processing techniques and electrostatic filters were replaced in 1999 at the coal power plant of Smijev (300 MW, built in 1965): the first joint CCT venture between western and Ukrainian partners.[90]

6.2.2 Regional overview

What are the general trends and lessons?

15% of coal-firing capacities in CEE/CIS are presently equipped with flue gas desulphurization; ... finance is the bottleneck; ... $38 billion is required.

i. The policy: Except for low-sulphur coals (Russia), CCT is a necessity for the survival of coal as a power generation fuel in CEE/CIS. This has been recognized as a policy objective in all countries.

ii. The facts: At present, about 21 GW or 15% of coal-firing capacity in CEE/CIS are equipped with FGD; they are almost exclusively located in CEE, where they represent 30% of installed capacities; if the new German Länder were excluded, about 13 GW or 10% of CEE/CIS capacities would be equipped with FGD.

Further desulphurization units for 10.9 GW are under construction and will be operational by 2001-2003; by then, about 32 GW will be equipped with such facilities. This is 22% of CEE/CIS and 46% of CEE coal-fired capacity, including the former GDR. Fluidized bed boilers are also increasingly installed. Their capacity is not documented.

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[88]; UNECE, Prospects for coal utilization in the electric power sector of the Russian Federation, document ENERGY/WP.1/R.73/Add 3, p. 3 and 4; A. G. Tumanovskii, V. P. Glebov, Promising air protection technologies in power engineering, and A. G. Tumanovsky et alii, Improvement of fuel combustion technologies, papers submitted to the 60th American Power Conference, April 1998, Chicago

[89] IEA Coal Research, Air pollution control ..., op. cit. p. 47

[90] Frankfurter Allgemeine Zeitung, 9 March, 1999

Table 7: Coal in power generation

Country/region	coal-firing capacity in MW	capacity operating with FGD in 1998	additional FGD capacities under construction	share of 1998 coal production delivered to power stations, in%
Albania	35	-	-	-
Bulgaria	5000	-	460	45
Czech Republic	8500	5510	400	75
Estonia (shale)	1647	-	-	98
ex-GDR	9000	7600	2770	86
Hungary	1750	-	800	91
Macedonia	800	-	-	77
Poland	31 718	6600	3400	99 bc. / 32 hc.
Romania	7694	-	-	44
Slovakia	2000	-	220	48
Slovenia	1020	-	-	95
CEE	69 100	19 700	8050	72
Kazakhstan	13 900	-	...	…
Russia	39 000	200	...	50
Ukraine	23 000	215	...	50
CIS	75 900	415	...	50*
CEE/CIS	145 000	20 115	...	61
Sources: see country profiles; FGD = flue gas desulphurization				

iii. The perspectives beyond 2003: For CEE, the aim should certainly be to push the share of desulpherized coal combustion from the anticipated 46% by 2001-2003 to close to 100%; this is also true for the Ukraine, but not for Russia, where low-sulphur coals account for close to 80% of production (and more in power generation). This means that beyond 2003, 65-75 GW of coal-based power generation in the economies in transition need to be equipped with FGD.

iv. The obstacles: Coal properties as such are not the obstacle to introducing CCT, as evidenced by the experience of the ex-GDR, the Czech Republic and Poland. However, low-rank coal – predominant in CEE/CIS – requires highly site- and coal-specific solutions which increase cost and add uncertainty as to the reliability of operations; hence the tendency to apply proven and low-cost CCT. Large-size units (>250 MW) can be an obstacle.

The real bottleneck is finance in those countries that have not restructured or privatized their coal and electric power industries. If the Czech experience (CCT investment cost of 260$/kW)[91] were representative for the region as a whole, repowering and compliance with SO_2, NO_x and particulate standards for power stations and co-generation would require $18 billion in CEE and $20 billion in CIS, i.e. $38 billion for the region as a whole. Out of this total, $8 billion has already been spent, $4 billion is being invested, and $26 billion still need to be mobilized. If advanced super-critical and ultra-super-critical CCT were applied, the billion would be (only) 5% and 10% higher.[92]

Box 7: Multilateral funding of CCT

Azerbaijan: Mingechaur, EBRD $26.7M
Bulgaria: power sector refurbishment, EBRD $75M
Kazakhstan: Ekibastuz, EBRD $85M
Poland: Dolna Odra, IBRD $215M
Poland: Rybnik, IBRD $140M
Romania: 1000 MW, IBRD, and EBRD
Russia: Krasnodar, IBRD $510M
Slovakia: Vojany
Ukraine: Krivoj Rog, IBRD $166M and electricity market development, IBRD $300M

It is evident that the bulk of CCT funding has to come from domestic sources: here, external funding can play an important stimulating role. Funds have been forthcoming from multilateral banks such as the European Bank for Reconstruction and Development (EBRD) and the World Bank, but also bilaterally (e.g. from Germany to the Czech Republic, from Austria to Slovenia), from equipment manufacturers and from individual companies (e.g. the Dutch SEP restructured electricity transmission company which generated "activities implemented jointly" projects under the Kyoto Protocol in Poland and Romania).

v. The opportunities: But there are also opportunities offered by multilateral project finance and business. The transfer of technology and capital clearly depend on progress in restructuring of the coal industries: where this was accomplished or will be soon, technology and capital transfer proved sufficiently attractive for foreign investors and increasingly involved CEE/CIS design institutes and manufacturers.

Multilateral project finance was available particularly for refurbishing coal-based power plants**:**

- Azerbaijan: an EBRD loan of $26.7M for Mingechaur
- Bulgaria: an EBRD loan of $75M for power sector refurbishment
- Kazakhstan: an EBRD loan of $85M for Ekibastuz
- Poland: a World Bank loan of $215M for Dolna Odra and of $140M for Rybnik
- Romania: World Bank and EBRD support for refurbishing the power sector
- Russia: a World Bank loan of $510M for Krasnodar
- Slovakia: an EBRD loan for Vojany
- Ukraine: a World Bank loan of $160M for Krivoy Rog

[91] according to IEA Coal Research, Air pollution control ..., op. cit., p.39 ff, in 1995 typical capital cost ($/kW) were 160-240 for wet scrubbing, 140-170 for spray dry scrubbers, 80-90 for sorbent injection and (as regards NO_x control through selective catalytic reduction) 60-80 for new and 80-110 for old plants

[92] a 1997 survey of the IEA Coal Industry Advisory Board identified capital costs of CCT as follows: sub-critical or conventional pulverized fuel technology (166 bar/538^0 C) 294 $/kW, super-critical (240/538) 310 $/kW and ultra-super-critical PF (311/593 with wet flue gas desulphurisation and scrubbers) 323 $/kW

Apart from pre-financing equipment supplies, private foreign capital began to acquire equity:

- Power generators acquired equity in ex-GDR (MIBRAG), Hungary (RWE/EVS, AES ...), Poland (EDF - CHP Cracow-Lek) and Kazakhstan (Ispat-Karmet, AES, Access Industries, Sverdloenergo, Samsung, NTD, US Global Mineral Reserves, Ormat/National Power).
- In Romania and Poland, SEP (NL) initiated "activities implemented jointly" according to the Kyoto-Protocol.
- Joint ventures in equipment manufacturing for power plants were formed in most CEE/CIS countries, involving western partners such as SIEMENS and ABB
- For FGD in the Czech Republic, occasionally joint ventures were concluded between Czech companies and foreign suppliers: Bischoff, Mitsubishi, SHL (Germany), Marubeni-Chiyoda-Burmeister, Hoogovens, Steinmüller, IVO and Austrian Energy & Environment; for fluidized bed combustion with ABB-PBS Brno, ACC, Vitkovice-Lurgi-Babcock, Lurgi-Tlmace and Austrian Energy & Environment.[93.]
- For FGD in Poland, occasionally joint ventures were formed between Polish companies and foreign suppliers: HTS (NL), Rafako (Pl)-Steinmüller (G), FLS Miljo (DK), Holter Industrie Beteiligung (G), ABB-Flakt (Pl), Foster Wheeler (US); fluidized bed boilers by Rafako (Pl), Babcock, Stork Boilers, Rolls Royce, IVO, Burmeister-Wain Energi, Ecoenergia-Institute of Power Engineering; circulating fluidized bed boilers by Foster Wheeler and Rafako.[94]
- In Romania, IPROMIN seeks foreign partners to develop its CCT for small and medium-sized enterprises and domestic uses.[95]
- In Slovakia, foreign and domestic investors financed the desulphurization of four units of the Vojany and Novaky power plants (4 x 110 MW) and the first fluidized bed boiler at the Novaky Power Plant; the main contractor for Vojany was Austrian Energy & Environment, for Novaky: Tlmace-Lurgi.[96]

6.3 CLEAN DIRECT USES: DISTRICT HEATING AND INDUSTRIAL BOILERS

Compared with power stations and co-generation, international attention and regulation has been considerably less for district heating and briquetting plants, and for direct use of coal in industrial boilers (under 50 MW) or in houses. A draft EU Directive on Small Combustion Plant has been

[93] UNECE, Recent developments and preconditions for further implementation of clean coal technologies in the Czech Republic, document ENERGY/WP.1/R. 73/Add. 4/ of 18. 8. 1997, p. 6

[94] UNECE, Clean coal programmemes in Poland, document ENERGY/WP.1/R.73 of 25. 7. 1997, p. 4 and 5

[95] I. Stanciu, op. cit., p. 4

[96] Slovenske Elektrarne, Annual Report 1997, Bratislava 1998, p. 77

considered for some time, but remains dormant[97]. National legislation applies, which – while different – systematically allows higher emissions for "smaller" boilers.

Yet, these plants and boilers need attention for three reasons: for their huge number, for the difficulty of auditing their performance, and – where low-grade coal is used – for the need to apply CCT technologies suitable to their size. This is particularly true in the economies in transition, where energy-intensive industries, district heating, briquettes and direct use of solid fuel by industry and households play a much bigger role than anywhere else in the world: customers other than power and coking plants absorb about 200 Mt or 40% of total coal supplies. Plants and equipment are outdated, polluting and inefficient:

- In Albania, where pollution from coal burning by end-users is high, the future of coal use depends on the application of low-NO_x burners and fluidized bed technology in small industrial boilers.[98]
- In Bulgaria, 20% of the population is linked to district heating systems and 9% of coal production is earmarked for briquetting. Industrial coal-fed boilers are a major polluter.[99]
- In the Czech Republic, emissions from small combustion plants were 412 kt of SO_2 compared with 636 kt from power stations, and 138 kt of NO_x compared with 79 kt from power stations.[100]
- In Estonia, in 1997, there were 3674 boilers below 1 MW and 816 of 1-15 MW; 35% of all boilers run on coal, shale, peat or wood.[101]
- In Romania, CCT for small and medium-sized enterprises and for residential use have been evaluated but implementation rests on foreign partnerships and support.[102]
- In Russia, in eastern Siberia, there is a huge number of small coal-fired boilers, with low combustion efficiency and significant releases of hazardous substances into the environment. A programme to enhance boiler efficiency and rational use in the housing and public sectors in Sakhalin has been initiated.[103]

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[97] John Topper, Andrew Botting, Developments in environmental legislation and regulation relating to coal-fired plants, op. cit. p. 4

[98] National Committee of Energy, Energy report of Albania, op. cit., p. 18

[99] IEA Coal Research, Coal in Bulgaria, op. cit., p. 21

[100] IEA Coal Research, Coal in the Czech Republic, op. cit. p. 25

[101] EESTI Energetika 1997, p. 24

[102] see country profile in Part II; also I. Stanciu, J. Stratulat, Difficulties and achievements in the field of environment protection in the coal mining sector of Romania, manuscript

[103] S. Filippov and others, Main ways to enhance energy and ecological efficiency of coal-fired boiler-houses of small capacity, in: Center for Energy Efficiency (CENEf), Moscow, Energy Efficiency Quarterly, 23/1999; I. Bashmakov, Programmeme of energy efficiency improvement for the Sakhalin Oblast, 1999-2006, Energy Efficiency Quarterly, 24/99

- In China, there are some 500 000 small industrial and residential boilers mostly using coal. These boilers, often located in densely populated areas, consume around 400 Mt of coal and account for most of China's ground-level air pollution. With their low thermal efficiencies, they emit some 500 Mt of CO_2 annually and are responsible for over 36% of particulate and 39% of SO_2 emissions.

In sum: as and when pollution from power generation diminishes, direct users of coal become the number one polluter both in absolute and relative terms. Substituting natural gas for coal offers a long-term solution for densely populated areas, but is of little help in the short-term, in sub-urban and rural areas and in an economic environment where large front-end capital outlays for gas pipe infrastructure are not available.

6.4 CLEAN-UP OF MINING DAMAGE

Coal mining has serious environmental effects: pollution of rivers (acid mine drainage, saline discharges), lowering of water tables and pollution of ground water, special and hazardous wastes, subsidence, land disturbance, dust, spoil heap fires, methane accumulation. The coal industry has also the answers: back-filling, selective mining, improved coal preparation, closed water systems, re-use as construction materials, recultivation, soil decontamination, and methane drainage.

The apparent issue in CEE/CIS is funding. If the experience in the ex-GDR was representative for the region, $35-40 billion (or 27 $/t of 1990 production) would be needed to neutralise the impact of mining on water systems and land surfaces. While this amount corresponds to only 5.5% of one year of GDP in CEE/CIS, funding is insufficient in the more advanced reforming countries, and symbolic in the others. State funds are increasingly re-directed towards social protection, community needs and environmental damage generated before privatization and restructuring. The new owners have either not internalised the environmental cost of their activities or view it as a target for cost reduction:

- In Bulgaria, for lack of funding, wastewater from mining activities is a serious problem: hundreds of hectares of land around mines and power stations are contaminated by waste. Only 10% of the opencast mining area has been recultivated.[104]
- In the Czech Republic, during 1993-95, CZK 4.575 ($140M or 1.8 $/t of 1990 production) was allocated to rehabilitation; the original deadlines for undertaking recultivation were not met because of reduced state funding.[105]
- In the ex-GDR, from 1990-97, about half the required recultivation had been undertaken at a cost of DM 8 billion ($4.5 billion or 18 $/t of 1990 production); for 1998-2001, every year another DM 1.2 billion ($670M) is allocated from State funds to conclude recultivation, at an average cost of 20.7 $/t of 1990 production.[106]

[104] IEA Coal Research, Coal in Bulgaria, op. cit., p. 29

[105] UNECE, Restructuring the coal industry ... in central European economies in transition, op. cit., p. 9

[106] Der Kohlenbergbau in der Energiewirtschaft der Bundesrepublik Deutschland, op. cit., p. 26

- In Hungary, land reclamation in conjunction with the closure of mines is almost completed.[107]
- In Poland, funding aimed at improving coal quality and addressing the environmental legacy is considered inefficient.[108] Still, 14 new coal preparation plants have been put into operation, with another 14 planned.
- In Russia, the environmental performance of mining depends on mining regions, - the newer ones operate with "close to best international practices" (World Bank); restoration is estimated to cost $100 - 150M in the Kuzbass and perhaps $10M in each of the other surface mining areas.[109]

  In 1992, preparatory work began for the ecological certification of mining operations in accordance with the British Standard BS7750. It covers environmental control and nature management, atmospheric emissions, effluents, environmental effect, interaction with suppliers, and ecological strategies of mining companies (see country profile in Part II).
- In Slovenia, the Velenje coal mine was certified in 1998 for its mining activities according to ISO 9001 and will be certified according to ISO 14001 for environmental protection in 2000; the mine is planning to obtain a BS 8800 certificate for workplace health and safety in 2001 (see country profile in Part II).

6.5 ENVIRONMENTAL CLEAN-UP: THE RESULTS SO FAR

Environmental measures focus on air pollution control from large stationary sources. In countries that have introduced CCT, emissions fell considerably:

- In the Czech Republic, power sector emissions between 1993 and 1998 fell by 92% (SO_2), 53% (NO_x), 44% (CO) and 89% (fly-ash).[110]
- In the former GDR, between 1990 and 1997, SO_2 emissions from power stations fell by 79%, NO_x by 58% and dust by 99%.[111]
- In Poland, 14 coal preparation plants have been refurbished and another 14 commissioned. For the period between 1980 and 2000, emissions from energy sources are expected to fall as follows: SO_2 by 41%, NO_x by 37%, dust by 77%, CO_2 by 12%.[112]

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[107] UNECE, Restructuring the coal industry ... in central European economies in transition, op. cit., p. 9

[108] UNECE, Clean coal technology in Polish hard coal mining, document ENERGY/WP.1/R.73/Add. 1 of 18 August 1997, p. 4

[109] IEA, Coal prospects in Russia, op. cit., p. 44

[110] M. Vlcek, T. Spilkova, The environmental programme of the Czech power industry, in "Energy in the Czech Republic", publication of the WEC National Committee of the Czech Republic, 1998

[111] communication by VDEW - Vereinigung Deutscher Elektrizitätswerke

[112] Ministry of Industry and Trade, Energy policy guidelines for Poland to 2010, Warsaw 1995, p. 54

Table 8: Emission limits for a new plant mg/m^3

Country	Particulates	SO_2	NO_x
Bulgaria	50-100	400-2000	650-1300
Czech Republic	100-150	500-2500	650-1100
Germany	50-150	400-2000	200-500
Hungary	50-100	400-2000	200-600
Poland	190-3700	540-1755	95-460
Romania	100	400-2000	400-500
Slovakia	50-150	400-2500	550-650
Slovenia	50-150	400-2000	200-500
European Union	50-100	400-2000	650-1300
Source: IEA Coal Research, Bulgaria, op. cit., p. 31			

In the other countries, emissions stabilized or decreased under the impact of the recession:

- In Bulgaria, emissions from power stations stabilized due to decreasing demand and a higher share of nuclear power in total supply.[113]
- In Estonia, pollution from all stationary sources fell between 1990 and 1996 as follows: CO by 50%, SO_2 by 52%, and NO_x by 29%.[114]
- In Hungary, emissions from power plants stabilized during 1990-1997, with a slight increase in SO_2 emissions.[115]
- In Slovakia, emissions from the national power company – Slovenske Elektrarne – in 1993-97 for the most part fell: ash -16%, SO_2 -33%, NO_x - 4%, but CO rose 51%.[116]

A comparison between the two groups of countries shows that the correlation between declining GDP and falling emissions observed in the earlier 1990s has been broken recently in CEE. GDP is rising again in this region, but emissions continue to fall. What really mattered were specific CCT measures applied to coal mining and combustion. This lesson might also apply to reducing CO_2 emissions by either general or specific measures: indeed, compared to the more general (and hence more drastic) methods of reducing CO_2 emission through carbon taxes, CCT offers a cheaper, faster and more focussed alternative for the economies in transition. It offers additional advantages in terms of local environmental cleanup, increased efficiency and revitalization of the coal industry, hence of social and regional revival.

CCT offers a cheaper, faster and more focussed alternative to ... carbon taxes.

6.6 THE TASK AHEAD

[113] Black Sea Regional Energy Center, Bulgaria, op. cit. p. 27

[114] EESTI Energeetika 1994-1996, op. cit., p. 28

[115] MVM Statistical Data 1997, Budapest 1998, p. 40

[116] Slovenske Elektrarne, Annual Report 1997, op. cit., p. 81

The status of CCT deployment in the economies in transition requires continued attention by all actors:

- governments must:
  - pursue restructuring,
  - assume liability for past damage,
  - support CCT test and demonstration projects,
- Environmental agencies must:
  - pay greater attention to direct burning of coal,
  - adopt international standards for small industrial and residential boilers
  - tighten emissions standards and calendars for existing installations and to enforce them.
- Industry:
  - New owners: must internalize environmental obligations
  - National CCT designers and manufacturers must enlarge their CCT knowledge and business base including through joint ventures
  - suppliers of CCT must become aware of the emerging CCT market for small boilers below 50 MW, but also of the need to offer financing packages
- UN/FCCC, IEA...
  - must realize the merits of CCT compared with more general, hence more drastic measures with uncertain effects such as carbon taxes

7 THE INTERNATIONAL DIMENSION: FROM SUPPORT TO BUSINESS

Was coal industry restructuring and privatization in CEE/CIS an international issue? If so, why? What types of cooperation developed and in what sequence? Has the process lead to significant involvement of foreign investors?

In 1999, some 90 Mt of coal production and 17 GW of power production are owned by foreign investors. The winning ticket was investment in power plants and associated mines at (an initially low) cost of $1 -1.5 billion.

7.1 ASSISTANCE: TRANSFER OF KNOW-HOW

The international efforts to support the reform of the coal industries in CEE/CIS have been immense and, at times, frustrating. But motivations on both sides remain strong: furthering economic integration, securing unbiased competition on European coal markets, reducing transboundary air and water pollution, and enabling business. The resulting transfer of information has been huge and adequate, but exclusively east-west, with little or no co-operation east-east.

International cooperation expanded from assistance to foreign investments in line with needs and circumstances. Assistance was the first step:

- In the early stages of reform, the governments of Germany and Austria offered financial assistance to upgrade near-border power plants in the Czech Republic and in Slovenia, respectively.
- Several countries had their lignite tested in fluidized boilers in Austria, Germany and the United Kingdom.
- All CEE/CIS power companies benefited from twinning arrangements with Western power generators when planning restructuring and refurbishing.
- Georgia contemplated the acquisition of an inexpensive second-hand German thermal power station equipped with air pollution control.[117]
- The Japanese Energy Agency donated an accelerator using electron-ray technology with ammonia as active absorbent of sulphur and nitrogen oxides[118] to Bulgaria.

[117] UNECE, Clean coal programmeme in the Republic of Georgia, document ENERGY/WP. 1/R. 73/Add. 5, of 5. 8. 1997

[118] UNECE, Seminar on restructuring of the coal industry ..., op. cit., p. 8

7.2 POLICY ADVICE: ENHANCING MARKET-ORIENTED REFORMS

Market-oriented reform required that policies be redesigned:

- The EU PHARE programme undertakes and finances feasibility studies, furthers institution building and EU approximation of national legislation, and provides policy recommendations in central Europe. From 1990-96, PHARE spent ECU 4.505 billion ($4.1 billion) on power engineering issues in CEE.[119]
- The EU TACIS Programme pursues the same objectives in the CIS as PHARE in CEE.
- UNECE, through its ad hoc Group of Experts on Coal and Thermal Power and its predecessors, undertakes studies and seminars on mining legislation, coal industry restructuring and clean coal technologies in the economies in transition.
- The World Bank undertakes feasibility studies and offers policy advice in conjunction with loans.
- The IEA Coal Industry Advisory Board, through its Committee on East and Central Europe and the CIS, surveys coal industry development in CEE/CIS.

7.3 RESTRUCTURING LOANS: BACKING BROAD GOALS

Multilateral funding organisations contributed loans in support of broad reforming goals:

- The IMF supported CEE/CIS economies with loans to support monetary and macro-economic stabilization
- Russia was offered a $520M World Bank loan in 1996[120] for coal industry restructuring and, in 1999 another loan of $400M for social support and privatization of the coal industry.[121]
- In Romania, the World Bank intends to give a loan to assist the restructuring of the mining sector.[122]
- The Ukraine, in December 1996, was offered a $300M World Bank loan to restructure its coal industry. A first instalment of $150M was released; Ukraine failed to meet the terms of the loan agreement and further releases were stopped. The remaining $150M was ready for release in 1999, pending approval of a renegotiated agreement by all parties.[123]

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[119] J. Poucek, PHARE programmeme in power engineering and integration with the European Union, in WEC Czech Republic "Energy in the Czech Republic", Prague, 1998, p. 5

[120] IEA Coal Research, Coal prospects in Russia, op. cit., p. 30 and 31

[121] International Coal Report, 6 February, 1999

[122] APER Monthly News Bulletin, 24 October, 1998

[123] International Coal Report, 6 February, 1999

7.4 PROJECT FINANCE: SUPPORTING ACTION IN THE FIELD

The transfer of technology and capital clearly depended on progress in restructuring the coal industries: where this was accomplished, or within view, technology and capital transfer proved sufficiently attractive for foreign investors and increasingly involved CEE/CIS design institutes and manufacturers. Multilateral project finance was available particularly for refurbishing coal-based power plants:

- Azerbaijan: an EBRD loan of $26.7M for Mingechaur
- Bulgaria: an EBRD loan of $75M for power sector refurbishment
- Kazakhstan: an EBRD loan of $ 85M for Ekibastuz
- Poland: a World Bank loan of $215M for Dolna Odra and of $140M for Rybnik
- Romania: World Bank and EBRD support for refurbishing the power sector
- Russia: a World Bank loan of $510 for Krasnodar
- Slovakia: an EBRD loan for Vojany
- Ukraine: a World Bank loan of $160M for Krivoy Rog

7.5 FOREIGN DIRECT INVESTMENTS: ENABLING BUSINESS

Apart from pre-financing equipment supplies, private foreign capital began to acquire equity.

7.5.1 Coal mining

- Foreign companies acquired equity in the ex-GDR (MIBRAG), Hungary (Tractebel, AES, RWE/EVS(EnBW)/Rheinbraun) and Kazakhstan (Ispat-Karmet, Access Industries, Sverdloenergo, Samsung, NTD, US Global Mineral Reserves)
- In Poland and Ukraine, joint ventures in methane extraction were initiated (but were not successful).
- In Russia, Japanese investors are reported to contemplate a loan of $400M to invest in Siberian mines.

7.5.2 Coal preparation

- In Poland, as most of the equipment for refurbished or new coal preparation plants was foreign, joint ventures have been formed.[124]

7.5.3 Combustion

- Foreign companies acquired equity in the ex-GDR (MIBRAG), Hungary (RWE/EVS, AES ...), Poland (EDF - CHP Cracow-Lek) and Kazakhstan (Ispat-Karmet, AES, Access Industries, Sverdloenergo, Samsung, NTD, US Global Mineral Reserves, Ormat Industries).
- In Romania and Poland, SEP (NL) initiated "activities implemented jointly" according to the Kyoto-Protocol.
- Joint ventures in equipment manufacturing for power plants were formed in most CEE/CIS countries, involving Western partners such as SIEMENS and ABB.

[124] UNECE, Clean coal technologies in Polish hard coal mining, document ENERGY/WP.1/R.73/Add.1, of 18. 8. 1997, p. 4 and 5

7.5.4 Infrastructure

- In Russia, foreign investors contributed 80% of the financing of the $166M coal terminal at Ust-Luga near St. Petersburg; Krupp-Fördertechnik (G) supplies the loading equipment.

7.5.5 Clean coal technologies

- In the Czech Republic, for flue gas desulphurization, occasionally joint ventures were concluded between Czech companies and foreign suppliers Bischoff, Mitsubishi, SHL (Germany), Marubeni-Chiyoda-Burmeister, Hoogovens, Steinmüller, IVO and Austrian Energy & Environment; for fluidized bed combustion, with ABB-PBS Brno, ACC, Vitkovice-Lurgi-Babcock, Lurgi-Tlmace and Austrian Energy & Environment.[125]
- In Poland, for flue gas desulphurization, occasionally joint ventures were formed between Polish companies and foreign suppliers: HTS (NL), Rafako (Pl)-Steinmüller (G), FLS Miljo (DK), Holter Industrie Beteiligung (G), ABB-Flakt (Pl), Foster Wheeler (US); fluidized bed boilers by Rafako (Pl), Babcock, Stork Boilers, Rolls Royce, IVO, Burmeister-Wain Energi, Ecoenergia-Institute of Power Engineering; circulating fluidized bed boilers by Foster Wheeler and Rafako.[126]
- In Romania, IPROMIN seeks foreign partners to develop its CTT for small and medium-sized enterprises and domestic uses.[127]
- In Slovakia, foreign and domestic investors financed the desulphurization of two units of the Vojany Power Plant (2 x 210 MW) and the first fluidized bed boiler at the Novaky Power Plant; the main contractor for Vojany was Austrian Energy & Environment, for Novaky: Tlmace-Lurgi.[128]

However selective the above list may be, coal industry restructuring in CEE/CIS is no "terra incognita" for the international business community: in 1999, some 90 Mt of coal production and some 17 GW of coal-based power generation in Kazakhstan, Hungary, Poland (CHP) and the ex-GDR are owned by foreign investors; this is around 20% of coal production and 12% of coal-fired power generation in CEE/CIS. The winning ticket was investment in power plants and associated mines at an initially cheap $1-1.5 billion.

[125] UNECE, Recent developments and preconditions for further implementation of clean coal technologies in the Czech Republic, document ENERGY/WP.1/R. 73/Add. 4/ of 18. 8. 1997, p. 6

[126] UNECE, Clean coal programmes in Poland, document ENERGY/WP.1/R.73 of 25. 7. 1997, p. 4-5

[127] I. Stanciu, op. cit., p. 4

[128] Slovenske Elektrarne, Annual Report 1997, Bratislava 1998, p. 77

7.6 TRADE: COMPETITION FROM THE WORLD MARKET

7.6.1 Slowly eroding net exports

Coal exports were an appreciated earner of hard currency under the socialist regime, whatever the cost. In 1986, Poland earned 23% of its total hard currency revenues this way.[129] No wonder that exports were planned, to rise in 1980, and to attain 38 Mt (CEE) and 50-90 Mt (USSR), respectively by 1990.[130]

However, realities were different (see Table 9): market reforms and cost awareness brought about a decline of coal net exports of 15% in 1988-1997 (which is rather modest compared with the decline of production of 41%).

Table 9: Exports/imports of hard coal from/to CEE/USSR, 1975-1997 in Mt

	1975	1980	1988	1997
Exports from				
CEE	37.7	30.4	31.7	36.1
of which CSSR	6.0	5.6	3.8	1.6
Poland	31.7	24.8	27.5	29.5
USSR/CIS	22.9	24.8	31.7	21.0
Total	60.6	55.2	63.4	57.1
Imports by				
CEE	17.0	18.1	20.1	21.1
of which Bulgaria	4.9	5.3	5.3	3.1
CSSR	4.6	4.3	4.3	2.2
Hungary	2.3	2.5	2.7	2.8*
Poland	0.9	0.8	1.0	3.2
Romania	4.3	5.2	6.8	4.8
USSR/CIS	9.8	5.2	6.7	5.0+
Total	26.8	23.3	26.8	26.1
Net exports	33.8	31.9	36.6	31.0

Note: for 1997, trade between the Czech Republic and the Slovak Republic, and between CIS countries has been disregarded in order to be comparable with 1975, 1980 and 1988
Sources: for 1975, 1980 and 1988: UNECE, Energy reforms in central and eastern Europe - the first year, New York 1991, annex; for 1997: IEA Coal Information 1997, Paris 1998, p. I.128 ff; Statistik der Kohlenwirtschaft, Der Kohlenbergbau in der Bundesrepublik Deutschland im Jahre 1997, Essen 1998, table 101; UNECE, Coal demand and supply in the ECE region in 1997, document ENERGY/GE.1/1998/4 of 27 July 1998; * = estimate; + = 1996

At the same time, world coal trade expanded by 43%. Interestingly, coal imports by CEE/CIS

[129] (UK) House of Commons, Session 1988-1989, Energy Committee; testimonial of K. Brendow on "Development prospects of east-west energy trade", 10 May, 1989

[130] UNECE, The energy economy in Europe and North America, in Economic Bulletin for Europe, vol. 33/no. 2 of June 1981, p. 223

customers remained practically unchanged which suggests a shift in favour of world market coal; in 1997, 6 Mt were imported from non-CEE/CIS sources. As a result, the net export position of the European transition countries on the world coal market declined: from 10% in 1988 to 6% on 1997.

7.6.2 Anticipated developments

In CEE, chances are that the slow decline of exports and the modest increase of supplies from the world coal market will continue in the short- and medium-term (2010). In the longer-term, only a generalized nuclear phase-out in western Europe and a notable rise of gas prices are likely to change this outlook for central European and foreign exporters.

- In Poland, exports are largely unprofitable due to high railway rates and low world market prices. The loss (i.e. the difference between export revenues and cost of production) exported was $11/t in 1996. Dredging the Odra would be a long-term option to reduce transportation costs, and is actively pursued by the government, whose "Odra 2005" programme aims to double throughput on the river. The present strategy consists of defending domestic and neighbouring markets while retreating from international markets. The competitive range of Polish coal is said to be 200 km from major ports which corresponds to 600-800 km from Polish mines. The government's 1996 restructuring plan aims to reduce of exports from 29.5 Mt in 1995[131] to 20 Mt by 2000, and 10 Mt in 2007.
- Czech exports of coking coal (2/3) and steam coal (1/3), competitive as such, depend on the uncertain future of neighbouring iron and steel industries, declining direct uses and dedicated power stations whose fate in turn depends on compliance with air pollution standards.

In the CIS, Kazakhstan and Russia try to turn the tide:

- In Kazakhstan, which exported 26 Mt (net) in 1997, exports will be 10 - 41 Mt in 2010.[132]
- In Russia, investments are undertaken to raise coal exports from 22 Mt in 1997 to possible 36-38 Mt[133]; in 1999, the construction of the new 8 Mt coal terminal at Ust-Luga near St. Petersburg should be commissioned; this terminal is designed to ship coal from the Kuzbas to customers in the region. Railway freight rates that had increased 14 000 times and practically "killed" coal exports have been reduced.[134] Modern storage facilities to handle high-quality blast-furnace coal and steam coal are envisaged at the Slovak border, in Ushgorod. A new port is built at Novy on the Black Sea; for 2010, net

[131] IEA CIAB, Committee on East and Central Europe, East and central European coal industry issues: an international perspective, Madrid/Paris 1997, p. 14 f; UNECE, Clean coal technologies in Polish hard coal mining, document ENERGY/WP.1/R.73/Add.1 of 18. 18. 1997, p. 3

[132] UNECE, Present situation and prospects for the fuel and energy complexes in the countries of the CIS, document ENERGY/R.131/Add.1 of 26 September 1996, table 5

[133] UNECE, State of and prospects for coal exports in the Russian Federation, document ENERGY/WP.1/R.40/Add.1 of 12 July 1995, p. 5

[134] Edward Adamovsky, Ust-Luga - new transport hub, in International Bulk Journal, Febr. 1998; UNECE, Restructuring of the coal industry and thermal power sector in the CIS, document ENERGY/1998/15 of 30 July 1998, p. 6

exports of 7-8 Mt are foreseen

- The Ukraine, a net exporter in the past, has turned net importer for lack of price competitiveness; this does not exclude export opportunities for selected existing or new anthracite and coking coal mines as explored by Australia's CCI Holding,[135] but prospects for a general reversal depend on the (so far delayed) restructuring of the coal industry. Net imports of 1-7 Mt are foreseen for 2010.

By 2000 and 2010, falling exports and rising imports from outside the region will marginalize CEE/CIS coal as a player on the world market.

Table 10: Projected CEE/CIS hard coal trade 2000, 2010 in Mt

	1973	1980	1997	2000	2010
Imports					
CEE	17	18	21	20	30
CIS	11	5	5	2	2
Total	28	23	26	22	32
Exports					
CEE	39	30	36	27	30
CIS	29	25	21	20	20
Total	68	55	57	47	50
Net exports					
CEE	22	12	15	7	-
CIS	18	20	16	18	18
Total	40	32	31	25	18

For 2000 and 2010, IEA forecasters[136] confirm the trends of falling CEE/CIS coal exports. CEE imports from outside the region will rise (as shown above). Exports from the CIS (essentially Russia) are projected to stagnate at 18 Mt [137]. At the same time, world coal trade will grow from 505 Mt in 1997 to 853 Mt in 2010, thereby marginalising CEE/CIS coal as a player on the world market. By 2010, the region's share of global exports will fall to 6% and 4% for global imports.

[135] International Coal Report, 2 June 1997

[136] IEA, Coal Information 1997, op. cit. p. I.150

[137] an intergovernmental group of CIS experts estimated net coal exports of Russia for 2010 at 7-8 Mt and for the CIS as a whole at 12-47 Mt; UNECE, Present situation and prospects for the fuel and energy complexes in the CIS, document ENERGY/R. 131/Add. 1 of 26 September 1996, table 5

8 THE PROSPECTS: COAL - A REVITALIZED PLAYER

Assuming economic recovery and completed coal industry restructuring, what would be the role of coal in central and Eastern Europe by 2010, 2020, 2050? Is there a light at the end of the tunnel of coal industry reform?

Between 1997 and 2010, coal production will increase by one third in the CIS , and stabilize at about 80% of present levels in CEE where imports will double. Market shares of coal in electricity generation need not necessarily erode in favour of gas.

8.1 PROSPECTS TO 2005

A short-term projection results from the contention in Chapter 5.4 and Table 5 that by 1997 some 80-90% of coal production had become actually or virtually "viable". This implies the need for a further reduction (mainly of hard coal) of about 10% or 130-150 Mt to a production level of 700-720 Mt. There would be a decline in CEE, and an increase in the CIS. The suggested adjustment does not preclude, indeed is a precondition for, a possible rise in coal production thereafter, prompted by the hoped-for economic recovery in the CIS.

8.2 PROSPECTS TO 2010

For 2010, national authorities foresee coal production in the region as a whole of 760-862 Mt, – a net increase of 16-118 Mt or by 2-16% in comparison with 1997. However, this overall total covers diverging trends, with production declining in CEE by 18-22% and increasing in CIS by 23-45% (see Table 11):

- The Czech government has developed two scenarios, one resulting in practically phasing out coal production by 2040, the other anticipating a decline of only one third. Reserves suffice to support continued production of coal, the use of which depends largely on the application of clean technologies.
- In the ex-GDR, brown coal production is expected to stabilize around 65-75 Mt/year.
- The government of Kazakhstan anticipates growth in coal production of 60-100% in 1997-2010.
- The Polish government, in its 1998 "Programme of the Reform of the Hard Coal Mining Industry in Poland for the Years 1998-2020" opted to reduce hard coal production from 116.9 Mt in 1998 to 105 Mt in 2005 and 92 Mt in 2010.
- For Russia, see country profile in Part II.
- The Ukrainian government projects coal production to rise by about 40% in1997-2010.
- For the CIS as a whole, a group of government experts projects coal production to rise from 426 Mt in 1995 to 538-624 Mt in 2010 and net exports to range from to 12 to 47 Mt in 2010 compared with 21 Mt in 1997.

Table 11: Production outlook to 2010 by country in Mt

Region/country	1997	2010	2020	2040
CEE				
Czech Republic	71	53-56	44-53	45-47
ex-GDR	74	65-75	...	...
Poland, brown c.	63	63	62	
hard c.	138	92	81	
sub-total above	346	273-286	...	...
CIS				
Kazakhstan	78	125-155	...	...
Kyrgistan	0.3	2	...	...
Russia	239	250-300	400-500	...
Tajikistan	-	1	...	...
Ukraine	76	105-110	...	...
Uzbekistan	3.6	5-8	...	...
sub-total above	397	488-568	...	...
CEE/CIS	743	761-854	...	...
1997 = 100	100	102-115		

Sources: UNECE, Recent development and preconditions for further implementation of clean coal technologies in the Czech Republic, op. cit., p. 5; Der Kohlenbergbau ..., op. cit., p. 25; Polish Member Committee of the WEC, The energy sector in Poland, Cracow 1999, pp. 8, 9, 37, 40; country profile Russia; UNECE, Present situation and prospects for the fuel and energy complexes in the countries of the CIS, op. cit., table 5.

8.3 PROSPECTS TO 2020 AND 2050

8.3.1 The WEC/IIASA view

The 1998 WEC/IIASA study "Global Energy Perspectives" attempts to give an energy outlook for CEE and CIS to 2020 and 2050, assuming that by 2020 the 1990 GDP/capita ratios would have been reached again in CIS and exceeded in CEE. Six scenarios were designed, of which scenario A_2 ("high economic growth, coal-based"), C_2 ("ecologically driven") and B ("business-as-usual") are shown in Table 12 overleaf.

Taking scenario B as a mid-range projection: coal's share in the region's primary energy supplies would drop from 25% in 1990 to 22% in 2020 and 16% in 2050. Production would fall from 444 Mtoe in 1990 to 371 Mtoe in 2020, but stay at that level through 2050. This would be an overall decline of 18%. (Between 1990 and 1998, production already fell by 41%. This scenario implies an increase of coal production through the remainder of the projection period of 25% [41-16%] on average or 320 Mtoe).

Table 12: Production outlook to 2020 and 2050: the WEC/IIASA view in Mtoe

	1990	2020			2050		
		A2	B	C2	A2	B	C2
CEE	159	181	130	110	185	135	40
CIS	285	313	241	159	457	236	5
CEE/CIS	444	494	371	269	642	371	45
WEC/IIASA, Global Energy Perspectives, Cambridge 1998, appendix							

In the coal-based scenario A_2 , coal production would rise from 444 Mtoe in 1990 to 494 Mtoe in 2020 and 642 Mtoe in 2050 (implying an even greater increase during the remainder of the projection period than in scenario B: 680 Mtoe and 1100 Mtoe, respectively).

In the ecologically driven scenario, carbon dioxide emissions (which are below Kyoto-agreed limits) would be reduced by two thirds by 2050, thereby practically phasing-out coal.

In all scenarios, coal's most important customers would be power stations. Coal's share in electricity generation, at 32% in 1990, would rise in scenario A_2 to 36% by 2020 and in scenario B to 38%, but fall in scenario C_2 to 23%.

8.3.2 The IEA view

IEA's World Energy Outlook 1998 describes a business-as-usual projection for 2020 for CEE/CIS. Compared with WEC/IIASA [138], the IEA assumes faster GDP growth and, hence, faster growth of primary energy demand, but lower growth in efficiency. For coal, the results do not differ. IEA records a decrease of solid fuel supplies from 412 Mtoe in 1990 to 300 Mtoe in 1995, and projects an increase of 357 Mtoe in 2010 and 360 Mtoe in 2020 (WEC/IIASA, Case B: 371 Mtoe in 2010). During the whole of 1990-2020, this implies a decrease of 19% compared with 16% in scenario B of the WEC/IIASA study. The US Department of Energy also projects a 16% decrease.[139]

According to IEA's outlook, coal's share in the primary energy balance would fall from 26% in 1990 to 22% in 2020, and in the electricity balance from 31% (1995) to 23% (2020). But in absolute terms, electricity generated from coal would increase from 498 TWh in 1995 to 770 TWh in 2020, implying a significant increase of coal supplies, close to 50%. By contrast, direct use of coal in households and under industrial boilers is expected to fall from 171 Mtoe in 1990 to 120 Mtoe in 2020. The main competitor for coal will be gas.

[138] it will be noted that base year (1990) data differ between the two studies, reflecting the deficiencies of the data base

[139] USDOE, Energy Outlook 1998, Washington, 1998, Table A2, p. 134

Clearer than the WEC/IIASA study, whose base year is 1990, the IEA anticipates a recovery of coal production for the CEE/CIS as a whole during 1995-2020, and a significant increase of supplies to power stations, while being less optimistic as to the share of coal in power generation.

Table 13: Outlook to 2020: the IEA view in Mtoe

Item	1990	1995	2010	2020
GDP, $(1990) billion, ppp	1550	1369	2146	3066
primary energy supplies	1584	1154	1429	1664
of which coal, Mtoe	412	300	357	360
or%	26	26	25	22
Source: IEA World Energy Outlook, Paris, 1998, chapter 14				

8.4 A SYNTHESIS: SHARED EXPECTATIONS AND NUANCES

The international ("top-down") and national ("bottom-up") analyses reviewed above agree in anticipating an increase of coal production in the region as a whole between actual production by 2010 and 2020. As shown in table 14, the increase for 1997-2010 lies between 2 and 19%, say 10%, with prospects for further growth by 2020 (1997-2020: 15%).

Table 14: Synthesis of coal production projections to 2020

Region	1997-2010		1996-2020 WEC/IIASA (B)
	IEA	national	
CEE	...	- 17 to -23	-11
CIS	...	+ 23 to +43	+36
CEE/CIS	+19	+2 to +15	+15

The projected increase reflects an assumed increase of economic activity and primary energy needs and completed coal industry restructuring.

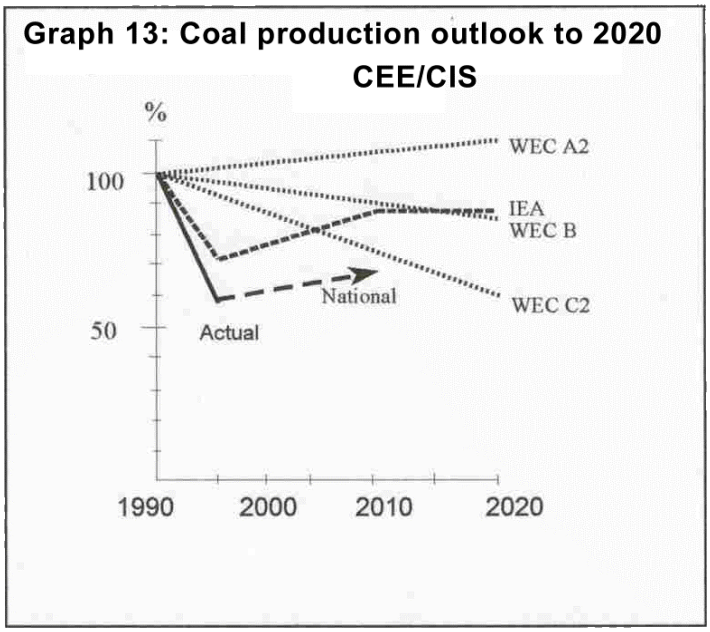
The analyses also agree in anticipating developments to diverge between CEE (a decrease of, say 20%) and the CIS (an increase of one third). The difference can be attributed to the adoption of tighter environmental standards and notable competition from gas in CEE, whereas coal production in the CIS would benefit from economic recovery, better geological conditions[140] and a policy reappraisal of coal versus gas as a power-generating fuel.

[140] in Russia, the share of opencast production in total production will rise from 57% in 1993 to 75% in 2005; see country profile in Part II

As seen in (chapter 7.6 above) to some extent, CEE compensates the decrease of domestic coal production by doubling coal imports (Table 10) and that CIS producers intend to raise exports by 15% between 1997 and 2010.

In sum: by 2010, when coal industry restructuring has long been concluded, additional supplies of domestic coal of about 33% or more (compared to present levels) would be needed in CIS, and 20% less than presently produced in CEE. By then, coal will be better equipped to compete with gas in power generation and, with economic recovery, might take a fresh look at its long-term perspectives.

Graph 13: Coal production outlook to 2020



9 POLICIES AND BUSINESS STRATEGIES: CONCLUSIONS

What are the lessons for policy makers and business leaders? What are the policy priorities now, ten years after the beginning of reforms? Should existing business commitments be expanded, new ones initiated? If so, which ones?

As reforms progress and address the remaining issues, more businesses will feel that the time has come to have a fresh look at existing or new commitments.

"The worst is over." This is the general impression that emerges from the previous analysis. Surely, this appraisal, which many will still consider as optimistic, does not apply to each and every country. Nor does it mean that the difficulties are overcome. What it means is that decisive, qualitative progress has been made in terms of

- **determination:** governments have determined goals, priorities, institutions and means of action as firmly as this can possibly be done on a sensitive policy issue;
- **predictability:** direction, sequence and calendars of coal reforms have emerged clearly – a precondition for business involvement;
- **acceptability:** earlier resistance of industry and trade unions has diminished as governments developed a better balance between social protection, regional conversion and industrial restructuring;
- **conversion:** the various national approaches are increasingly "federated" by EU energy policies and directives, in particular the Commission Directive on State Aid to the Coal Industry.

In a nutshell: the industry whose image, thrust and viability has been affected, and deeply so, by a decade of immense economic, social and environmental difficulties, does see the light at the end of the tunnel.

Thus, a fresh appraisal of its further perspectives appears justified, indeed necessary. All the more so as the cards are reshuffled on the global and European energy scenes: the reappraisal of natural gas as a power-generation fuel in the CIS, the role of nuclear power in various west European countries, or emerging technologies not only for mitigating but also sequestering CO_2, may be quoted as evidence.

However, benefiting from achievements and new constellations requires action at the governmental and industry level.[141]

[141] for a broad discussion of measures required, see UNECE: Coal in sustainable energy development - recommendations for a coal strategy, doc. ENERGY/GE.1/1999/5, of 16 August 1999

9.1 AT THE GOVERNMENTAL LEVEL

Governments still play the determining role in coal industry restructuring. The analysis of their role in the previous chapters suggests that they

- emphasize success rather than difficulty; the road already covered in modernising the coal industry and in raising its viability, has been long (at present, already 80% of production is "viable" locally or at the national level, while not being "profitable" in international terms);
- stress the potential of a restructured coal industry in terms of covering power station demand, diversity and security of supplies and environmental protection standards;
- conclude reforms and respect their calendar – a precondition for private investors to plan their own commitments;
- strengthen (top-down) legislative and regulatory frameworks and institutions at the governmental level and (bottom-up) management responsibilities and skills at the industry level;
- encourage private investors; the approach "unbundling profitable from unprofitable mines + customerization of mines with power stations and steel works + equity privatization" has proven superior to "bundling of all mines + state ownership + mass or voucher privatization";
- secure funding of social security and regional conversion programmes;
- dispense the industry from past ecological and financial liabilities so as to enable profitable operation and privatization, and attract investors;
- resolve the payment crisis, which impedes restructuring and investments;
- enhance and enforce implementation of emission standards including for small- and medium-sized coal-fired boilers, so as to protect the environment and markets for coal;
- phase-out indirect and cross subsidies when aiming to join the EU.

9.2 AT THE BUSINESS AND INDUSTRY LEVELS

On their part, the coal industries and related businesses (utilities, iron and steel works, equipment manufacturers, strategic investors, energy service companies) have every interest to

- take seriously the prospect of a continued albeit reduced role for coal in CEE;
- note the prospect of rising coal supply and production in CIS, driven by economic recovery, increasing electricity demand and a reappraisal of the role of gas as a generating fuel;
- continue to adapt to competition; reduce cost; improve product quality;
- raise profitability; as-yet-unexploited potential productivity resulting from redundancies is significant (+ 30%): fresh investments promise to liberate this potential rather quickly;
- explore alliances with customers and strategic investors: already 20% of mining capacity in the region is investor-owned;.
- enhance skills in mine management;
- undertake ecological, health and safety certification according to ISO and BS standards;
- explore new trading possibilities given CEE's reduced role as a net exporter of coal, possibly in conjunction with independent power producer projects

- pursue already dense business relations in mining machinery, clean coal technologies, methane drainage and ecological clean-up of past mining, processing and combustion activities;
- open a new market: upgrade/replace tens of thousands of obsolete, inefficient and polluting small- and medium-sized coal-fired boilers.

Investing in the coal industry and related businesses is a long-term undertaking. Many businesses have already committed themselves despite uncertainties and difficulties. Others may now feel that the time has come to take a fresh look as "there is light at the end of the tunnel".

PART II
COUNTRY PROFILES

ALBANIA [142]

1 GENERAL

In Albania, coal production fell from around 2 Mt in the 1980s to 0.04 Mt in 1997, due to the collapse of demand, unprofitability of production and bad quality. Coal's future is bleak, except perhaps for power generation. Restructuring implies the closure of mines, improved processing and briquetting of coal, the reduction of the labour force and clean coal combustion. Coal mines have been commercialised, but remain under the authority of the Ministry of Mineral Resources and Energy. Their privatisation, including to foreign investors, is legally possible but unlikely seen the lack of competitiveness.

2 GEOLOGY

The geological conditions are difficult, with unpredictable inclines and high pressure in the surrounding rock. Layers are 0.4 to 0.7m thick only and located in seams at 400m depth. Total coal reserves are estimated at between 350 Mt to 712 Mt; the lower estimate disregards seam thickness less than 0.7m.

The coal reserves are located in four major basins:

- Basin of Tirana-Durres, accounting for 613 Mt, with an average heating value of about 3130 kcal/kg and seam thickness less than 0.7m
- Basin Pogradec, accounting for 33 Mt, with an average heating value of 3100 kcal/kg
- Basin Memaliaj, accounting for 30 Mt, with a heating value of 4900 kcal/kg
- Basin Korce-Ersek, accounting for 32 Mt, with a heating value of 2800 kcal/kg.

Most coal resources are brown coal or lignite of poor quality. During the production process, the quality is further reduced by non-mineral contamination. The obsolete extraction technology raises losses and reduces the heating value as produced to less than 3000 kcal/kg, with an ash content of 38-62% and sulphur content of 3.1 to 3.8%.

Albania has also some peat resources, however its exploitation is not profitable.

3 MINING

High production costs, poor coal quality and difficult mining and geological conditions were the major constraints in making the domestic coal sector prosperous and economically viable in the longer term. The closure of mines started in 1990, when there were 19 mines in operation. This number has fallen to 5 in 1997. Coal production has declined continuously from 2.07 Mt in 1990 to 0.11 Mt in 1995 and 0.035 Mt in 1997. Thus, the coal industry has been almost fully liquidated. The number of miners decreased from 16 621 in 1990 to 1067 in 1997.

To maintain or reinvigorate coal production, it would be necessary to restructure the industry, i.e.

142 UNECE, Restructuring of the coal industry and thermal power sector in south-Eastern Europe, doc. ENERGY/1998/16 of 7 July 1998; (Albanian) Committee of Energy, Energy report of Alblania, Oct. 1996

concentrate production in a small number of more effective mines. According to studies undertaken up to 1996, the Memaliaj mine could continue to be in operation, provided mines No. 1 and 2 are merged, mine No. 3 was closed and the existing coal preparation plant refurbished.

4 USE

Domestic coal was mostly used for electricity generation and heating in the household sector. Of poor quality, high price and high environmental impact, indigenous coal has no chance to recover those markets unless it is upgraded (briquettes of good quality) or burnt in special or low NO_x boilers, in fluidized beds or – in the longer term – combined cycles.

5 LEGISLATIVE FRAMEWORK

The management of solid fuels and mineral resources in Albania is governed by the Mining Law Nr. 7491/1994 and supported by the Law on the Privatization of Commercial Entities Operating in the Mining Sector, Nr. 8026/1995.

The restructuring of the coal industry started in early 1990 with financial support from the World Bank. In 1993, the government created the Enterprise Restructuring Agency (ERA) whose mandate was to manage the restructuring programme of all industrial enterprises, including the most important coalmines. Other mines with less significance to the economy are supervised and managed by the Ministry of Mineral and Energy Resources.

The Law on Privatization allows the privatization of all state entities operating in the mineral sector. There is no restriction as to the nationality of the "strategic investor", although that term is not properly defined.

ARMENIA [143]

Exploration of solid fossil fuel resources in the past has been non-systematic and superficial, but resources exist estimated at 200 to 250 Mt. Deposits at Ijevan and Jermanis appear exploitable and can be extracted upon obtaining a licence. Coal production is nil. There are plans to open one (state-owned) mine. Coal imports and distribution are liberalized.

143 REWG Regional Forum, Kusadasi, Izmir, October 1996; presentation on Armenia; Black Sea Regional Energy Centre, Armenia, Sofia 1996, p. 48

BULGARIA

1 SUMMARY

The reform of the Bulgarian coal industry is guided by the (1998) "National energy strategy to 2010" and the Energy Law (1999). These documents assign a strategic role to domestic coal as a means of reducing energy import dependence. Recoverable coal reserves, at 2.7 Gt (of which 91% lignite)[144] could play this role as they could supply 80 years of energy demand at present production rates. Moreover, reserves could be exploited economically and with environmentally sound technologies, provided investments in the order of $ 437M (1998 - 2010) are forthcoming. This in turn requires the restructuring of the coal (and electric power) industry, including the closure of unprofitable mines, the refurbishment of coal-based power stations particularly in the Maritza East Basin, the involvement of private, particularly foreign, investors and the complete liberalization of coal prices. Given that these policies are implemented, the assumed increase of electricity demand and the reduced availability of nuclear power would raise coal production from 33.3 Mt in 1998 to 46-47 Mt in the next five to ten years.[145]

2 STRUCTURE AND IMPORTANCE OF COAL

In early 2000, the coalmines are still State-owned, controlled by the State Energy Agency. There are 29 mines, grouped in 12 mining companies (5 opencast, 4 underground, 3 mixed). Over 95% of coal supplies are delivered to 7 thermal power stations with a total of 5000 MW, 2 of which run on imported coal.

Indigeneous production is concentrated in the Maritza East opencast coalmines that account for 85-90% of production. This coal is supplied to adjacent power plants that generate 40% of national electricity output. On the whole, Bulgarian coal secures about 46% of electricity generation, compared to more than 30% based on nuclear power whose contribution is likely to decline. These numbers explain the strategic importance, that the National Energy Strategy and Energy Law attach to coal as a means to secure supplies and increase energy import independence[146].

3 VIABILITY

The coal industry as a whole is viable and makes a profit (1997: $21M). However, its viability has declined since about 1996, when government-regulated prices no longer covered inflation and costs, and subsidies proved ever more insufficient to compensate for revenue losses. In addition, customers including power plants were increasingly in arrears with payment.

144 WEC, Survey of Energy Resources 1998, London, 1998
145 UNECE, Development of the energy sector in transition to market economy in Bulgaria, prepared by D. Stancho Andreev, document ENERGY/GE.1/1998/5 of 16.7. 1998; IEA Coal Research, Clean Coal Centre, Coal in Bulgaria, London 1999
146 UNECE, Restructuring of the coal industry and thermal power sector in south-eastern Europe, document ENERGY/1998/16, 7 July 1998

The overall profitability of the industry covers loss-making underground mines (1997: state subsidies $14.7M) and profitable opencast mines (1997: $36.3M). Opencast production costs were lower than government-imposed prices and cheaper than imported coal and gas.

The most important opencast mines in the Maritza East Mining and Power Complex are profit-making. In 1997, the production cost of domestic coal was 23 $/tce and of electricity 0.9 c/kWh compared with 50 $/tce of imported coal, 1.5 c/kWh for electricity generated from imported coal and 2.6 c/kWh based on imported gas. The costs quoted for coal do not include expenses for recultivation, waste water treatment, desulphurization and investments in equipment which should have been committed but were not.

Dynamics of coal industry restructuring, Bulgaria, 1993 -1998

Indicators	1993	1995	1997	1998
coal production, Mt	30.2	31.9	30.6	33.33
number of mines	33	33	29	29
number of employees	37,612	37,006	34,477	33,104
productivity growth in%	100	107.41	110.48	125.46
state subsidies in%	100	62.45	4.99	17.85

Source: UNECE, doc. ENERGY/1998/16

4 INVESTMENTS

As discussed above, the goals of increased coal production and energy independence over the next five to ten years require investments in the order of $437M in coal mining, recultivation, waste water treatment and ecological clean-up, and $3.2 billion to upgrade coal-based power generation capacities.[147] These investment needs compare with the cost of an energy savings programme of $2.4 billion. expected to save 3.9 Mtoe of fuel per year and 2400 MW of electricity generating capacity.[148]

Private, in particular foreign, investors are expected to play an important role in financing the coal and power industries. While foreign investors are already actively involved in power station refurbishment and new construction (Energy Power Group, Consolidated Continental Commerce, RWE), the delays in coal industry restructuring and ecological clean-up, in privatization and price liberalization have so far prevented private sector interests from coming forward.

5 OUTLOOK

Ten years after the beginning of reforms, the legislative framework for coal industry restructuring has been determined as have been steps, costs, means and calendars of implementation (2005-2010). As to the dynamics of implementation, the most important factor may turn out to be the restructuring and privatization of the electric power sector, in particular the "customerization" of adjacent mines. As 95% of national coal production is supplied to power stations and 85% of it is

147 M. Rouytcheva-Dulguerova et al., Bulgarien – Energiedrehscheibe der Schwarzmeerregion?, in Energiewirtschaftliche Tagesfragen, Nr. 11/1999

148 G. Stoilov, P. Tzvetanov, T. Vassilev, National energy efficiency program of Bulgaria, Zeitschrift der österreichischen Energieverwaltungsagentur, Nr. 4/1999

already "viable" with considerable potential for productivity gains, "customerization" appears to be a driver of privatization rather than a break. The uncertainty lies in the internalization of environmental costs, which may alter the competitive position of Bulgarian coal versus imported energy. Yet the rewards for a fast and determined completion of the (integrated) restructuring of the coal and power industries are evident: a better service to customers at lesser environmental costs, greater independence and an enhanced role for Bulgaria as a transit and export country in south-European and trans-European power exchanges.

CROATIA [149]

ABSTRACT

According to the Constitution of the Republic of Croatia, mineral wealth is a public good of legal interest to the Republic of Croatia and enjoys its special protection. The Mining Law further establishes that mineral wealth is the property of the Republic of Croatia. Among other mineral raw materials, this refers to mineral raw materials that are used for power production. These mineral resources are an unrecoverable natural resource. The use of that natural resource may be granted only by concession.

There are exploitable reserves of hard and brown coal and lignite. However, exploitation of these reserves is not economically feasible. Since the end of 1999, all coal is imported. The coal market in Croatia is open. In the power sector, there are two coal-fired power plants. They use imported hard coal. In addition to power generation, coal is used in the industrial, residential and service sectors.

Legislation in the Republic of Croatia, which refers to exploration and exploitation of mineral raw materials for power generation, allows the economic utilisation of that unrecoverable natural wealth in compliance with practices in Europe.

1 LEGISLATIVE FRAMEWORK

1.1 Mining Law

After the establishment of an independent and democratic Republic of Croatia in 1990, a new Mining Law was put in operation in 1991. Mining Law directives were in line with the new legislation framework in Croatia and with an open market economy in Europe. According to the Constitution, mineral wealth is a public good of legal interest to Croatia and enjoys its special protection. The Law determines in how licensees and owners may use public goods, which constraints they are forced to apply and the price they have to pay for their use.

The Mining Law in effect today was established in 1995. It covers exploration and exploitation of mineral raw materials. Exploration of mineral raw materials means any work or action for determining the existence, position and form of mineral raw materials deposits, their quality, quantity and conditions of exploitation. Exploitation of mineral materials means extraction from deposits and refining. Among other activities, refining means separation of different mineral materials, waste and water extraction. Mining wealth in Croatia has been State governed for more than a hundred years. Mining wealth cannot be owned by other persons and it can not be liquidated. The right to use that natural resource may be granted only by concession.

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1.2 Concessions

According to the Concession Law (1992), the licence to use natural resources and other public goods of legal interest for the Republic of Croatia can be granted. The Concession Law is very simple in its formulation and contains only 10 articles. Specific concessions are regulated through additional legislation. Concessionaires can be domestic and foreign, legal persons or private investors registered in Croatia. The longest concession period is 99 years.

The concession (licence) for exploration and/or exploitation of mineral raw materials may be granted to a legal entity (e.g. corporation) or an individual investor registered in Croatia for that kind of activity. The government issues licences for oil and natural gas exploration and exploitation. The Ministry of Economy issues licences for other mineral raw materials for power production (coal).

The charge for mineral raw materials exploitation is 2.5% of the revenue. The charge is payable to the local community where the exploitation takes place.

The concessionaire is to conduct exploration of mineral raw materials reserves. For exploration activities a company or a private investor must use at least 3% of the revenue. These funds are property of the investor, but must be used for the exploration. This obligation is not applied if there are known and confirmed reserves of mineral raw material for at least 25 years of exploitation.

The Ministry of Economy monitors exploration and exploitation of mineral raw materials. A special committee, the State Mining Commission, inspects exploration and exploitation activities according to specific rules.

The concession decision must be approved by the Croatian Parliament if it does not fall under specific jurisdictions: according to the Mining Law, the Ministry of Economy issues a licence for exploration and exploitation of coal reserves. The concession may be granted through standard tendering procedure or upon request. Licences for exploration and exploitation of mineral raw material are issued upon request as stated in the Mining Law.

1.3 The Energy Law

While the Energy Law is the fundamental regulation, the organisation and development of the energy market will also be covered by three other market laws: the Electric Energy Market Law, the Gas Market Law and the Oil and Oil Derivatives Market Law. While the Energy Law is being elaborated, two main projects in the electric energy sector are already implemented that apply "build-operate-transfer" and independent power producer principles. Those concern the combined cycle gas turbine power plant Jertovec in cooperation with Enron, USA, and the coal-fired power plant Plomin 2 in co-operation with RWEE, Germany. The main domestic co-operators are HEP (Croatian Electric Utility) and INA (Croatian Oil Utility).

1.4 Air pollution protection

In the seventies, Croatia started intensive building of thermal power plants (heavy fuel oil, gas, coal). The concept of environmental protection was unclear and at a very early stage. There were

no specific laws to regulate this problem. In the beginning of the eighties, long range transboundary pollution and the effect of acid rain were noticed. Air, water and land pollution became international problems. There are several international conventions on this matter.

Two important conventions apply directly to the energy sector. The Long Range Transboundary Air Pollution Convention (LRTAP) and additional protocols define the control and reduction of gas, heavy metal and organic compound emissions. As a former Yugoslav republic, Croatia joined the LRTAP Convention. The Protocol on further SO_2 Emission Reduction was signed in 1995, but not ratified. According to the second SO_2 protocol, the Croatian obligation is to reduce SO_2 emissions by 11% in 2000, 17% in 2005 and 22% in2010 compared to 1980. Croatian 1996 SO_2 emissions were significantly lower than the level allowed by the Protocol.

In March 1999, Croatia signed the Kyoto protocol of the second important convention – the United Nations General Climate Change Conventions (UNFCC). After it is ratified by the Croatian Parliament, the Croatian obligation will be to maintain CO_2 emission at the 1990 level until the end of the century. At the Kyoto conference, Croatia took the responsibility of reducing CO_2 emissions to 95% of the highest emission year in the 1985-90 period (some 4.8t per capita). This is an extremely serious responsibility. In 1990, Croatia had almost the lowest emission of CO_2 per capita in Europe, half the west European average. As a transition economy country, Croatia was able to choose a reference year among the years from 1985 to 1990. This option introduces the question of the status of the HEP thermal power plants outside Croatian borders. How these power plants will be treated is yet not known because such cases are not included in the existing Convention documents. These emissions amount to 3 Mt of CO_2, more than all the HEP emissions during the past few years.

Apart from international conventions, there is the Environmental Protection Law, ratified by the Croatian Parliament in 1995. The Law establishes norms of environmental acceptability for new and existing constructions. For existing sites the government defines a period in which to conform to environmental rules. HEP thermal power plants have to apply this Law, but also the special document from 1997 on emissions from static sources. This document defines emissions and periods for adaptation (for the existing sites).

2 GEOLOGICAL COAL RESOURCES OF IN CROATIA

There are exploitable reserves of coal in Croatia. Poor technical and economic parameters make exploitation of these reserves uneconomic. Coal reserves at the end of 1998 were as follows:

- pit coal 3 731 kt
- brown coal 3 646 kt
- lignite 37 787 kt

In 1998, there was only one hard coal pit: Tupljak, Istria county, with a production of 51 800 t. In the first half of the 1999, an additional 15 000 t were extracted, and by the end of the year, the last coal pit in Istria was shut down. Underground extraction of the coal became too expensive. Although this coal has excellent characteristics in combustion, its sulphur content is too high (8-10%). Coal-fired thermal power plants Plomin 1 and 2 use low-sulphur (1%) imported hard coal. In that way, after more than two hundred years and 24 Mt, coal production in Istria has

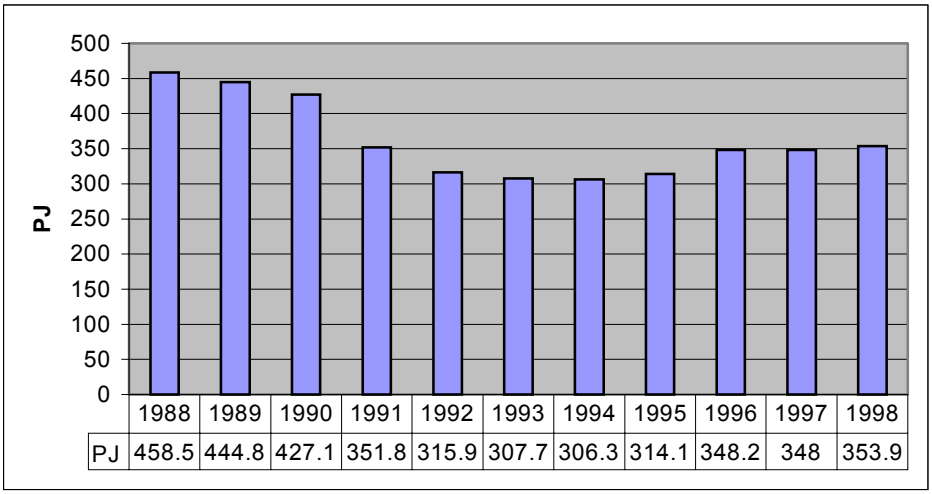
stopped. This is also the end of the domestic coal production. However, there are two more valid concessions for coal exploitation. Both are for opencast lignite production (in Bilogora near Bjelovar and Croatian Zagorje), but possibilities are very poor. No future domestic coal production is forseen.

3 COAL USE

3.1 Demand and production

Total energy demand in Croatia has changed substantially in the past ten years. The political and economic changes started at the beginning of the 1990s with a serious economic crisis. The situation in the economy (especially in industry) was further influenced by war and war damages. The decreasing trend in total energy demand over the last decade is shown below. After 1994, there is a slow increase. Total energy demand in 1998 is still 23% lower than it was in 1988.

Figure 1: Total Energy Demand in Croatia for 1988-1998



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
PJ	458.5	444.8	427.1	351.8	315.9	307.7	306.3	314.1	348.2	348	353.9

There is a similar situation with coal. Coal's share of total energy demand decreased continually. Table 1 overleaf shows coal and coke energy balances for 1988-1999.

Domestic production has constantly decreased since 1988 and ceased entirely by the end of 1999. Since 1996, there has been no export of coal and no coke production. The import of coal decreased too, up to 1996. After 1996 coal imports rose. The reason for this outcome may be explained by the power plant Plomin 1. As of 1996, Plomin 1 has been fired with a mixture of (decreasing) domestic and imported coal. We can expect a further rise in imported coal, because Plomin 2 was synchronized on the grid (to operate in line with demand) at the end of 1999. Plomin 2 has double the installed capacity of Plomin 1. For the annual operation of the Plomin power plants, about 800kt of hard coal is required. The direct supply of coal into Plomin port has a low price, and the produced electricity is cheaper compared to other alternatives (other ports and additional transport by ground vehicles). From today's perspective, further coal-fired power plants are possible after 2010, so we expect similar situation in importing for the following years. In 1998, coal for thermal power plants absorbed 54% (279.3 kt) of total coal energy demand in Croatia.

Table 1. Coal and coke: 1988-1998

Thousand t	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total Production	970	976	730	611	528	537	379.7	82.2	66.3	48.5	50.8
coalmines	230	197	174	155	120	115	103.2	82.2	66.3	48.5	50.8
coke-oven	740	779	556	456	408	422	276.5	0	0	0	0
Import	2225	2146	1648	1005	997	856	563.2	322.4	219.5	291.8	351.1
Export	549	505	390	361	344	361	233.9	3.5		3.4	0.6
Stock change	-99	-99	169	209	-56	16	-23.7	-38.3	6.8	111.6	17
Energy supply	2547	2518	2157	1464	1125	1047	685.2	362.8	292.6	448.5	418.3
Energy transformation	1540	1535	1337	994	900	836	519.5	240.3	164.4	324	279.3
thermal power plants	124	90	254	181	247	189	38.1	96.2	55.3	230.2	229.4
industrial cogen plants	267	223	195	107	110	106	115.6	140.2	92.8	92.3	48.6
industrial heating plants	119	119	89	79	13	6	5.1	3.9	16.3	1.5	1.3
coke-oven	983	1052	747	610	530	535	360.6	0	0	0	0
blast furnaces	47	51	52	17		0	0	0	0	0	0
Final energy demand	1007	983	820	470	225	211	165.7	122.5	128.2	124.5	139
Industry	453	464	402	241	165	127	122.2	86.3	91.6	91.9	92.5
iron and steel	176	192	214	121	59	32	35.3	18.7	8.8	18.2	11.3
no-metal minerals	14	14	7	6	6	7	6.9	6.8	7	4.5	6.2
chemical	18	17	1	0	0	0	0.1	0.1	0	0	0
construction materials	227	219	165	104	93	83	74.2	54.1	70.2	56.3	62.2
pulp and paper	1	1	0	0	0	0	0	0	0	0	0
food production	9	13	10	7	4	2	3.7	4.6	3.7	11	12
not elsewhere specified	8	8	5	3	3	2	1.9	2	1.9	1.5	0.8
Transport (rail)	17	16	14	6	0	0	0	0	0	0	0
Other sectors	537	503	404	223	60	84	43.5	36.2	36.6	32.6	46.5
households	444	417	329	183	51	43	26.9	21.9	23.2	19.9	28.1
services	81	77	67	37	7	39	15.5	14.3	13.4	12.7	18.4
construction	12	9	8	3	2	2	1.1	0	0	0	0

Apart from the electricity sector, coal is supplied to industry, industrial cogeneration plants, industrial heating plants, households and services. Table 2 (1988) and Table 3 (1998) illustrate the use of different forms of "coal" fuels over a ten year period.

Table 2 Coal energy balance for 1988

1988 (kt)	Anthracite	Hard coal	Hard coal for coke oven	Brown coal	Lignite	Briquettes	Coke
Production	-	215.1	-	-	15.3	-	740.0
Import	180.7	-	1044.8	-	-	11.9	32.4
Export	-	-	-	-	-	-	318.3
Buy	-	-	-	445.6	478.5	-	31.0
Sale	-	-	-	-	-	-	231.0
Stock change	-27.0	-45.3	-62.2	20.8	9.7	-	4.5
Energy supply	153.7	169.9	982.6	466.4	503.6	11.9	258.7

Table 3 Coal energy balance for 1998

1998 (kt)	Hard coal	Brown coal	Lignite	Coke
Production	50.8	-	-	-
Import	229.7	61.8	39.5	20.1
Export	-	-	-	0.6
Stock change	12.4	-	-	4.6
Energy supply	292.9	61.8	39.5	24.1

Coal use has continually decreased in the past decade as illustrated by Figures 2-7. We can see a relative and absolute decrease of coal's share in its different uses. The period after 1994 can be seen as a period of stagnation or slight rise in coal consumption.

Figure 2 Coal in primary energy production for 1988-1998

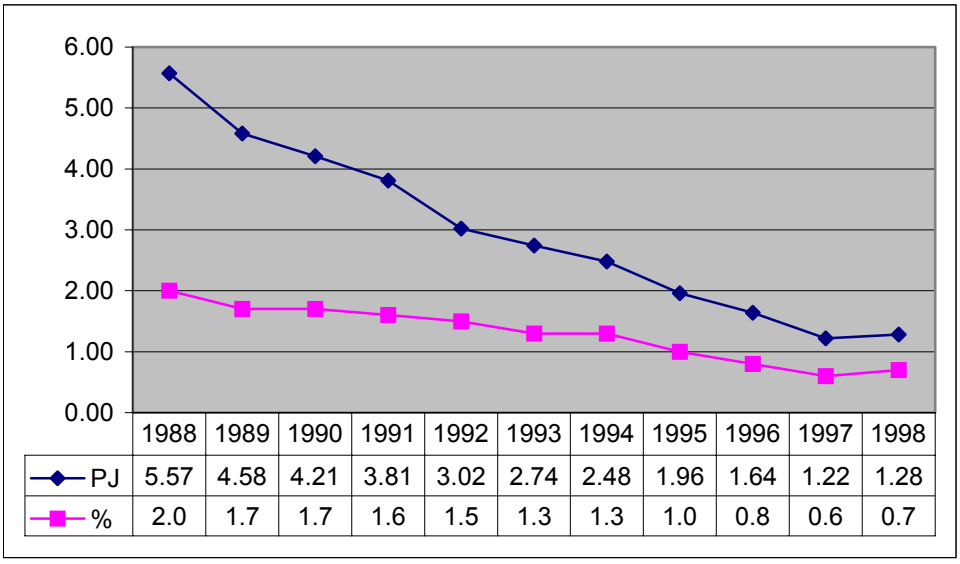
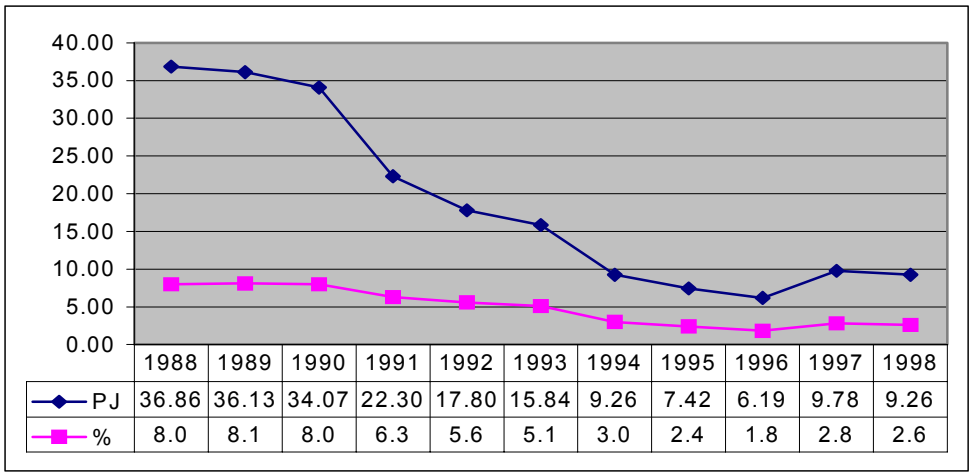
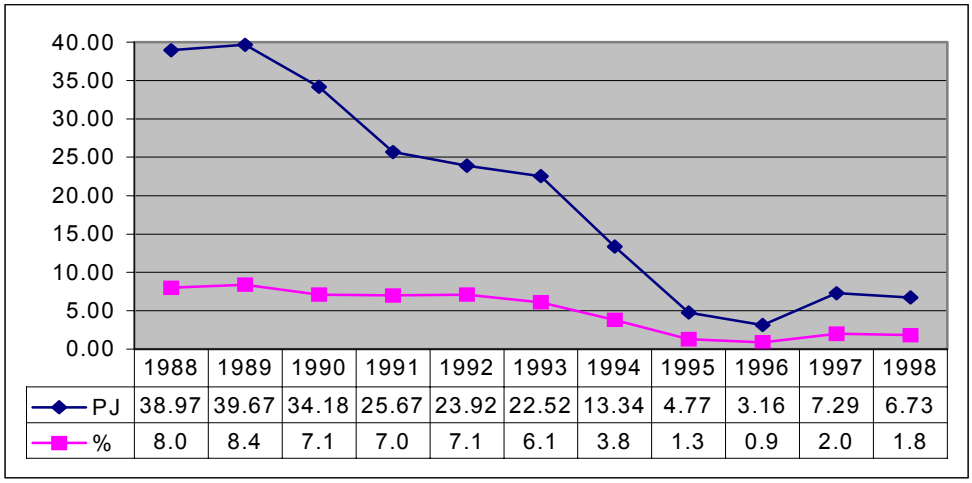


Figure 3 Coal in total primary energy supply for 1988-1998



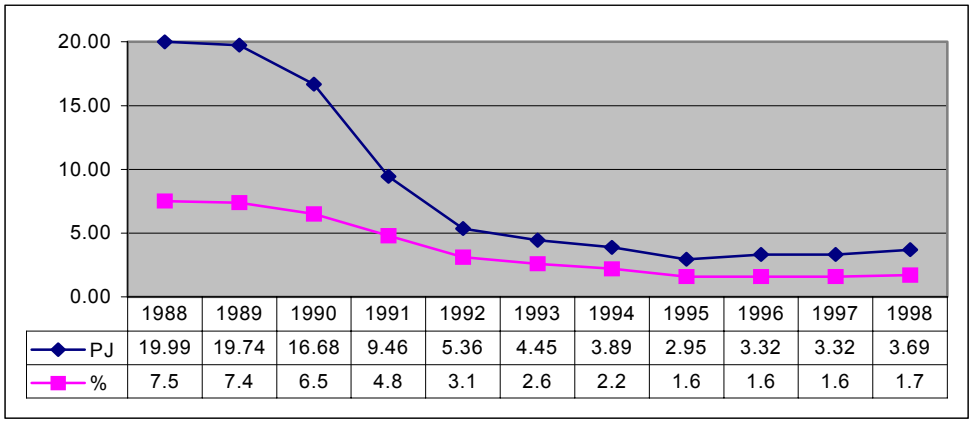
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
PJ	36.86	36.13	34.07	22.30	17.80	15.84	9.26	7.42	6.19	9.78	9.26
%	8.0	8.1	8.0	6.3	5.6	5.1	3.0	2.4	1.8	2.8	2.6

Figure 4 Coal for energy transformation inputs



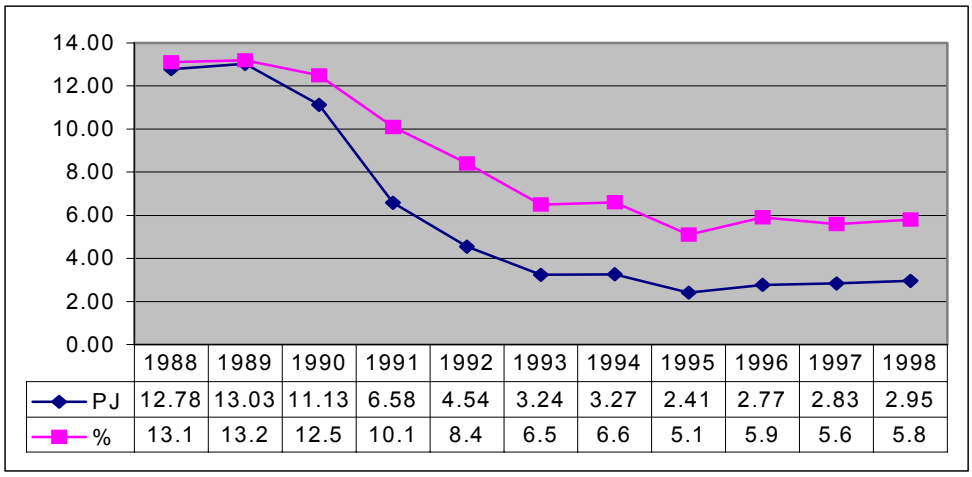
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
PJ	38.97	39.67	34.18	25.67	23.92	22.52	13.34	4.77	3.16	7.29	6.73
%	8.0	8.4	7.1	7.0	7.1	6.1	3.8	1.3	0.9	2.0	1.8

Figure 5 Coal in final total energy demand for 1988-1998



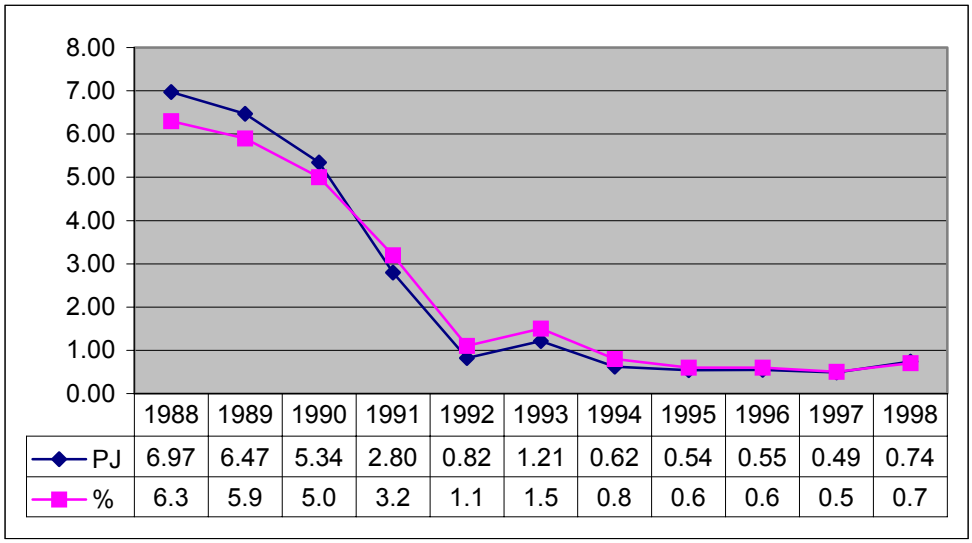
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
PJ	19.99	19.74	16.68	9.46	5.36	4.45	3.89	2.95	3.32	3.32	3.69
%	7.5	7.4	6.5	4.8	3.1	2.6	2.2	1.6	1.6	1.6	1.7

Figure 6 Coal in final energy demand in industry for 1988-1998.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
PJ	12.78	13.03	11.13	6.58	4.54	3.24	3.27	2.41	2.77	2.83	2.95
%	13.1	13.2	12.5	10.1	8.4	6.5	6.6	5.1	5.9	5.6	5.8

Figure 7 Coal in final energy demand in other sectors for 1988-1998



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
PJ	6.97	6.47	5.34	2.80	0.82	1.21	0.62	0.54	0.55	0.49	0.74
%	6.3	5.9	5.0	3.2	1.1	1.5	0.8	0.6	0.6	0.5	0.7

3.2 Coal market

At present, there are about fifteen larger and several smaller coal suppliers in Croatia. Average coal prices at the Croatian border (without duty, variable costs and VAT) are as follows:

Table 4 Coal import prices in DM/t

brown(18 MJ/kg)	90
lignite	56
coke	186

Because Croatian exploitable reserves of hard and brown coal and lignite are non-profitable, all coal demand will be supplied from imports. The coal market in Croatia is open. There is a need to regulate quality and to prevent imports with a high percentage of impurity.

Plomin 1 power plant used to work with a mixture of domestic and imported coal. The coal was imported at the port of Bakar. In 1998 coal is CIF Bakar was 38 $/t. Transport price to Plomin power plant cost about 12 $/t. The final price of the mixture fuel was around 57 $/t. Before the second block of Plomin power plant was finished, HEP did some price calculations that indicated that the average coal price should be about 50 $/t for coal imported directly through the newly built Plomin port. This evaluation is in line with average contract coal prices for the thermal power plants in European Union countries.

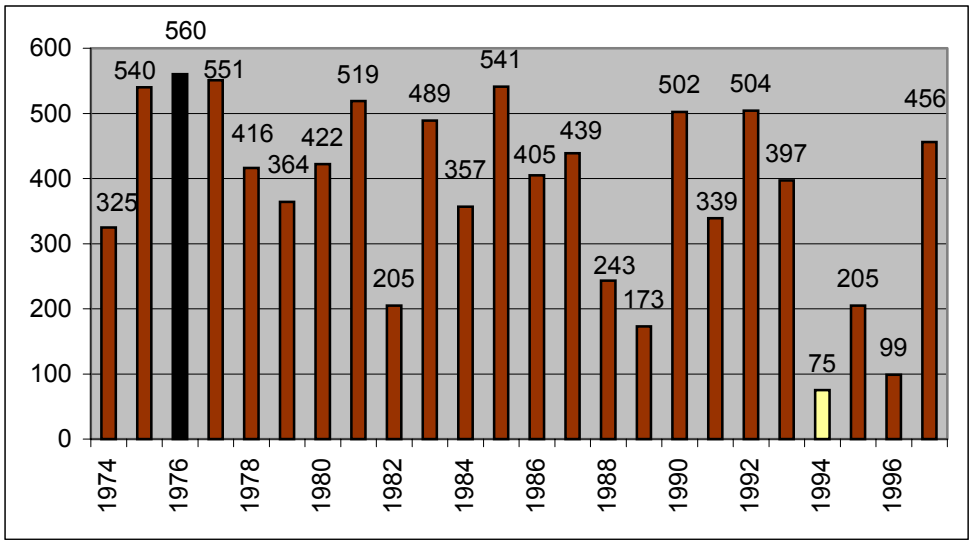
4 COAL-FIRED THERMAL POWER PLANTS AND AIR POLLUTION PROTECTION

There are two coal-fired thermal power plants in the Croatian power system, excluding thermal plants outside Croatian borders. Both of the plants are situated in Plomin, Istria county. Fuel for these plants is imported low-sulphur hard coal.

4.1 Plomin 1

Block Plomin 1 has been in use since 1970. Plant operator is HEP. Maximum (gross) output power is 105 MW. Figure 8 shows Plomin 1 production during 1974-1997. Annual average production is 380 GWh.

Figure 8 Plomin 1 production during period 1974-1997 (GWh)



4.2 Plomin 2

Construction of the second block, Plomin 2, was contracted to Ingra (Croatian construction company). "Turn-key" contract started back in 1985. Start of the commercial operation was

scheduled for 1989. In the meantime, the Ministry for Construction and Environmental Protection called on the investor to add a desulphurization system. At the same time it became clear that no domestic hard coal reserves were available for operation, even for the first block, Plomin 1. Domestic coal would be abandoned in any case because of poor ecological (sulphur content 8-11%), technical and economic parameters. In the beginning of 1991, the contract with Ingra was terminated. In April 1992 construction stopped. At the end of 1995, the Croatian government requested HEP to complete the plant construction as soon as possible. After the war had ended, there was intensive preparation to resume construction. At the end of 1996, HEP and RWEE (Germany) jointly founded PP Plomin Ltd. The year after, following the tendering procedure, a contractor was chosen. After first synchronisation with the net on 29 September,1999 and after usual operation tests, from 1 December, 1999 Plomin 2 has been in commercial operation.

The plant operation is licensed to PP Plomin Ltd., a jointly owned company by HEP Ltd. and RWE Energie. HEP's share is 50%, based on pre-1996 construction of the plant. RWEE's share is also 50% based on its investments and credits from German banks. The value of the project is evaluated at 500M DM. When the contract expires, the plant will be totally owned by HEP. The plant will be in operation for 30 years, and upon revitalisation it is expected to run additional 10 years. Plomin 2 is among the largest foreign investment projects in Croatia.

The second block with maximum power output of 210 MW (net out 192 MW) will produce around 1.2 billions kWh/year of electric energy. Average price for HEP at the net injection point will be around 0.03 $/kWh. Coal consumption (hard coal=24 MJ/kg) will be around 80 t/h. According to the Project of Restructuring and Organisation of the Croatian Energy Sector (PROHES), the plant will be around 6350 h/year on the net. Table 5 shows hourly planned dispatching and characteristic loads to fulfil the grid's requirements for the period till 2025.

Table 5 Planned dispatching for the PP Plomin 2 for 2000-2025

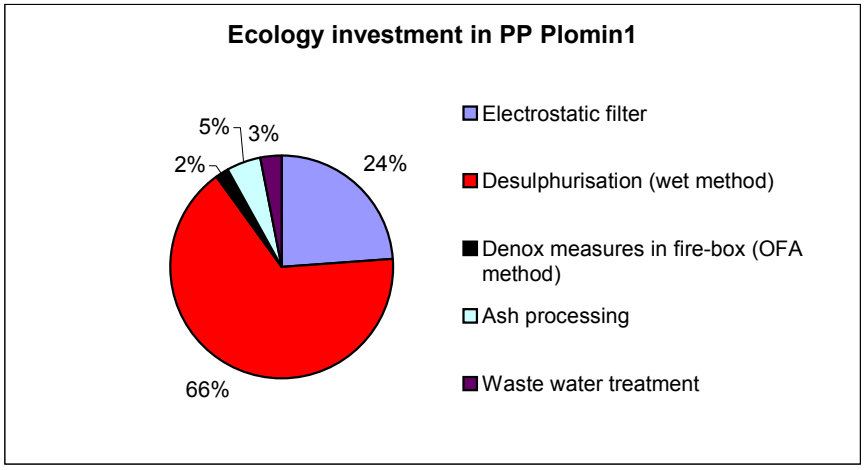
Year	71 MW	89 MW	153 MW	210 MW	Total (hours)
2000-2005	3000	6000	10 000	15 000	34 000
2006-2015	5000	10 000	18 000	40 000	73 000
2016-2025	5000	10 000	24 000	23 000	62 000
Total (hours)	13 000	26 000	52 000	78 000	169 000

Analyses of the daily load diagrams of the Croatian power system show a max/min load ratio during the day of 1.90, which is too high. Reasons for this are a low base consumption and large share of households in overall electricity load. This situation can be handled if thermal units are flexible (unit load changes between technical minimum and maximum load). Expectations for Plomin 2 are similar: operation with variation in load, particularly at night.

Plomin 2 uses imported low-sulphur (1%) hard coal. Maximum SO_2 contents in exhaust gasses after fire-box is 3000 mg/n m^3. Following wet desulphurization, the SO_2 content is reduced to

maximum of 400 mg/n m^3. The suspension is $CaCO_3$ mixed with water. A by-product of the process is a commercial gypsum. SO_2 concentrations in the area are at a level approved by the World Health Organisation. Plomin 2 is the only thermal power plant with desulphurization in the Mediterranean. Investment in the desulphurization equipment is about 40M DM. The height of the chimney is 340 m. Transportation of coal from the Plomin port to the power plant is through a closed system.

Figure 1 Ecology investment allocation for PP Plomin



Using primary measures for nitrogen oxide emission reduction, the concentration of these substances in exhaust gas is less than 650 mg/m^3. Dust from the exhaust gas is removed using electrostatic filters. Emissions are limited to 50 mg/m^3. Waste water is refined up to the level at which water can be used as a technological water, or up to level at which water is acceptable for the drain to river Boljunèica.

The monitoring system for the Plomin plant has automatic air and land emission measurement equipment. There are also other systems for impact measurement. The surveillance system is connected to the operation room in the power plant, but also to local environmental protection authorities. If the emissions exceed permitted limits, the plant is obliged to bring them back down immediately.

The final phase of the power plant project is to rebuild the local economy through about 20 projects from different sectors (tourism, transport, food processing, small industry, local infrastructure).

Investments total about 100M DM.

4.3 AIR POLLUTION

One of the most important issues in the electricity sector is the environmental impact of fossil fuel thermal power plants on air quality. The main pollutants in this respect are SO_2, NO_X, CO_2, dust and other firm particles.

Of the total emissions in Croatia, HEP's thermal power plants contribute 29.8-49.7% of SO_2 emissions, and 9.5-19.2% for NO_X emissions and 14.1-25.7% of CO_2 emissions. For the past four years, total emissions fell because industrial production and the use of low-sulphur fuels (heavy fuel oil and hard coal) in thermal power plants declined.

HEPs thermal power plants' share of total Croatian emissions is much lower than in other European countries. We can state that the electricity produced in Croatian power sector is much "cleaner". If we look at emissions from the electricity sector on a per capita basis, in 1990 HEP had 1.6 times less emissions of SO_2 compared to power sectors in EU countries (on average). For NO_X and CO_2 emissions were 3.4 and 3.2 times lower.

With regard to Plomin 1 and 2, completion of the second block means a better situation for the first one too. While domestic coal was the main fuel for the Plomin 1, SO_2 emissions were around 34 000 t/year. Mixing domestic and imported coal brought this down to 20 000 t/year. After Plomin 2 is complete, emissions from Plomin 1 will be 1000 t/year. Annual SO_2 emissions from both blocks will be about 2800 t. In that way, completing the second block will manage the problem of the first one.

Ash disposal has grown in the last 20 years. Adding ash to soil is a "green" disposal solution. All of the ash and slag will be re-used for construction purposes.

4.4 An assessment of future investment needs in air protection

An assessment of the need to investment in air protection was carried out in 1997, as part of the Master plan for the Croatian electric energy sector. For the average protection scenario (or expected situation scenario), there is a need for investments of $260-390M. Annual discounted costs (investment and operation) are $69-88M. Additional cost of the electricity from the thermal power plants would be 0.65-0.83 ¢/kWh_e. Compared to the present average electricity prices, this is an increase of 9-11%. If the additional cost were shared by the whole power system (nuclear+hydro+thermal), the increase would be 0.36-0.44 ¢/kWh, or 4.8-5.9%. Costs of the scenario with the highest emissions reduction (ecology scenario) are 3 times higher than the expected scenario’s costs.

Apart from air impacts, there are other environmental pollution factors: noise, soil and water pollution, solid waste. These are not negligible, but less investment-intensive. They are on the local level and will be studied along with corresponding specific projects.

5 COAL IN ENERGY SCENARIOS (PROSPECTS TO 2010 AND 2020)

5.1 Energy and coal scenarios in general

Total energy demand in Croatia for the period up to 2020 was considered through three scenarios - S1, S2, S3. The difference between these scenarios is in the treatment of the different energy sources and in State involvement. In scenario S1, we assume classic technology implementation, without special State involvement. Scenario S3 is highly ecological. S2 is somewhere in between. Table 6 shows some results for coal use in scenarios for the years 2010 and 2020.

If we compare final energy demand from Table 6 overleaf and Figure 5, we can see that coal's share by 2020 would decline by only 1% (in S1 scenario) or 0.8% (S2, S3). This is the consequence of intensive gasification (one of the main energy sector development goals) and decline in energy-intensive industry. Coal's share in the high-energy scenario will be only about 5% in 2020. The decline in use is expected for industrial cogeneration and heating plants, households and services.

Table 6 Coal in energy demand in Croatia for 2010 and 2020 for scenarios S1, S2, S3

		2010			2020		
		PJ	kt	%	PJ	kt	%
Coal in final energy demand	S1	4.15	173	7	4.21	175	1
	S2	2.26	94	1	3.12	130	0.8
	S3	3.26	136	1	3.21	134	0.8
Coal for electric energy sector	S1	50.12	1928	33	70.86	2725	37
	S2	23.41	900	17	43.21	1662	27
	S3	23.37	899	17	42.78	1645	28
Coal in total energy demand	S1	55.78	2208	11	76.56	3007	12.4
	S2	28.11	1169	6	47.81	1898	8.2
	S3	27.45	1093	6	46.59	1822	8.2

In total energy demand, coal's share will rise up to 12.4% (S1) or 8.2% (S2, S3) in 2020 due to projected higher coal utilisation in the power sector: 28% (S2, S3) - 37% (S1). Coal supply will depend on imports. For each scenario, environmental impacts and gas emissions were simulated. In scenario S1 certain difficulties in complying with CO_2 emissions limits are expected.

5.2 Coal's future in the Croatian electric energy sector

Present analyses and studies predict a rise in electricity demand by 2-3% per year. One of the most important tasks in power system management is system development planning. The basis for these activities lies in different electric energy demand forecasts. The main decision is which technology to use: hydro, thermal, nuclear or renewable (solar, wind). In Croatia almost all larger water resources are already in use for electricity production. Up to 300 MW of additional hydro capacity is predicted. The nuclear option is, at present, a back-up plan because of the geo-political situation in the region and public opinion about new nuclear capacities in Europe.

With regard to thermal power plants, dilemmas are fuel (gas, coal, liquid fuels), location and construction schedule. Diversification of energy sources and fuels in thermal power plants is very important for secure and reliable operation of the power systems. In the recent past, gas has become a very popular fuel (combined cycle gas turbines). A coal-fired thermal power plant

means higher investment but is competitive in the long run. Even for independent power producers, there are significant differences between gas and coal. Coal is the worldwide energy fuel, with estimated reserves for more than 200 years. About 37% of electricity generation in the world is from coal-fired thermal power plants. Present technology in coal combustion and exhaust gas purification make these power plants environmentally acceptable compared to other polluters - transport and industry.

Croatia has an excellent location (Adriatic Sea) and possibilities to generate cheap base-load electricity from imported coal. According to draft energy sector development strategy of the Republic of Croatia, new coal-fired plants may be developed after 2010.

CZECH REPUBLIC [150]

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1 COAL SECTOR – PRIORITIES AND POLICIES

Mining of coal on an industrial scale has been recorded in the territory of the Czech Republic since 1876. In the period after the second World War, Czech coal mining was primarily to satisfy the requirements of the extensive development of heavy industry, especially the energy (power and heat generation) and metallurgy (smelting, coke production) sectors.

Industrial coal mining has been associated with the Czech portion of the Upper Silesian Basin (Ostrava-Karviná Coal District), inter-Sudetic Depression (Krkonoše Foothills Basin), Rosice-Oslavany Basin, Plzeň and Radnice Basins (West Bohemian Coal District) and Central Bohemian Carboniferous Basin (Kladno-Rakovník). Hard coal has been mined mostly by underground methods.
Brown coal has been mined in the Ore Mountains Foothills Basins (North Bohemian Brown Coal

150 Czech Association of Coal and Crude Oil Mining Companies; Czech National Committee for the WEC

District and Sokolov District). In the first half of the 20th century, brown coal was mined mostly underground, whereas in the post-war period the share of opencast mining has dominated significantly. Lignite is mined in the South Moravian portion of the Vienna Basin underground.

Table 1 Historical development of coal mining in the territory of Czech Republic (Mt)

year	Hard coal			Brown coal		Lignite	Brown coal and lignite in total	Coal in total
	Ostrava-Karviná District	Other districts	Total	North Bohemian Brown Coal District	Sokolov Coal District	South Moravian lignite		
1900	5.77	4.03	9.80	14.67	2.69	0.19	17.55	27.35
1940	16.25	4.54	20.79	16.15	4.80	0.52	24.47	42.26
1950	13.72	3.78	17.50	19.83	6.26	0.52	26.61	44.11
1960	20.87	5.53	26.40	39.08	14.60	1.13	54.81	81.21
1970	23.86	4.34	28.20	54.52	19.89	1.70	76.11	104.31
1980	24.69	3.51	28.20	66.70	20.45	1.93	89.09	117.28
1990	20.84	2.35	23.19	60.70	11.85	1.81	74.36	97.55
1998	20.60	1.43	22.03	40.88	10.43	0.65	51.96	73.99

1.1. Bases and development in 1989-1990

The overgrown character of coal mining in a planned economy was enhanced by other negative elements of the system such as the particularities of socialist ownership and production relations; high energy electricity generation requirements; regulated prices; centrally planned consumption and production; limited investment in the development and reproduction of capacity, limited funds for rehabilitation of the effects of minerals mining, political and social aspects, etc.

Investigation of the cost-effectiveness of individual mining enterprises in the late 1980s showed that costs in many mining sites exceeded production revenues. The necessity to take certain restructuring measures began to gain ground.

The change of political and economic conditions led to a crisis in the economics of the coal sector as early as 1990. Subsidies to various economic sectors were discontinued, including power. Funds previously redistributed to the gas and power sector were replaced by so-called "returnable financial support" from the State budget, for the most part from so-called "mining rent" created by profitable mining enterprises.

As early as 1990, the federal government adopted a contraction programme for the mines in the then Concern of Kladno Hard Coal Mines. Closures of unprofitable operations began in all the districts of the Concern, i.e. in the Kladno, West Bohemian, East Bohemian and Rosice Districts.

In 1991, a contraction programme for the opening of the Slanỳ, deposit was adopted. Contraction and closing selected operating mine sites in the Ostrava portion of the Ostrava-Karviná District, selected mine fields in South Moravian mines and the Julius III Mine in the North Bohemian brown coal basin was announced as the first phase.

A governmental decree issued in 1991 enabled financial sources to be made available to mining enterprises whose costs exceeded sale prices, but whose coal production was needed.
A comprehensive solution to mining contraction for 1993-1996 was adopted by Government Resolution No. 691 in December 1992.

1.2. Transformation and restructuring programme

- contracting ineffective production – technical liquidation – organizational, technical, financial, social and institutional aspects of restructuring; privatization

In February 1992, the Government of Czech Republic approved Resolution No. 112/1992 on the "Energy Policy of Czech Republic" which defined the strategic principles of transformation and restructuring of the Czech energy economy. The restructuring programme for coal mining was approved by Government Resolution No. 691/1992.

Following a cost and technical analysis, the coalmines were divided into three economic groups. Mines operating permanently at a loss and ineffectively were placed in the first group. The second group included conditionally effective mines with a risky future in view of emerging competition in the solid fuels market. The mines with prospects of competitiveness were placed in the third group. The third group formed the basis to establish commercial coal mining companies. This new structure made it possible to define the principles of State participation in contracting ineffective mine operations, particularly in settling the problems of

- statutory social claims
- technical liquidation of mining operations
- rehabilitation of the effects caused by mining operations in the past.

The object of the coal industry restructuring programme was to create conditions to establish sound and competitive joint stock companies.

Until 1989, the organisational structure of coal industry was characterised by centrally planned concerns run by the Ministry: hard coal was mined by two concerns (Ostrava-Karviná Coalmines in Ostrava and Kladno Hard Coal Mines in Kladno), brown coal and lignite by three concerns (North Bohemian Brown Coal Mines in Most, Brown Coal Mines and Briquetting Plants in Sokolov and South Moravian Lignites Mines in Hodonín within the Slovakian Coalmines). Starting in early 1990, this structure was gradually replaced by State-owned enterprises.

In 1991, hard coal was mined by seven State enterprises, brown coal by eight State enterprises and lignite by one State enterprise:

<u>hard coal</u>	1) Ostrava-Karviná Coalmines, State enterprise, Ostrava	- 13 mining enterprises
	2) CŠM State enterprise, Stonova	- 1 mining enterprise
	3) Kladno Mine, State enterprise, Libušin	- 6 mining units
	4) Tuchlovice Mine, State enterprise, Tuchlovice	- 1 mining enterprise
	5) East Boh. Coalmines, State enterprise, Trutnov	- 3 mining units
	6) West Boh. Coalmines, State enterprise, Zbůch	- 2 mining units
	7) Rosice Coalmines, State enterprise, Zbýšov	- 1 mining enterprise

brown coal 8) Mines and Preparation Plants
State enterprise, Komořany - 3 mining units
9) Hlubina Mines, State enterprise, Litvínov - 5 mining units
10) Ležáky Mines, State enterprise, Most - 2 mining units
11) Bílina Mines, State enterprise, Bílina - 1 mining enterprise
12) Nástup Mines, State enterprise, Tušimice - 2 mining units
13) Fuel Combine Ústí, State enterprise, Ústí n.L. - 1 mining unit
14) Brown Coal Mines, State enterprise, Březová - 5 mining units
15) Fuel Combine Vřesová, State enterprise - 2 mining units

lignite 16) South Moravian Lignite Mines
State enterprise, Hodonín - 4 mining units

Altogether five commercial coal companies were formed by transformation from the above State enterprises:

- 2 joint stock companies for hard coal mining by underground extraction
1. Ostrava-Karviná Coalmines, a.s. Ostrava (OKD, a.s.) from State enterprise 1 above;
2. Czech-Moravian Coalmines, a.s. Kladno (ČMD, a.s.) from State enterprises 2, 3 and 4.

- 3 joint stock companies for brown coal mining with prevailing opencast operations
3. Most Coal Company, a.s. Most (MUS, a.s.) from State enterprises 8, 9 and 10.
4. North Bohemian Mines, a.s. Chomutov (SD, a.s.) by combining State enterprises 11 and 12.
5. Sokolov Coal, a.s. (SU, a.s.) by combining Enterprises No. 14 and 15.

This restructuring associated enterprises with only medium prospects for improvement with enterprises for which a long-term economic stability may be expected after organizational, structural and technical measures are implemented.

The above joint stock companies were founded with 100% State ownership.

A number of long-term problems were not settled at the time of the discussion and approval process of privatizing mining companies. Their resolution has been complicated for a long time by the transformation of the economy as a whole and actually delayed privatization. The problems to be settled were particularly:
- property useful for mining undertaking
- financial and material liabilities of the past
- proprietary relationships for certain land plots and real estate.

The newly formed Residual State Enterprises' main activity will be to settle those problems.

In accordance with the government programme, the newly formed commercial coal companies were included in the privatization process, which started in 1993 for the coal mining industry. Shares were distributed as shown in Table 2.

Table 2 Ownership percentages in privatized coal companies

	OKD	ČMD	MUS	SD	SU
National Property Fund	51.00	34.00	34.00	46.00	43.00
Coupon privatization	40.00	43.00	42.00	33.00	40.00
Restitution fund	3.00	3.00	3.00	3.00	3.00
Communities	3.00	9.00	9.00	9.00	9.60
Others	2.00	11.00	12.00	9.00	4.40

Note:) The State's ownership interest in ČMD and MUS join stock companies was sold to the majority owners (from the coupon privatization) in the course of 1998 and 1999. Completion of the privatization would mean the sale of the National Property Fund's remaining interest.

Contracting and liquidating the loss-making mines of the first group became a significant part of the restructuring process. As concerns hard coal, mines in the whole Ostrava portion of the Ostrava-Karviná District (OKD, a.s. Ostrava) and selected mines in Kladno District (ČMD, a.s. Kladno), were contracted. Mines in Rosice-Oslavany District (RUD, s.p. Zbýšov), in the East Bohemian Coal District – Krknoše Foothills Permian/Carboniferous (VUD, s.p. Malé Svatoňovice) and in the West Bohemian Coal District (ZUD, a.s. Zbuch), were technically closed.

In the case of brown coal, the Marie underground mine and opencast mines, Lomnice, Boden, Medard (Josef), Michal, Libík and Marie in Sokolov Basin; the underground Žižka Mines, Centrum, Alexander minefield; and Ležaky opencast mine in Most portion of North Bohemian Brown Coal Basin, were included in the contraction and liquidation programme. As a result of Government Resolution No. 331/1991 on the Determination of Regional Environmental Limits for Brown Coal Mining, Chabařovice opencut mine (PK, s.p. Ústí n.L.) and mines in the South Moravian part of the Vienna Basin will be closed, leaving in operation the only underground mine Mír Mine in Mikulăce which was sold to Lignite Limited Liability Co.

The State's participation in restructuring was laid out in Government Resolutions No. 691/1992 and No. 558/1995 and consists of three areas:

a) technical closure of mines
b) the rehabilitation of damages caused by mining operations in the past, and
c) social and health claims of a statutory nature.

However, the original assumptions about the materials and time needed for restructuring changed due to more striking changes affecting the generation and consumption of electric power and heat, and hence the structure of the fuel market. It became necessary to accelerate the contraction and beyond the extent of the approved programme. By its Resolution No. 558/1995 the Government of the Czech Republic approved an amended programme to contract underground and opencast mines with more State funding up to the end of 1998. This was modified again up to 2000 (Government Resolution No. 814/1995) and subsequently also for the period after 2000 (Government Resolution No. 192/1999).

2 TRANSFORMATION OF THE COAL INDUSTRY

2.1 Forecasting demand

The basic problem of forecasting consumption by fuel within the energy balance consisted of insufficiently formulated quantification of assumptions about key macro-economic indices beyond 2005.

Table 3 Consumption of fuels and energy

	1991	1992	1993	1994	1995	1996
Primary energy sources-PJ	1899.0	1788.0	1748.0	1687.0	1710.0	1740.0
- annual index - %	91.74	94.15	97.76	96.51	101.36	101.75
- basic index - %	100.00	94.15	92.05	88.84	81.50	91.63
Final consumption-PJ	1217.0	1096.0	1092.0	1054.0	1048.0	1060.0
- annual index - %	90.17	90.06	99.64	96.52	99.43	101.15
- basic index - %	100.00	90.06	86.61	86.61	86.11	87.1

Source: Ministry of Industry and Trade - 1997

2.2 Development of production and consumption

The transformation of the economy together with structural and system changes in the power system have resulted in a reduced demand for coal as a primary energy source, as documented by the table below:

Table 4 Saleable coal output in 1989-1999 (in kt)

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
hard	25 050	23 186	19 877	19 378	18 296	17 491	17 006	16 394	16 038	15 863	14 349
brown	85 060	72 553	71 030	63 068	62 068	55 330	54 460	55 464	53 078	47 967	40 913
lignite	1 970	1 814	1 500	1 419	1 263	912	784	902	747	652	578

During 1989-1999, the saleable production of hard coal dropped to 57%, of brown coal to 48% and lignite to 33%. Up to 2020, production and consumption will decline by another 18-32%.

Table 5 Anticipated production and consumption of coal 2000-2020 in Mt

	2000	**2005**	**2010**	**2015**	**2020**
Total hard coal	15.0-16.0	14.5	12.0	11.0-11.5	8.0-9.5
power	6.5	6.5-7.0	6.5	6.0	4.5-5.5
other	8.5-9.5	8.0-7.5	5.5	5.0-5.5	3.5-4.0
Total brown coal	48.5	43.0-44.5	41.0-44.0	38.5-43.5	36.0-43.5
power	43.5	39.0-40.5	39.0-40.5	35.0-40.0	33.0-40.0
other	5.0	4.0	4.0	3.5	3.0-3.5

The structure of coal production has significantly changed since 1989:

- in the period up to 1990, the demand for good quality sorted coal exceeded production capacity;
- after 1990, the demand for good quality sorted coal dropped markedly; sorted coal has been in abundance on the market (as a result of the transition of households and small consumers to other fuels-predominantly to natural gas).

It is evident that the real demand is less than had been originally anticipated. The tendencies so far indicate that this decline will also be more marked after the year 2000 than the strategic scenario has expected. The present nearly chaotic and uncontrolled structural change in the

metallurgy sector will quite certainly affect the coking coal market. In our opinion estimates of permanent volumes of coke or coking coal exports appear to be optimistic.

Putting into operation of the new nuclear plant of Temelin will definitely affect the volume of brown coal demanded by ČEZ, a.s. A pessimistic scenario foresees a fall of 10-12 Mt.

2.3 Labour force, productivity

Workforce
At the beginning of the transformation, the coal industry counted more than 100 000 jobs. Restructuring brought about pressure to reduce the numbers of employees, as is shown in the following table.

The total number of employees in the coal industry was considerably reduced in the past decade, i.e. by 60%

Table 6 Number of jobs in the Czech coal industry, 1990-1999

organisation	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**[1]
ČMD	10 402	9 607	9 271	8 844	8 523	7 684	7 752	7 333	6 190	5 166
OKD Ostrava	57 630	49 350	48 470	39 495	33 651	31 854	30 345	28 671	26 072	18 288
VUD Trutnov	*822*	*827*	*853*	*643*	*---*					
GEMEC	--	--	--	--	--	--	--	--	150	311
ZUD Zbuch	*1 152*	*1 067*	*861*	*804*	*1 065*	*479*	--	--	--	
RUD Zbýš	*1 660*	*1 295*	*793*	--	--	--	--	--	--	
Hard coal	**71 666**	**59 838**	**60 248**	**50 000**	**43 882**	**40 017**	**38 097**	**36 004**	**32 412**	**23 765**
MUS Most	18 636	18 089	17 133	16 366	13 570	7 913	9 810	10 070	9 366	8 667
PKÚ Ústí	*842*	*811*	*761*	*726*	*1 318*	*981*	*875*	*449*	--	*309*
SD Chomutov	10 427	10 000	9 418	8 986	8 350	7 866	7 197	7 159	6 346	6 085
SU Sokolov	8 811	8 543	10 384	9 815	5 447	5 027	4 849	4 768	4 700	n.a.
JD Hodonín	*2 761*	*2 239*	*2 273*	*1 863*	*1 285*	--	--	--	--	--
Lignite Hodonín	--	--	--	--	245	503	620	623	611	n.a.
brown coal, lignite:	**41 377**	**39 682**	**39 969**	**37 756**	**30 315**	**22 290**	**23 351**	**23 069**	**21 023**	**21 285**
Coal in total	**113 043**	**99 520**	**100 217**	**87 756**	**74 097**	**62 307**	**61 448**	**59 073**	**53 435**	**45 050**

Note: [1)] statistical data for 1999 is not definitive
- organisations with names written *in italics* are being scaled back and liquidated

The most significant decline occurred in the hard coal industry, where the number of employees fell by 67%. As regards individual coal districts, the most significant decline was experienced in Ostrava-Karviná, particularly due to closures in part of the District. In the second operating hard coal mine enterprise, Kladno ,the fall in the number of employees has not been so pronounced – some 40%. The number of employees in brown coal districts fell by 49%.

After 2000, increased productivity may bring about additional structural changes in the brown coal sector. The loss of one of the producing companies – and extreme assumption – would mean a notable decline in production capacity with regional impact on jobs.

2.4 Investment – structure, financial sources

"Special treatment" in the form of branch or sector taxes or subsidies, is in principle not used in the industrial sector of the Czech Republic. One of the exceptions, however, is the coal industry, which pays specific taxes and receives specific subsidies.

Specific levies (taxes) result from provisions of §32a of the Act on the Preservation and Exploitation of Mineral Wealth (Mining Act) and operating regulations. Coalmines pay an annual remittance for the granted Extraction Areas amounting to 10 000Kč/km^2, as well as royalties for the produced minerals. According to the type of mineral and the mining method concerned, the royalty for coal mined underground is 0.5% for opencast 1.5%. Subsidies are tied specifically only to the contraction and liquidation of selected mines and settlement of liabilities due to mining before the privatization process. Subsidies are not granted for operation, innovation or development.

Table 7 Productivity 1998 (in kt)

Hard coal	1998	**Brown coal & lignite**	1998	1999
1. total production	22 030	1. total production	51 964	(44 846)
OKD.a.s. ČMD.a.s. GEMEC.s.r.o.	20 599 1 384 47	MUS.a.s. SD.a.s. SU.a.s. Lignit.s.r.o.	18 765 22 115 7 678 652	13 250 21 200 6 513
2. total sales	15 863	2. total sales	48 619	(40 913)
OKD.a.s. ČMD.a.s. GEMEC.s.r.o.	14 760 1 070 33	MUS.a.s. SD.a.s. SU.a.s. Lignit.s.r.o.	18 741 21 548 7 678 652	13 200 21 200 6 513
3. Total employees	32 412	3. Total employees	21 023	n.a.
OKD.a.s. ČMD.a.s. GEMEC.s.r.o.	26 072 7 190 150	MUS.a.s. SD.a.s. SU.a.s. Lignit.s.r.o.	9 366 6 346 4 700 611	7 754 6 080 6 533* n.a.
4. t/employee		4. t/employee	2.47	
OKD.a.s. ČMD.a.s. GEMEC.s.r.o.	0.67 0.79 022	MUS.a.s. SD.a.s. SU.a.s. Lignit.s.r.o.	2.00 3.48 2.21 1.06	
		5. stripping of overburden:(in km^3)	200 185	172 266
		MUS.a.s. SD.a.s. SU.a.s. Lignit.s.r.o.	54 974 109 949 40 262 --	49 500 97 900 24 866 --

Note: item 3) * includes steam-gas cycle employees

3 COAL UTILISATION

At present, coal utilisation is concentrated in two principal markets:

a) metallurgy, smelting – hard coking coal, coke
b) power generation – hard steaming coal, brown coal, incl. Lignite

Table 8 State funding for hard coal restructuring, 1991-1999 (millions Kč)

	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Number of sites	1	6	12	14	34	30			
technical liquidation	224	495	1120	1347	1356	1865	611	624	490
social health costs	27	59	1108	1158	1250	1232	1318	1370	1465
remediation	--	--	538	840	473	1163	547	625	494
replacement production	75	42	--	--	--	--	--	--	--
Total subsidy	**326**	**596**	**2766**	**3345**	**3079**	**4260**	**2477**	**2617**	**2451**

Table 9 State funding for brown coal & lignite restructuring, 1993-1998 (millions Kč)

	MUS, a.s.	SD, a.s.	SU, a.s.	JD, s.p.	PKÚ, s.p.
Total costs	**1777**	**2054**	**425**	**872**	**1714**
Mine's own funds	1499	2026	52	73	699
Subsidies:	327	28	373	799	1015
technical liquidation	63	0	254	458	173
social-health	71	28	13	151	24
remediation	193	0	106	190	817

In the medium-term, a crucial portion of brown coal production will still be used for power generation. Bearing in mind the quality parameters of the mineral, pulverized fuel and fluidized bed combustion will be mostly used. An advanced method – steam-gas cycle with gasification – was implemented in the Solokov District but its further application has so far been limited.

The data used by the Ministry of Industry and Trade in 1997 for the preparation of the Energy Strategy suggested that, in the long-term, roughly 50% of total generation in the Czech Republic would be in coal-fired power plants. This implies a brown coal production of 40-45Mt/year – a level of production that has also been adopted for the period up to 2015 in the "Energy Policy" strategy approved by Government Resolution on 12 January 2000.

However, as mentioned earlier, the real development is below projections and nothing has as yet indicated that the situation after 2000 might improve to the benefit of coal mining.

3.1 Clean coal technologies (CCT) in the power sector, industry and households

Brown coal:
The utilization of coal in a medium- to long-term horizon (up to 2020 – 2030) is to a considerable extent dependent on the newly emerging economic structure of the country and demand for coal conversion to energy, derived fuels or chemical products.

The "PHARE D2/92 Project – study of the Coal Sector" dealt with this problem in 1992-1995. It envisaged the use of coal

a) for power and heat generation by major consumers (main consumption)
b) for benefication into solid, gaseous and liquid products to be used directly for the production of synthetic fuels and chemical products
c) in small-scale consumption (households) likely to decrease owing to the demanding and specific nature of the technology and the considerable expansion of gas distribution

In the period up to 2030, the following generation technologies are assumed to be applied in mind the quality of the raw material:

- reconstructuring of conventional boilers (to reduce emissions)
- fluid bed combustion technology
- integrated steam-gas facilities
- new technologies of powdered-fuel combustion
- direct coal conversion

In response to concluded international agreements on emissions reduction, ČEZ, a.s. implemented an extensive programme of desulphurization and denitrification for its coal-fired power generators from 1991-1998.

A progressive technology – steam-gas cycle with gasification – was introduced in Sokolov District (SU, a.s.). Installing another unit would make sense only if the coal production limit in the ČSA opencast mine (MUS, a.s.) in North Bohemian District, imposed due to regional environmental limits, were lifted. If regional environmental limits were not reduced by 2002 at the latest, any utilization of the confined coal reserves will be made permanently impossible by the urbanization of the area.

Certain chances for implementation as late as 2010 are opened by the ongoing development of a steam-gas facility with gasification and combustion of the remnants (Topping Cycle) that can use coal with an ash content up to 30%.

With respect to technical development domestic coal reserves and the assumed alternatives for electricity generation, studies have defined the implementation of combined cycle technology (CCT) in three phases:

I. phase – up to 2000

- reducing SO^2, No^x and dust emissions from the existing power plants of ČEZ
- making the existing gas generator in Vřesová into a steam-gas facility for electricity and heat generation
- developing atmospheric fluid combustion

II. phase – 2000-2015

- operating reconstructed power plants
- possibly building steam-gas facility, depending on revised regional environmental limitations for coal production in the North Bohemian brown coal basin

- installing new coal-using capacities only once supply for the whole life of the facility has been secured and sufficiently proved

III. phase – period after 2015

- end of reconstructed power plants life-cycle; their replacement by new technologies will be determined by environmental limitations of brown coal production
- installing new capacity of pressurized or fluid combustion, efficient preparation of high-ash brown coal for steam-gas cycle with gasification.

Hard coal:

Hard coal for power generation is burnt only in Dětmarovice power plant with a consumption of up to 2Mt per year. The power plant was recently reconstructed to improve environmental aspects of operation.

For system facilities, the application of advanced technologies (atmospheric or pressurized combustion, pulverized-fuel combustion with supercritical parameters, steam-gas cycle with gasification) may be considered as late as 2010-2015. For facilities with regional or local significance, these technologies might be introduced earlier. Utilization of coking coal might be also considered under favourable circumstances.

3.2 The effect of coal mining on the environment

3.2.1 Land use, rehabilitation and restoration – previous ecological liabilities, debt of the past

A new system of mining law has been in effect since 1988, amended partially in 1991 and 1993. The amendments make it possible for any entrepreneurial entity to undertake mining operations provided it has been granted mining authorization and an approval to undertake mining operations. At the same time, the amendments have imposed an obligation to create financial reserves to remedy the effects of mining operations and to settle mine damages.

The new ownership changes have complicated the settlement of conflicts of interests, which now require quite new and in most cases lengthy and elaborate agreements with land and real estate owners.

a) <u>Hard coal – regional and environmental limitations</u>

A total of 67 hard coal deposits were registered in Czech Republic in 1998, 33 in the granted Production Areas. Thirty-one deposits are in Protected Deposit Area to prevent other developments from making their exploitation difficult or impossible.

Since 1992, a total of 10 Production Areas have been cancelled: the overall area has decreased from 858.7km^2 to 496.3km^2, i.e. to 58%.

In the Ostrava-Karviná Coal District, the most serious conflict of interest was between the mines and the town of Karviná. This conflict was resolved only after a complex study provided a new (modern) solution for the co-existence of mining operations and the community. The solution required that industrially utilisable coal reserves in the granted Production Areas be reduced by 151Mt in the Čs., Aramády Coalmine and by 148 Mt in the Darkov Coalmine. A similar solution

may be expected when settling conflicts of interests in the area of the 9. Květen Coalmine in the Stonova community. This additionally enforced reduced availability, shortened the economic life of the mine and devalued the investment placed in its utilization without any compensation.

With regard to remediation of mining operations impact, settlement of mine damages land rehabilitation and restoration as well as other activities in accordance with approved technical liquidation, projects are in progress in the Ostrava-Karviná Coal District. Since a considerable portion of these impacts is due to mining operations before restructuring, the remediation is financed with a significant contribution from the State budget.

In recent years, the problem of closing old abandoned mine workings leading to the surface became very significant. A total of 489 old mine workings (426 shafts, 63 galleries/adits) are registered in the Production Areas taken over by OKD, a.s., which were abandoned before the end of 1945. Securing or liquidating is a statutory obligation of the Ministry of Environment. Of the disclosed number, 25 shafts and 2 adits were secured in 1996-1998. The need to secure old mine workings quickly was underlined by releases of mine gases from old shafts in the densely populated region of the Ostrava Basin and by dangerous events such as the explosion of mine gas at Hugo mineshaft in 1996.

Closures in other hard coal districts is under way or almost completed in compliance with approved technical liquidation guidelines. Environmental remediation is also carried out in accordance with these guidelines. The focus is on pumping of mine water, degasification of closed mining areas, measures against gas releases, remediation, restoration and maintenance of waste heaps, supplementary filling of the closed vertical mine workings, recovering and restoring of damaged mines, monitoring groundwater levels, checking and maintaining the surveying networks and points, observing point and line structures.

In compliance with the provisions of the Act No. 244/1992 Coll. On the Assessment of Effects upon Environment (EIA), mining enterprises are obliged to accompany their applications for an Approval to Conduct a Mining Operation with the result of an environmental audit. The most pronounced problem in underground mining appears to be subsidence, with direct effects on topography, gradients of water flows, housing and community structures, roads and infrastructure networks. Under the Mining Act, a proposed remediation of mining consequences with a schedule for a technical solution as well as proposed financing sources must be part of the submission.

b) Brown coal – regional and environmental limitations

A total of 79 brown coal deposits (incl. Lignite) were registered in the Czech Republic in 1998. Of these 43 deposits were granted a Production Area and 25 deposits were granted a title of a Protected Deposit Area. Since 1992, the number of Production Areas has been reduced and the overall area has decreased from 416.16 km^2 to 364.87 km^2 (down to 87.5%) for brown coal and from 115.17 km^2 to 17.79 km^2 (down to approximately 16%) for lignite.

In the Czech Republic, brown coal is produced mostly by opencast operations, which affect the surface more than underground operations. This is why contracting unpromising underground and opencast mines creates difficult technical and economic problems in terms of rehabilitation and land restoration. Mining in the granted Production Areas has been under way for a number of years. The brown coal producing enterprises were owned by the State, and the profits obtained from their operation were redistributed directly by the State. In spite of the fact that the results of land restoration were assessed quite positively, only a part of the profits were released for rehabilitation. Priority was given to agricultural land restoration. The progress of remediation and land restoration did not correspond to the rate of land occupation and did not meet the needs of the region.

Therefore, rehabilitation and land restoration in operated mining sites can be split into two distinct periods:

- the first deals with the costs of environmental remediation required by mining operations prior to privatization.
- the second covers the operation of a mining enterprise from 1993 to the end of the (underground or opencast) mine life.

Under the Mining Act effective in 1993, producers must create financial reserves to remediate the consequences of mining. Therefore, funds being accumulated to remediate present production cannot be sufficient to cover all the historical damage. This produces a dispute between the State assuming that all environmental remediation costs will be borne by the producing organization, and the private sector requiring the State budget to pay for the environmental liabilities of the past. This dispute should be resolved before the privatization of a company is completed. The new concept requires that technical, economic and legislative conditions are defined for optimal remediation of environmental damage.

Current legislation concerning mining and remediation of damages is externally and internally inconsistent. Legal acts, regulations and management tools are directed more towards supporting and creating conditions for an integrated, environmentally, economically and technically efficient solution.

The exploitation of brown coal reserves has been significantly affected by the Resolution of the Czech Government No. 444/1991 Coll. on Regional Environmental Limits of Brown Coal Production and Power Generation in North Bohemian Brown Coal Basin, and by the Resolution No. 490/1991 Coll. for the Sokolov District. According to the private sector, these environmental limitations have been adopted without necessary analyses due to emotive pressure from citizen lobby groups.

If regional environmental limitations are not modified, production of the ČSA opencast mine (MUS – 2015), and Jiří opencast mine (SU – 2026) will finish prematurely. If currently confined coal reserves are not unblocked by new regional and institutional measures, the mineral basis will be reduced, leading to a gradual discontinuation of production in the Ore Mountains Foothills (Podkrušnohoří) region prematurely around 2035.

Lignite is produced in only one Production Area in the South Moravian part of the Vienna Basin.

Its utilisation is dependent upon the demand of Hodonín power plant. The effects of mining on the surface are manifested particularly by land subsidence in a region with intensive agriculture. Following its stabilisation, the land surface is being restored and recultivated.

3.2.2 Mine water, wastewater
Under the provision of § 40 of the Mining Act, mine water is any ground, surface and rainwater that entered and underground or opencast mine working.

The mine is entitled to use mine water for its needs free of charge and release it into surface or underground water flows under the conditions specified by the water administration authority and hygienic authority. In accordance with water economy regulations (Water Act, Act on State Administration in the Water Economy), any water released into surface or underground water flows most not impair its quality (as controlled by the Water Economy Authority and Inspectorated for Water Protection). In the event that waste or mine waters would impair the quality of water flows, a wastewater treatment plant must be constructed by order of Water Law Authority. The mine operator has a statutory obligation to monitor the quality of wastewater released and to pay a corresponding remittance.

The State Mining Association and Water Economy Authorities may both impose sanctions for a failure to comply with the obligations associated with mine water and wastewater management, respectively.

4 INTERNATIONAL ASPECTS OF RESTRUCTURING AND TRANSFORMATION

4.1 Foreign participation in the restructuring of the coal industry

The government's efforts to resolve the coal mining problems in the course of the transformation of the Czech economy resulted in the adoption of the Restructuring Programme of the Coal Industry by Government Resolution No. 691 in December 1992. The Restructuring Project was prepared under the guidance of a foreign adviser (Mr. Gheyselink) to the Minister of Economy.

In the first phase of privatization, a significant portion of the shares of mining companies was placed in the coupon privatization (these shares were gradually bought up by investment and privatization funds). Part of the shares was handed over to communities and insurance companies. The remaining State-owned interest administered by the National Property Fund (FNM) will be sold in the second phase to complete privatization. By purchasing a portion of shares in the first phase and a portion of the State-owned shares from the FNM, the U.S. investor Apian Group has become a majority owner of MUS, a.s.

Direct foreign capital investment in mine opening and development is not mentioned. Loans from abroad were used by the Solokov Coal Mine (SU, a.s.) for the reconstruction of a pressurized coal conversion gas plant and for the construction of the steam-gas power plant in Vřesová.
With the participation of the PHARE Fund within the framework of the D2/92 Project, a Coal Sector Study was prepared evaluating the potential introduction of clean coal technologies both to mining and generation sectors. Though the results of the Study were valued positively,

financial support for suitable projects has not yet been forthcoming.

Beyond the framework of the PHARE Study, the application of Gravimelt and K-Fuel methods and of the exploitation of coalbed methane were assessed at the research level.

Because the energy economy is so far insufficiently stabilized there is a need for many sector studies and scenarios of the assumed development. The development of the economy has not yet fulfilled the hoped-for trends of growth and it appears that current assumptions of the energy economy's structure are not realistic. Therefore, further studies and scenarios are being prepared where lover primary energy demand brings about additional pressures on to contract coal mining further.

4.2 Foreign trade – export/import

Exports and imports of coal are regulated by a governmental licence policy, which aims to liberalize trade and coal prices and bring conditions closer to those of the European Union.

On the whole, hard coal imports before coal mining restructuring were negligible. Steam hard coal was imported to supply the Dětmarovice power plant. The volumes of imported hard coal rose, particularly from Poland where it was subsidised by the State, therefore cheaper than domestic production. Imports have only fallen gradually since 1997.

The current level of hard coal exports is partially prompted by the surplus due to the above-mentioned Polish coal imports and partially by a significant fall in domestic demand. Slovakia became a significant market for exports. Stable volumes are exported to Austria. However, owing to adverse political development, certain markets in the Balkans have been lost.

Exports of brown coal to meet the demands of power generators in border areas of the Federal Republic of Germany have already become history. Brown coal exports reached their maximum in 1995; since then they have shown a decreasing tendency.

Table 10 Imports/exports of hard coal and brown coal

Coal in kt	1991	1992	1993	1994	1995	1996	1997	1998
Hard imports	3714	3112	1940	1721	2676	3211	2274	1578
exports	2500	2788	5137	6499	7022	6738	6609	6726
Brown imports	2	0	29	7	0	5	3	2
exports	2267	3147	5008	5282	6903	6173	5000	3930

5 BASIC LINES OF THE DEVELOPMENT CONCEPT: 2005 – 2020

The development of the coal industry is closely linked with that of the economy and the corresponding state of the energy economy. Therefore, hypotheses concerning the future of the coal industry are based upon basic development trends of the relevant environment, particularly electricity generation.

The basic directions have been set by the newly formulated Energy Policy, which was approved by the government in December 1999 after an environmental audit. The main goal is to encourage environmentally conscious behaviour in energy producers and distributors. One of the long-term strategic objectives is to lower energy and raw materials demands for the whole national economy to the level of advanced industrial countries. To achieve this, new energy-efficient production technologies must be supported to use less raw material and maximize national labour productivity.

The Energy Policy is based upon the long-term government intent to secure continuously sustainable development of the Czech Republic, with reliable and secure energy supplies, an economically optimal and environmentally-conscious approach by energy producers and consumers. It is founded on the principles of the Energy Policy of the European Union (EU) and emphasizes:

- environmental preservation and respect for the principles of sustainable development
- security of energy supply
- economic competitiveness

In light of these priorities, the Czech Energy Policy aims to:

a) secure efficient and economically beneficial utilisation of domestic primary energy sources (to reduce dependence on energy imports) and to maintain, at the same time, adequate national control over domestic energy sources and the appertaining energy infrastructure.
b) Create transparent and relatively stable material and legislative conditions for efficient management by private suppliers of energy and energy services.

Projections this far have assumed that coal would meet about one quarter of the energy balance of the country up to 2030 and that this proportion would not fall below 20%, even with strong environmental pressure. It was assumed, at the same time, that power generation would remain a dominant consumer even after 2010. However, regardless of the State's declared support of sustainable mining of domestic energy minerals, we consider brown coal mining policy to be simplistic and in any case not implemented.

Indeed, the steeply falling coal consumption in the last years is more severe than the scenarios of the Energy Policy anticipated. Contrary to expectations, the demand for electric power is lower. Upon commissioning of the new nuclear power plant, the demand for brown coal will decrease further by approximately 10-12 Mt. The uncontrolled disintegration of the metallurgical sector will unfavourably affect coking coal consumption.

For these reasons, it will now be inevitable to revise

- considerations for implementing new coal utilization technologies and the potential construction of a new steam-gas facility
- the replacement of refurbished coal-fired power plants
- the regional environmental limitations of coal production in North Bohemian Brown Coal Basin
- and the installation of new capacities based upon pressurized or fluidized bed combustion, burning of high-ash, and washed coal in a steam-gas cycle.

6 ASSUMPTIONS

The energy consumption trends and decreasing demand for power generation and end-consumption indicate that the assumptions of the State Energy Policy adopted not long ago are already outdated. The gradual decrease of actual volumes of coal production below expected levels brings about particular economic, technical and competition problems, whose resolution raises a number of interrelated difficulties.

6.1 Legislation – system of mining law

The private sector takes a critical view of the legal framework for mining determined by the system of mining laws (Mining Act, Act on Geological Works and State Administration in Geology, Act on Mining Operation and State Mining Administration). These are seen as unstable, with too many and different kinds of approaches creating unjustified uncertainties and risks.

The concept of mining law is still based on previous federation arrangements, which left responsibilities both at federal and national levels. The Mining Act – Act on Preservation and Exploitation of Mineral Wealth – was common to both republics and based upon socialist ownership relations and central directive management. Although certain fundamental changes to suit the needs and conditions of a market economy have been implemented by amendments to the Act, many provisions do not correspond to current needs. The State administration may interfere with economic activities in the private sector and has still a pronounced influence.

In addition, a new Mining Act cannot be drafted until the dispute about which ministry is responsible has been restored. According to the government's plan of the preparation of legislative acts, the Ministry of Environment should prepare an amendment to the Mining Act in 2000. The State Mining Administration however, by resolution of the government on the Concept of Raw Materials Policy, has been charged with preparing amendments to the acts by the end of 2003, after a full analysis of the mining law has been carried out.

The private sector, having analyzed the situation, has earmarked the following issues, which must be addressed in the successful drafting of a new Mining Act:

a) the ownership of mineral resources, distribution of minerals and deposits, public interest in the utilisation of mineral resources
b) the approach to mineral resources, mining authorization, ownership of mines
c) payments, statutory formation of reserves
d) the settlement of conflicts of interest

e) the remediation of environmental damage caused by mining.

The Act on Geological Works also belongs to the system of mining laws. Responsibility for geological works also lies with the Ministry of Environment, which prepared an amendment to the Act. Due to a number of procedural and formal deficiencies, however, discussion of the amendment in the Czech Parliament is jeopardised. The private sector and the Ministry of Environment appear to have certain fundamentally opposed opinions. Mine operators do not recommend that individual laws be prepared separately but rather that the system of mining law be resolved as a whole.

The Employers' Union of Mining and Oil Industries (ZSDNP), having discussed the outline of the concept of coal mining in the Czech Republic, has formulated the following views:

a) Coal will remain an important driver of economic development and gross domestic product growth at least until the middle of the 21st century.
b) Coal will meet about one quarter of the energy demands in the energy balance of the State as late as 2030; only under strong environmental pressure might this proportion fall below 20% of total energy consumption.
c) Sales will gradually focus on power generation as the dominant share of coal market.
d) Coal's share of the energy balance depends on the development of progressive production and utilization technologies, especially in combustion processes.
e) Coal, nuclear energy and gas cannot be considered as competing primary energy sources in the energy balance of the country; they represent a system of synergetic components, the respective shares of which are dependent on a number of agents both inside the energy economy and outside in its relevant surroundings.

According to ZSDNP, the adopted Energy Policy formulates the role of coal in the energy economy ambiguously and insufficiently. On the other hand, the conditions for mining operations have not been determined. The role of the State has not been defined. Support is voiced for the use of environmentally friendly primary sources, but the necessity of resolving the legislative conditions for mining undertaking has been completely ignored.

6.2 Risks affecting the development of coal mining

Risks may be divided according to their internal and external nature.

The internal risks are inherent in the transformation and development of the economy. The conditions concerning the utilization of coal are complicated especially by

- a greater-than-expected reduction of energy demand.
- slow growth of electric power consumption in the industrial sector.
- support for the growth of the share of lower carbon fuels, especially of natural gas.
- electricity generation monopoly.
- insufficient legal protection for coal producers against customers whose payment defaults go undisciplined.
- the beginning of electricity generation in the Temelín nuclear power plant. This will bring about a pronounced change in the primary energy mix, including a drop in demand for steam coal.

Other internal risks arise from efforts to "ecologize" industrial production:

- direct interference by the environmental protection authorities using prohibitory or mandatory orders addressed to individual enterprises or industrial branches to direct mining undertakings, limit production and revise mining authorizations
- economic interference by introducing special supply obligations for mining and energy enterprises, directly increasing production prices/

Use of hard coal is further complicated by a slow and largely chaotic restructuring of the metallurgical sector.

The external risks may be associated particularly with the development of the international economic situation, especially in the fuel market. Not long ago, a significant danger for the Czech coal industry came from uncontrolled imports of cheap coal at dumping prices, especially from Poland. Efforts to import electricity from East European countries imply a similar danger. The risks were successfully eliminated, but similar attempts may be repeated.

GEORGIA [151]

Coal resources are estimated at 700 Mt: 250 Mt of hard coal in Tkibuli-Schaori and 70 Mt of brown coal in Achalziche are exploitable. Annual production, at 2.3 Mt in 1970, declined to 20 000 t in 1996 due to competition from oil and gas. In 1995, a Presidential Ordinance aimed to revitalize the coal mining in Tkibuli-Schaori, but the required financing ($30-50 M) could not be secured.

151 G. Barudaschwili et al: Die Energiewirtschaft Georgiens im Űbergang, in Energiewirtschaftliche Tagesfragen, 12/99

HUNGARY [152]

1 ENERGY DEVELOPMENTS AND POLICIES

The last decade has witnessed significant changes in Hungary's energy supply, primarily because of the political changes and related economic transformations. It is a quarter of century since the oil crises, therefore present changes can not be attributed to them.

Annual gross (not accumulated) energy consumption had reached 1400 PJ ten years ago (as shown in Table 1), but then growth has stopped since then. By the beginning of the 1990s, gross consumption was reduced to 1000-1100 PJ. It can be expected that this value shall not exceed 1200 PJ in the foreseeable future. This trend can be seen as favorable, but considering the specific energy consumption per capita, we are far behind our western neighbors. Both energy efficiency and energy economy are equally important for safety of supply and environmental protection.

Table 1 Particulars from the domestic energy balance, PJ

	1980	1985	1990	1995
I. Production	**632**	**704**	**603**	**554**
Coal	291	263	188	130
Crude oil	83	81	78	68
Natural gas	224	255	170	170
Primary power[1]	1	66	139	142
Other	33	39	28	44
II. Import				
Coal[2]	**692**	**705**	**725**	**609**
Crude oil, oil products	91	113	65	44
Natural gas	380	346	331	309
Primary power[3]	135	138	218	232
	86	108	111	24
III. Total resources	**1324**	**1409**	**1328**	**1163**
Export	-45	-67	-71	-88
Changes of stocks	-8	-14	+11	-8
IV. Domestic consumption	**1271**	**1328**	**1268**	**1067**

Notes: 1 hydro- and nuclear-based power
2 including briquettes and patent fuel
3 import-export balance

The share of imports in the total value of energy supplies exceeded 50% ten years ago and today is 54%. However, our import dependence will increase, as indigenous coal, oil and natural gas production decreases. Uranium production will be terminated and the share of renewable energy resources is very low. On the other hand, greater dependence on imports would not cause a major problem if it can be compensated by adequate profitable exports. A problem would arise rather with unilateral import dependence, e.g. the dependence on a single country. Therefore, diversification is very important, for this can guarantee the necessary safety of supply.

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The domestic production of energy has been reduced by more than 20% during the last decade, differently in different sectors: coal production by only one-sixth and natural gas production by one third. These decreases are moderated by the growth of domestic nuclear energy production. If nuclear energy is considered an imported resource, the import dependence of our country is as much as 65%.

In the last decade, electricity imports have been reduced significantly; coal imports have been reduced by 50% and crude oil by 10%. However, natural gas imports have doubled, and in 1999 reached 295 PJ, e.g. about half our total energy imports.

Hungary's domestic energy production – oil, gas, nuclear power, very low-calorific coal and lignite – covers around half of energy requirements. Hungary thus depends on imports for approximately half of its primary energy supply. Domestic production has peaked and when energy consumption begins to increase in the future, import dependency will probably further increase.

Hungary has been experimenting with market-oriented economic reforms for several decades and a major revision of the central planning systems was begun as early as in 1968. By 1988, a modern tax system was established together with a two-tier banking system. Joint stock companies were permitted from 1988 onwards and direct foreign investment was encouraged.

The Hungarian energy policy under development is meant to enable a secure, rational and economic long-term energy supply for the country. Social changes and new international relations, as well as the transformation of the economy, have called for a change of the principles and practices of the previous energy policy, which had essentially been State controlled through central subsidies and planning.

The major elements of the new Hungarian energy policy are:
- eliminating one-sided energy import dependence – which results in economic dependence – and implementating opportunities to diversify imports by source and origin
- improving energy efficiency, partly by encouraging energy conservation and partly by influencing the restructuring of production
- establishing market conditions in energy supply and developing a liberalized pricing policy that reflect relative international values (this will not only assist economic clear-sightedness, but also motivate people to conserve energy and use it rationally)
- searching for low capital-cost solutions and economic means of supply as well as creating a flexible energy system adaptable to demand which promotes such solutions
- implementing environmental protection priorities in the field of energy
- involving the public in decisions concerning the development of the system which have an impact on the whole society, and making all efforts to reach social consensus
- developing new organizational and control formulas corresponding to a market economy and preventing a monopoly
- limiting State intervention to a justified and necessary level
- securing the availability and adequate supply of energy sources for society as the basis of economic development and improving living standards. However, energy supply is only a

prerequisite for development and its ability to influence the economy is limited. That is why the objective of energy policy may not be more than an endeavor to achieve secure and economic energy supply. Economic development can only be achieved as a result of operating efficiency in the manufacturing sectors. The energy supply system has, in this regard, not reached international standards.

2 ELECTRIC POWER GENERATION

The current capacity of the Hungarian power plants is 7500 MW: approximately half is produced by hydrocarbon-fired units. Although the capacity of the ten existing coal-fired power plants is still about 2000 MW, there is a great pressure to phase out outdated plants that are operationally unreliable in the long run. We have increased the capacity of our nuclear power plant to 1840 MW (4 x 460 MW) with good cooling conditions, and with sufficient cooling water availability, even a 470 MW load can be maintained.

Our power plants, especially the coal-fired plants are old: even the youngest one was put into operation a quarter of a century ago. Their average lifetime is 28 years, based on their capacity. Also, the average lifetime of the hydrocarbon-fired plants is nearly 20 years, and our nuclear power plant has already reached half of its expected lifetime. We have built only a few plants since in the 1990s and only a few gas turbine power units (Dunamenti 145 MW, Kelenföld 137 MW) in addition to some smaller steam turbine projects (Inota, Debrecen) and a gas turbine peak load plant (Dunamenti G2):

The efficiency of the power plants is also unsatisfactory. Our coal-fired plants work with 20-28% efficiency, while the oil-fired plants work with 33-37% efficiency. Only cogeneration allows some improvement, therefore nearly all of our plants are connected to district heat supply.

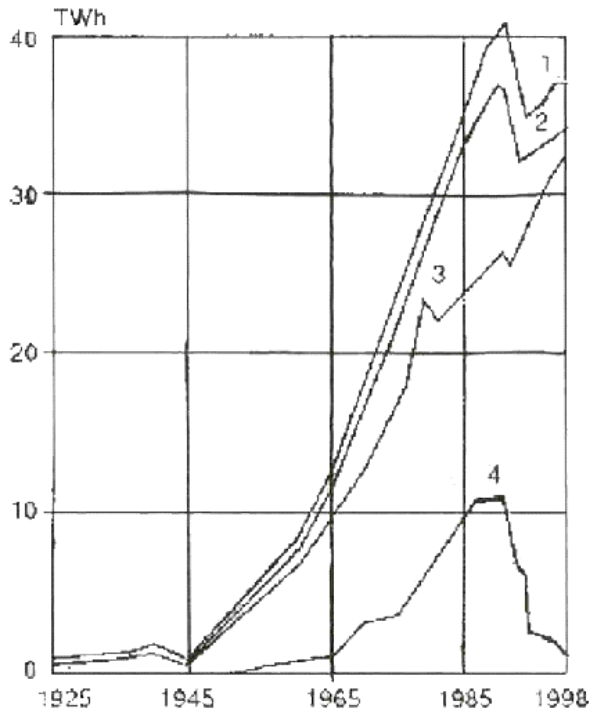
Our power plants are not flexible enough, as the majority of them were built for base load. But even peak load gas turbines do not start fast and reliably, either. The fate of power plants based on local fuels is connected with the future of the local mines. None of our coal-fired plants can operate exclusively with imported coal.

Our plants do not meet the ever-stricter environmental regulations, either. They are not equipped with sulfur and nitrogen control devices, though the built-in dust controls equipment works with good efficiency practically everywhere. To comply with the new environmental regulations, and to meet the specific emission limits prescribed for the protection of clean air, the power plants need reconstruction and supplementary equipment. After 2004 or 2005, the old power plants will not be allowed to operate without meeting these standards.

Consequently, several plants must be decommissioned or reconstructed in order to meet current requirements. It has been estimated that 21 plants of 200 MW capacity (200-230 MW) will need reconstruction and refurbishment after 2005: namely, 3 lignite-fired units of the Mátrai Plant, 10 hydrocarbon-fired plants and 8 secondary units of the nuclear power plant of Paks. Even recently reconstructed plants may need to be refurbished for environmental reasons (for example the new boilers of the Pécs plant, installed in 1992).

Graph 1 shows the trend of the consumption + network losses (gross consumption) at the national level between 1925 and 1994. Needs were covered by domestic generation and imports by customers. The diagram also shows total electric energy consumption at the national level, i.e. gross consumption increased by the self-consumption of the power plants – since this figure is usually applied for planning on the national level. Net generation of the domestic power plants as well as the import balance is also shown. This diagram enables us to analyze the changes in the above categories.

Graph 1 Electricity supply 1924-1998



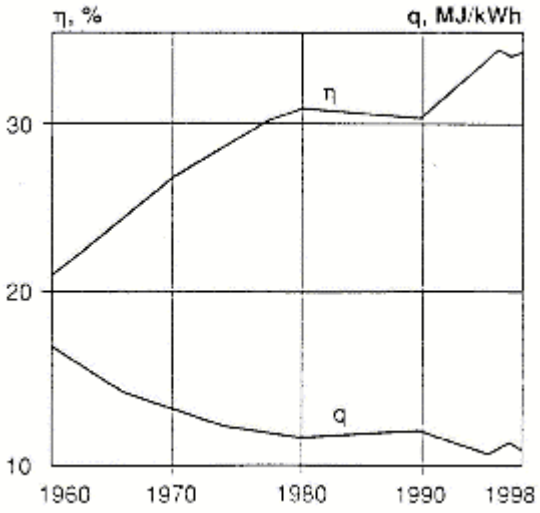
Code	Item	1980	1997	1998	Change, %	
					98/97	98/89
1	Total consumption (gross consumption + self consumption of p.p.)	40.66	37.55	37.90	0.90	-6.80
2	Gross consumption (consumption + network losses	38.07	34.58	35.00	1.20	-8.10
3	Net generation	26.98	32.43	31.30	5.80	-27.10
4	Import/export balance	11.08	2.45	0.70	-67.40	-93.70

Almost 98% of national gross consumption is covered by the Hungarian power system and by import. Generation by independent producers not connected to the grid covers not more than 2%. Generation by hydropower plants is not displayed separately as it is less than 0.6% of domestic production.

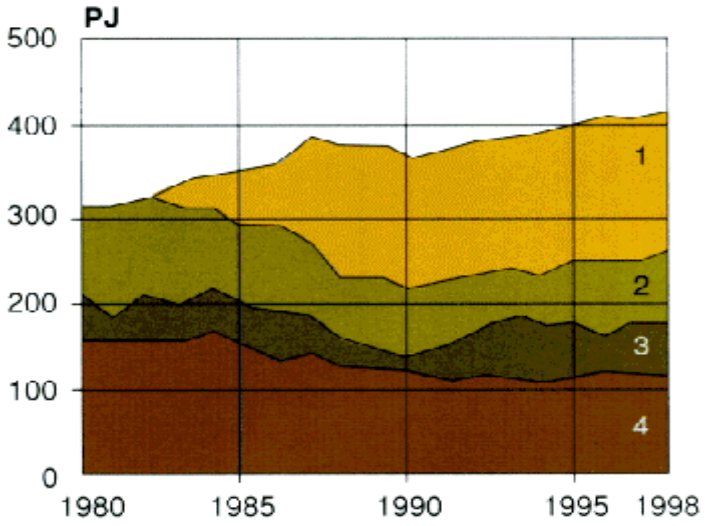
As demonstrated in Graph 2, the share of production in modern facilities has gradually increased year by year, while the heat rate of the electricity produced has decreased.

Graph 2 Heat rate of public power plants

	Average efficiency η %	Heat rate q, kJ/kWh
1950	-7.4	20 666
1955	-8.2	19 808
1960	21.1	17 078
1965	24.1	14 951
1970	27.2	13 234
1975	29.2	12 041
1980	31.1	11 561
1985	30.9	11 650
1990	30.6	11 747
1995	33.6	10 729
1996	34.2	10 511
1997	33.8	10 650
1998	34.9	10 331



Graph 3 Fuel consumption of power plants 1980-1998*



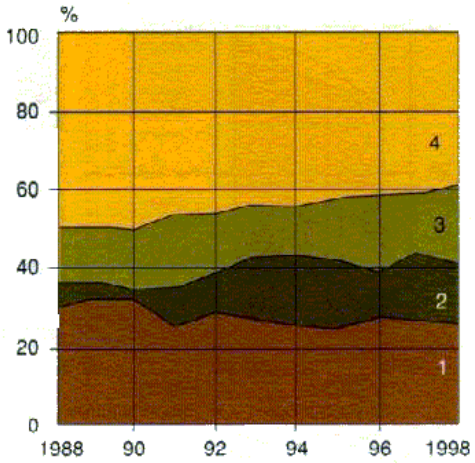
Code	Fuel	1980		1990		1995		1998	
		PJ	%	PJ	%	PJ	%	PJ	%
1	Nuclear			148.3	40.6	152.3	38.5	151.5	36.8
2	Gas	52.6		73.8	20.2	68.3	17.3	80.7	19.6
3	Oil	63.8		18.6	5.1	61.0	15.4	58.9	14.3
4	Coal			124.4	34.1	114.0	28.8	120.5	29.3
	Total	116.4		365.1	100.0	395.6	100.0	411.6	100.0

Primary energy consumption of the public power plants

*Categorization of electricity production by energy sources**

Item	1988		1998	
	GWh	%	GWh	%
Energetic brown coal	5,012	17.8	3,884	10.7
Lignite	2,709	9.6	4,701	13.0
Hard coal by-products	1,055	3.7	783	2.1
Coals as total (1)	8,776	31.1	9,368	25.8
Fuel oil (2)	1,505	5.3	5,686	15.7
Natural gas (3)	4,333	15.4	7,095	19.6
Hydrocarbons as total	5,838	20.7	12,781	35.3
Fossil fuels as total	14,614	51.8	22,149	61.1
Hydro power	169	0.6	155	0.4
Nuclear power (4)	13,445	47.6	13 ,949	38.5
Total	28,228	100.0	36,253	100.0

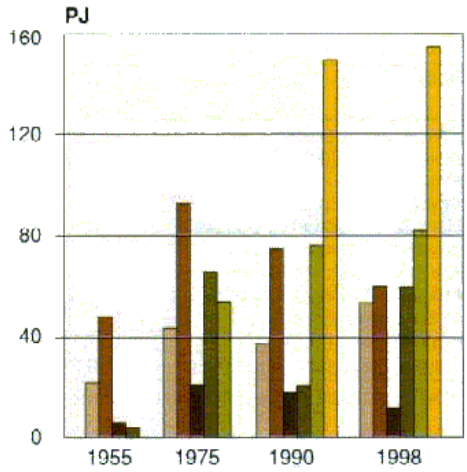
* Without PowerGen and EMA Power.



Categorization of fuels

The diagram shows the categorization of fuels consumed for electricity generation and heat supply in the public power plants.

Item	1998 PJ	1998 %
Coal	120.5	29.3
Hydrocarbon	139.6	33.9
of which natural gas	*80.7*	*19.6*
Nuclear fuel	151.5	36.8
Total	411.6	100.0



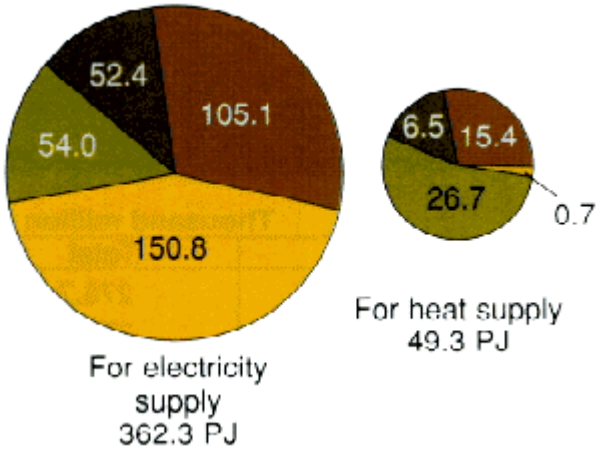
Year	Lignite 1 Mt=6.75 PJ		Brown coal 1 Mt=9.75 PJ		Hard coal by-products 1 Mt=10.99 PJ		Fuel oil 1 Mt=40.34 PJ		Natural gas 1 Gm³=30.84 PJ		Nuclear fuel	Fuel as total
	10^3t	TJ	10^3t	TJ	10^3t	TJ	10^3t	TJ	10^6m³	TJ	TJ	TJ
1955	2,370	19,326	4,038	47,772	244	4,110	42	1,649	–	–	–	72,857
1965	2,871	22,038	8,247	92,204	1,258	13,605	491	19,590	254	8,692	–	156,130
1975	6,230	41,758	7,916	90,969	1,797	19,314	1,579	63,859	1,471	52,526	–	268,426
1985	6,758	46,462	7,676	75,368	1,352	14,815	1,479	59,769	2,761	84,976	72,736	354,126
1990	5,387	35,474	7,437	72,792	1,469	16,129	466	18,573	2,382	73,847	148,366	365,121
1995	6,893	46,531	5,748	56,047	1,036	11,385	1,512	60,975	2,216	68,342	152,304	395,584
1996	7,558	51,016	5,782	56,370	947	10,406	1,262	50,898	2,580	79,568	155,210	403,468
1997	7,906	53,366	5,813	56,675	1,013	11,135	1,483	59,814	2,263	69,786	151,644	402,420
1998	7,555	50,994	6,061	59,092	950	10,439	1,460	58,891	2,617	80,701	151,505	411,622

Data of PowerGen and EMA Power public power plants are not included.

Graph 3 above shows the breakdown of the total fuel consumed for the electricity generation and heat supply in the power plants of the MVM group. The increase of hydrocarbon consumption in the seventies, followed by nuclear energy, is distinctly visible.

Graph 4 below gives a breakdown of fuel uses in 1998. Electricity generation accounted for 88.0% of total fuel. Heat was supplied with 12.0%. Nuclear fuel was used as 41.6% for electricity generation, and natural gas was used as 54.8% for heat supply in 1998.

Graph 4 Categorization of fuels in 1998*



For electricity generation in the MVM power plants in 1994, nuclear fuel was for 45.4%, while natural gas was used to the tune of 47.2% for heat supply.

3 COAL SUPPLY

Customers have made efforts to change from coal to natural gas or oil. At present 90% of domestic coal is used by power plants. This is the reason behind the mergers of power plants and mines into one organization. Imported coal cannot be used in our power plants: the existing technology is suitable only for use of domestic coal of lower quality.

Production of deep mines is decreasing: mining by opencast method is maintained on an annual level of 50 PJ. The share of hard coal in residential consumption for the last decade has been reduced from 30% to 10% and a further reduction is expected. In the medium and long term, only power plants can utilise larger quantities of coal. However, the coal-based power plants built in the 1950s and 1960s are obsolete. As deep mines are running out of resources, exploitation is expensive. Only the opencast method or the cheap and high-quality coal shall have a future. Presumably a lignite-based power plant will be built and lignite consumption will double. But the highest attainable share of lignite in the primary energy balance of the country is 10% in the next 15 years. In order to diversify imports, different power plants based on imported coal should be built. This is the main strategic question, for the growth of natural gas imports can be compensated only by importing coal.
The quality of coal entering domestic power plants had gradually become more and more inferior

in the past years due to the increase in ash content. Fuels consumed by the power plants are composed of by-products and poor quality materials that cannot be utilized elsewhere. Consequently, they include, in addition to the useful components, inert matters and humidity in large volumes.

Of the components of fuels used in power plants, most problems are caused by ash content. Our domestic coals contain unpleasant kinds of ash at a great percentage. The ash content of different kinds of coals ranges between 20-65%, depending on the nature of mining and coal treatment.

The ash content causes serious troubles both in the treatment of the fuel and in firing, as well as in the operation of the firing equipment. Significant problems arise in the transport of the fuel; in crushing; ignition; regulation of the boiler and scorification; and as a result of wear on the mill, coal dust pipes, certain components of the boiler equipment and in the system of slag removal. While recognizing the problems caused by high ash content, we have to emphasize that favorable firing conditions can be established by developing equipment that takes into account burning specificities, sulfur and nitrogen content, the effects of xilitol in the case of lignite, as well as specificities of ash and the harmful effect of humidity.

Finely ground inert material entering the furnace unfavorably affects the conditions of ignition and may lead to scorification. In particular, at high temperatures next to the burners, finer fractions may reach the temperature of stickiness and stick to the uncooled parts of the wall.

Problems caused by humidity in the fuel are less frequently discussed recently, although the problems with fuel utilization occur as the joint effect of high ash content and humidity. Humidity causes trouble during transport and ignition. Humidity retained in the coal powder and getting into the furnace causes wearing and corrosion of the post-heating surfaces, too. In addition to humidity, in the case of younger coals and lignites, xilitols from the wood tissues at different degrees of decay create problems in grinding and firing.

Although in the course of coal utilization, the remains after quality coal is separated contain a great volume of harmful components in respect of firing, it is still a very valuable and important basic energy material. The ever-increasing deterioration of the quality may be counterweighted by thorough theoretical examinations and high-level development of the equipment. This research and development activity has to be performed both for fuel treatment and the process of firing itself. Hungary, due to her unfavorable resource base, belongs to the top-ranking countries of the world in this respect. Equipment which treats coal according to the demands of firing and ensures stable burning for a wide range of fuels may be developed on the basis of a thorough knowledge of crushing and burning theory.

4 THE MINE-POWER PLANT INTEGRATION IN THE MVM GROUP

The integration of mines and power plants was carried out in three steps and concluded by 1994. As a result, more than 90% of coal demand for power was supplied from mines associated with the MVM group. The main goals of the integration were the following:

- to increase the competitiveness of coal-based power by decreasing common operating

costs of power plants and mines which are interdependent and in close technical and economic connection
- to allow the coordinated development or divestiture of mines and power plants, and decrease losses resulting from former lack of coordination
- to speed up the reorganization of coal-mining, to reduce social tensions in mining regions and to promote job-security in prospective mines by their integration
- to promote profitability of mining assets, thereby advancing liquidation procedures and compensation of creditors.

Integration entails evaluating the assets and liabilities of the mines. Power plant companies covered the capital difference between necessary funds and liabilities of the assets, and issued limited shares equivalent to that. The shares were given to the mine liquidators, and after liquidation, to the former creditors. In this way, the capital-structure of the electricity sector has been changed.

After the first step of the integration (30 April, 1993), the 50% ownership of MVM Rt. decreased to 38.3% in the Mátrai Power Station Ltd.; 43.8% in Pécsi Power Station Ltd. and 41.4% in the Bakonyi Power Station Ltd. As the result of the integration, 7150 mining employees became employees of the power plants, and 2100 persons were taken to the staff of other ventures.

In the second step of integration (31 December, 1993), ownership of the Tiszai Station Power Ltd. in its subsidiary the Borsodi Energetic Ltd. became 69.7% after the integration of the mine. The company employs 2765 persons from the former mine. The Balinkai Mining Works – integrated with the Bakonyi Power Station Ltd. – took on an additional 1268 employees. The ownership of MVM Rt. in the company decreased to 34.7%.

The third step of integration affected the North-Transdanubia region. As of 1 April, 1994, the ownership of MVM Rt. in the Vértesi Power Station Ltd. decreased from 50% to 39.5%. The integration resulted in the take-over of 4503 employees. After the merger of the MVM Rt. mine with Tatabányai Energetic Ltd., the ownership of MVM Rt. in the Vértesi Power Station Ltd, became 69.6%, and 1764 employees were taken over by the power station.

Now there exists a legal framework for building new power plants. Projects are licensed by the Hungarian Energy Office and constructed by private contractors. New capacities can be built within a competitive framework, but the possibility is also given for the State to exercise influence. The minister approves the selection of the energy carrier. The government makes the licensing decision for 200-600 MW power plants, while larger projects and nuclear power plants fall under the competence of the National Assembly. The government, through the National Assembly, reviews the updated national power expansion plan biannually.

The majority of power plants has been privatized: first the Csepel power plant, the Mátrai and Dunamenti power plants, then Dunaújvárosi and Tiszai, and finally the Budapest power plant. In total, 4600 MW of capacity has been privatized, i.e. 60% of existing power plants. Some have been owned so far by individual owners (industrial power plants), or a municipality. By now, only the three Trans-Danubian coal-fired plants (720 MW), the nuclear power plant owned by MVM Rt., three peak load gas turbines and the hydroelectric power plants are owned by the State

(37%). However, in the long run, the State shall not directly finance the building of new power plants, and MVM Rt. can only build reserve power plants required for system control and perhaps, later on, also a storage power plant. This means that by the end of this decade, private companies will build the majority of the new power plants.

5 FUTURE PROSPECTS

If we know where we are, and where we want to go, the only thing to do is to select the way leading to our goal. For this, we have to determine the basic principles for the development of the Hungarian power plant system, in harmony with national energy policy. These are the following:

- safe satisfaction of the quantitative and qualitative power demands of the consumers,
- power production at the lowest possible cost, sold at the lowest possible price,
- operation of the Hungarian power plant system according to current environmental standards,
- safe power supply by diversifying primary energy sources, at a socially acceptable risk,
- a flexible power plant system, with the necessary reserves, which meets the requirements of the co-operating Western-European power system, and
- profitable operation of the power plant system at prices according to official regulations.

KYRGHYSTAN[153]

Among the central Asian States, Kyrghystan has the biggest coal resources: 24.4 Gt. In 1996, there were 7 underground and 5 opencast mines with a production capacity of 2.6 Mt, operated by the state-owned Kyrghyzkomur company. In addition, there were some smaller mines. Since independence, coal production declined from 3.7 Mt in 1990 to 0.5 Mt in 1998. The decline was prompted by the economic recession, rising prices, loss of coal export markets in Kazakhstan and Usbekistan, difficulties in obtaining material and spare parts, and insufficient financial resources and budget allocations. Imports also declined significantly (from 2.8 Mt in 1990 to 1.1 Mt in 1994). Policies aim to reduce the country's energy import dependence. Assuming an economic recovery and improved quality of coal products, production is expected to rise again.

153 REWG Energy Forum, Kusadasi, Izmir, October 1996, presentation on Kyrghystan; UNECE, Present situation and prospects for the fuel and energy complexes in the countries of the CIS, document ENERGY7R. 131/Add. 1 of 26 September 1996, tables 5 and 7; IEA, Coal Information 1998, Paris 1999, p. II.114 and I.183

LATVIA [154]

INTRODUCTION

The main objectives of the Latvian energy sector are to diversify fuel supply, to promote competition, to use high-quality fuel and to increase coal's share in the country's energy balance.

The structure of energy resources in 1998 was the following: oil products (heavy oil, light oil products) – 38%, natural and liquefied gas – 26%, hard fuel (coal, wood and peat) – 26%, hydro-electricity (including imported electricity) – 10%.

Significant changes in the balance of energy resources in the next five years are not predicted in view of existing heat and electricity supply capacities and large industrial, commercial and household energy customers. Imported coal and local resources of peat are the solid fuels used in Latvia. Since 1993, there has been a free market for solid fuel in Latvia. Purchase and sales of fuel is within the scope of competence of private companies. In 1997, imported coal was evaluated as 2% of total energy consumption and local fuel (wood and peat) as 20%.

1 SUPPLY AND CONSUMPTION OF COAL

Latvia imports coal from Russia (Pechori and Kuzneck), Kazakhstan (Karaganda) and Ukraine (Doneck). In 1996 deliveries from Poland were renewed, although in small quantities. Coal is supplied by rail and distributed domestically by road.

Coal is traditionally used by local small-scale heat sources with 2-3 MW capacity. Compared to previous years, coal consumption is constantly decreasing. This is caused by the substitution of coal by local fuels like firewood and peat. Such substitution is encouraged by the relatively high price of coal. Coal prices were 36-56 LVL/t in 1996 (65-100$/t).

Table 1 Consumption of hard coal by sector in t

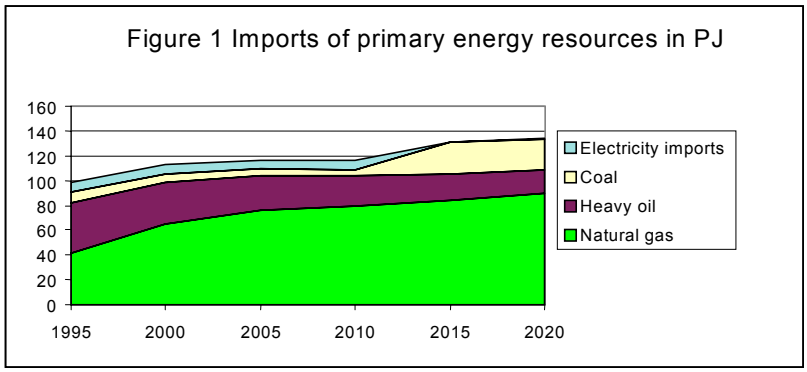
Economic sector	1997	1998
agriculture and forestry	7.2	4.6
fishing	32	8
industry	32.0	27.4
construction	1.1	0.9
hotels and restaurants	105	158
wholesale and retail trade, repair of vehicles and household goods	3. 3	5.2
transport, storage and communications	15.9	15.6
real estate, renting and business activities	3.7	3.9
public administration and defense, compulsory social security	33.5	27.7
education	18.9	17.4
health and social work	11.3	9.7
other community, social and personal activities	59.8	33.5
TOTAL	204.7	1346.0

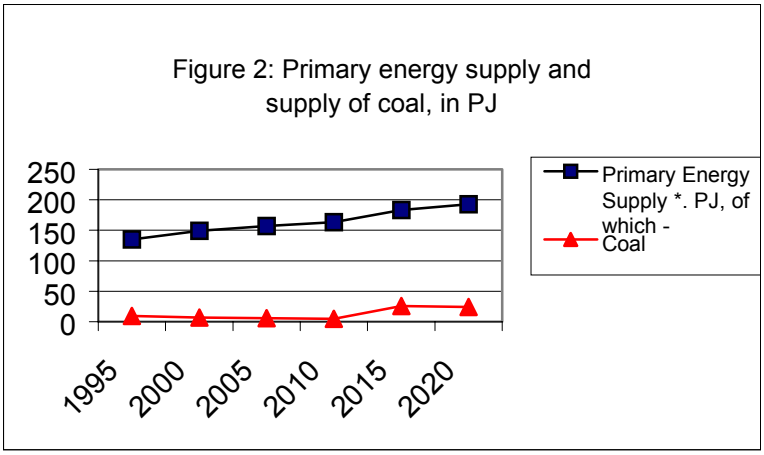
The decline of coal in Latvia was very significant for the last years. In 1990, coal supply was 26.5 PJ; 9.5 PJ in 1995; and 4.3 PJ in 1998. In 1995 coal covered just 5.3% of total primary energy

154 M. Chaikovska, Dr. I Stuits and Prof. N. Zeltins, Academy of Science, Riga

supply and 8% of fuel consumption. Coal consumption by sector in 1995 was: 37% district heating, 36% households, 9% industry and 18% other. In 1998, households consumed 22.6%, industry 9.5%, and 67.9% went to other sectors.

The Latvian National Energy Programme (accepted by the Cabinet of Ministers on September 9, 1997) foresees an increase of the share of coal primary energy resources (see Figures 1 and 2), in accordance with a possible construction of a new electricity power station in Latvia (Liepaja's coal plant).





2 PRODUCTION OF ELECTRICITY

Reliability of energy supplies in Latvia's circumstances was considered an important factor. At present coal is not used in Latvia for power generation, while in the world it occupies a considerable share in the fuel balance, up to 25% and higher in some countries, e.g. Denmark (43%), Finland (34%), Germany (33%). Coal-fired generation in Latvia has a number of advantages:

- it provides a way to diversify fuel supplies and improve security of supply;
- it is one of the cheapest fuels on the world market;
- there is theoption to chose from an almost unlimited number of suppliers;
- coal supplies are arranged by cheap sea transport.

These advantages are strong arguments for the construction of a new coal-fired power station that is considered and discussed in Latvia. This station could solve a negative tendency in the Latvian electricity balance where annual production of electricity every year is less than consumption. A new plant could open the possibility of securing the country's electricity needs by its own generation.

3 PRODUCTION OF THERMAL ENERGY

The current heating situation in Latvia may be characterised in terms of de-centralisation.

Total thermal energy consumption has dropped compared to previous years. In 1995 approximately 70% of thermal energy was supplied by district heating systems. In 1995, the share of coal in total fuel consumption for thermal energy generation was 7% or 5.3 PJ (centralised supplies were 1.5 PJ and local supplies, 3.7 PJ). In 1998, the share of centralised district heating amounted to 55-60% and the rest was provided by local sources. According to 1998 statistics, coal's share of fuels used for centralised heating was 2%. Coal is mainly used in local systems with small capacities (less than 1 MW). Coal is used evenly all over Latvia.

The majority of district heating systems in Latvia were installed 1960-1990 and many of them are approaching the limit of their technical lifespan. Average annual efficiency of installed boilers does not exceed 85%. Average efficiency of boilers rated below 1 MW with low quality solid fuels is 50-60%.

Systems generally lack control equipment. In smaller plants, burning regulation and control equipment is in unacceptable condition or is not installed at all. In many cases there were no water treatment facilities in small plants. Wear is significant. Low boiler efficiency, unacceptable controls of burning and utilisation of low-quality high-sulphur coal have substantial environmental consequences.

Boiler plants lack equipment for ensuring automatic fuel burning. Airflow in many cases is regulated manually. In most cases, there is no equipment for estimating the plant's efficiency, actual capacity and other important parameters.

In plants designed for solid fuel burning, first of all, new boilers that are designed for specific fuel types have to be installed, later on followed by construction of fuel storage. Finally, measures connected with burning control and automating have to be carried out.

It is planned to substitute low-quality coal with high-quality coal imported from Western markets.

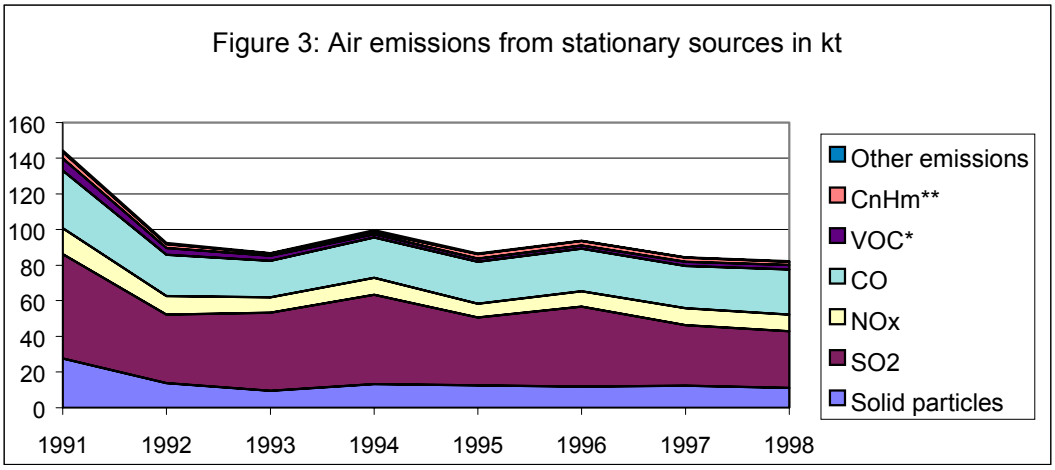
Approximately 3000-3500 boiler plants with installed capacity of over 0.2 MW were operating in Latvia in 1996. Ninety percent of boiler plants have capacity below 4 MW, though this group produces just 30% of thermal energy. These plants were cast iron boilers utilising the largest proportion of solid fuels. Installed cast iron boilers, due to features of their construction and low efficiency, are not suited for conversion and future operation. Approximately 1000 boiler plants with capacities 0.2-4.0 MW must have their old cast iron section boilers replaced.

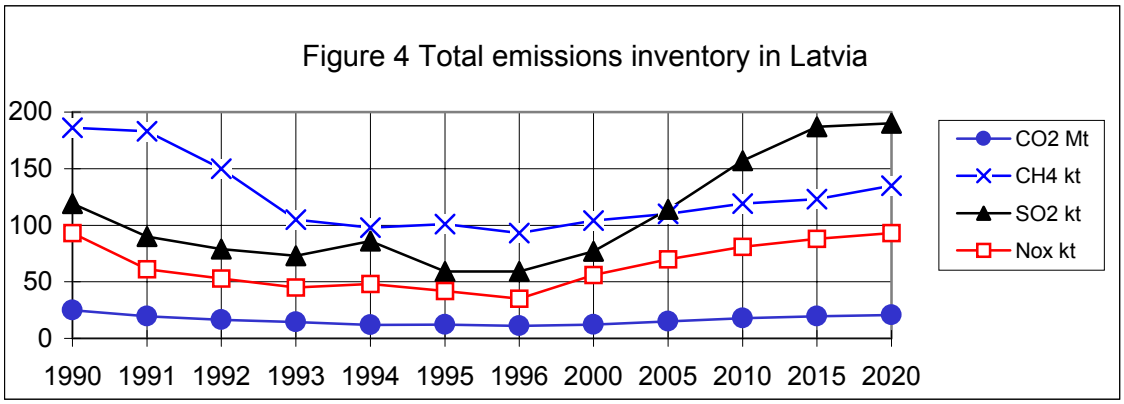
Replacing these old boiler plants by more modern plants requires domestic and foreign investments. Also, enterprises producing small boiler plants should take an interest in this field of Latvia's market.

4 ENVIRONMENTAL PROTECTION

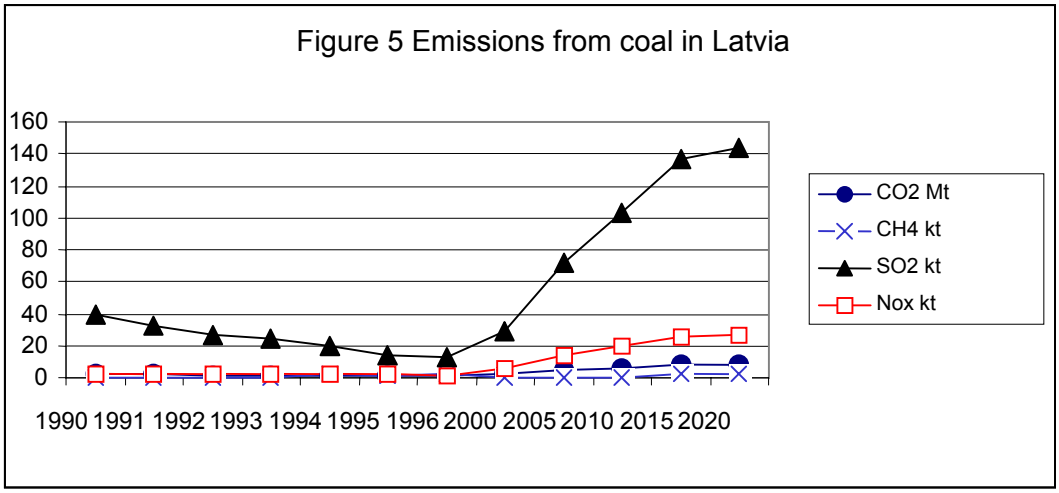
A significant objective is the development of efficient, safe and environmentally friendly energy supply systems in Latvia. Transition towards European Union environmental regulations and standards will be reinforced.

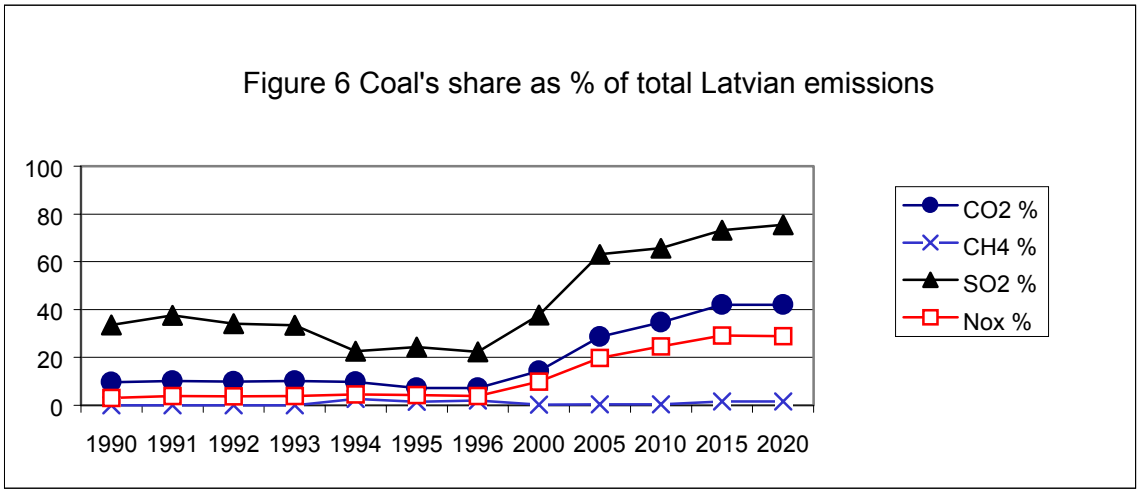
The Latvian National Energy Programme anticipates increasing domestic electricity generation, which in turn will generate additional pollution. Statistics from the Latvian Environmental Data Centre on air emissions from stationary sources and total emissions in Latvia are seen in Figures 3 and 4.





The anticipated shares of emissions from coal are shown in Figures 5 and 6. To reduce emissions, it is planned that new fuel burning technologies will be introduced in newly constructed and reconstructed plants together with advanced cleaning of flue gasses and water preparation.





Sulphur dioxide emissions in coal power plants will be limited by application of lime flue gas cleaning technologies, which reduce emissions by 95%.

To reduce nitrogen oxide emissions from power plants, it is planned to install advanced burners, re-circulation of flue gasses and multistage burning processes. For deeper NOx cleaning, catalytic processes will be applied.

Ash collection in power plants will be arranged by means of mechanical or electrical filters with 99% efficiency. That is expected to reduce substantially emissions of acid ash and vanadium pentoxide.

Large volumes of gypsum and slag (in total approximately 200 000 t per year) will be generated by Liepaja coal plant’s flue gas cleaning system. These residues should be used in road construction and manufacturing of building materials. The plants' planning should take into account use or disposal of gypsum and slag.

It is planned to install in all facilities a permanent instrumental system for pollution control and monitoring, integrated into the power plant's unified management and control network.

Investments as indicated by this programme in relation to construction and reconstruction of power generation facilities include provisions for environmental protection.

One of the most important short-term objectives is to introduce certification and quality control of imported fuels.

References

1. Economic Development of Latvia. Report; Ministry of Economy, Republic of Latvia, Riga, June 1999
2. Latvian National Energy Programme, Phare TA Energy Programme for Latvian Energy 96-1021.00; Strasa Consulting SIA, June 1997
3. Latvian Energy Review, 1996; Annual Report of Energy Department, Ministry of Economy, Republic of Latvia.
4. Statistical Yearbook of Latvia 1998

LITHUANIA

In Lithuania, there are no coal resources. Imports are around 0.2 Mt, mostly for use under industrial boilers and in households. Prices are free.

MACEDONIA [155]

Coal reserves are estimated at 730 Mt of lignite. Recoverable reserves would cover domestic needs for another 25 years. Current production is at 7.2 Mt, concentrated in four mines. The two bigger ones supply lignite to nearby power plants owned by the national utility – ESM. ESM is a vertically integrated state monopoly for electricity generation, transmission and distribution, which owns the mines it is supplied from. Four lignite power plants account for about 70% of power generating capacity of 1.44 GW. There is also one district heating scheme. Two more State-owned mines supply big industrial consumers and households. While prices of electricity, gas and oil are still controlled, those of coal and heat have been liberalized. The coal industry does not receive any direct or indirect subsidies, as it operates profitably.

Main coal industry indicators

Indicators	1990	1993	1995	1997	1998
coal production, Mt	6.69	7.10	7.47	7.50	7.63
number of mines	4	4	4	4	4
number of employees	2070	1800	1850	1890	1800
productivity growth	100	106	112	112	114
investments in $ M	n. a.	n. a.	n. a.	13.5	12.5

MOLDOVA [156]

Moldova has small lignite resources (estimated at 30 Mt), but whose depth prevents exploitation. Coal needs to be imported and comes exclusively from the Ukraine and Russia. Due to the deep recession, coal use declined from 4.5 Mt in 1989 to 1.7 Mt in 1995 when it accounted for about 20% of the country's primary energy supplies. Approximately 80% of the coal is used in power generation and district heating, the remainder in steel works and industry. Coal-based power generation accounts for about one third of total electricity generation while it accounts for more than half of installed capacity. Prospects for coal are limited not only in the short-term (payment crisis, lack of investments) but also in the longer-term as oil and oil products are the preferred fuels for diversification of supplies. This may imply coal consumption and imports of about 1.2 Mt by 2005 corresponding to 17% of total primary energy consumption. Much depends on the chosen transport routes, in particular on the building of a port of Giurgulesti on the Danube, which in principle would open access to the world market.

155 UNECE, Restructuring of the coal industry and thermal power sector in south-eastern Europe, document ENERGY/1998/16 of 7 July 1998

156 TACIS Project EMO92/110, Energy programmeme for Moldova 1995-2005, Kishinev 1995

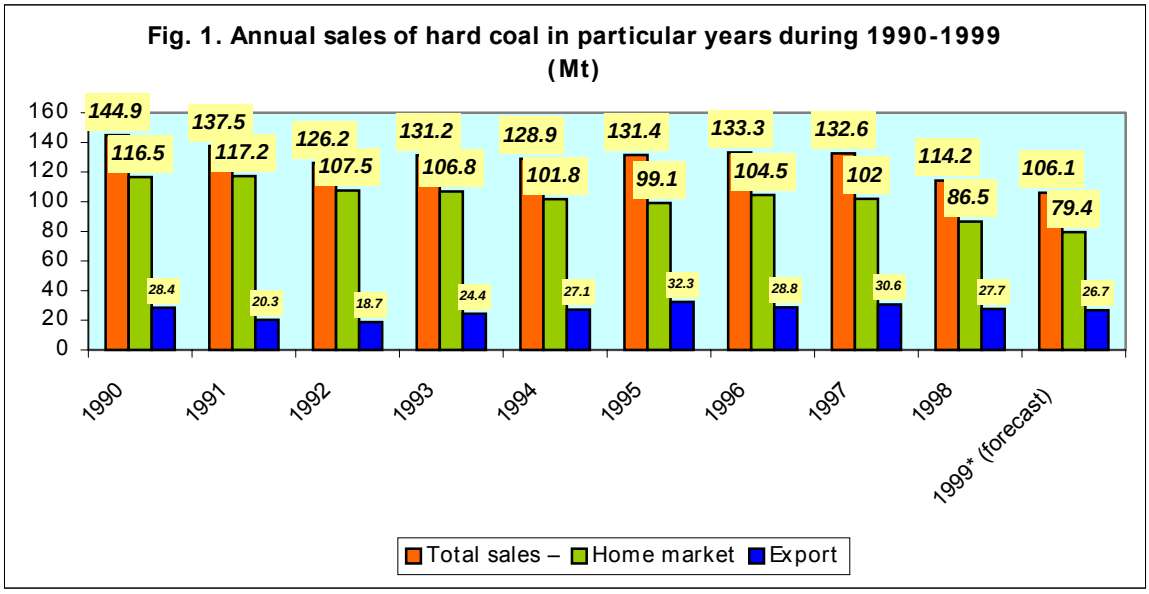
POLAND [157]

At the beginning of the 1990s, the Polish hard coal industry found itself in an unfavourable situation. With inherited production capacity reaching 180 Mt per annum, a visible drop in coal demand had taken place in the home market, reducing sales to about 100 Mt in 1994. At the same time, prices for coal in domestic and foreign markets maintained a decreasing trend.

As the result of many unfavourable factors such as excessive production potential, over-employment at the mines, reduced coal demand and prices, the majority of coal mines became unprofitable and the hard coal mining industry as a whole generated losses from 1990 onwards.

1 PREMISES FOR UNDERTAKING THE RESTRUCTURING OF THE HARD COAL INDUSTRY

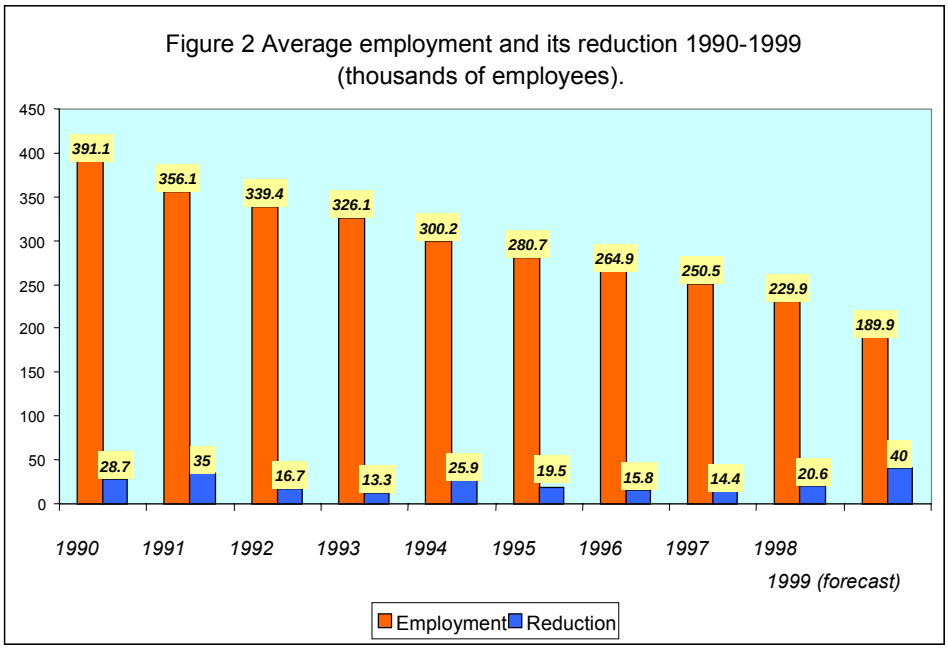
The basic indices with respect to hard coal production and economic results obtained in 1990-1999 have been presented in Figures 1-5.



The basic reasons why the Polish coal industry has generated losses for several years are :

- An excess production capacity of 10-12 Mt/year with regard to the production level obtained in 1993-1997. Excess capacities have been inherited from a period of intensive development of the sector in the centrally planned and command system.
- over-employment in the mines of about 50-60 thousand people, against the production level in previous years. This lead to high production costs, threatening the competitiveness of Polish coal in domestic and international markets.

157 Z. Smolec, Director, European Integration and Foreign Relations Department, State Hard Coal Restructuring Agency, Katowice



2 BASIC ASSUMPTIONS AND DIRECTIONS OF COAL INDUSTRY RESTRUCTURING

The current programme of coal industry restructuring "Programme of the reform of hard coal mining industry in Poland for the years 1998-2002" approved by the government in June 1998 addresses the following areas:

- financial restructuring
- closure of permanently unprofitable mines
- employment restructuring
- re-conversion of industry in mining areas together with diversification of activity of coal companies
- improvement of management in the coal industry
- privatization of mines
- improvement of environmental protection standards.

The programme of restructuring has been approved by a law on "Adjustment of the hard coal mining industry to function in a market economy and special powers and tasks of mining settlements" voted by Parliament on 26 November, 1998. The adjustment of output and production capacity to coal sale possibilities is one of the basic problems requiring solution in the process of the coal industry's reforming.

The reform programme envisages the adjustment of the coal industry to economically effective units functioning in a market economy by, among other strategies:

- liquidation of less effective production potential (liquidation of production in 15 mines, partial liquidation or merger of 9 mines, reduction of production potential by 25 Mt)
- reduction of coal sales (from 132 Mt in 1997 to 110 Mt in 2002)
- reduction of coal exports (from 30.6 Mt in 1997 to 10 Mt in 2007)

- restructuring and reduction of employment (from 243 000 in 1997 to 138 000 in 2002)
- re-qualification and creation of new workplaces
- economic activation of mining settlements, the so-called "gminas"
- environmental protection: rectification of mining damages
- debt settlement for coal companies with liabilities to the State budget, National Insurance Fund, environmental protection fund, or mining "gminas"

In the long-term, the programme foresees that in 2020 coal sales will amount to 80 Mt, of which 10 Mt for export. After 2000, coal companies will reach a financial surplus that will be devoted to the repayment of overdue liabilities.

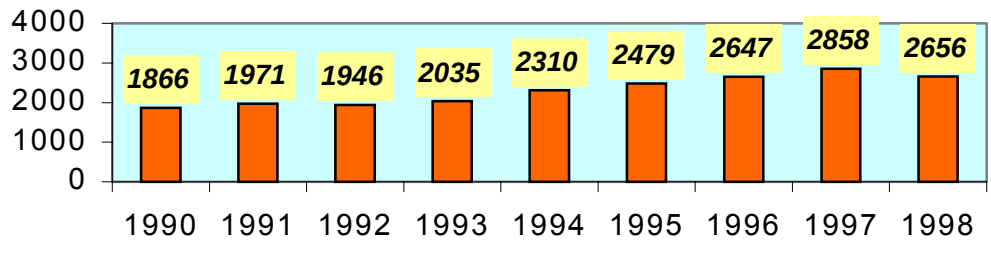
However, the continuing systematic deterioration of market conditions as demonstrated by decreasing coal prices in the home market and in exports, and by decreasing demand for coal, will require modifications to the 1998 programme to adjust it to changing market conditions.

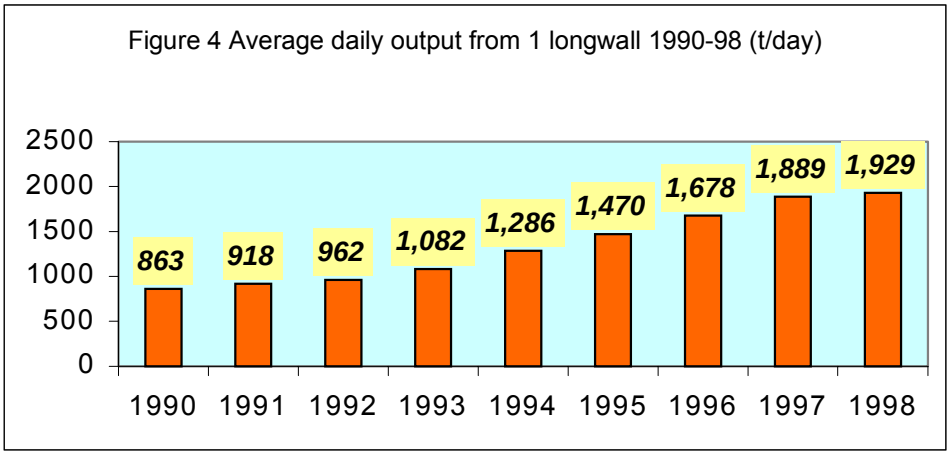
The government approved corrections to the programme in December 1999. The corrected programme sets the following key objectives:

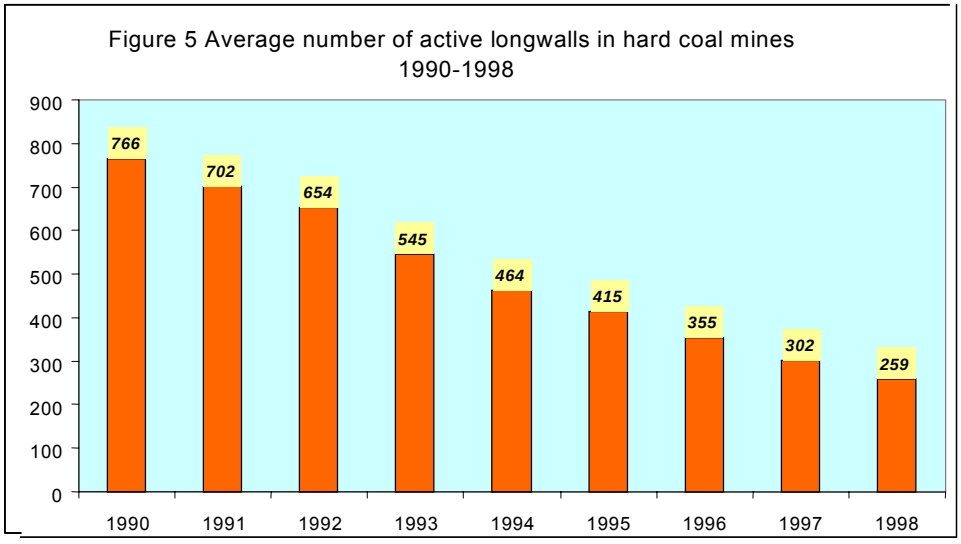
1. Coal companies should stop generating losses on coal sales as of 2001.
2. In 2002, the coal companies should start to generate positive net financial results, which will be dedicated to repaying overdue liabilities towards the State Treasury, coal mining municipalities and suppliers of goods and services.
3. Coal production capacity is forecast to reduce by about 36 Mt a year by 2002.
4. Coal sales in 2002 will reach 100 Mt: domestic consumption at 80 Mt and exports at 20 Mt.
5. Employees in the sector are expected to number 128 000 by the end of 2002, a reduction of about 115 000 people.

The programme also stipulates that the privatization of mines is one of the basic tools for accomplishing the objectives of reform. Therefore selected mining entities will be privatized. The mines meant for privatization must, anyhow, be potentially able to achieve positive financial results in a long perspective.

Figure 3 Total productivity 1990-1998 (kg/m^3)







The financial support of the programme is a key problem for the success of the coal industry's restructuring process. Total needs with respect to state support for financing of basic spheres are presented below.

Table 1 Investment needs in M ZL

Specification	Years					Total
	1998	1999	2000	2001	2002	
Total of which for:	**754.4**	**1792.0**	**1814.1**	**1372.0**	**1458.0**	**7180.5**
mines closure	211.4	413.0	462.0	225.0	176.0	1487.4
employment restructuring	505.0	1044.0	1017.1	812.0	947.0	4325.1
rehiring for environmental rectification	28.0	35.0	35.0	35.0	35.0	168.0
refunding of extra benefits to old age pensions paid by ZUS (equivalent for in kind (coal) contribution)	-	250.0	250.0	250.0	250.0	1000.0
creation of new jobs in mining gminas	-	50.0	50.0	50.0	50.0	200.0

Total State aid allocated to settle coal companies' outdated liabilities in 1998-2002 will amount to

6.9 billion ZL.

3 STATUS OF IMPLEMENTATION OF COAL INDUSTRY REFORMS

The government programme "Reform of hard coal mining industry in Poland during 1998-2002" began implementation in 1998. On 26 November, 1998, Parliament accepted the law on "Adjustment of the hard coal mining industry to function in conditions of a market economy and special powers and tasks of mining settlements" that was implemented in 1999. There was no legal basis to implement reform in 1998. Irrespective of that, reform brought about measurable effects.

Sales of coal 1998-1999 have significantly decreased from 132.6 M t in 1997 to 108.8 Mt in 1999, exceeding the scheduled reduction by about 7.7 Mt. Domestic sales were 83.6 Mt in 1999, and exports 25.2 Mt. Employment is expected to decrease by 67 000 jobs (from 243 300 in 1997 to 176 300 in 1999) while the programme assumed a reduction of 53 900 jobs. In mine assets, 13 new economic units have been established, thus creating about 900 new jobs.

3.1 Mine closures

As a result of the commercialization of the coal mining industry in 1993, 7 mining companies were created grouping 61 mines, while 8 individual mines remained outside the coal companies. Currently coal companies operate 44 active mines, while 5 mines remain outside. It is expected that by the end of 2000, coal companies will operate 39 mines.

From June 1998 to the end of 1999, production of coal was terminated in 8 mines, whereas 25 mines were partially or completely closed.

In the period 1998-1999, 12 Mt of production capacity was liquidated, while programmed reduction was 9.5 Mt. Total production capacity until the year 2002 should be reduced by 36 Mt, thus exceeding programmed reduction.

3.2 Employment restructuring

An essential element of the programme consists of converting jobs and restructuring of the labour market in mining localities. The State aims not to allow unemployment to increase. Measures include:

- re-employment of mine employees leaving the industry.
- providing social protection measures: to mitigate the negative social outcome of the complete or partial closure of mines and to create conditions favouring the reduction of employment, the so–called "Mining Social Package" has been worked out. The Package includes allowances such as "five-year miners' leave". This facility makes it possible for miners that are up to five years short of retirement to leave the mines and become entitled to a social allowance that will amount to 75% of monthly wages.
- unconditional redundancy payment of 24 monthly wages granted to the employees who leave the mining industry and resign from all other employee benefits.
- free of charge re-qualification and training processes adjusted to labour market demands.

The results show that the most attractive forms of allowances for the miners were the five-year

miners' leave and unconditional redundancy payments. All those allowances, along with natural retirements in 1998 and 1999, will enable 67 000 jobs to be cut, a 27% drop compared to 1997.

To stimulate the creation of new jobs, the programme besides providing a wide range of easily accessible free-of-charge professional retraining courses, also offers essential financial incentives for the employers of those who ceased working at mines. Those incentives include:

- refunding the full value of obligatory employers' contribution to social protection fund,
- preferential terms of credit for enterprises involved in enlarging activities and re-hiring miners who had left,
- mining communities could also apply for preferential credits that could be utilised to create new jobs.

3.3 Economic- financial results

During 1999, the hard coal industry is expected to generate net losses of about 3300M ZL This is better than in 1998, when losses reached 4276M ZL. The losses result from fewer sales and decreasing prices – both at home and in exports. Long and short-term liabilities for the industry will be about 19 billion ZL, whereas receivables will amount to around 4 billion ZL.

4 ENVIRONMENTAL PROTECTION

Hard coal mining, irrespective of applied coal extraction technologies, exerts a negative impact upon the natural environment. The basic ecological problems of hard coal mining include:

- salinated waters,
- mining waste, reclamation of waste stock-piles and industrial lands, and
- mining damage to buildings, roads, farmlands, forest areas and hydro-technical conditions as well as underground infrastructure.

These problems are even more serious in Poland since they affect a very densely populated and built-up area.

A number of ventures to be implemented 1998-2002 aim to improve the natural environment and reduce mining damages:

- reducing the discharge of saline mine waters to rivers by their re-injection into the underlying strata, expanding the existing desalination plant and possibly constructing a new one,
- increasing the volume of solid mine wastes relocated in underground workings by building new installations and modernizing existing ones, including using saline waters in mixtures with flotation rejects and fly ash,
- intensifying land reclamation,
- carrying out exploitation while minimizing mining damage.

It is expected that as a result of such activities the coal industry should be able to:

- use coal wastes in underground workings to the tune of 2.62 Mt/year,
- reclame about 150 ha/year and manage land with the view to its industrial utilisation,
- reduce delays in rectifying mining damage,

- reduce methane emissions to the atmosphere on average by 30M m^3/y,
- increase production of construction materials and diversify industrial utilisation of solid mine wastes.

Some statistics may help to visualise the problems associated with waste management in 1998: 47.5 Mt of waste were produced in total by the mines. More than 91% of the waste came from coal washing in coal preparation plants. About 3.6 Mt were stored in underground workings of the mines, while 12.2 Mt were stored at the surface. The remaining 31.6 Mt were economically utilised, that is 66% of the waste produced by the mines.

The wastes were mainly used for terrain levelling and engineering works conducted within the framework of local space management programmes and for the production of construction materials. The mines used more than 3.9 Mt of foreign waste, mainly fly ash and slag for hydraulic backfilling and for fire prevention.

5 PRIVATIZATION

The restructuring programme envisages privatization of a first hard coal mine, Bogdanka, during the early months of 2000. The Budryk mine will be next.

6 PROBLEMS ENCOUNTERED DURING THE REALISATION OF THE REFORM

The following problems were encountered in the first year of implementing reform:

- Coal demand decreased faster than production capacity, which resulted in an imbalance in the home market (surplus of several Mt), a drop in coal prices as well as deteriorating financial results for coal companies.
- Satisfactory financing was lacking for greater-than-planned unconditional payments to employees leaving the coal sector.

7 SUMMARY

- The results achieved during the implementation of reform in 1998 and 1999 confirm the rightness of the main lines of action pursued by the government programme. Production capacity and employment are being reduced at the stipulated rates.
- The drop in coal demand in 1998 and 1999 proved to be even greater than anticipated in the government programme (8.4 Mt domestically compared to 1997). It may happen that in subsequent years the situation regarding coal demand and prices could deteriorate further. The unfavourable financial results of the coal industry in 1998 and 1999 are a symptom of the difficulties that will have to be overcome in order to realise the objectives of the government programme.
- Experiences gained in 1998 and 1999 confirm that key reform issues still consist in effectively reducing production capacity and employment. The dynamic implementation of the plan requires, however, a systematic inflow of investment.

ROMANIA [158]

1 BACKGROUND

Romania has a long lasting tradition in the mining industry and has important reserves of coal that can ensure continuity of production for about 70 years. However, the coal industry has to face the difficulties of transition to a market economy and future integration into the EU.

Starting in 1998, the coal industry was confronted with reduced energy demand. This trend will continue also in the near future. The restructuring and de-monopolizing process that the energy system in Romania will undergo and the privatization and opening-up of the energy market will enhance competition between coal producers and the producers of other primary energy resources (gas, oil, etc.). The international agreements on environmental protection and reducing CO_2 emissions (Kyoto Protocol) mean new constraints for the coal industry.

Coal producers have to respond to these challenges and maintain their place in the energy market of the country.

2 RESERVES AND MINING

2.1 General features

A very complex geological structure and a large variety of useful minerals in the underground characterize the territory of Romania. Among these minerals, special attention should be given to coal deposits, as coal covers 29% of Romanian energy production (1998).

The coal deposits of Romania are located and grouped in four zones:

Zone I, mainly located in the Southern Carpathian Mountains, includes all the high-grade coal such as anthracite, brown coal and pit coal from the Petrosani, Anina and Tebea - Brad basins.

Zone II, located within the Pre-Carpathian creep, between the Olt and Valea Buzaului rivers, includes the lignite deposits of Campulung, Sotanga, Filipestii de Padure and Ceptura. The coal basins of the Eastern Carpathian are also included within this zone: Baraolt-Virghis (lignite) and Comanesti - Bacau (brown coal).

Zone III is located in the Sub-Carpathian creep of the Getic Plateau, between the river Olt and the Danube and this zone includes the lignite deposits of Rovinari, Motru, Jilt, Berbesti-Alunu and Mehedinti.

Zone IV is located in the Panonian creep in the northwestern part of Transylvania and includes the brown coal and lignite deposits of Sarmasag, Voievozi, Surduc and Borod.

The total coal reserves of Romania amount to approximately 1.0 Gt of hard coal and 3 Gt of brown coal and lignite.

More than 90% of Romanian coal reserves are located within Zone II, namely in the mining

158 Dipl. Eng. M. Slevoaca, Deputy General Director, Directorate for Mines and Geology, Romanian Ministry of Industry and Trade, Bucharest

basins of the Oltenia Region. More than 80% of Romanian lignite reserves can be mined profitably in opencasts, while the remaining 20% require underground mining.

Coal deposits are of low quality; lignite has only 1600-1800 kcal/kg; hard coal contains about 3000-4000 kcal/kg. The average humidity varies from 42% in lignite to 10% for pit coal. The average sulphur content is 0.8-1.2% for lignite and 2% for pit coal.

Table 1: General characteristics of coal in Romania

Coal location	Caloric value (kJ/kg)	Ash content (%)	Humidity (%)	Sulphur content (%)
lignite				
EM Rosia Jilt	6 780	42.5	43	1.5
EM Rovinari	6 800	43.0	41	0.9
EM Motru	6 700	43.5	41	1.5
washed hard coal				
Jiu Valley	25 120	11	11	2.0

Source: Ministry of Industry and Trade

2.2 Hard coal

The most important hard coal reserves are located in the mining basin of Valea Jiului, situated in the Petrosani mountain creep. The deposit has a triangular asymmetrical syncline shape 48 km long and 2 km wide on the western side and 9 km wide on the eastern side, covering a total surface of 155.5 km^2.

The reserves are distributed in 13 mining perimeters where hard coal is extracted for power generation and coking. Coal quality varies from one perimeter to another, from one layer to another.

The hard coal deposit of Valea Jiului is characterized by complex tectonics as the deposit is divided in numerous crosses and slices and in smaller tectonic blocks, the sizes of which vary between 200 and 600 m. Twenty coal layers belong to the Oligocene formation. Some of these layers are very thin and they cannot be mined, while others are only sporadically mined.

Considering the configuration of the coal layers, their geometry and vertical development, their exploitation was carried out using vertical shafts drilled from the surface, vertical shafts underground and crosscuts within the floor of the coal layer.

The mining operations are performed under very difficult conditions due to several reasons:

- complex tectonics of the deposit,
- presence of methane gas and coal dust which is explosive, and
- self-ignition properties of the pit coal which can cause underground fires.

The diversity of deposit conditions in the Valea Jiului mining basin led to the application of different methods and technologies for the extraction and beneficiation of coal. In line with the evolution of mining technologies, new working methods have been introduced and older ones improved. During the last decades, long walls with individual support and mechanized cutting have been extended together with complex mechanized mining.

Today, the following mining methods are used in Valea Jiului:

- longwall face mining using directional or inclined mining of thick horizontal slices extracting the coal either in slices or mechanically;
- mining the thick layers with inclined slices and extracting coal in face workings or front workings.

The utilization of complex mechanized methods mentioned above allowed an increase of production by 30-50% and of work efficiency by 15-25%, reducing inputs of power, material and labor. Throughout 1999, the long directional pillar sub-caving method has been used in Valea Jiului with better economic results than those obtained with the old methods.

2.3 Lignite

The recoverable coal layers are 1.0-8.0m thick and they occur as packs with rock intercalations. In their vecinity, there are aquifer formations both in the floor and the roof, either free or captive, causing much difficulty and additional costs both during the opening of works and during mining; drainage is required. The lignite deposits are located within areas where younger geological formations prevail – Dacian, Levantine and Quarternary – consisting of soft rocks (marns, clays, sand, etc.).

Lignite extraction is carried out both in opencast and underground mines, while brown coal is mined only underground.

2.3.1 underground mining

The opening of the lignite mines is carried out either through galleries, inclined platforms or mineshafts depending on the land configuration and the depth of the reserve location. Most used is the inclined ramp method with circular section with concrete support, metal frames or prefabricated block masonry. Underground mining of lignite and brown coal deposits is carried out, in almost all mines, using long-wall workings with mechanized combines. This mining method was preferred as it ensures a high concentration of production, an efficient survey and control of production, a significant increase of work productivity and lower operation costs.

The strategy of the national companies aims to maintain a constant production level for the underground mines provided that the work efficiency increases and the operations run profitably. Starting in 1999, lignite production was concentrated in areas with most favorable geological and mining conditions, thus ensuring an increased work efficiency at a cost of less than 15$/t of lignite. The mines where the costs are higher than 15$/t are included in a programme for mine activity restriction and closure.

2.3.2 opencast mining

The mining operations are developed in opencasts where the lignite deposits are located at low depth and where the land configuration ensures suitable conditions for such operations. The opencasts were designed for production capacities of 1-8 Mt per year.

In the beginning, the opencasts were equipped with discontinuous technologies consisting of bucket shovels and truck transportation both for the rock and for the coal. Later on, in 1960, continued flow sheet opencasts were designed and completed, equipped with bucket wheel

excavators, belt conveyor, dumping equipment for the overburden, and stocking and excavating machines for the stockpiles. The classical technologies are mostly used in smaller opencasts and for preliminary excavations in hilly regions. Large opencasts use continuing flow sheet and traveling platforms for bucket wheel excavators.

In several opencasts where the coal layers are clearly separated from the rock, the technological flow is easier and each shovel operates either in the coal or in the rock on benches forming separate technological lines. There are also some opencasts where the coal layers are separated by rock bands on several benches, which makes the extraction process difficult and influences the quality of the extracted coal.

Today in Romania, lignite is extracted from 20 discontinuous opencasts and 19 large continuous flow sheets and their total designed capacity is 40 Mt/year. On the basis of an economic assessment of the 19 continuous flow sheet opencasts, it was concluded that only 8 opencasts have been running profitably, obtaining operational costs below 11 $/t of coal. The other opencasts are in an opening stage and have not reached the designed capacity yet.

Table 2: Evolution of coal production since 1989 in Mt

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total net output:	61.5	37.6	32.4	38.4	39.7	40.5	41.1	41.8	33.4	26.2	24.0
lignite + brown coal	53.2	33.7	28.6	34.3	35.5	35.7	36.2	36.5	29.1	23.0	21.2
net hard coal	8.3	3.9	3.8	4.1	4.2	4.8	4.9	5.3	4.3	3.2	2.8
-fuel	5.1	2.6	2.9	3.1	3.7	4.4	4.5	5.0	4.0	3.0	2.5
-metallurgic	3.2	1.3	0.9	1.0	0.5	0.4	0.4	0.3	0.3	0.2	0.1
Gross hard coal .	11.2	5.9	5.4	5.6	5.7	6.3	6.3	6.7	5.6	4.4	3.6

3 INSTITUTIONAL STRUCTURE

Three national companies are active in the coal industry: National Lignite Company OLTENIA, Tg. Jiu, National Hard Coal Company, Petrosani and National Coal Company, Ploiesti. To these, four research/development entities are added and four geological prospecting and exploration groups.

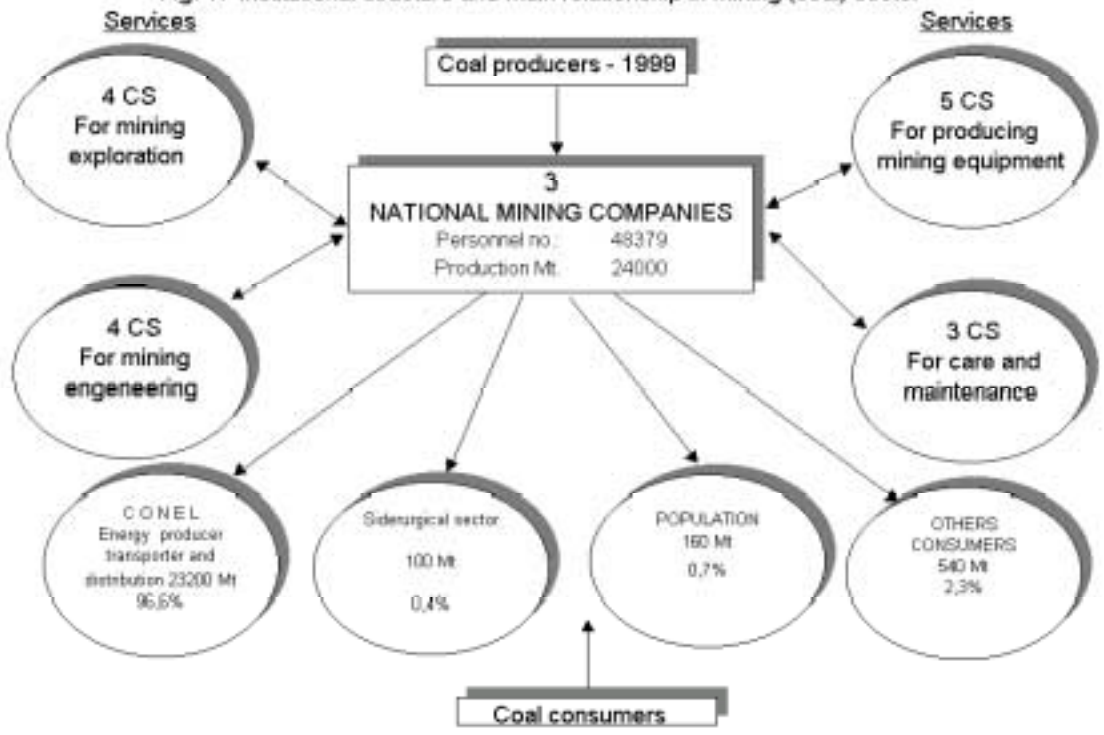
A new mining law and implementing regulations have been approved by Parliament (Mining Law 61/1998). This law and the accompanying regulations aim to provide the legal basis for the restructuring of the sector and facilitate the development of a private sector in the mining industry.

In accordance with the requirements of this law, all mining activities will be based on licenses for administration or concessions. All enterprises with ongoing mining exploitation and exploration activities must apply for licenses in areas where they are currently active and would be required to relinquish all other areas which will be re-demarcated by the competent authority to be offered competitively to Romanian and foreign investors. The National Agency for Mineral Resources has been appointed as the competent authority for extraction. NAMR has the competency, on behalf of the State, to manage the mineral resources of the country and to enforce the provisions of the exploration and utilization of mineral resources. The Ministry of Industry and Trade issues and enforces government policy in the mining field and administrates and monitors public property in the field of mineral resources.

The government plans to review the legal framework regarding: (a) mine closures and, environmental rehabilitation in former mining areas and (b) reducing barriers impeding private investment in the mining sector.

The structural reform would also strengthen and modernize the public institutions involved in monitoring and regulating mining activities. At present, these institutions are deficient in their level of expertise, lack capabilities and do not have adequate equipment to undertake their functions. They are poorly funded and have limited experience in dealing with the private sector. Under this strategy, these institutions will be offered technical assistance to train and procure equipment to strengthen their capabilities.

Fig. 1: Institutional structure and main relationship in mining (coal) sector



4 GOVERNMENT STRATEGY REGARDING THE RESTRUCTURING OF MINING

As mentioned at the beginning, Romania has a long tradition in mining, still a large number of personnel working in this area, strong labor unions and significant State support and participation. Because of geological and mining conditions, operational malfunctioning and a management not adapted to the market economy, the mining sector has become inefficient to a large extent, leading to losses that exceed State subsidies.

In response to this situation, the government issued in 1998 an integrated strategy to restructure of the mining sector. According to this strategy, the government took steps to

- adapt the mining industry to commercial operations;
- reduce the government's direct involvement and seek investment sources in the private sector;
- ensure the development of mining activities without damaging the environment;
- fully support:(a) the mitigation of social problems caused by the closure of uneconomic mines; and (b) the revitalization of the economy in mining regions.

4.1. Eliminating financial losses, restructuring production capacities

Analyses of the economic performance of mining operations in Romania have shown that the majority both for brown and hard coal are uneconomic. These should be closed and those that can become efficient after modernization should be supported.

Furthermore, the government plans to restructure the electric power sector to encourage private sector investment in power generation and reduce pollution. It can be anticipated that private power generating companies would be more inclined to switch from coal to combined cycle plants.

Current lignite producers would be required to concentrate on the open pit mines and continue underground operation wherever economically and socially justifiable. Subsidies for operating underground mines would be reduced and later eliminated completely. Enterprises, once converted to joint stock commercial companies, would be encouraged to restructure themselves to eliminate high-cost underground coal mining operations. Also, incentives would be provided to encourage private sector joint ventures for open pit mines to further reduce production costs and to support their development through investments.

As a new restructuring solution for the coal industry, measures to develop integrated systems with coal and electricity producers were initiated as part of the general energy sector strategy.

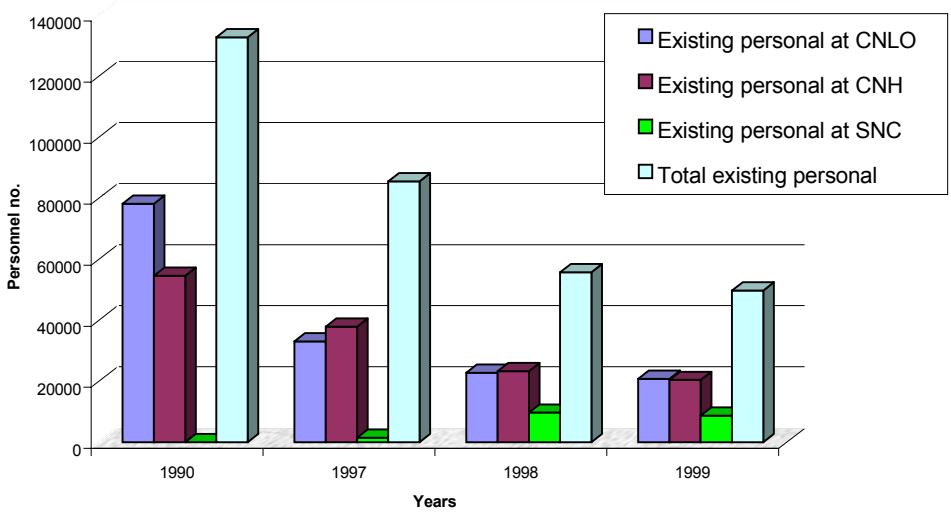
With a view to improving the technical and economic performance of viable coal mines in the medium run, priority projects were elaborated. They aim at technological modernization, including through external financial support, of large lignite open pit mines in Oltenia and the introduction of new technologies in some hard coal mines. These measures would be correlated with national programmes in the power sector and would satisfy special technical, economic and ecological criteria.

4.2 Closure of uneconomic mines

The government strategy calls for the reduction of financial losses through the closure of uneconomic mines. Up to now, 162 mines have been identified as uneconomic and have to be closed. Production activities from these mines have ceased, in most cases, and except for workers required for care and maintenance prior to closure, all other workers have been laid off.

The Central Group for Mine Closure was created through Order no. 1670/25 September, 1999 within the Ministry of Industry and Trade (now the Directorate for Mining Closure). It will lead the mining closures, manage the funds and hire on a contractual basis a private or State-owned commercial company responsible for the physical closure and for environmental rehabilitation. For this purpose, the contractors will employ specialized people who have been laid off (miners, electricians, mechanics, foremen and engineers).

Figure 2 Existing personnel in mining sector in 1990, 1997, 1998 and 1999



The mine closure programme started in 1999 initially for the closure of 35 mines; for the remaining mines the initial works will start in the next years.

According to the provisions of the law, the Directorate for Mining Closure together with the National Agency for Development and Implementation of Mining Regions Reconstruction Programmes will determine the use of assets such as buildings or other utilities, for initiating new business. The assets may be used as an alternative for a job creation programme for laid-off miners in the areas where mining was stopped.

4.3 State budget subsidies for the coal sector

In compliance with the legal procedures in force, the State generally supports mining production by granting subsidies. The list of subsidized products is approved yearly by the government, and the amount of the subsidies is approved in the State budget.
The State supports mining financially in three ways:

- subsidizing the costs of mining output, depending on production and supplies, and taking into account inflation estimated for the particular year
- transfers, i.e. expenses that ensure social protection of the staff in the mining sector (hot meals, transport from and to work, coal allocations, protection equipment, antidote liquids, etc.)
- capital expenses, to replace depreciated production capacities or enable investments in new construction and equipment

These funds are added to the own sources of the company.

In 1996, government production subsidies for the mining industry were about $385M, of which $139M for the coal sector. To stop the constant outflow of funds, the government decided to:

- discontinue all mining activities in mines that operated in dangerous conditions or where reserves were close to becoming exhausted;
- reduce the labor force in the mining industry by offering generous compensation packages of up to 20 months of wages (Ordinance no. 22/1997);
- increase investments to modernize production in mines that were considered to be potentially profitable.

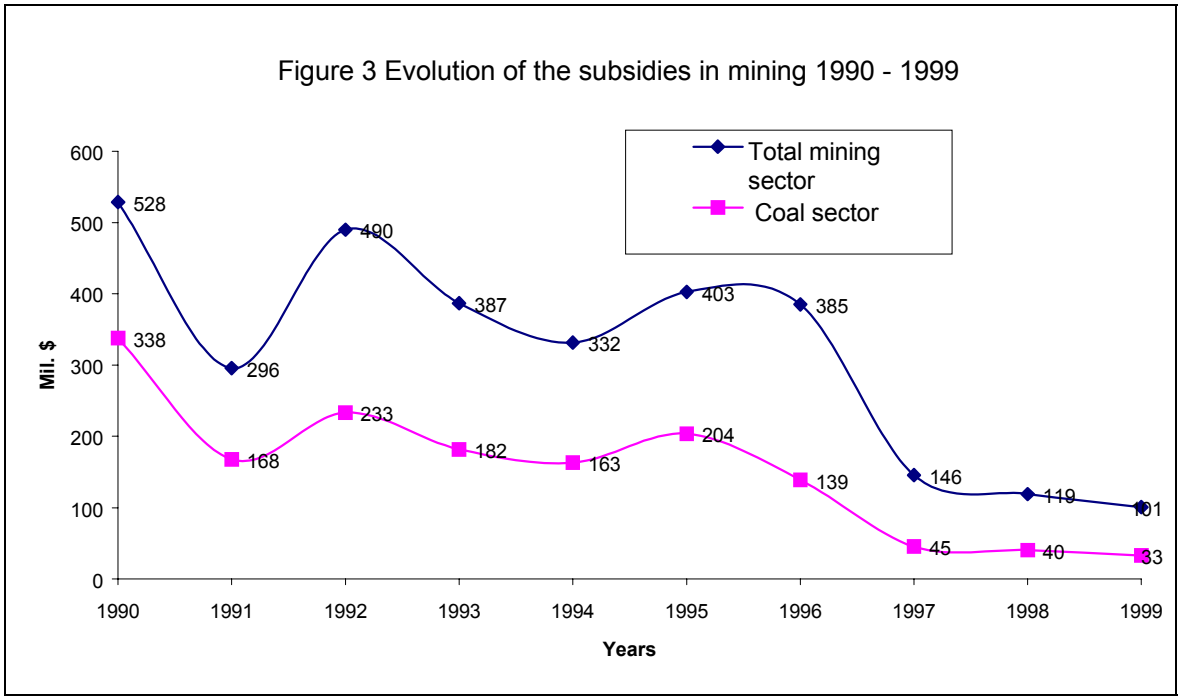
In 1998, mining production subsidies were reduced to $119M and are expected to be further reduced to $100 M in 1999, as shown in Table 3 below.

Table 3: Annual production subsidies for the mining sector 1990-1999 in $M

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total subsidies	528.4	295.5	489.9	386.9	331.5	402.5	384.9	145.5	118.9	100.7
coal sector	337.8	167.6	233.3	181.6	162.9	203.9	138.7	45.2	40.2	33.0

In 1997 and 1998, firm restructuring measures were applied to the sector, determined by the necessity of diminishing or eliminating budget subsidies and losses. Among these measures, Ordinance no. 22/1997 allowed compensatory packages to redundant workers equivalent to 12-20 branch medium salaries (depending on the number of years of service). The year 1997 brought massive layoffs of mining personnel in three ways: by unbundling commercial societies, by retirement and by redundancy (mainly voluntary redundancy) combined with compensatory packages.

It is necessary to mention that as of the first quarter of 1997, lignite production of the National Company for Lignite Oltenia (NCLO) was no longer subsidized. In 1999, this production represented 79% of the total coal output.



4.4 Protecting and enhancing the environment

Although a legislative and regulatory framework exists to address environmental impacts, the procedures to execute these regulations are fragmented and the institutions lack the capability to monitor and address environmental problems efficiently. As a consequence, considerable environmental degradation has occurred in mining areas.

In order to assess the gravity of this problem, a global environmental impact project in the mining industry has been initiated with the World Bank and terms of reference prepared. The project calls for the development of a comprehensive environmental impact assessment study of the mining sector that would provide the basis for the environmental rehabilitation programmes for the closed mining areas and environmental abatement measures to be implemented in the operating mining areas.

4.5 Gradual changes of coal sector activities to comply with EU regulation

Preparations made by Romania to join the European Union are based on the European Agreement in force as of February 1995. The implementation of measures recommended in 1995 in the White Paper regarding the domestic market and the harmonization programme approved by the government represent a special element of the strategy to join the EU.

Key elements of the "acquis communautaire" for energy relate to competition and State subsidies of the domestic energy market.

Regarding the sector of solid fuel minerals, EU regulations related to the domestic market are partially introduced in Romania's Law of Competition (Law nr. 21/1996). Also, the recent Mining Law regulates concessions for exploration and mining by any interested Romanian or foreign entity.
Regarding the coal sector, the European Community Directive no. 3632/92 (ECSC) related to

State aid has not yet been implemented. According to article 2(1) of this Directive, State allowances to the coal industry can be considered compatible with the adequate functioning of a normal market economy when they help to achieve at least one of the following objectives:

- progress towards economic viability in the light of coal prices on international markets, provided aid is digressive;
- solving the social and regional problems generated by total or partial closure of production units, and supporting the coal industry in adjusting to environmental protection standards.

4.6 Issues of implementation

In implementing its strategy, the government faces several major issues:

- completing the permanent closure in the first stage of at least 162 mines in an environmentally acceptable manner;
- undertaking social mitigation measures for 50,000 of the 70,000 workers who took voluntary redundancy from the mining sector and who are in the active labor market but have been unable to find employment;
- a further round of mine closures and mitigating the social consequences for those miners;
- preventing further environmental harm caused by presently operating mines and set priorities for reducing the accumulated historical environmental liabilities;
- strengthening the Directorate for Mine Closure, the National Agency for Development and Implementation of Restructuring Programmes for the Mining Regions (NAD) and the National Agency for Mineral Resources (NAMR) so that they are able to implement the closure and reform programmes completely;
- improving the legal and fiscal regime and removing obstacles to mine closure and private investment;
- progressively reducing subsidies covering operating losses, employee social allowances, detailed exploration and new investment;
- phasing-out subsidies for exploration enterprises by the end of 2000 and for mining enterprises by the end of 2001
- increasing subsidies for mine closures, environmental rehabilitation and social mitigation;
- developing and implementing a reform programme (including financial restructuring) for the hard coal/lignite National Mining Companies taking into account the phasing out of subsidies, so that low cost mines/companies can be privatized and uneconomic mines/companies closed.

5 TOWARDS A COST- EFFECTIVE VIABLE COAL INDUSTRY

5.1 Coal demand

Table 4 1999 Romanian coal production in kt

Use	Hard coal		Lignite and brown coal		Total	
	kt	%	kt	%	kt	%
Total	2800	100.0	21 200	100.0	24 000	100.0
• coke	100	3.6	-	-	100	0.4
• steam coal	2576	92.0	20 624	97.2	23 200	96.7
• household	49	1.8	111	0.6	160	0.6
• others	75	2.6	465	2.2	540	2.3

Taking into account that 96.7% of the total coal output is earmarked for power generation, this

sector is described shortly below:

CONEL - the Romanian Electricity Authority (former RENEL) - which was a State-owned, vertically integrated authority has passed, since 1998, through a deep restructuring programme meant to create a competitive power sector within a proper institutional and legislative frame. This process will lead to the reconsideration of existing capacities and of the use of primary resources, the modification of power generation and consumption structures and a decrease of the environmental impact of related power activities. The main principles of the reorganization are the following:

- the unbundling of basic activities in the sector (generation, transmission, distribution and supply);
- the right of eligible consumers to buy power directly from generators;
- non-discriminatory access to the transmission and distribution grid;
- the creation of a wholesale power market and a power exchange.

As a first stage, RENEL was split, in July 1998, into:
-National Electricity Company (CONEL);
-National Nuclear Company;
-National Authority for Heavy Water.

Within CONEL, the generation, transmission and distribution activities were organized as independent companies.

In October 1998, the National Energy Regulatory Authority was established as the regulating authority in the power sector.

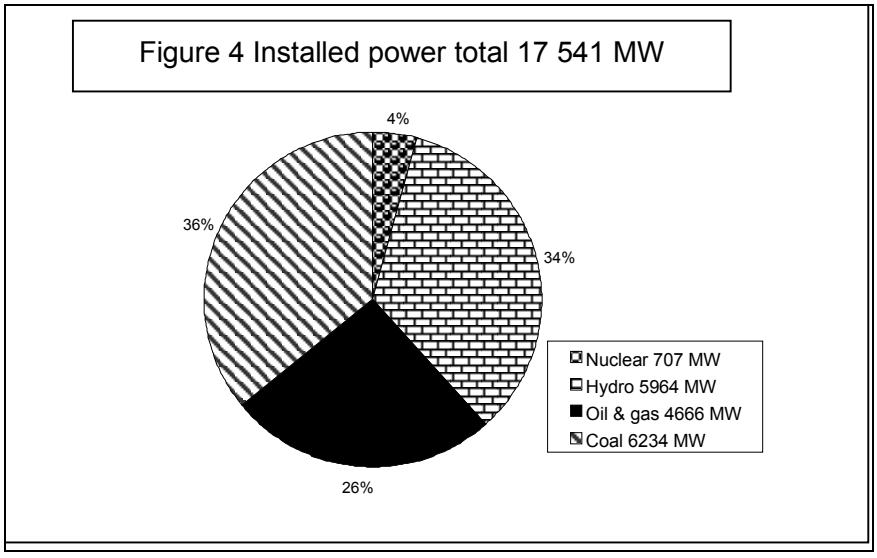
In December 1998, the governmental Ordinance regarding electric and thermal energy was issued, enabling further development of the restructuring process. The next steps that need to be implemented are:

- to create more generation and distribution subsidiaries by splitting Termocentrala and Electrica companies, then privatize them;
- to set up the commercial operator;
- to set-up the power exchange.

5.2 Present situation of fossil-fired power plants

At the beginning of 1999, the Romanian power system had 17 571 MW of installed power, out of which 15 879 MW in CONEL's power plants; 11 015 MW are installed in thermal power plants, including 5934 MW in coal-fired power plants.

In 1998, the electricity generated in Romania was 53.4 TWh, 5.7% less than in 1997. CONEL's power plants have generated 137 000 TJ, out of which 37 000 TJ from coal (about 40% of the country's coal consumption). In 1998, fuel consumption in CONEL's thermal power stations was about 21.1 Mt lignite and 2.6 Mt hard coal.



The operation of coal-fired plants at present is determined by

- decreasing electricity and heat demand, due to a decline of industrial activities and irrigation systems;
- the important share of power installed in oil-gas fired combined heat and power plants;
- the important share of electricity generated in hydropower plants;
- the closure of some coal-fired units, either for rehabilitation or because of their poor technical condition and low efficiency.

5.3 Future use of coal for electricity and heat generation

Electricity demand decreased in 1998 by 40.6% compared to 1989. During this period energy efficiency was low compared with EU countries. Considering the current possibilities for economic development and also the necessity of increasing energy efficiency, we can assume that the yearly average rate of increase of electricity consumption during 2005-2008 will not grow.

Between 2000-2010, about 20 Mt/year of lignite will be necessary to generate electricity and heat. But after 2010, due to the retirement of the obsolete coal-fired units, the share of coal in the electricity generation will go down to about 15%.

For Romania, the efficient use of domestic coal and a low environmental impact represent a high priority since this allows for a significant decrease of gas imports and a more balanced import-export ratio. The problem depends on the cost of new "clean coal technologies" (atmospheric or pressurized fluidized bed combustion, supercritical parameters) and on the level of environmental protection, compared with the cost of combined cycle gas turbines running on imported natural gas.

Today Romania imports about 30% of its energy demand, especially oil (35% of total energy imports) and natural gas (23% of the total import). Increased power plant efficiency could reduce imports, albeit not significantly. Therefore, it is very important to maintain the current level of coal use for electricity and heat generation in an efficient and environmentally friendly manner.

5.4 Productivity in the coal sector

Because of the conditions previously mentioned, productivity in the coal sector is not very high. However, a positive fact is that since 1990 this indicator increased continuously, due to different influences.

Table 5: Productivity (t/man/year)

Year	Total	of which :		
		CNLO	CNH	SNC
1997	391.0	782.4	116	218
1998	471.0	896.0	139	269
1999	496.0	944.7	133	288

5.5 Investments

Usually, in mining investment capital flows from:

- own sources of the companies;
- State aid for replacing, maintaining or modernizing depreciated equipment;
- funds from local or foreign investors and also from external credit.

So far, the most important part of this capital was allocated by the State budget, but the level of the allocations was poor compared with necessities. In the period 1990-1999, the total amount from the State budget for the mining industry was $1150M, of which $660M for the coal sector.

In order to concentrate capital investments on viable mines and mines that could become viable in the short and medium term, a cost-benefit analysis was undertaken for 174 mines and open pits using the data of 1997. According to the results, mining units were classified as follows:

R= total costs:sales	<1	1-1.5	1.5-2.2
No. of mines and quarries	25	30	42

According to the government strategy for the mining sector, in future investment will be allocated only to viable mines, for modernization, introduction of new technology, reconstruction and privatization. Coalmines are all included in the above mentioned ratios; open pits are profitable.

6 CLEAN COAL TECHNOLOGIES

Romania remains heavily dependent upon coal in the electric power sector and particularly as a source for heat for the residential sector. However, existing combustion systems are inefficient and polluting. As a result, many residential units are insufficiently heated in the depths of winter. Often customer use electric heaters to supplement central heating supply.

6.1 In the electric power sector

Before 1990, measures to reduce polluting emissions were limited to providing electrostatic precipitators and high stacks (250-280m). The efficiency of precipitators was about 94-97% (the design efficiency of 99.1%). To decrease SO_2 emission, limestone was added in the furnace, or in both the furnace and flue-gas channels. The decrease of NO_x has been achieved through reducing excess air.

At the end of 1995, the Law on environmental protection was passed including emission norms for existing and new thermal power plants. For the new plants, norms are in line with EU norms. An "Environmental impact assessment study for the power and lignite subsector of Romania" has been conducted within a PHARE programme.

For existing plants included in the above mentioned rehabilitation programme, measures will be taken to decrease the impact on the environment by:

- improving the burning process control system;
- introducing low NO_X burners;
- increasing the performances of electrostatic precipitators;
- providing specialized portable and fixed pollution measuring equipment .
- substituting domestic lignite by imported hard coal in some combined heat and power plants.

It can be estimated that rehabilitation and environmental protection measures will allow a step-by-step reduction of emissions, and fulfillment of EU norms.

6.2 In the residential sector

It is recognized that Western European coal-fired appliances perform much better than their Romanian counterparts. By way of example, underfeed stokers of 150-300 kW (sufficient to heat a single apartment) operate at typically 75% efficiency in EU countries, whereas a maximum of about 30% is attained on similarly sized units in Romania. In part, the difference is due to better-prepared coal, but a major factor is improved combustion technology.

The main objectives of a research project in this field are:

- to establish the research requirements to modify clean and efficient coal boilers developed in western Europe to burn indigenous Romanian coals, by testing the coal in existing test plants;
- to develop basic boiler design packages for the Romanian market which will be available for later application.

The project is a first step to improve the efficiency and environmental impact of coal in Romania. This measure should lead to a number of benefits, which are:

1. The transfer and adaptation of basic combustion technology from the EU to Romania that will allow coal to be burnt both cleanly and efficiently; this will lead to significant savings and reduced emissions of greenhouse gases and pollutants.
2. Widespread application of clean coal technology will lead to improved standards of health through reduced atmospheric pollution and improved standard of living by ensuring that homes/apartments are heated to acceptable levels in winter.
3. The project will be an initial step in developing the domestic coal market; this will assist in preserving jobs in mining communities and developing a new manufacturing industry in mining regions with new jobs and a boost to the Romanian economy.

Table 6. Romanian coal in an Ashwell/CRE boiler and a refurbished Metalica boiler

Hard coal type	Coroiesti I	Coroiesti I	Petrila	Lupeni
Boiler	Metalica	Ashwell	Metalica	Ashwell
Flue gas temp ^0C	107.2	215	127	151

O_2 in flue gas% vol.	18.2	11.1	14.4	14.7
Gross efficiency%	72.5	80.5	81.0	79.4
Net efficiency%	75.3	84	83.5	82.7
Sort of test coals:				
- Ash%	21.7		9.6	22
- Humidity%	4.9		8.5	6
- Calorif. value% Kcal/kg	5620	5620	6200	6180
- Granulometry mm	10-30	10-30	10-30	10-30

The steps of the project

1. In June 1998, Romanian coal samples were delivered to the United Kingdom (Ashwell/CRE) for testing on an underfeed appliance (boilers of 150-300 kW) and also on a downburning stove of 6-20 kW.
2. At the same time, a Romanian boiler "Metalica" was redesigned.
3. The results of the tests for both boilers are shown below (Table 6).
4. Since November 1999, a CRE boiler of 300 kW is functioning in the thermal plant of the National Company for Hard Coal - Petrosani, together with the refurbished Metalica boiler.
5. In 2000, the intention is to introduce in Romania under license the fabrication of new and performing boilers and stoves.

6.3 In recultivation and treatment of waste water

In the Romanian economy, the mining sector is a main polluter of land and water. Despite these realities, policy in this field did not much evolve until 1999. At present, the problem is approached on a new basis.

- For mines whose closure was approved by the government, the closure programme is also submitted to the authorities in charge of implementing Romanian environmental law and international agreements. Only after their approval, that the closure project will be put into operation.
- For mines that will operate after 2000, a global assessment of the impact of mining on the environment will be undertaken, according to agreements signed by the Romanian government and the World Bank in 1999. The study would provide the basis for environmental rehabilitation in each mining area.

7 THE INTERNATIONAL DIMENSION OF COAL INDUSTRY RESTRUCTURING

The Romanian government has acted firmly especially since 1997 in reforming the mining sector by identifying and closing uneconomic mines with no perspective to become viable, and reforming national mining companies and State exploration societies to make them able to operate in a viable manner. The mining sector must also increase its competitiveness in view of privatization, by developing a 5-year plan for the mining companies. The International Bank for Reconstruction and Development decided to grant Romania a $44.5M loan to create in Romania a strong and reliable mining sector.

Therefore, IBRD and the Romanian government agreed to design a plan for gradually reducing and phasing out subsidies to cover mining operation losses, capital investment and social

allowances, and progressively increasing subsidies for mine closure, environmental rehabilitation of mine sites and social mitigation. For these actions, terms of reference were elaborated and recently submitted to the Bank for comments and approval.

The World Bank (IBRD) is also involved in a pilot project to close 29 mines, which will start in early 2000 focused on environmental conditions in mining areas, the rehabilitation of land and water treatment., and in other projects:

- to improve the institutional structure of the entities involved in mining activities, to make them able to implement the reform programme;
- to improve the legislative framework in this field, including the Mining Law;
- to assist the National Agency for the Development of Mining Zones to develop coherent programmes for new job creation, especially regarding infrastructure, and to attract investors in small and medium enterprises.

8 CONCLUSIONS

8.1 General strategy

- The evolution of the coal sector in Romania will be determined by the forecast development of the national economy, based upon scenarios developed by specialized organizations.
- The government of Romania is preparing a strategy for sustainable development with the following objectives:
  - ♦ The development and application of an economic and financial policy that ensures:
  - stable and sustainable economic growth
  - competitiveness of our products
  - better technical level of assets
  - increased volume and efficiency of exports
  - keeping up with world trends in the development of industrial sectors.
  - ♦ Restructuring of the economy by:
  - concentrating financial and human resources on a reduced number of products
  - closure or re-conversion of oversized production capacities
  - adapting to European and international standards
  - ♦ Accelerated privatization and development of the private sector, especially for small and medium-sized enterprises
  - ♦ Increase of managerial performance
  - ♦ Restructuring of the national system and of transport infrastructure
  - ♦ Safeguarding of a long-term investment programme
  - ♦ Full employment to the extent possible.
- The strategy is based up using material and strategic resources as effectively as possible, by developing scientific and technological research.

- The coal sector in Romania will reach the above-mentioned targets with the support of the World Bank, EBRD, the European Union and the American Investment Programme in Romania.
- The Loan Agreement with the World Bank for the Project of Restructuring of the Mining Sector aims to eliminate dependence of the mining sector on the State budget; and sustainably

develop the sector, taking into account economic efficiency and environmental protection.

In order to achieve these objectives, the government has initiated measures such as:

- closure of loss-making mines, ensuring the protection of redundant personnel and the environment;
- changing the role of the State from owner-operator to regulator and administrator, in compliance with the Mining Law and related legislation;
- reduce State involvement (subsidies) in the exploration and mining companies and transformation of the "autonomous regies" (agencies) into national joint stock companies (this measure was implemented in 1998);
- creation of a legal, institutional and regulatory framework that promotes private investments in the mining sector and environmental protection.

8.2 Objectives of the mine closure component

In 1997-1998, mining stopped in 162 mines and open pits. According to the legal provisions in force in Romania, closure and environmental rehabilitation have been initiated. An additional 67 mines and open pits have been submitted to approval procedures. For the co-ordination, completion, financing and monitoring of mine closures and environmental rehabilitation, the Directorate of Mine Closure has been set up within the Ministry of Industry and Trade. Closure of 35 mines was financed in 1999 with funds allocated from the State budget. The World Bank financed the closure of further 29 mines.

Mine closure involves insulation and sealing of underground mining works and their connection with the surface according to industrial practice; and prevention of inflow of mine waters and gas that can have negative effects on neighboring mining activities and/or on the environment.

Environmental rehabilitation of the mining surface includes:

- demolition of the buildings and disassembling installations and removing the related materials and equipment
- land reclamation
- protection against sliding, monitoring of surface waters, rehabilitation of areas affected by subsidence
- collection and treatment of polluted mine waters
- protection of surface buildings that will continue to work (electricity networks, oil and gas transportation pipelines, etc)
- post-execution monitoring.

RUSSIA [159]

1 THE REFORM PROCESS

The necessity for the restructuring of the Russian coal industry has long been evident, while adequate solutions for the problem were absent. At the beginning of the reforms, over half of underground mines had been operated for more than 40 years and only 18 underground mines were relatively new with a remaining service life of at most 20 years. For many years, 109 underground mines have undergone no reconstruction. As a rule, the annual production capacity of most operating underground mines did not exceed 600 000 t.

Reforms of the coal sector have been based on the main principle of social partnership of the federal government, regional administrations and the sector management bodies, to neutralize the eventual deterioration of social and economic conditions for social groups involved in the process of restructuring.

For economic and political reasons, the process of coal sector reform was divided into two stages. At the first early stage of reforms, social security measures for redundant personnel lagged behind the process of mine closures, while at the second stage main efforts were concentrated on the complete coordination of mine closure with social support to redundant personnel. It turned out that the lack of correspondence between these two interrelated processes at the first stage had provoked an unpredictable outburst of industrial actions, including civil unrest. This bitter experience was not lost on us. We took it into account later in the second stage– successfully, as evidenced by the complete elimination of social conflicts and industrial action in 1999.

At the current stage of coal sector restructuring, the main focus is on two sets of objectives:

- to completely meet national coal demand and to improve the efficiency of production so that subsidies may be cut, eventually enabling the coal sector to operate without any subsidies.
- to implement measures to improve the efficiency of coal mine operation and to provide timely social support for redundant personnel to prevent the decline of their actual living standards.

The reasonable combination of earnings from coal sales and subsidies from the Federal budget has become the economic basis for coal sector operations. The structure and size of subsidies have been optimized through a step-by-step growth of the share of funds used for investment and social projects and a reduction of funds covering operational losses of subsidized mines.

The economics of the coal sector are based on: actual coal demand in regional markets and open pricing, with due account for transportation costs; a selective approach to subsidizing mines; a change of the production structure and forms of ownership; the development of free competition; and consolidation of industrial and market structures.
As a result of the second stage of restructuring (1995-1999), subsidies for the coal sector declined

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from 8% to 1% of GDP. This has substantially cut the burden on the country's budget. Unfortunately, it has proved impossible to completely make good the reduction of federal subsidies through the escalation of coal prices and cutting production costs alone.

Besides, the ratio of subsidies to funds of enterprises in total sector finances has radically changed: in 1993 (the beginning of reforms) subsidies accounted for 77%, while by 1999 it was reduced to 12% of the total.

The reform strategy has been thoroughly worked over by Russian specialists, i.e. mining engineers and scientists, in close co-operation with experts from the International Bank for Reconstruction and Development. It has been enshrined in the Main Guidelines for the Restructuring of the Russian Coal Industry. With due account for international practices, the main idea of the strategy implied privatizing operating promising mines, constructing new profitable enterprises, and closing loss-making mines and those with hazardous conditions. A legal framework for the efficient restructuring and operation of the coal industry has been elaborated and approved.

In 1994-1998, 140 coal (oil-shale) mines with an aggregate planned production capacity of 46.9 Mt per year stopped production. This has resulted in the loss of only 15.7 Mt of annual coal output (one third of the planned production capacity).

In 1999, production stopped in 10 underground and opencast mines with an aggregate production capacity of 2.45 Mt per year. In this case it is expected that coal output losses will not exceed one third of the total, i.e. 0.8 Mt per year.

Presently, 149 underground and 4 opencast mines are undergoing various phases of decommissioning. The closure of loss-making underground and opencast mines by main coal producing regions can be briefly described as follows:

Over the period 1994-1999, restructuring enabled a stable trend towards improved production efficiency. Coal output completely meets the country's demand and can be expanded if necessary.

Table 1 Mine closures by production basin

Coal basin	Loss-making mines, total number	Including:	
		Mines being closed	Mines already closed in engineering measures
Kuznetsk basin	38	34	23
Pechora basin	8	6	5
Eastern Donbass	27	27	24
Kizel Basin	13	13	11
Moscow Basin	22	21	19
OAO Primorskugol	18	16	16
OAO Sakhalinugol	11	11	7

Today, much of the coal sector has reached a stage where coal companies have been formed rejecting unprofitable operations; some companies can successfully operate in market conditions. This is particularly true for Eastern Siberia and the Far East, where 90% of the total coal output is

provided by the most advanced surface mining methods. In 1998, surface mining in total coal output accounted for 64%; in 1999 it is expected to reach 65%, while in 1993 it accounted for 57% only. Most comes from the Kuznetsk basin (over 51 Mt), Krasnoyarsk Territory (35 Mt), Irkutsk (14 Mt) and Chita (7.3 Mt) regions. In these areas, the most profitable high-capacity opencast mines have been constructed. Now these enterprises are successfully operating. They are equipped with high-performance domestic and foreign mining and transport machinery. They use advanced technologies, and depending on geological conditions of coal deposits, production costs range from RBL 35-100/t.

With the normal operation of the Russian economy, such enterprises could work rather profitably meeting demand for cheap fuel. By 2005, surface coal mining is expected to reach 75% of total coal output.

The efforts undertaken have improved the most important technical and economic indices, primarily the one of annual coal output per man (over three recent years an increase of 30%, from 682.6-917 t).

These results provide hope that further restructuring will turn the coal industry into a profitable, reliably operating sector, substantially improving the country's energy security.

2 THE SOCIAL DIMENSION

Coal sector restructuring cannot be successfully undertaken without settling social problems. Therefore, social problems and social security of the redundant personnel have always been and still remains a top priority. The structure of subsidies in 1999 ensures that over half is spent to settle social problems.

To compare: in the countries of the European Union, where coal industry restructuring has covered nearly 30 years, redundancy rates are 6.6% per year. In Russia, redundancy rates in 1994-1998 were 14% per year. Over this period, 140 underground and opencast coalmines ceased production. For a number of reasons, 435 400 workers and engineers have become redundant, i.e. over half of the total number of men employed at the start of restructuring. Of these, 132 500 people or 30.4% were employees of already closed or would-be closed enterprises in the sector.

The restructuring of the Russian coal industry, which has no precedent in the world by its rates and scale, has dictated the necessity for an adequate social strategy.

Consolidated efforts of the federal government, local administrations of coal mining regions and trade unions aimed to provide advanced employment assistance for redundant miners have nearly completely prevented large-scale unemployment in coal basins. Of certain importance for miners' employment is the creation of new job opportunities through the diversification of production. Since 1996, this has been realized within the frame of local programmes for the development of mining towns and settlements.

Active implementation of the social strategy in 1999 has resulted in the relaxation of tension in

labour markets of coal mining regions and further neutralization of the social consequences of restructuring.

3 OWNERSHIP CHANGE

The transformation of coal sector enterprises into joint-stock companies has been completed. Today, 207 joint-stock companies operate in the sector, 90 of them with less than 50% State ownership. Preferential railway rates for coal transportation have been set in Russia. The necessary market infrastructure has been established (investment, consulting, insurance companies). Privatization of coalmines for cash has been initiated through the sales of State-owned parcels of shares.

The coal sector was the first in the Russian economy to introduce leasing of high-performance equipment to mines. With the extremely limited financial resources, it was the most reasonable way to accelerate technological refurbishment.

To develop coal markets it seems feasible to consolidate and co-ordinate the efforts of coal producers, power generators, steel and railway operators. The idea of integrating coal companies with power generators was more than once considered. Unfortunately, the national practice is rather limited. The establishment of the LuTEK integrated energy-coal company through the amalgamation of the Primorskaya Regional thermal power plant and that of the Luchegorsky-1 opencast coal mine is the only example. Such integration aimed to reduce electricity generation costs and improve financial and feedstock flows.

The advantages and shortcomings of the integration of coal companies and electric utilities can be analyzed from various viewpoints. Many factors are of a qualitative nature, and it is too early to assess particular quantitative results.

It is worth mentioning that the programme for the KATEK development envisaged the establishment of integrated coal-energy enterprises: the construction of the Berezivsky opencast mine and the Berezovskaya Regional power plant. Today, the RAO EES Rossii (United Energy System of Russia) is reverting to this idea and in co-operation with the administration of the Krasnoyarsk Territory is undertakins feasibility studies for the project.

In our view, coal-energy complexes should be established with the essential participation of manufacturers of marketable end products (steel works, chemical operations, etc.), as these products will become the main source of reimbursing all the participants of the technological process.

The establishment of a coal-energy complex can be expected in the Krasnoyarsk Territory involving the Krasnoyarskugol coal company, Krasenergo electric utilities and Krasnoyarsk aluminium works. The analysis of the efficiency of such a consolidation has shown that the share of cash in the payments due to the KATEK enterprises for coal supplied to the consumers may grow from the current 4-6% to 40-45%. In this case, the share of non-payments may be cut by 20-25%. Such new conditions would be favorable for investors, which would in turn allow further development. Similar patterns may be used for the establishment of integrated companies in the Kuznetsk coal basin, Primorsky Territory, Eastern Siberia and other regions.

Coal accounts for only 11.8% in the primary energy balance, and its share in the pattern of fuel consumption is less than 18%, while in the mid-1970s coal fuel accounted for a quarter of the total fuel and energy balance of Russia.

Actually, no other country in the world is oriented towards oil-and-gas to such an extent as Russia. At the same time, on average, coal-fired power plants cover nearly half (44%) of the electricity generated in the world, over half of the electricity generated in the United States and Germany (56-58%) and between 70% to 98% of power in China, Australia, Denmark and Poland. Only in Russia, the share of coal in electricity generation accounts for 26%. Such a situation in Russia can be explained by the producers' strive for short-term gain: today, it seems more profitable to use cheap gas and oil, which substituted for coal in the fuel market. The advantage of these fuels has been provided by intensive non-repayable investments allocated in 1965-1975 from the state budget to develop oil-and-gas complexes. Available estimates show that the expansion of coal consumption by electric utilities and in technological processes to produce hydrocarbons may become constrained in Russia by the year 2020.

Such prospects are determined by the fact that oil and natural gas reserves are by far less abundant than explored coal reserves, and production costs of the former are ever growing. Calculations show that unit capital investments for the commissioning of coal production capacities are five-fold lower than those required for gas (in comparable units of calorific value). However, until now, in some areas, including coal mining regions, rather expensive gas supply projects have been considered. Moreover, trustworthy comparative economic estimates of such projects have not been made so far.

In our view, it is preferable to orient reforms towards the use of available coal resources in power generation and in the country's economy in general, in parallel with the expansion of Russian coal exports.

4 CLEAN COAL

At the current stage of development, one can hardly speak of a broad-scale application of clean coal technologies. However, the idea that coal cannot be used at all because of its harmful ecological effect, is completely inconsistent. Even today, Russia possesses a wide range of ecologically clean coal processing and utilization technologies. These technologies imply energy- and resource-saving methods, recycling some wastes and products, minimizing wastes and making them more ecologically safe. The development of such technologies contributes to higher

competitiveness and safety of coal as an energy source and feedstock for the chemical industry. Only technologies which can radically reduce CO_2 emissions and improve energy and technological efficiency may be actually considered ecologically clean coal technologies.

The current restructuring of the coal industry in Russia, primarily aimed at improved economic efficiency, must be oriented towards the creation of such clean technologies, developing new and modernizing existing methods of coal processing and utilization, as well as towards the adequate application of their energy and chemical potential. Due account given to process requirements at the mining stage could improve the energy-efficiency and ecological safety of fuel application and provide for the production of competitive coal-derived commodities and non-fuel products. High economic efficiency cannot be attained without adequate technological efficiency.

From the viewpoint of coal consumers, it is preferable to get coal with a pre-determined content of sulfur, ash, moisture, etc. While using such coal, they will be able to minimize the emission of greenhouse gases (CO, CO_2, CH_4), So_x, No_x and fly ash. From the viewpoint of power generators, fluidized-bed combustion, preliminary gasification of coal, lower fuel combustion temperature and some other processes prove to be most efficient.

Coal producers have another approach to the problem, namely, the creation of technologies and operations produce clean coal or refined coal-derived products, that can be further processed in conventional equipment for lower emission rates. Such technologies include:

- coal liquefaction at a pressure of 100 at. for liquid fuel production, coal-based energy-chemical systems for the production of liquid fuel and a wide range of chemical products (this is a Russian technology now used in South Africa);
- complete ash and sulfur removal from coals used as a feedstock for electrode coke production;
- hot-cure coal briquetting technologies using no binders;
- thermal drying of brown coals reducing moisture from 30% to 10%;
- production of high-quality adsorbents from various types of coal for water purification;
- application of water-coal slurries, which present a new ecologically clean energy source.

Modern coal preparation methods improve coal quality, which is comparable to the effect of chemical treatment. Besides, all the stages of coal processing envisage waste utilization with the recovery of various useful products.

The restructuring programme takes due account of locally available primary materials, which may be produced or recovered at a minimal cost and converted into saleable products thanks to clean technologies. Such materials include solid coal mining and processing wastes from spoil dumps (slurry ponds) belonging to coal mines being closed or wastes accumulated by operating enterprises (opencast and underground mines, coal preparation plants). The Fossil Fuel Research Institute and some other research establishments have developed ecologically clean processes to use coal waste in road construction; various construction materials (wall ceramics, drain pipes, facing tiles, porous aggregate for structural concrete, binding and cementing materials, etc.); production of aluminum sulfate (chloride) for water purification; high-grade (solid or gaseous) fuel for heat and power plants; various components for fertilizers; refractory (acid-resistant) materials and other useful products. Coal wastes may be used in combination with ash and slag, provided the latter are accumulated adjacent to the mines which are being closed or modernized.

The technological and economic feasibility of a particular process depends in many ways on the characteristics of coal wastes and market demand.

Therefore, in selecting any particular utilization process, it is very important to be aware of the composition and characteristics of coal wastes, i.e., preliminary tests are required. The formation of an appropriate database will be helpful to select coal waste utilization processes, and it will be very important to resolve numerous problems arising in the process of the Russian coal industry restructuring.

5 ENVIRONMENTAL PROTECTION

World practice of modernizing the coal industry shows that only a reasonable and consistent ecological strategy, closely coordinated with economic and social reforms, may neutralize negative environmental effect of coal production.

The ecological strategy of Russia envisages the implementation of the constitutional right of Russian citizens for a safe environment, the right of future generations to use natural resources for further sustainable development, as well as the settlement of current social and economic problems in close correlation with adequate environmental protection measures and measures aimed at the conservation of natural resources.

The State strategy envisages the following four main directions:

1. ecologically safe sustainable development under market conditions
2. protection of the human habitat
3. rehabilitation (restoration) of damaged ecosystems in environmentally unsafe regions
4. participation in solving global ecological problems.

Thus, with due note of world practice in social development, the State ecological strategy has been conceived as an integral part of the country's development strategy. It is oriented towards sustainable development and envisages the following:

- practical application of economic analysis, planning and forecasting of ecological parameters providing for a balanced (stable) environment under conditions of economic growth;
- customizing the entire economy management system according to these parameters.

The programme of coal sector reform was formulated in the Main Guidelines for the Restructuring of the Russian Coal Industry, approved by the Government of the Russian Federation on July 14, 1995. In this document the main emphasis was on the top-priority importance of ecological aspects of institutional reforms in the sector and ecological rehabilitation of coal mining regions.

In production, the Main Guidelines envisage the following:

- in the short-term (up to 2005): establishing profitable coal production on the basis of promising and reliably operating enterprises; unbundling enterprises not involved in production, mainly those belonging to the social infrastructure; closing loss-making mines, which have no future;
- in the long-term (beyond 2005): expanding productive capacities to meet the turn to a broad-scale application of coal as the main energy source, on the basis of radically new economically efficient and ecologically clean coal technologies.

To identify top priorities for environmental protection and reasonable nature management, general estimates of the negative effects of the coal industry on the environment were made for large enterprises to be restructured as soon as possible according to the Main Guidelines.

The closure of loss-making coal mining enterprises will help to improve the economics of operating mines, to reduce the effect on the environment and subsequently to improve the general ecological situation in the regions. The Coal Act developed by the Rosugol Company must become a basis of legal and economic guarantees for settling ecological problems arising from the closure and conservation of loss-making underground and opencast coalmines.
Only implementing the entire system of environmental control and rehabilitation measures stipulated in the projects will ensure the planned results. Otherwise, the closure of coalmines and the loss of control over the situation in man-made ecosystems may lead to unpredictable ecological troubles.

Orienting the structural development of a region towards stabilizing coal production financially and ecologically (according to ecological examinations) must become the basis for coal sector restructuring. Due account should be given to the financial support, which can be actually obtained from the government.

To elaborate optimal ecological and economic option to develop enterprises, the regions concerned may use the available information and methodological recommendations, while in future they will also use methodological and scientific fundamentals from the model of sustainable development for coal mining regions, which should be elaborated in the meantime.

Since coal mining has natural, social and technological impacts, good decision-making is impossible without reliable information about all these effects in a given region. Therefore, top priority importance must be attached to establishing adequate automatic systems to control and monitor coal industry operations. These will provide a complete, standardized, trustworthy and continuous flow of information characterizing the condition of the natural environment and social-engineering subsystems of the coal sector enterprises.

In 1992 in Britain, over 40 companies began preparatory work for the ecological certification of operations and technological processes in compliance with the British Standard BS7750 for Environment Management Systems (EMS). This standard covers all the aspects of activities concerning environmental control and nature management: atmospheric emissions, effluents, environmental effect, interaction with suppliers on environmental issues, ecological strategies and programmes of a company, etc. Ecological certification of companies, operations and

technological processes in compliance with British Standard BS7750 is similar to that for the ISO 9000 series.

In 1992, the Commission of the European Community submitted a draft Eco-Management Audit Scheme (EMAS) Regulation. If approved, this document will spread the principles of ecological certification stipulated by the British Standard BS 7750 to all countries of the European Community.

Ecological certification in Russia has been developed in several directions. Moreover, some organizations have undertaken regional studies to introduce ecological certification on a system-specific basis (Leningrad Region, Moscow, Khakass Republic, Rostov Region, etc.).

As a result of the consolidated efforts of the State Standard Committee and the Ministry of Natural Resources to harmonize, in April 1993 these two agencies signed the Agreement to co-ordinate their actions in standardizing, metrology and certification. Among other things the Agreement envisages the Ministry of Natural Resource's participation in the certification of products according to ecological safety criteria of the Certification System GOST R (State Standards R), as well as establishing a Certification System based on ecological requirements.

6 COAL EXPORTS

The restructuring of the Russian coal industry accompanied by the national economic crisis could not help but affect coal exports. In 1991-1998, coal exports declined from 41 Mt to 23 Mt, i.e., by 53%. This decline was accompanied by dramatic changes in the distribution of coal exports to the CIS and other foreign countries. In 1991, the CIS countries accounted for 42.7% of total Russian coal exports, while in 1993 it was cut to 29.6% and in 1998 it accounted for 22.7% only. This trend can be explained by:

- low demand and broad-scale bartering
- imposed value added tax (in contrast to exports to other foreign countries)

Coal exports to the CIS countries declined from 23.5 Mt in 1991 to 5.1 Mt in 1998. However, exports to other foreign countries did not change significantly during this period, remaining at 17 Mt per year – the only decline being in 1994 (14.6 Mt). Data on Russian coal exports by consumer countries for a five-year period is presented in Table 2 below.

Coking coal exports were cut from 7.67 Mt in 1991 to 2.60 Mt in 1998, with shipments to Eastern Europe reduced nearly to zero. In 1989 coking coal exports to these countries totaled 5.24 Mt. Today, nearly 100% of coking coal exports go to Japan and South Korea. Steam coal exports to Eastern Europe also declined significantly as compared to 1989, although recently there has been a certain growth of steam coal exports due to a radical increase of shipments to Poland (up to 2.2 Mt in 1998). This increase followed the restructuring of the Polish coal sector and rising coal prices in the Polish market.

Table 2 Russian coal exports by country in kt

	1994	1995	1996	1997	1998
Japan	4786	5841	6018	6455	4397.4
Italy	884	896	468	304	92.9
Greece	155	128	3	35	-
Slovakia	1131	1224	1504	699	703.8
Romania	1752	1868	1485	788	1521.9
Great Britain	183	18	862	1212	898.9
Germany	376	623	311	66	78.9
Bulgaria	422	743	828	345	281.8
Finland	1116	866	719	664	409.1
Turkey	662	1704	3973	3958	4608.7
Poland	39	24	678	1860	2207.4
Korea	158	511	362	319	407.2
France	495	474	7	11	-
Belgium	306	524	226	255	620.7
Hungary	211	1409	250	143	182.6
Denmark	354	273	250	277	82.4
Portugal	167	94	-	-	-
Sweden	776	516	48	32	-
Mongolia	111	45	19	97	40.6
Switzerland	-	-	-	92	-
USA	-	-	-	-	68.9
Norway	-	-	-	-	40.6
Spain	-	-	-	-	128.2
Other countries	503	308	511	1082	80.7
Total	**14 587**	**18 089**	**18 522**	**18 694**	**16 853**

In the last decade, steam coal exports to other countries have been more stable due to shipments to Japan and South Korea, and a more than seven-fold growth (as compared to 1994) of steam coal exports to Turkey.

The Russian coalmines' painful efforts to improve efficiency of exports are undertaken in conditions of severe competition between the principal coal producers in the world market. At present, Russia's coal exports accounts for nearly 6% of the world market, ranking below those of Australia, South Africa, United States, Indonesia, Canada, China, Columbia and Poland. However, Russia possesses a good export potential. In 1999, Russian coal exports are expected to increase by 2.3 Mt.

7 COAL'S FUTURE

Over recent years, the importance and position of coal in the fuel and energy balance of the country has become progressively less significant. The current Energy Strategy approved in 1995 by the government of the Russian Federation served as a basis for the restructuring of the fuel and energy complex. It's top priority importance was to develop natural gas, the so-called "gas pause" phenomenon. However, according to the forecast of the International Energy Agency, world

energy demand will grow from 12.5 Gtce in 1990 to 17.3 Gtce by 2005 (1.4 times), while coal demand will grow from 3.3 Gtce to 5 Gtce (1.5 times) in the same period.

This can be explained first by the fact that oil and natural gas reserves are far less abundant than proven coal reserves. Production costs and capital investments required to commission new oil and gas capacities are constantly growing. According to some available estimates, the expansion of coal consumption by electric utilities and in technological processes for the production of hydrocarbons will become pressing even by the year 2020. This dictates the necessity for the country to orient itself towards the use of the available coal resources to meet the demand of the power generating sector and the country's economy in general, in parallel with expanding coal export potential.

This reasoning suggests that it is feasible to radically update the main directions for the development of the Russian power generation sector, with due account for the expansion of coal's share in the energy balance in the mid- and long-term. To improve the reliability of the fuel balance and energy security, coal must remain the principal fuel for the traditional consumer regions, such as Siberia and the Far East, and its application must be expanded in such areas as the electrical utilities of the Urals and the European part of Russia. The Ministry of Fuel and Energy is now reassessing the importance of coal in the revised Energy Strategy.

Updating of the Energy Strategy implies a transition from the "gas pause" to a gas-coal alternative for the development of power engineering. For the coal industry, the realization of the "gas-coal strategy" will include the following stages:

- **Stage 1** covers the period up to 2010, when all the resources of the coal, railway and power sectors available for coal production, transportation and utilization will be mobilized to the maximum possible, but with limited capital investments. According to preliminary estimates, at this stage, coal use may be extended to 250-300 Mt, including 200-250 Mt of steam coal.

- **Stage 2** covers the period of 2010-2020, when coal output in the Kuznetsk and Kansk-Achinsk basins will be extended. This will require a radical improvement of coal mining and utilization technologies:
  - large-scale processing of coal at mining sites to raise the product quality;
  - the upgrading methods and equipment for long-distance transportation of coal by radically improving railway transportation technologies and developing new kinds of transport (for instance, pipeline systems); and
  - introducing ecologically efficient technologies on a broad scale for coal utilization in power engineering.
  - The implementation of these innovative measures will inevitably require substantial capital investments, however, it is the only way to extend the country's coal output to 400-500 Mt by the end of the period under consideration.

8 PROGRAMME OF ACTION

The future importance of coal sector development for the sake of the long-term energy security of Russia dictates the implementation of some urgent effective measures. These are as follows:

8.1 Normalizing the financial performance of coal companies

This can be achieved through the growth of actual earnings from coal sales. Special importance will be attached to enhancing marketing activities of coal companies and improving consumer characteristics of coal products. In the domestic market, it is necessary to promote the expansion of sales of the Kuznetsk and Kansk-Achinsk coals.

Russian coal's position must also be strengthened in the international market. by minimizing production costs and reducing transportation costs in coal prices.

To settle the problem of non-payment in coal markets promptly and efficiently, a "Federal Fuel Fund of the Ministry of Fuel and Energy of Russia" should be established which directly accumulates money allocated from the Federal budget for fuel supply to enterprises and establishments including financial resources from the government's special Fund for seasonal fuel purchases.

8.2 Radical restructuring of the system of fund raising and crediting

Today, foreign investors have no opportunity to get the required information on the financial performance of coal companies and their position in the market.

8.3 Application of new management approaches in the sector

A reasonable combination of State regulation and management methods based on the ownership of coal companies seems most feasible. It is necessary to make some amendments to the existing legal framework, to allow an efficient vertical structure of sector management. So far, no regulations or norms are available to assess the value of State-owned shares in coal companies offered for sale.

It is very important to elaborate principles to establish and operate business activities involving coal, and to establish effective structures that could combine the interests of coal producers and consumers (steel operators, power generators and municipal authorities for example.)

8.4 Establishment of a system of ecological monitoring

This implies planning for force majeure situations with ecological consequences, with engineering and financial support for safety and employment of the population where coalmines are either in operation or being closed.

8.5 Continued restructuring

In context of the above, what are the prospects for the Russian coal industry? It is quite natural that the future brings a further implementation of the restructuring process to the extent stipulated by the updated programme for the closure loss-making underground and opencast mines for the years 1999 – 2001 including the following:

- implementation of projects to operate promising underground and opencast mines including through technological refurbishment of production facilities
- provision of safe working conditions
- minimization of production costs

- improvement of the ecological situation financed by mines and donors
- implementation of the privatization programme for the years 1999 – 2000;
- restructuring of coal companies through unbundling loss-making and non-core operations and establishments
- restructuring debts and eliminating duplicated functions and operations
- incorporation of subsidiaries and their transformation into coal companies' affiliated structures
- formation of optimal production complexes through, among others, transferring the property of subsidiaries to coal companies; centralizating sales, accounting and some other managerial functions; arranging coal sales through coal companies only; transforming coal trade agencies into structural components of coal companies;
- sales of State-owned shares of auxiliary operations and service centers, which are not incorporated in coal companies.

9 INTERNATIONAL CO-OPERATION

The following areas of cooperation are covered:

- co-operation with coal producing countries, especially in Central and Eastern Europe, to exchange experience and possibly co-ordinate activities aimed at coal sector restructuring
- participation in international projects of governmental and non-governmental organizations aimed at the sustainable development of the world coal industry
- raising foreign investments to develop promising coal deposits, construct new mines and technologically modernize operating profitable mines
- development of bilateral trade and economic, scientific and technical co-operation with leading coal producing countries
- providing technical assistance to developing countries to expand their coal output
- development of international co-operation in the creation and application of clean coal technologies and environmental protection methods for coal mining utilization of processing waste.
- expansion of exports in view of the growth of world coal markets.

SLOVAKIA [160]

1 PRODUCTION, CONSUMPTION

Primary energy resources are limited in the Slovak Republic. Energy needs are covered 90% by imports. In 1998, overall primary energy demand was 708 PJ, of which solid fuels were 196 PJ, or 27.7%. Out of this quantity, domestic brown coal accounted for 45.1 PJ. Brown coal is the only important domestic energy resource.

The Energy Concept of the Slovak Republic up to 2005 with a perspective to 2010, approved in 1993, marked coal mining as a strategic activity. At present, energy policy remains on the negotiation table of the Slovak government because the future position of coal mining is not definitely determined. It is evident, though, that coal mining is justified for social considerations. Conditions for the Slovak Republic to join the European Union are also considered, especially strict ecological aspects. Discussions about coal mining in the Slovak Republic are expected to conclude by mid 2000.

In 1988, brown coal consumption was 14.8 Mt and domestic production 5.7 Mt. In 1999, consumption dropped to 4.7 Mt while domestic production was 3.9 Mt. Hard coal consumption was 6 Mt in 1988, but decreased to 4.3 Mt in 1999. Since hard coal is not exploited in the Slovak Republic, the whole quantity was imported.

Brown coal is mined in three regions – Prievidza, Zahorie and Vel'ky Krtis. Of the overall volume of 3.9 Mt, 0.6 Mt is sized coal for households with a heating value of 16 GJ/t. The remaining coal is coal dust for power stations with an average heating value of 10.5 GJ/t. Sulphur content ranges from 0.9-2.0%.

The coal dust market is liberalized, with the average price ranging from SKK60-80/GJ. The sized coal market is liberalized too, but the government subsidises producers of sized coal for households. In 1999, the subsidy was SKK167/t, decreasing every year by 10%.

2 MANPOWER

At present, 8000 people are employed in coal mining. Their social situation has become worse in the last years. While in 1989 wages of coal miners were 154% of the average wage in industry, in 1999 it dropped to 110%. Miners receive some special allowances besides wages:

- loyalty bonus – paid once a year,
- allowance for energy paid monthly
- underground workers receive also snacks free of charge.

The three coal mining companies are joint stock companies. Two of them are 100% private, the third one is 34% State-owned. This last company does not work profitably and the government has adopted a programme to close it by 2004, funded by State subsides. However, a full regional

160 F. Boroska, D. Slamka, Slovak Member Committee of the World Energy Council

response to the problem of redeployment is missing, which could result in a rise of unemployment. The government process and intentions concerning this problem will be known by mid 2000 when coal mining perspectives will be discussed in all its ramifications.

Underground workers had some legal advantages compared to other employees in the past, like retirement at 55 and higher pensions. Since 1 January, 2000 these preferences have expired which, together with the unclear and incomplete position of Slovak coal mining, is a reason of certain social uncertainty.

After rapid decline, coal mining has been stable since 1995. The drop in exploitation has partly caused a drop in the number of employees. At the same time, measures to increase production efficiency have been taken and in 1997 labour productivity increased to 467 t/person compared to 368 t/person in 1988.

In addition to miners, there are employees of the company producing and repairing mining machinery – powered supports, shearers, etc.

3 COALMINES

Hornonitrianske bane Prievidza – coal production of 3 Mt per year, of which 0.6 Mt of sized coal. Dust coal for power generation is transported to a coal-fired power station of 512 MW installed capacity 15 km far from the mine. Desulphurization technology is fitted to 220 MW; 97 MW has a fluidized bed combustion boiler and the remaining technology is a classical one. The mine and the station are in central Slovakia.

Baoa Dolina Vel'ky Krtis – coal production of 0.4 Mt per year. Production is not cost-effective because of transportion costs: the power generation facility lies 200 km from the mine. It has been decided to terminate exploitation. The mine is in southern Slovakia.

Baoa Zahorie Holie – coal production of 0.5 Mt per year, supplied to heating plants. The mine is in western Slovakia.

4 PROSPECTS

Market analysis indicates that coal consumption will gradually drop because of the continuous penetration of natural gas all over Slovakia and required environmental protection.

Strategic plans for coal mining aim to rationally mine reserves on existing sites. By 1 January, 1999, exploitable reserves amounted to 100.6 Mt. Investments are determined accordingly. They mainly concern repair and renewal of equipment and development of unavoidable mining workings. Investments will not exceed the value of depreciation.

In 1999, restructuring and privatization of the coal mining industry in the Slovak Republic was completed. Coal mining is dependent on mine capacities. Although there are other 15 brown coal

deposits and one hard coal deposit in the Slovak Republic, all these reserves are situated in extremely difficult technical and hydrogeological conditions and it is not considered to develop them in the next decade.

Problems concerning coal were also analysed by foreign consultants in the recent years. Their conclusions were as follows:

- the economy of domestic mining is limited
- it is not possible to increase production without external capital
- mining conditions require a lot of special work
- conditions in mines require a relatively stable production level
- labour is about 40% of total cost
- coal is the only domestic resource besides water and new renewables
- unemployment is a significant social problem
- production based on natural opportunities is dependent on legislature concerning environmental protection. If capital for technological innovation (desulphurization, FBC) is limited, mining will be reduced by up to 40% of present levels by 2003.

Brown coal is presently not a trading commodity on the international market because of the high transport costs per GJ. The attitude of the Slovak Republic concerning coal mining in the future is based on this fact. Generally, it appears desirable to achieve maximum production efficiency and maintain a special position for domestic coal production in view of the country's low energy self-sufficiency.

5 CLEAN COAL TECHNOLOGIES

The role of coal in the Slovak power system is still significant. About 20% of the total 26 TWh of electricity generated in 1998 was produced in coal burning furnaces. In total, 3.54 Mt of lignite and 1.15 Mt hard coal were burned in 1998 to produce electricity and heat in district heating systems. These numbers indicate that the impact on the environment of coal utilisation in the Slovak electricity industry is significant.

There are several possibilities how to mitigate the negative influence of the flue gases originating from the burning of coal for electricity generation. The two most commonly used in Slovakia are the replacement of the coal by natural gas and the use of clean coal technologies.

The first has been employed in combined heat and power plants in areas with high population density. It is worth mentioning that this approach has been applied merely to boilers connected to small district heating systems, block boilers or local household furnaces. Gasification is the major tool of environmental protection for distributed energy conversion or in big municipalities.
The second way is the introduction of clean technologies. This comprises processing raw coal, arrangements to minimize the creation of dangerous substances during combustion and processing the flue gases.
Processed/sized coal is earmarked for retail to households and small consumers. There is no use of processed coal for electricity generation. The best kinds of the raw coal are separated and processed to decrease the content of ash and other ballast matters or poisonous substances.

Minimizing the creation of dangerous substances during combustion can be achieved by almost stechiometric conditions of combustion. This requires advanced control and metering equipment applied in all coal burning thermal power or combined heat and power stations in Slovakia.

Thermal power station Novaky
Another way is to introduce of the fluidized bed combustion (FBC) technology into existing or newly constructed boilers. This happened in the power station Novaky where the first FBC boiler with a capacity of 97 MW has been put in operation. The Lurgy Co. technology was supplied by SES Tlmace, which is the only producer of big industrial boilers in Slovakia. A special processed limestone is fed into the fluid bed in order to remit the creation of sulphur oxides.

Operation of the first FBC boiler at the Novaky power station is considered a trial operation. After confirmation that expected results will be achieved and meet all requirements and provisions of the Clean Air Act, four more old Novaky boilers could be replaced by FBC boilers.

Another accomplishment in the power station Novaky was the implementation of desulphurization technology on two 110 MW units. Wet limestone technology will provide for a decrease of the SO_2 and NO_x content in flue gases to comply with the limits set by the Clean Air Act. The supplier of the main equipment was Austrian Energy & Environment.

The above mentioned measures will provide for acceptability of further consumption of the indigenous lignite for electricity production and will stabilize coal mining activities in Slovakia.

Thermal power station Vojany
The largest Slovak thermal power station Vojany (1320 MW) is facing similar remedial action. Six units of 110 MW burn imported hard coal. Another six units burn natural gas or heavy oil.

The first two units were recently rehabilitated (at a time when previous limits of pollutants were valid). However, maintaining the original wet bottom burning chamber technology did not comply with Clean Air Act requirements. It had been decided to add desulphurization equipment. The supplier of the wet limestone technology is Austrian Energy & Environment. The equipment came into operation in 1999.

Another four coal burning units are being or will be rehabilitated, replacing original wet bottom technology by fluidized bed combustion. The key technology equipment is being manufactured by Austrian Energy & Environment. Commissioning of the first two rehabilitated units shall be in 2000. Special processed limestone shall be fed into the fluid bed to remit the creation of sulphur oxides.

SLOVENIA [161]

ABSTRACT
The decision of the Republic of Slovenia to accede to the European Union has put the coal-mining industry and the power sector as a whole on a hard road of adjustment to the liberalization and demands of the common energy market. The directives set by the Green Paper and the White Paper concerning power and energy policy will exert a powerful influence on the business operations of many companies in a number of ways, and cause significant social shifts in employment in the coal mining and power industries. In this process of approach and adjustment to the free market, it will be necessary to introduce a transition period for Slovenia, since not every company will be able to make the required adjustments in such a short time.

The Republic of Slovenia's energy and power economic development model emphasizes the following issues:

- reorientation of the economy towards less energy-intensive manufacturing;
- efficient use of energy;
- utilization of quality forms of energy;
- adjustments in the use of available domestic energy sources to achieve best possible results for the national economy;
- timely and effective environmental restoration of sites for the generation, transmission and distribution of energy; and
- realistic price relationships in the energy market.

At present, the analysis of the current situation and forecasting of coal-mining and power generation in Slovenia is an extremely difficult task. This is mainly due to a number of concurrent processes taking place on administrative as well as business levels requiring considerable forethought, preparation of relevant documentation and agreement in relation to future directions.

The Republic of Slovenia is still in the process of adopting legislation in the area of coal-mining and power generation. In 1999, two fundamental laws were adopted: the Mining Law and the Power Generation Law. All relevant implementing regulations (decrees, directives, decisions) must now urgently be adopted, bearing in mind negotiation positions for the accession to the European Union – by the end of 2001. Conditions and relations in the Slovene energy and power market shall be wholly determined by the National Power Generation Programme, which is currently being developed.

1 COAL POLICIES AND PRIORITIES

The policy of the Republic of Slovenia in the area of power generation has been set by the Resolution Regarding the Strategy of Efficient Use and Supply of Energy in Slovenia (1996). The objectives of the Resolution are in line with the power generation policy of the European

161 Milan Medved, Ph.D., Director R&D, Velenje Coal Mine, Velenje

Union. The Republic of Slovenia shall adopt the amendments to the Strategy in relation to market liberalization by the end of 2000, including provisions arising from the Kyoto Protocol. The provisions of the power generation policy have been set by the Ministry of Economic Affairs, Ministry of the Environment and Physical Planning, and Ministry of Economic Relations and Development.

1.1 Legislation

As we have seen, the Mining Law and the Power Generation Law were passed in 1999 and must now be implemented by the end of 2001. The legislation of the Republic of Slovenia in the area of classification of fossil fuels has been fully brought in line with the acquis communautaire (i.e. Community patrimony); therefore no further legislative adjustments are required.

1.1.1 Mining Law

According to the Mining Law, the ten-year national programme of mineral resource management should be periodically updated and adopted by the government. The national programme will determine priorities in utilizing these resources (e.g. coal-mining) for the Republic of Slovenia. It is imperative for the programme platform to include the degree of protection of the environment from over-utilisation and a conservation management programme for protected mineral resources. The Mining Law also provides for a Mining Fund to be established and to take charge of the management and planned use of the funds acquired from mineral rights payments to the government. Under the provisions of the Law, the holder of the mining license has to bear the entire costs of restoring the mining site by paying a set amount per each unit of excavated (or mined) mineral resource into the Mining Fund on a monthly basis. These accumulated funds are then to be used for a partial or total site restoration.

1.1.2 Power Generation Law

The main objective of the Power Generation Law is to establish certain conditions to enable safe and reliable supply of energy resources to the customer – based on market principles and principles of sustainable development while taking into account efficient utilisation of energy, including renewable energy, as well as environmental concerns. The Law ensures competitiveness in the energy market in line with the principles of equality and transparency, while protecting customers and enabling efficient control over the supply of energy. Significant provisions include:

- A National Power Generation Programme, developed by the government at least every five years which includes the objectives, directions and chosen strategies for the consumption and supply of energy as well as forecasting the energy balance for a period of ten years (within a framework of at least twenty years). The new Law sets the deadline for the programme as March 2001.
- In line with the provisions of the National Power Generation Programme, businesses within the power generation area are to develop relevant ten-year plans of future development on a bi-annual basis.
- Every five years, the government will issue a long term energy balance statement for a period of twenty years which must include:
    - ◊ a forecast of energy consumption, taking into account efficient utilisation of energy as well as the principles of sustainable development

- ◊ meeting energy demands by energy source
- ◊ the burden on the environment from the energy generation and consumption
- ◊ level of stockpiles and spare capacities required to achieve the planned level of reliability of supply
- ◊ ways to encourage the use of environmentally friendlier fuels.

- Energy supply is to be viewed and carried out as a market activity – suppliers and customers are to mutually agree on the quantity and price of the energy supplied, without any restrictions. Supply agreements can be either short-term or long-term contracts or made directly in the organized power market.
- The domestic power market should be open by the end of April 2001, with foreign suppliers to be given market access by the end of 2002. Legislation provides for third-party access to be granted to the power grid only in line with national regulations.
- Privatization of state-owned enterprises for power generation, transmission and distribution as well as coal-mining companies, can be accomplished by a direct sale to a strategic partner, via a tender process or by issuing shares. Until 2003, State-owned organizations can privatize up to a maximum of 45% of their equity, while the equity share owned by an individual entity or a mutually aligned group of entities may not exceed 24%.
- To solve the problems arising from stranded investments (investments planned and executed prior to 1997, which have proven unprofitable in market conditions), operators in the area of power generation are entitled to government subsidies.

1.2 Closing coalmines

During the 1980s, Slovenia made large investments into the coal-mining industry. The combined production of 6 coalmines was in excess of 5 Mt of lignite and 1.8 Mt of brown coal. Legislation to protect the environment and consequently reduce coal consumption for private and industrial purposes has led to the decision to close down smaller and unprofitable parts of coalmines. In 1995, the Law on Funds for the Closure of Coal-Mines in Zagorje, Senovo and Kanizarica was adopted. The Law makes provisions to implement the following measures:

- temporary funding of production
- closing down of the underground parts of coal mines
- environmental restoration of the degraded surface
- finding solutions to social and employment issues (1220 redundant workers).

All tasks in relation to the programme of closing down of coal mines are funded from the national budget. The plan anticipates these tasks to be completed by the end of 2000.

2 TOWARDS A COST-EFFECTIVE, VIABLE COAL INDUSTRY

2.1 Coal reserves

The reserves of lignite and brown coal in Slovenia are as follows:

- Accessible reserves of brown coal and brown boiler coal are 42 Mt. The brown coal has a calorific value of 14.6 MJ/kg, and contains 21% ash and 2.44% sulphur. Boiler brown coal has a calorific value of 11.7 MJ/kg, and contains 30% ash and 2.52% sulphur.
- Accessible reserves of lignite are 177 Mt. Lignite has a calorific value of 9.8 MJ/kg, and contains 18.5% ash and 1.43% sulfur.

2.2. Coal production to satisfy demands of the power generation industry

Underground coal mining is the sole way of production in Slovenia. There are two companies: Coal Mine Velenje, a public enterprise, in which the majority of the shares (89.9%) are held by the State, produces approximately 4 Mt of lignite; and Trbovlje-Hrastnik Mine, 100% owned by the State, with a total production of 0.85 Mt of brown coal per year. Due to mostly ecological reasons, the coal is almost entirely used by large thermal power plants.

In 1999:

- Sostanj Power plant produced 2900 GWh of power from Velenje lignite,
- Trbovlje Power plant produced 603 GWh of power from Trbovlje-Hrastnik brown coal,
- Ljubljana Power plant produced 862 GWh of power from imported coal and domestic brown coal.

The total output of the Slovene power generation industry in 1999 was 3895 GWh of power. Fossil fuel-fired power plants represented 32% of the total power supply (12 176 GWh) in Slovenia (or 4% less than in 1998).

2.3 Outlook on coal production

In future, coal production in Slovenia shall be entirely oriented towards supplying the thermal power plants and heating plants with built-in pollution control equipment. Anticipated annual production of lignite is to remain between 3.8 and 4 Mt. The production of brown coal is tied-in with the Trbovlje power plant operation, i.e. the plant must be revitalized and brought up to the required environmental standards. If no revitalization takes place, the plant should be decommissioned in 2004. At the moment, alternative solutions to this problem are being sought:

- revitalizing Trbovlje 2 and continuing to mine coal in Trbovlje-Hrastnik until 2015
- operating Trbovlje 2 up to 2004, and thereafter closing Trbovlje-Hrastnik

The programme of government subsidies in this area shall be adopted by the 31 March, 2001.

2.3.1. Production of lignite

Sostanj Power plant, the largest thermal power plant in Slovenia, produces electricity and heat solely from the Velenje lignite coal mine. In terms of their technological capacities and economies of scale, both companies have been optimised to produce 3200 GWh of power and 4 Mt of coal a year respectively. The ash residue and other by-products of incineration in the plant are being used by the coal mine to fill in depressed areas and restore degraded surfaces over the mining fields. Significant quantities of ash are processed into ash paste which is returned to the mine to be used as a filler of excavated areas in the technological process of coal extraction, as fire-proof insulation coating and as a means toensure geo-mechanical stability of the mining rooms and tunnels. The coal-mine and the power plant thus form a closed technological cycle leading to a significant reduction of the total costs of both. The strategy of both companies, in terms of the roles they play in the common energy and power market, is based on the following facts:

- accessible reserves of lignite are 177 Mt. The lignite has an average energy value of 9.8 Mj/kg, and contains 18.5% ash and 1.43% sulphur.
- In terms of adjusted output, the capacity of the coalmine is as follows:
    - ◊ 4 Mt per annum up to the year 2023 and

    - ◊ 2.2 Mt to 2060 when the coal deposits will have been exhausted
- the operating lifetime of individual power plant units is as follows:
    - ◊ Unit 1, capacity 30 MW, up to 2011
    - ◊ Unit 2, capacity 30 MW, up to 2011
    - ◊ Unit 3, capacity 75 MW, up to 2015
    - ◊ Unit 4, capacity 275 MW, up to 2017
    - ◊ Unit 5, capacity 345 MW, up to 2023
- The installation of all required pollution control equipment in the Sostanj power plant will be completed in 2000. The power plant will continue to rely on Velenje lignite as its only source of fuel.
- The sale of lignite for general consumption and industrial purposes will be discontinued in 2000.
- Reducing the price of lignite is an urgent and, above all, long-term task. In comparison with imported coals extracted mainly from open cuts, subterranean coal mining is more demanding in terms of associated costs. Further cost reductions will depend mainly on reducing the number of employees, lowering investment and overall downsizing of the mining area. In 1998, the cost price of lignite at the production level of 4063 Mt was DEM 5.77/GJ. The anticipated cost price after the year 2005 is DEM 4.5/GJ. Until 2005, the price of lignite must remain at a certain level to enable the implementation of adjusting measures (in the transition period) required for entry into the common European market. After 2005, the price of Velenje lignite will not differ from competitive producers' prices by more than 6%.
- In 1998, Velenje coalmine succeeded in acquiring ISO 9001 certification in the area of coal mining. ISO 14001 certification in the area of environmental protection will follow in the first half of 2000. The mine plans to obtain BS 8800 certificate in the area of workplace health and safety in 2001.
- Sostanj power plant shall acquire ISO 9001 certification in 2000 and ISO 14001 certification in 2001.

2.4 Subsidies

At present, coal production in Slovenia is being indirectly subsidized via the "value points" system of Energy & Power Slovenia. The system allows up to 10% higher prices than imported coal purchased by Ljubljana heating plant.

On the whole, the government regulates the business operations of companies in power generation and coal mining. Every year, the government sets the framework for the annual plans of these companies: the prices of energy resources, energy imports, workers' wages and salaries, level of expenditure for goods and services, the way depreciation is calculated, production output, level of debt, etc.

In the area of hard fossil fuels, the Republic of Slovenia expects assistance from the European Union to develop restructuring programmes and programmes of government subsidies for the coal-mining industry. The system of government subsidies for coal mining in the Republic of Slovenia has been brought in line with the Directive 3632/93/ECSC. This Directive shall be repealed on the 23 July, 2002 – the day the European Coal and Steel Community is to be abolished. In the course of future negotiations for the accession to the European Union, the Republic of Slovenia wants to retain the right to re-negotiate its position in relation to

government subsidies for coal mining.

3 ACCESSION OF SLOVENIA TO THE EUROPEAN UNION

In the course of negotiations for accession to the European Union, the Republic of Slovenia has assumed the following position with respect to power and energy issues:

- The deadline for closing the Zagorje, Senovo and Kanizarica coal mines should be extended to 2002
- A decision was taken not to proceed with the construction of Trbovlje 3; therefore the proposal to revitalize the thermal power plant Trbovlje 2 for at least another ten years should be adopted. Furthermore, a programme to integrate the Trbovlje-Hrastnik coalmines into the common energy market of the European Union should be developed.
- A law on funding the eventual closure of the coalmines Trbovlje-Hrastnik should be prepared and adopted prior to the 23rd of July 2002. Following this date, a ten-year transition period of government subsidies from the national budget is requested to bring about a successful completion of the decommissioning programme.
- A programme to integrate the Velenje coalmine into the concept of the common energy market of the European Union should be developed.
- Directive 3632/93 should remain in force at least until 2005; until then, the implementation of the nationally adopted energy policy should enable coalmines to prepare for the abolishment of subsidies and total integration into the Common European Energy Market.

4 CLEAN COAL TECHNOLOGIES

4.1 Sustainable coal production and use

The expression "environmentally acceptable ways of coal production" denotes technologies enabling economically efficient production and utilisation of coal with an environmentally acceptable total life cycle. Use of "clean coal technologies" leads to the reduction of harmful emissions, generates less waste and improves the efficiency in the process of power generation. It denotes a whole range of activities directed towards modernizing and improving the efficiency of conventional methods of coal combustion, as well as intrducing new, integrated processes of carburation and combustion to generate heat and power. Above all, the introduction of clean coal technologies aims to

- improve efficiency in the utilisation of thermal power plants
- reduce emissions of carbon dioxide, sulfur dioxide, nitrogen oxides and dust
- recycle and reuse waste and by-products generated in the process of mining and combustion of coal
- achieve concurrent combustion of coal and waste;
- integrate measures to protect the environment and prevent climate change into the process of transforming coal into power.

4.2 Provisions of the Kyoto Protocol

The Slovene coal mining industry has succeeded in achieving a significant reduction of the carbon dioxide emissions in relation to 1986 as well as 1990 levels. Data analysis, performed by

the environmental institute ERICo of Velenje, shows an 11.6% reduction for lignite in1990-1996 (i.e. from 103.9 t of CO_2/TJ to 90.2 t of CO_2/TJ).

5 WORKFORCE

The biggest problem in the process of adjustment of the coal-mining industry to satisfy the requirements set by the European Union to enter the free energy market, is the reduction of the number of employees. The mining industry has been facing this problem since the mid-1980s. The main reasons for reducing the workforce are:

- the reduction of coal and power production levels
- the requirement for a continuous productivity improvement of at least 2.6% a year
- the increasingly mechanized process of coal extraction.

In order to reduce the number of workers, the coalmines have used various approaches: early retirement (with the option to "buy" years up to the retirement age), redundancy packages, creating new jobs, and establishing new companies. In all these years, there have been no involuntary terminations on technological grounds. In future, the number of employees will have to be reduced even further. It is imperative to achieve this in a way that does not cause social traumas in the local as well as in the wider community. Further investments in this area are required and alternative employment schemes will have to be developed. In the course of the implementation of this task, any assistance would be most welcome. However, it is also imperative to learn from the experience of countries that have already gone through this restructuring process.

TAJIKISTAN [162]

There exist high-quality coal reserves of 500 Mt which, except for 80 000 t (1998), are not exploited due to high cost of extraction. About 0.5 Mt of coal is imported covering about 10% of primary energy needs. Consumption is expected to be stable towards 2010.

TURKMENISTAN [163]

In Turkmenistan, coal resources are estimated at 800 Mt, but not exploited. About 1 Mt is imported – a number which is not expected to grow in the foreseeable future. Coal covers about 5% of the country's primary energy needs.

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162 REWG Regional Forum, Kusadasi, Izmir, October 1996, presentation on Tajikistan; UNECE, Present situation and prospects for the fuel and energy complexes in the countries of the CIS, document ENERGY7R. 131/Add. 1 of 26 September, 1996, tables 5 and 7; SIEMENS, Elektrizitätswirtschaft Tadschikistan, without year

163 REWG Regional Forum, Kusadasi, Izmir, October 1996, presentation on Turkmenistan; UNECE, Present situation and prospects for the fuel and energy complexes in the countries of the CIS, document ENERGY/R. 131/Add. 1 of 26 September 1996, tables 5 and 7

UKRAINE [164]

ABSTRACT
The main trends, priorities and possibilities of developing the coal mining and heat and power industries of Ukraine are described against the background of an energy policy aimed at increasing the share of domestic energy resources and at further diversifying import sources. The intended use of domestic coal forms the basis for the development of the Ukrainian solid fuel and power generation industries.

1 ELECTRIC POWER NEEDS AND GENERATION

Electrical power engineering is a highly developmental branch of the national economy implying a full technological cycle from design to equipment manufacture, production, distribution and marketing.

The rated capacity of the electric power stations of the United System remained stable between 1996 and 1999 at 53.9 GW, of which 36.4 GW (67.5%) thermal, 12.8 GW (23.8%) nuclear and 4.7 GW (87%) hydro. While electric power generation decreased (from 183 TWh in 1996 to 178 TWh in 1997 and 173 TWh in 1998), thermal plants generated the main share (60% in 1994; 58.4% in 1995, 51.7% in 1996; 49.8% in 1997 and 47.3% in 1998). Their capacities covered the base load (51.5% in 1998), compared with 12.2% by hydropower and 36.3% nuclear power stations.

The needs of Ukraine for energy resources to generate electricity and heat grow with each passing year. In 1996 the country needed 61 Mt of coal; in 1997, 76 Mt; in 1998, 65.5 Mt. In 1996, thermoelectric plants consumed 60.4% of energy resources (coal, gas, residual oil) the share of coal being 25.5%. The picture was almost the same in 1998. However, power plants in the Ukraine operate under the double constraints of short supply of fossil fuels and mass-scale non-payment for power consumed. Such a situation affects the safety and reliability of the whole Ukrainian power generation system.

There exist more problems, though. The whole structure of generating capacities in Ukraine is characterized by insufficient peak load power. The high proportion of nuclear power stations makes it necessary to put thermal power generating units in operation under peak load conditions for which they have not been designed. That is why thermal power stations operate at very low efficiency and safety levels, and pollution of the atmosphere exceeds all permissible norms. Therefore, it is now urgent to rehabilitate existing thermal power stations by using new technologies to burn Ukrainian coal.

All enterprises of the power industry in Ukraine face decreasing load with an unacceptable level

164 A. Shidlovsky, Vice-president of the National Academy of Sciences of Ukraine, academician G. Pivnyak, academician of the National Academy of Sciences of Ukraine

of ecological problems. In future the need for electric power generation will grow. But by that time, the main part of the equipment will have become unsuitable. The wear of the main power generating equipment will have become a real problem. While about 7% of the equipment at thermal power stations is far from being modern, the rest of the equipment (40-90%) suffers from severe wear. Wear and physical ageing causes the efficiency to become much lower than designed – on average 32%.

Nowadays we observe a reconstruction of the power generation sector in Ukraine and the change of property relations. That is why it is especially important to solve the problem of financing. Under existing economic conditions, it is necessary to stimulate foreign investments, which will help us to solve our tasks. However, this must be done on a rational scale and under mutually advantageous conditions. With this in mind we must:

- create an efficient pricing policy
- create a stable legislative framework, of interest for investors
- modernize contractual arrangements in international relations.

Based on the above assessment, we define the main tasks and problems to be solved as follows:

- introduction of new power generating units
- mastering new long-term power-saving technologies
- creation of new types of equipment
- modernization of the power consumption process
- use of modern computer control systems.

2 Coal production and use

The coal-mining industry of Ukraine occupies a leading position in supplying the country with power and securing its national safety and independence. Such a role is confirmed by the tendencies of world power generation: coal is the main source of global power generation and provides 40% of generation in Europe and 44% in the world. Coal will also be one of the main raw materials for power generation in future. The resources of coal in the world are five times those of oil and gas. The potential resources of coal are 15 times those of oil.

There are, first, the economic advantages of coal use. The cost of coal at the world market is half that of natural gas. There is a second - political - advantage, connected with the energy independence of the country. The main source to meet Ukrainian demand for natural gas is imports. But under the existing economic conditions, coal is more economic in comparison with natural gas. The experience of leading countries shows that power generation policy should take into account the country's own natural resources.

The main strategically important power generation raw materials in Ukraine are coal and coal gas methane. Real coal extraction potential is estimated at 100 Mt per year. Coal is the only power resource mined in Ukraine in sufficient quantities to meet the requirements of the country in this type of fuel. This determines the strategic role of coal not only in the development of power generation, but in the development of the Ukrainian economy as a whole.

The Ukraine has different kinds of coal: hard coal, bituminous coal, anthracite, etc. Though the amount of coal resources is sufficient, coal mining continually has decreased. From 1991 to 1998, coal mining was cut by half (164.8 Mt in 1990 and 76.2 Mt in 1999). The crisis of the coal mining industry in Ukraine is due to a number of factors. The main reason was the investment policy of the former USSR: coal-mining operations were reduced in the Donbass, because it was possible to develop coal fields in the eastern regions of Russia, containing cheaper coal.

While production decreased, productivity increased as shown in the table below.

Table 1 Productivity index 1996-1998

	1996	1997	1998
average per worker (in t/month)	15.8	18.2	19.8
face productivity (in t/day)	244	289	312
for mechanized faces (in t/day)	357	421	463

In 1990 there were 642 mechanized faces, down to 634 in 1991, but since 1992 their number has decreased by half and does not exceed 370-330 units now.

Nearly 40% of all mines have been functioning for more than 50 years, and14.9% for more than 70 years. Over 35% of the mines have a productive capacity of 300 kt a year, which is lower than the annual productivity of one modern powered face mining system. About 90 mines, characterized by low productivity, mine less than 10% of coal. One fifth of miners are employed at these mines, which absorb about 20% of State investments. In 1998, in the Ukraine 211 mines were in operation and 62 of them produced 7.8 Mt of coal more than planned, and 149 mines were not able to fulfill the plan of coal extraction, mining16 Mt less.

Thus, it is possible to come to the following conclusions: it is possible to raise the level of coal mining if all non-productive mines were closed and the released funds and material resources were used to re-equip and modernize profitable mines and collieries.

New technologies are to play an important part in the revival of the coal mining industry. We mean both the technologies of coal mining and the technologies of using coal. In 1998, the ash content of coal mined in the Ukraine was 35.7-36.4%, while the ash content of processed coal was only between 23.3-25.3%. It is not the quantity of the coal mined, but the production of finished marketable products that must guide the operation of an enterprise.
High manufacturing cost of coal may be explained by high operating expenses and by the low level of technical equipment of mining industry enterprises.

3 HEAT SUPPLY

The specific fuel consumption of Ukrainian thermal power stations is four times higher than that in the countries of western Europe, the USA and Japan. This can be explained by a number of factors, connected with the technology of fuel processing. Steam- and gas turbine power units, which operate on natural gas, are considered to be the most efficient. That is why a little more than 50% of supplies are natural gas. Natural gas consumption in 1997 was at 80 bcm, of which

only 18.1 bcm from indigenous sources. Thermal power stations consumed 12.8 bcm. Gas production in Ukraine will grow, but in insufficient quantities. That is why Ukrainian power generation will be oriented to natural gas import, although modern coal-fired power stations have high technical and economic indexes.

4 CLEAN COAL TECHNOLOGIES

The main aim of modernizing the power generation industry is lowering specific fuel consumption. Under present-day conditions and to the extent that the cost of a kWh is determined by the cost of the fuel component, coal is more competitive. At the present level of thermal power stations' efficiency, the competitiveness of coal with respect to natural gas is preserved at a break-even point of 54.3 $/t, taking into account transportation etc.

Power generation at coal-fired power stations is far from being an ecologically pure process. To keep high-ash, low-grade coal burning, it is necessary to use imported gas or residual oil. That is why we must use modern coal power technologies that keep strictly to ecological norms. These technologies also reduce the dependence of the industry on imported raw material.

The ecological and technical problems mentioned above do not only affect Ukraine, but the developed countries of western Europe, the USA and Japan. Experience as to how to develop and apply such technologies has already been accumulated. These technologies form the basis for the application of clean coal technologies in industrially developed countries.

Taking into account the present-day level of science and technology, it is necessary in future to design coal power-generating units with an efficiency of 45-50% and steam-gas turbines with an efficiency of 55-60%.

5 THE DIRECTIONS OF THE DEVELOPMENT

The problems of the coal mining industry may be solved through the legislative and financial support of the State. The way out of the crisis is projected and stipulated by the "Complex Programme of Branch Reform and Financial Recovery of Coal Mining Enterprises".
The Programme aims to provide the country with competitive coal products and to decrease the import dependence of the country, which in turn, will provide power safety to the Ukraine. The concept foresees both the use of indigenous resources to increase efficiency and the need for State support, as the foundation of the Programme.

It is especially important to provide coal in sufficient quantity, and at the same time to solve at the State level problems such as:

- elaborating quality standards and certifications
- providing the legislative, organizational and technical basis to reduce subsidies
- reducing the power-intensiveness of coal production
- redistributing State support to 40 mines with an annual coal production of 1Mt
- organizing coal mining with a view to better satisfying customers' quality requirements

- supporting inter-branch cooperation in processing (mine-preparation plant, thermal power station)
- applying selective mining of coal, raising methane production and the production of slurry
- creating coal markets within a framework determined by the State
- promoting non-expensive mechanisms to save energy and power
- developing and using fluidized bed boilers for all ranks of coal when refurbishing thermal power stations
- reducing specific coal consumption.

The implementation of the Programme will make it possible to increase coal production. At 62.7 Mt in 1999, production will reach 66.4 Mt in 2000 (an increase of 11.7% and 18.3% compared to 1998). The growth of the volume of production, the re-equipment of mines, the development of coal preparation and some other measures of the Programme will provide for the expected economic effect and will positively influence the realization of the energy programme in Ukraine as a whole.

Methane production from coal deposits can increase efficiency, provide safer coal-mining processes and improve the ecological situation in coal mining regions. According to various estimates of specialists, the potential storage of methane in Ukrainian coal deposits amounts to 2.5-3.7 bcm, but American experts consider the storage potential to be as much as 25-27 bcm of methane. That is why coal deposits may be referred to as coal-gas deposits.

The experience of both Ukrainian and foreign experts proves the expediency of methane production from coal deposits. Modern methane production technologies will make it possible to produce about 10-15 bcm by 2005 (over 20% more than the needed volume). By 2010, 25-30 bcm of methane will have been produced in Ukraine.

Complex mineral wealth exploitation during the process of coal mining, applying modern non-traditional technologies of coal mining and preparation, as well as creating small combined heat-and-power complexes will render products of coal mining enterprises even more competitive.

6 PLAN OF ACTION

The coal mining industry is part of the fuel and power-generating complex. Integration of activities takes place in three stages: State industrial policy; inter-branch State control and inter-firm control. Control criteria for defining efficiency are different at different levels.

The State industrial policy determines the development and structure of the fuel and power-generating complex. Present-day Ukrainian industrial policy with regard to coal mining aims to support and preserve a needed minimal sufficient scale, as coal is the only primary power generating mineral resource in abundance in the territory of the country.

Control of branch operations aims to increase competitiveness. Administrative and economic methods are used, applied with the help of laws in form of acts. To raise efficiency and create competition under market conditions, it is necessary to implement the Programme of Branch

Reformation. The Programme presupposes the realization of a strategy, to ensure the survival of a viable base of the branch. The branch will be able to produce coal of better quality when expenditures per unit are 20% lower than at present. The growth of labour productivity will be achieved thanks to restructuring and to modernizing technologies.

International experience of coal mining reform in countries that are the main producers of coal, such as Germany, Great Britain, France, the USA, Poland forms the foundation for structural changes planned in the Ukraine now. These structural changes are defined by the necessity of our country's transition from the planned to the market economy.

Restructuring stipulates closing mines that are not efficient enough. The rest are to be reconstructed into highly efficient mines. New coal mining enterprises are also to be set up. Reform will decrease the need for subsidies by raising labour productivity and immediately solving social problems. Raising labour productivity and lowering power-consumption in coal mining can be achieved by modernizing technologies and establishing new, well-equipped coal mining enterprises.

Environmental protection measures are to be undertaken to decrease the negative influence of coal mining on the environment by lowering the volume of discharges into mine waters, extinguishing burning waste dumps, recultivating disturbed ground, recycling wastes, reducing harmful effluents from thermal power stations and boiler houses, and promoting production and use of methane.

Privatization of coal mining enterprises is one more step in reconstructing the industry. All measures undertaken will give us the possibility to reduce mining expenditures and create competition for ancillary enterprises. In 1998, in accordance with the Programme, 12 mines were closed. In 1999 it seems also possible to close 20 more mines.

Clean coal technologies in power generation will turn coal into an ecologically acceptable resource, characterized by high efficiency and raise the competitiveness of power generation in the Ukraine. Among the technical aspects that define the scope of coal technologies, it is necessary to mention the ability to utilize a certain type of fuel, the designed capacity of the power-generating unit, and peculiarities connected with the specific conditions of its introduction.

Waste from coal preparation processes could be used quite promisingly: over 180 Mt with an annual increase of 5-6.5 Mt in electric power generation (6-8 Mt of solid fuel a year over 15-20 years). In this way, it would be possible to put into operation 10-12 power-generating units of 200 MW capacity.

Thus, the new concept differentiates the approach to the use of mined coal and its preparation products depending on their quality and the conditions required for economically proved heat extraction. The criteria used to estimate the efficiency of coal preparation and burning is the coefficient of power use of these products.

7 CONCLUSION

Most countries use solid fuel as the main source of power generation. Coal plays a very important role in our lives and its influence will remain great during a number of centuries, especially in developing countries. Long-term forecasts anticipate that coal will be used as a main fuel to generate power in a number of countries, and especially in Central and Eastern Europe. Huge reserves of coal, low prices and multiple sources of supply subjected to much less political influence than other sources of power are the main factors which make us prefer coal from the point of view of cheap and reliable power generation.

The growth of power demand in Europe may be met first of all by broadening the supply of both indigenous and imported coal. But at the same time, we need new strategies and policies, taking into account the changes taking place in coal mining and in power generation.

It is really important to define coordinated policy approaches to secure stable power generation, because the processes of liberalization, privatization and globalization of power markets will lead to growing competition, to the improvement of control processes, to new organizational structures and ownership patterns. New, more perfect technologies of ecological control will also be worked out.

New global and successful power generation policies will make it possible to introduce coal as the main component of this policy and to take coal as an equal partner to the power market. The closure of the coal mining industry will make the access to the resources of coal more expensive and even impossible in future.

The necessity of using coal in the Ukraine is dictated both by the need to ensure the independence of the country, and by the possibility of reaching a high technological standard in power generation while taking into account the need for environmental protection. These ideas form the basis of the concept of solid fuel and power generation development in the Ukraine.

In perspective, it is expedient for the Ukraine to generate electric power on the basis of using coal and natural gas. The main efforts of the country are to be directed at increasing the share of indigenous power resources and at further diversifying their sources of import.

UZBEKISTAN [165]

Economically recoverable coal reserves are estimated at 1 Gt. Coal plays only a minor role in the primary energy balance of the country (below 5%). Production, previously at 6.4 Mt, declined to 3 Mt in 1998. Production is supplemented by imports. Plans are to increase production to 5-8 Mt by 2010.

165 REWG Regional Forum, Kusadasi, Izmir, October 1996, presentation on Tajikistan; UNECE, Present situation and prospects for the fuel and energy complexes in the countries of the CIS, document ENERGY7R. 131/Add. 1 of 26 September 1996, tables 5 and 7; SIEMENS, Elektrizitätswirtschaft Usbekistan, without year; WEC, Survey of Energy Resources 1998, p. 16; IEA Coal Information 1998, I.113

YUGOSLAVIA (SERBIA AND MONTENEGRO) [166]

Proven reserves of coal amount to 16 472 Mt, of which 91% lignite and 9% sub-bituminous and some bituminous coal and anthracite. Production in recent years oscillated around 40 Mt of lignite (44 Mt in 1998). Imports of hard coal were below 0.1 Mt. Coal use covers approximately 50% of primary energy needs (i. e. in 1997 about 8.2 Mtoe out of 15.84 Mtoe). The major customers (to 80-85%) are power stations, with other non-specified customers accounting for the remainder. The energy industries are State-controlled and vertically integrated monopolies. Prices are controlled and below cost.

During the Kosovo operations in 1999, the coal mines and thermal power stations of Yugoslavia remained operational, but a third of the grid, including important transformer stations, was destroyed.

The two main opencast pits in Kosovo, at Belacevac and Dobro Selo (with a production capacity of 16.5 Mt), discontinued production , reducing generation by only one of the five units of the 617 MW Kosovo A and 618 MW Kosovo B thermal power plants[167].

Reconstruction began as of late 1999.

166 The IEA The energy situation and possible IEA activities in South Eastern Europe/Balkans, document IEA/NMC (2000)7 of 29 February 2000, p. 24;
167 Financial Times, Power in East Europe, 1 October, 1999