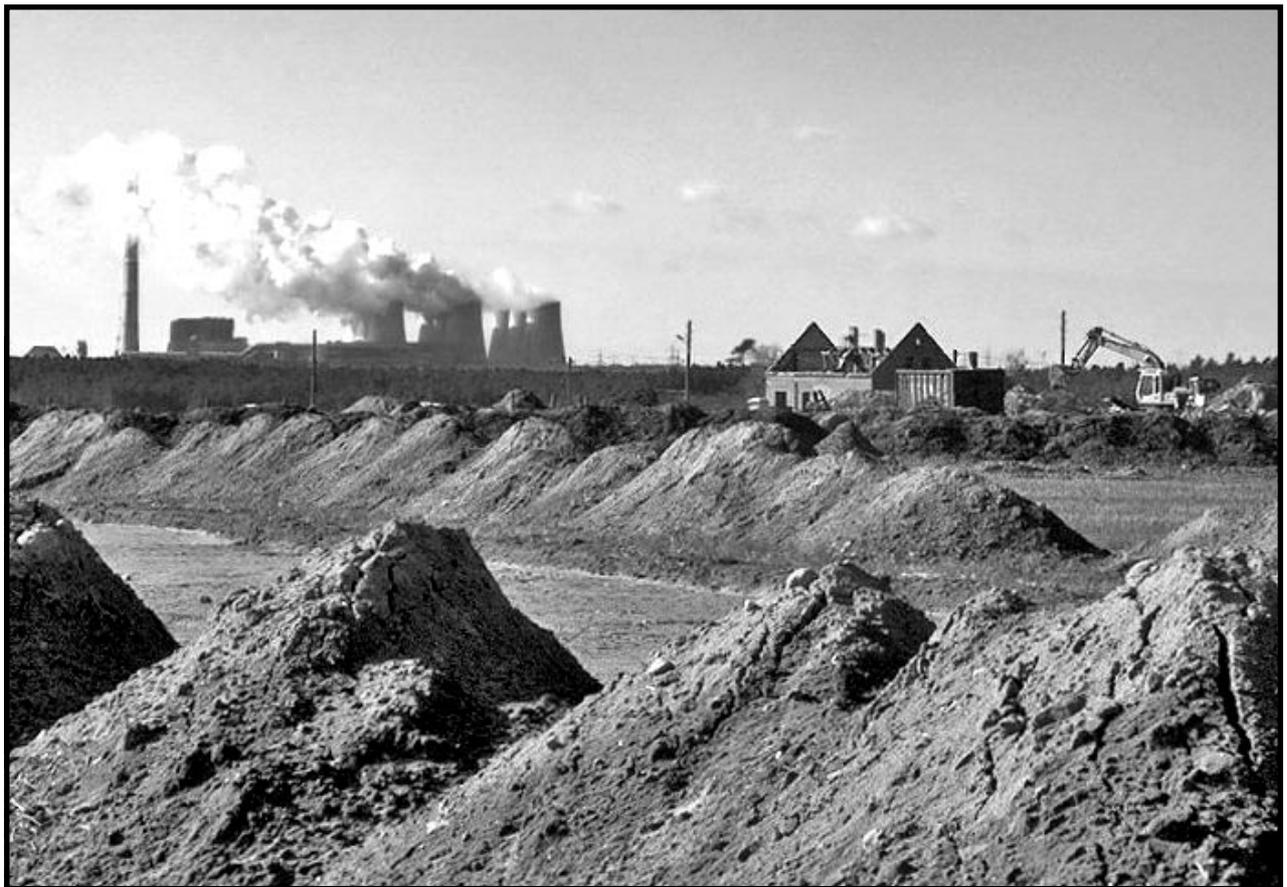


Status and Impacts of the German Lignite Industry



By

Jeffrey H. Michel



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Cover illustration: Devastation in 2004 of Horno, a traditional Sorb village near the Polish border, for the lignite-fired Jänschwalde power station seen in the background. Photo: © Gérard Petit.

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Executive Summary

Lignite, or brown coal, is the main domestic fuel resource in Germany. In contrast with the diminishing global reserves and increasing prices of natural gas and oil, lignite appears to offer long-term energy security at predictable cost. The accessible geological deposits between the Rhineland and the tri-country region of Germany, Poland, and the Czech Republic are sufficient for maintaining current levels of lignite power generation for more than two centuries. These reserves generally lie less than half a kilometer below the surface, allowing relatively inexpensive strip mining to be employed.

However, lignite is ultimately very costly to use because of factors not reflected in market prices. Lignite power production is exempt from taxes that have been levied on gas generating plants, and mining is likewise not subject to fees for groundwater depletion. According to a study released by the German environmental ministry in October 2004, the contribution of all such indirect subsidies approaches one billion euro per year. The financial burdens of environmental and health detriments are estimated at a minimum of 3.5 billion euro annually.

When the comprehensive effects of climate change are added, the total hidden costs of lignite use in Germany may lie as high as 35 billion euro per year. In relation to German mining production of 180 million tons annually, these concealed costs range from 25 euro to 200 euro per ton of lignite, or up to 22 cents for each kilowatt-hour of electricity produced. Lignite is delivered to power plants for only about 10 euro a ton. On an all-inclusive basis, however, it is considerably more expensive than renewable energy from wind or biomass.

More than one-quarter of German electrical power is generated using lignite. The future expansion of this sector appears likely due to the limited availability of viable alternatives for the country's 19 nuclear plants, which by law must be phased out within two decades. In 2003, these reactors delivered 165 billion kilowatt-hours (165 TWh) of electrical energy, thus accounting for 27.6% of total power consumption. The first plant was retired in November of that same year at the city of Stade.

Particularly comprehensive changes in the lignite industry have occurred in eastern Germany, where domestic lignite prevails over all other fuels for generating electrical power.

- Most lignite operations have been taken over by two foreign corporations, the Swedish state enterprise Vattenfall Europe AG and MIBRAG, owned by two American corporations through a Netherlands holding company, MIBRAG B.V.
- Advanced technologies have been employed to diminish environmental degradation and greenhouse gas emissions, but political compromises have inhibited further innovation.
- Lignite power production has risen despite continuing population decline.

After three eastern German lignite power stations were commissioned between 1997 and 2000, the federal government abandoned its self-imposed 25% carbon dioxide (CO₂) reduction goal for 2005 (referred to 1990). The less stringent Kyoto target of 21% must now only be attained by 2012 using a mixture of six greenhouse gases.

Crude lignite contains significant quantities of sulfur, inorganic impurities, and

over 50% residual groundwater, all of which detract from power plant efficiency. The remaining combustible portion consists largely of carbon. As a result of these two factors, about one kilogram of carbon dioxide is released into the atmosphere for each kilowatt-hour of electricity generated – nearly three times the amount produced by a combined-cycle gas turbine plant. While lignite accounts for 11% of primary energy consumption in Germany, it is responsible for 22% of the carbon dioxide produced.

Since 2000, German CO₂ emissions have stagnated at around 16% below 1990 levels. The three major mining companies – RWE Power AG (operating in the Rhineland), Vattenfall, and MIBRAG – now intend to increase lignite production in response to nuclear phase-out and rising power consumption. Half of the country's generating capacity must be substituted in western Germany within the next two decades, including all nuclear reactors and over 40,000 MW of ageing fossil fuel generating equipment. Vattenfall and MIBRAG have already announced the construction of additional lignite power plants in the east.

The Prognos AG research institute has estimated that lignite will be supplying 34% of all electrical power by 2040. The fulfillment of these expectations would make Germany less capable of meeting future climate protection obligations. New plants will be more efficient, so that the CO₂ emissions from lignite will be lower in proportion to power generation. However, even a long-term stabilization at present emission levels would constitute an unsustainable ecological burden. If a 70% to 80% CO₂ reduction were to be mandated by 2050 in accordance with the scientific evidence on global warming, then nearly all of Germany's emissions would emanate from lignite. That perspective is incompatible with the fuel requirements projected for industry, space heating, and transportation.

The German National Allocation Plan (NAP) precedent to EU emissions trading is dominated by concessions to the lignite industry. Vattenfall already announced its assurance of full CO₂ emissions allowances in August 2004, one month before the formal application procedure had begun. Lignite generating plants have largely precluded the use of combined heat and power (CHP) as a resource-efficient alternative.

Rather than reducing lignite consumption to enhance environmental integrity, liberal operating permits have been granted to the mining companies under the Federal Mining Act. This legislation traces its origins to two historic periods in which domestic energy supplies were regarded particularly vital to national security: the Third Reich and the international oil shortages of 1979–80. Over 300 communities have been destroyed by surface mining under its provisions.

Vattenfall devastated the traditional Sorb village of Horno near the Polish border in 2004, disregarding standards of ethnic inviolability and historic preservation that had supposedly been reinstated by German reunification. The company began pumping groundwater from beneath the nearby settlement of Lacoma in preparation for mining, even though this aquatic landscape is registered as an EU Flora-Fauna Habitat and as an Important Bird Area. MIBRAG has laid claim to the medieval village of Heuersdorf in Saxony, where lignite accounts for 85% of electrical power consumption. In the Rhineland, RWE intends to resettle 18 communities with nearly 8,000 inhabitants by 2045 for the Garzweiler II mine.

Despite ecological taxes and energy-conservation incentives, electrical power demand in Germany continues to rise by more than 1% annually. With total consumption approaching 600 TWh/year, the equivalent of one additional 800 MW generating plant operating 7,500 hours is required each year. Such “base-load” generation is ideally suited for lignite-fired steam boilers, which are designed for constant full-power service.

As a result, however, electricity from lignite is often sold below cost at night, over weekends and on holidays, when production greatly exceeds demand. Lignite power is then sometimes used as an inexpensive heat source for industrial

processes. Compared with onsite generation, several times the carbon dioxide (CO₂) emissions may be produced as a result. Surplus power is also fed to hydroelectric pump storage facilities for redistribution during periods of peak consumption. Although this practice is preferable to wasteful heating, more than one quarter of the lignite is effectively lost to pumping and to grid transmission.

Under present technological prerequisites, a number of strategies could be implemented or combined to comply with future climate production mandates.

The fossil-fuel alternative to nuclear or renewable power involves carbon capture and storage (CCS) using energy-intensive processes for liquefying carbon dioxide from power plant emissions. With sequestration in underground caverns or salt aquifers, the estimated costs of typically 50 euro per ton of CO₂ make dramatic price increases for lignite power appear inevitable. A ton of crude lignite produces about one ton of carbon dioxide when burned. Sequestration would therefore raise its effective market price considerably. At the same time, sequestration cannot be emulated by nations lacking the financial and/or geological resources available to Germany.

The first German CCS lignite plant may be fully operational only around 2025. The high energy expenditures required for compressing CO₂ from plant exhaust gases would necessitate even more lignite to be employed. The extensive groundwater depletion inherent to mining is already contributing to the transformation of Brandenburg into a steppe landscape, a process accelerated by global warming.

Wind power could supersede a great deal of conventional power generation. By the end of 2005, over 18,000 MW of land-based wind turbines will be in operation. However, six times this capacity would be required to equal the energy output of all nuclear reactors, assuming the present average wind utilization factor of 0.17. More productive offshore wind farms, predicted to attain maximally 25,000 MW by 2030, might provide up to one-third of the needed replacement power if generation and demand were closely matched. However, seasonal output fluctuations and the weak grid infrastructure of many coastal regions narrow the perspectives for offshore wind generation as a nuclear substitute, while it would deliver no net reduction of CO₂ emissions even if fully implemented.

Existing strategies may also be modified. RWE and Vattenfall have depicted the construction of new lignite power plants as an international model for the coal industry. Installing the same technology worldwide, it is claimed, would prevent the annual emission of 1.4 billion tons of CO₂ at a cost of less than 20 euro per ton. However, even greater reductions could be achieved by combining a variety of techniques for enhancing the net yield of available fuel resources. In many instances, other countries have taken the lead in their implementation.

1. Co-Firing of Low-Carbon or Biogenic Fuel. Several coal-fired power plants in Germany, Great Britain, Poland, and the USA already use agricultural biomass, sewage sludge, organic waste, or synthetic gas from industrial processes as a supplementary fuel. Since the proportionate net CO₂ emissions are nearly zero, the required investment costs might be compensated in the future by revenues from emissions trading.

2. Gasification. Lignite may be gasified to achieve an efficiency of 55%, compared with 43% exhibited by current best designs. In recent funding proposals submitted under the Clean Coal Power Initiative of the USA, fully 97% of the projects by value involved techniques of coal or lignite gasification.

3. Rankine Cycle. The surplus heat of combustion, which represents more than half the thermal energy of most lignite plants, can be employed to vaporize a highly volatile liquid such as ammonia or propane that in turn drives an additional generating turbine. The corresponding thermodynamic process, known as the Rankine cycle, is widely used in chemical factories to achieve improve-

ments in generating efficiency. The electricity produced by such techniques may qualify as green power, because no additional fuel is required for generation.

4. Load Management. Automated Meter Reading (AMR) allows time-of-use rates and real-time pricing to be implemented. The tariffs are raised during periods of highest power demand to motivate a reduction of consumption. In this manner, cost benefits are realized by both the grid operator and its customers.

5. Distributed Generation. A variety of integrated approaches are available or under development for providing semi-autonomous decentralized generation and automated control. Energy supply systems employing a combination of wind, solar, and biomass energy would significantly lower long-range transmission requirements.

None of these objectives has been pursued by the German power industry to the extent that modern technology would allow. CO₂ emissions trading may provide a financial impetus sufficient to overcome the impediments to effective climate protection strategies in this sector. The heedless use of lignite power only substantiates the observation of Albert Einstein that “serious problems cannot be dealt with at the level of thinking that created them”.

Non-governmental organizations (NGOs) have called for the reduction of lignite power capacities following nuclear phase-out. Lignite power generation materially contributes to deep-set socioeconomic and environmental changes that have become essentially irreversible, inasmuch as they exceed the resources available to prevent or correct them:

- Chronic deficiencies of employment perspectives in the mining regions.
- Hydrological imbalances, diminishment of rainfall, soil degradation, and steppification.
- Eradication of unique historic settings.
- Detachment from international efforts on energy resource diversification.
- Restricted transparency of public information and democratic participation.

These factors are of elemental concern to the future development of eastern Germany and Central Europe. It is imprudent and hence politically irresponsible to treat them as negligible or to expect that they will be benignly corrected by geophysical processes and human adaptability.

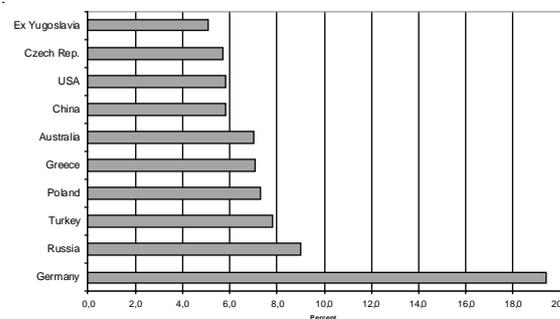
As irreplaceable natural resources are extracted from the Earth, alternative replacements must be derived from the financial proceeds of power generation for the use of future generations. If commercial corporations do not exercise this prerogative of their own volition, pluralistic democracies must institute appropriate measures by law in the interest of self-preservation.

1. Lignite Resources and Use

1.1. Worldwide Lignite Production

Lignite, a low-grade fossil fuel in geological transition from peat to coal,¹ is a major energy resource in many parts of the world. Its dull luster and earthy appearance are reflected in the common name “brown coal” (*Braunkohle* in German), expressing a lingering affinity with the prehistoric swamps and bogs of its origin. The current global mining output is nearly 900 million tons annually.² More than six trillion tons of lignite have been ascertained in the countries with the largest deposits: Russia, USA, Canada, Australia, and Germany.³ Depending on the prevailing prices for other fuels, several percent to as much as half these resources might be economically feasible to mine.⁴

However, it would be erroneous to assume that prospective energy shortages could be materially forestalled by using lignite. Even when annual mining output peaked in the 1980’s at over 1,200 million tons, lignite accounted for only about 3% of global commercial energy production.⁵ Nearly two thirds of all known resources lie in Rus-



sia and more than one quarter in the USA, but only a few locations in potential mining regions would be competitive with domestic hard coal owing to poor lignite quality or geological inaccessibility. Other countries, by contrast, are depleting their available reserves at a rapid pace. Germany, the world’s largest producer, will likely have expended all “minable” deposits by the end of the 22nd Century.

In comparison with deep shaft mining, lignite may be inexpensively extracted in open pits, or quarries (2.4). Since the shallowest deposits have largely been exhausted, however, increased costs and compounded ecological detriments appear inevitable to future lignite mining.

Global trade in lignite is essentially nonexistent, since its high water content makes long-distance transportation extremely costly, even within the countries of production themselves. Power stations are consequently built as close to the mines as possible. Lignite may also be processed to manufacture transportable fuel products such as cokes and motor fuel, but the production costs often exceed market value. In countries in which processed lignite fuels have been extensively employed, notably in Eastern Europe during the last century, high subsidies proved necessary to maintain the benefits of reduced import dependency.

1.2. Lignite in Germany

Lignite is the mainstay of electrical power generation at two of Germany’s largest energy corporations:

- RWE AG (*Rheinisch-Westfälische Energiewerke*), operating in the Rhineland, which is located in the western German state of North Rhine-Westphalia, and
- Vattenfall Europe AG in Berlin, serving the eastern German states of Berlin,

Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, and Thuringia, as well as the western state of Hamburg.

Total lignite mining output in Germany is approximately 180 million tons a year.⁶ This “brown gold” (*braunes Gold*) or “earth treasure” (*Bodenschatz*) can be extracted only after more than a billion cubic meters of groundwater and 900 million tons of soil and rock, termed “overburden” (*Abraum*), have been removed from the quarries. The average ratio of groundwater and overburden to lignite continues to increase as deeper deposits are mined.

About 100 million tons of lignite are used annually by RWE and 70 million tons by Vattenfall for electrical power generation. The remaining quantities are employed by other power companies, certain municipal utilities, chemical, cement, and sugar factories, and for manufacturing briquettes used in domestic heating ovens.

Lignite has been excavated on an industrial scale since the 19th Century in the eastern German regions of Lusatia (*Lausitz*), which encompasses parts of Brandenburg and Saxony, and in Middle Germany (*Mitteldeutschland*),⁷ lying southwest of Berlin in Saxony and Saxony-Anhalt. Before 1990, the German Democratic Republic (GDR), Marxist East Germany, was the world’s largest lignite producer, accounting for one-fourth of global mining output at over 300 million tons per year. Germany’s third and largest geological deposits are located in the Rhineland near the border to the Netherlands.⁸ With geological deposits of 13 billion tons in Lusatia, 10 billion tons in Middle Germany, and 55 billion tons in the Rhineland, lignite constitutes a hypothetical energy source for several hundred years to come.⁹ Yet only 40 billion tons are considered feasible to mine, allowing the current level of lignite production to be maintained for about two centuries. Scattered resources west of Middle Germany, in Helmstedt and Hessa, have largely been depleted. In Bavaria to the south, the last lignite power plant at Schwandorf ultimately employed lignite delivered from the Czech Republic before being retired from service.



Lignite is mined in Lusatia by Vattenfall and in the Rhineland by RWE. Mining operations in Middle Germany are conducted by a third corporation, the Mitteldeutsche Braunkohlengesellschaft mbH (MIBRAG).

Lignite is also mined for local power plants in neighboring regions of Poland and in Northern Bohemia, the mountainous region of the Czech Republic that lies between Bavaria and Saxony. Czech lignite is of particularly poor quality owing to a high degree of inorganic impurities (termed ash, or *Asche*) and elemental sulfur (S). Excessive airborne contaminants are produced by the combustion of all grades of crude lignite. The tri-state region of Poland, the former Czechoslovakia, and present-day Saxony was aptly known as the “Black Triangle” until power plants and factories were retrofitted with pollution control devices in the 1990’s.

The Federal Republic of Germany formed an Environmental Union (*Umweltunion*) with the GDR in May 1990, five months before the formal act of national reunification. Thereafter, all thermal combustion equipment in east and west that was refurbished or newly commissioned was obliged to comply with identical provisions of the Federal Immissions Protection Act (*BImSchG Bundes-Immissionsschutzgesetz*) governing air quality.¹⁰ Any subsequent reduction of

noxious sulfur dioxide (SO₂) and nitrous oxide (NO_x) emissions could not qualify as an “early action”, since voluntary compliance was no longer an option for plant operators. Power stations incapable of meeting the requirements were allowed to continue operation for a transition period that generally ended in 1996.¹¹

1.3. Perspectives for Lignite Deployment in Power Generation

Currently 92% of German mined lignite tonnage is employed for grid power generation.¹² In 2003, lignite accounted for 26.6% of national electricity production, ranking second only to nuclear power (27.6%).¹³ Although production has declined significantly since 1990, lignite remains by far the most important fuel for stationary applications in eastern Germany. The world’s three largest lignite generating plants (termed *Blocks* in German) are located in the state of Saxony, two at Lippendorf and one at Boxberg. Lignite covers 85% of electrical power consumption in Saxony,¹⁴ over three times the national average.

Lignite is poised to become the dominant source of electrical power in Germany as a whole. The construction of new nuclear power plants was prohibited in 2002, while the country’s existing 19 reactors were required to be shut down within two decades.¹⁵ In a study prepared for the German lignite mining industry association DEBRIV, the Prognos AG research institute has estimated that lignite will be supplying 34% of all electrical power by 2040.¹⁶ Due to efficiency improvements in newly constructed generating plants, the current levels of lignite production could prove adequate to fulfilling this goal. To insure long-term supplies, however, Vattenfall is considering the expansion of existing mining operations near the city of Cottbus.¹⁷ MIBRAG is conducting explorations at two new locations near Lübtheen in the state of Mecklenburg-Western Pomerania and Staßfurt in Saxony-Anhalt.¹⁸

It appears highly improbable that non-fossil energy sources, including offshore wind power, would be able to compensate for the generating capacities required by nuclear phase-out. Wind energy now delivers more power than hydroelectric installations, yet the national wind association Bundesverband Windenergie (BWE) foresees an ultimate increase to only 15% of total power generation.¹⁹ This prospect, together with rising prices for natural gas and imported hard coal, the overheating of atomic power plants during excessively hot summer periods, and the myriad dangers inherent to the nuclear fuel chain will reinforce the stature of lignite power generation.

2. Lignite Characteristics

2.1. Definition

The characteristics of commercially extracted lignite vary significantly in relation to the conditions of its geological formation as well as to the competitive status of other available energy sources, which ultimately determine the grades of lignite that are viable to be mined. In general, lignite is any variety of coal that contains:

- less than 70% water (thereby distinguishing it from peat),
- when dried and removed of impurities, a calorific value (*Heizwert* or *Verbrennungswärme*) greater than 24,000 kilojoules²⁰ per kilogram (kJ/kg),²¹ and
- less than 73.5% carbon but more than 50% volatile matter (carbon and hydrogen) for combustion.²²

These properties place lignite between peat and bituminous coal on the energy scale of fossil fuels. The German designation for domestic grades of lignite is brown coal (*Braunkohle*), while more rudimentary forms (found chiefly in the USA) that include only partially decomposed plant matter are called *Lignit*.

The lignite mined in Germany is likewise of comparably recent geological origin. It is designated “soft brown coal” (*Weichbraunkohle*) to distinguish it from older hard lignite that contains appreciable quantities (up to 42%) of inorganic impurities and a comparatively low water content of 20-30%.²³ This *Hartbraunkohle* is graded either as *Mattbraunkohle*, dull brown coal, or as *Glanzbraunkohle*, which exhibits a shiny appearance owing to its close affinity with hard coal. Hard lignite dominates in the Northern Bohemian mining ranges of the Czech Republic, in the Moscow Basin of Russia, and in Montana and North Dakota near the border of the United States to Canada.²⁴ On a global scale, it is the most common and commercially most important grade of lignite.

2.2. Quality Parameters

Crude (or raw) lignite delivers the lowest heating energy of any industrially used fuel. The calorific value is only about two-thirds that of wood. An equivalent mass of hard coal provides three times and oil four times the thermal energy. The following table summarizes the quality parameters of lignite in the three most important German mining regions.

The presence of water and numerous impurities contributes to the low calorific value of lignite in natural formations, which have not been subjected to the tectonic pressures and elevated temperatures necessary for the geochemical production of hard coal.

CRUDE LIGNITE QUALITY PARAMETERS ²⁵					
REGION	Calorific value	Ash	Water	Sulfur	Accessibility
	kJ/kg	%	%	%	Overburden / Lignite
LUSATIA	7,840 - 9,000	4.0 - 12.6	52 - 60	0.3 - 1.1	6.4 : 1
MIDDLE GERMANY	9,000 - 11,500	6.5 - 8.5	48 - 55	1.2 - 2.1	2.6 : 1
RHINELAND	7,800 - 10,500	1.5- 8.0	50 - 60	0.15 - 0.5	4.9 : 1

The sulfur content of the lignite found in Middle Germany is more than twice as high as that mined in Lusatia and several times the grades excavated in the Rhineland. Middle German lignite also contains appreciable quantities of sand (predominately silicon dioxide, SiO_2) and other inorganic matter. Higher expenditures are therefore required for desulfurization (DeSOx) scrubbers and precipitation filters to remove sulfur dioxide and ash particles from the flue gases. This sulfurous lignite may prove extremely corrosive to boiler components. On the other hand, the calorific value of Middle German lignite is unsurpassed. Furthermore, far less overburden must be removed prior to lignite extraction, thereby reducing equipment and personnel costs.

The negligible hydrogen content of lignite results in a lower firing temperature (typically $1,100^\circ\text{C}$) compared with other fossil-fuel power plants. Since significant quantities of the main nitrous oxide pollutant NO are produced only above $1,300^\circ\text{C}$,²⁵ proper control of the combustion characteristics precludes the requirement for subsequent denitrification (DeNOx) emission filters. The air required for combustion may be fed into the firebox in controlled stages to restrict the supply of oxygen (O) that would otherwise contribute to forming nitrous oxide compounds (NO_x). While the absence of NO_x pollutants constitutes a definite operational advantage in comparison with other fuels, the reduced temperature of combustion results in a lower efficiency than power plants fired with hard coal, gas, or fuel oil.

2.3. The Fuel of Many Hurdles

Lignite exhibits a number of physical properties that challenge its application in power generation.

1. Inhomogeneous quality. Originating in recent geological periods, crude lignite often retains marked characteristics of the prehistoric forests and marshes from which it has evolved. Large tree trunks and even mastodon skeletons have occasionally been unearthed during mining. The lignite may exhibit a shaggy appearance and contain visible remnants of ancient plant matter or wood, for which it has earned the derogatory name “potting soil” (*Blumenerde*). Weeds are occasionally seen sprouting on forgotten piles of lignite. The calorific value at different locations in a mine varies significantly, requiring various grades to be mixed to maintain the quality parameters required by the power plant being served.

2. Excessive water content. Before strip mining commences, a concentric array of wells is drilled around the mine to sink the groundwater level below the lowest lignite seam. Even after this draining procedure, about half the mass of the extracted lignite consists of residual groundwater. When freighted to distant locations, the wet lignite may freeze in unheated hopper cars during the winter months. Jet airplane engines are then sometimes used to warm the hopper walls before unloading. Dripping wet lignite is sarcastically called “gelatin dessert” (*Götterspeise*) by eastern German railroad workers. Piles of damp lignite are prone to spontaneous combustion due to their high compacting pressure. To avoid the danger of self-ignition, crude lignite is not be bunkered at power stations for any extended period. Whenever possible, the generating plants are erected in close proximity to the quarries that serve them to allow continuous lignite deliveries directly from the mine face.

3. High processing energy. To make lignite transportable and even exportable, lignite can be pressed into briquettes about the size of a cobblestone. This reduces its water content to 10–12% and doubles the calorific value of the fuel. However, a great deal of energy is required to manufacture briquettes, making them more expensive than imported coal. Highly subsidized briquettes were the main source of domestic heating throughout many parts of Eastern Europe until superceded by natural gas and heating oil in the 1990’s.

4. Expansive fuel volume. Since crude lignite delivers only one-third the heat

of an equivalent quantity of coal or gas, lignite power plants must handle enormous quantities of fuel. Generating 1000 kWh of electrical power consumes nearly a ton of lignite. A modern 920 MW base load power station typically requires 730 tons per hour,²⁶ or between five and six million tons annually for continuous operation. Using this voluminous fuel requires larger and consequently more expensive steam generating equipment. The cost of the 980 MW Schkopau power plant was originally projected at 2.1 billion deutschmarks for firing imported hard coal. When the decision was made in 1991 to employ domestic lignite instead, however, additional investments of 600 million marks were necessary for equipping the plant with appropriate boilers.²⁷

5. Excessive Greenhouse Gas Emissions. Undried crude lignite contains 24–32% pure carbon (C)²⁸ but less than 3% hydrogen (H). The greenhouse gas carbon dioxide (CO₂) is thus the primary gaseous product of combustion. As a rule, burning one ton of crude lignite emits about one ton of carbon dioxide, since the molecular weight ratio of C to CO₂ is 12 to 44, or 27% of 100. The combustion of lignite produces at least twice as much CO₂ per Megajoule than natural gas, 20% more than hard coal, and over 40% more than heating oil. This disadvantage may be offset to a certain degree by the unchecked emission of methane from natural gas or coal installations, resulting in 21 times the specific global warming potential of CO₂.

6. High sulfur content. Sulfur constituents of both organic and mineral origin (FeS₂) are transformed into sulfur dioxide as well as into small quantities of sulfur trioxide (SO₃) during combustion. The sulfur content of lignite ranges from several tenths of a percent in Lusatia and the Rhineland to over 2% at some locations in Middle Germany. In the GDR, 5.34 million tons of sulfur dioxide were emitted in 1985 from power plants, furnaces and ovens.²⁹ Extensive forest damage and soil acidification resulted both from gaseous permeation and from sulfuric acid (H₂SO₄) contained in precipitation. To mitigate these effects, power plants are now fitted with flue gas desulfurization (DeSOx) scrubbers (*Rauchgasentschwefelungsanlagen*, or *REA*). In the most widely used processes, the calcium in an aqueous limestone (CaCO₃) or calcium oxide (CaO) solution reacts with sulfur contained in the gas. The resulting product is calcium sulfate hemihydrate (CaSO₄) combined with water, or calcium sulfate dihydrate (CaSO₄•2H₂O) that is commonly known as gypsum (*Gips*).³⁰ The Lippendorf power station requires 50 tons of limestone per hour, thereby delivering 140 tons of gypsum, due to the exceptionally high sulfur content (1.86%) of the Middle German lignite at that location.³¹ The four Vattenfall lignite power stations produce 3.5 million tons of DeSOx gypsum (*REA-Gips*) annually, nearly half of the total in Germany (7.5 million tons). The plant operating permits stipulate the use of this material for plaster wallboard (sheetrock) production.³² According to the Law on Material Recycling and Refuse Disposal (*Kreislaufwirtschafts- und Abfallgesetz*), waste products must be employed as an input substance for some subsequent process if technically and economically feasible.³³ Due to continuing high unemployment in eastern Germany, however, reduced housing construction has diminished the need for building materials. Vattenfall presently deposits as much as half of the gypsum it produces in former quarries around the plants, while over 100 thousand tons yearly from its Jänschwalde power station are shipped overseas via the city of Stralsund on the Baltic Sea.³⁴ At the Lippendorf facility, the semi-permanent storage of DeSOx gypsum has been licensed by the Leipzig district administrative authority (*Regierungspräsidium Leipzig*) in apparent contradiction to the operating permit. A similar infraction has been determined around the Schkopau facility using aerial photographs. The legality of continued storage may be investigated within the scope of the environmental impact assessments recently ordered for the mines serving the plants. A greater market could be created for DeSOx gypsum if it were offered at sufficiently low cost. Despite the surplus of this product, natural gypsum continues to be mined in the Harz Mountains,³⁵ where various ecologically

sensitive areas are listed by the European Commission as Flora-Fauna Habitats (FFH).³⁶

7. Foreign Substances. When burned, the ash residue of eastern German lignite contains 20–65% SiO₂ (common sand) and 4–27% Al₂O₃ (corundum), as well as 4–25% Fe₂O₃, 2.5–22% CaO, 0.5–4.5% MgO, 2.5–30% SO₃,³⁷ and traces of toxic metals. Flue gas ash abrasion may make frequent equipment overhauls necessary. Crude lignite sometimes contains substances that are generally unsuspected in fossil fuel. The most unusual case is that of amber (*Bernstein*, C₄₀H₆₄O₄) extracted at the former Goitzsche mine near Bitterfeld. High concentrations of salt from prehistoric oceans are found in inferior grades of lignite that were often used in the GDR for domestic heating applications. This *Salzkohle* burns poorly and deposits salt residues in chimneys, impairing the oven draft and promoting masonry deterioration.

8. Potential Health Hazards. It is not uncommon for communities surrounding lignite surface mines to be blanketed for hours by airborne dust during dry, windy periods. In addition to acidic irritants, all lignite deposits contain traces of toxic metals such as arsenic (As), cadmium (Cd), lead (Pb), mercury (Hg), and uranium (U) that add up to many tons of potentially hazardous aerosol substances during the duration of mining activities. The responsible Federal Office for Radiation Protection (*Bundesamt für Strahlenschutz*) maintains that lignite in Germany exhibits an average activity of 200 Becquerel (Bq) per kilogram for Uranium 238, which is the upper limit for natural radioactivity in the ground.³⁸ In North Rhine-Westphalia (NRW), however, the BUND (Friends of the Earth) environmental organization has determined particularly high concentrations of microparticulate matter (PM10) in the vicinity of lignite mines that may be agents for the transport and inhalation of Radon 222.³⁹ Once lodged in the lung tissues, radioactive decay products ranging from Polonium 218 to Bismuth 214 would be produced over an extended period of time. Apart from the issue of radioactivity, these investigations indicate that the recurrently high microparticle concentrations around certain mines may constitute a greater health risk than hitherto acknowledged. Alerted by the BUND findings, the NRW state environmental ministry has established additional monitoring stations to measure airborne particle concentrations.

A further impediment to lignite use is the location of many deposits beneath established communities, which must be resettled to enable unimpeded surface mining (2.5 & 5).

2.4. Lignite Extraction

The organic material from which lignite was formed originated in tropical forests, swamps, and marshlands 12 to 65 million years ago. The plant matter was compressed into peat bogs that were subsequently covered by prehistoric oceans, creating the anaerobic environment necessary for metamorphosis to lignite. Because of this comparatively recent geological history, brown coal is generally found less than half a kilometer below the surface of the ground. The extraction technique is variously termed strip, surface, pit, quarry, opencast, or open-face mining. In German, any such mine is called a *Tagebau*, which could be translated as a daylight excavation pit.

Before extraction can begin, all places of human habitation are vacated by mutual agreement, persuasion and enticements, court orders, or finally police force in the case of entirely recalcitrant inhabitants, presuming that all legal means of preserving the area have been exhausted. The buildings are then broken apart by the mining company using construction machinery. Only occasionally are architecturally notable edifices disassembled and erected at another location. Archeologists scour the landscape and dig below the foundations of churches and other venerable buildings for traces of earlier settlements. For this reason, the mining regions are among the most meticulously documented archeological

sites in Germany. Yet even discoveries of immeasurable historic importance, such as Roman Villas in the Rhineland or Stone Age settlements in Middle Germany, do not change mining plans.

A circuit of pumps removes the groundwater from the mining site to enable dry-pit excavation. Most mines contain two or more seams of lignite ranging from five to 100 meters thick.⁴⁰ Having originated during different geological periods, they are separated by strata of sand, clay, or hard minerals. All soil material in the overlying layer (*Deckschicht*) and between the seams is collectively termed “overburden” (*Abraum*). In mines with deep-lying lignite formations, the production volume depends critically on the rate at which overburden can be removed. Bucket-wheel excavators (*Schaufelradbagger*) carve into the mine face and transfer the overburden into former mining areas several hundred meters to the rear by either a conveyor bridge (*Förderbrücke*) or belt for subsequent landscape recultivation. The largest conveyor bridge in the GDR, the *Abraumförderbrücke* AFB-60, weighed as much as 14,000 tons and was capable of removing soil layers up to 60 meters thick.⁴¹

The excavation area effectively migrates through the landscape. After overburden removal, bucket-brigade excavators (*Eimerkettenbagger*) scrape away the lignite from the seams. Different grades of mined lignite are combined at a mixing area (*Mischplatz*) to meet specified quality requirements before being transported to the power plant via conveyor belt.

Since a high percentage of subterranean material has been removed in the form of lignite, some quarry areas remain empty until used as repositories for power plant ash or gypsum. Alternatively, groundwater may be pumped in from other mines to create lakes for recreational purposes.

The areas of redistributed overburden (*Abraumhalden*, or “spoil surfaces” in international mining terminology) are characterized by random soil constituency and the disruption of former aquifers. If not dedicated to low-yield agriculture, forestry, or grazing, they may evolve into refuges for wildlife. Buildings and roads can be constructed on these surfaces once the soil has settled, a process usually requiring several decades. The groundwater that rises after the cessation of pumping often destabilizes building foundations in surrounding communities. Flooded cellars and broken sewer mains are among the collateral damages commonly experienced near former mines.

Due to the low thermal value of lignite, an enormous mass of material must be excavated for supplying a sufficient quantity of combustible material to any power plant. To the mind’s eye, a lignite mine resembles an inverted Egyptian pyramid built of antimatter. Appropriate to this analogy, the German lignite industry excavates the equivalent of 15 times the original Suez Canal each year, which was completed in 1869 after more than a decade of labor.⁴² A gala performance of Giuseppe Verdi’s *Aida* could thus be performed every twenty-five days to commemorate the epic proportions of this earthmoving task.

The gargantuan dimensions of German surface mining are epitomized by the Hambach quarry in the Rhineland, operated by RWE as “the biggest (manmade) hole in the world”.⁴³ The 2.3 billion tons of lignite in this area are located in deposits up to 450 meters deep. Eight 13,000-ton bucket-wheel excavators are employed, each 220 meters long, 87 meters high, and hence as tall as a 30-story office building. Excavation requires the devastation of 85 square kilometers of landscape, including the Hambach Forest with many rare plant and animal species.⁴⁴ Only 15 of the original 40 wooded square kilometers have not yet been eliminated. Mining involves draining 45 billion cubic meters of groundwater and resettling 5,200 local inhabitants. The lignite is extracted for the 3,864 MW Niederaußem power station, Germany’s largest single source of greenhouse gases that emits 30 million tons of carbon dioxide per year.

2.5. Devastation and Resettlement

Surface mining alters landscape topography and displaces or annihilates every vestige of indigenous human culture. The available statistics on the total number of German villages destroyed by lignite excavation are scattered and incomplete, since there is no official agency commissioned to compile them. The environmental organization Green League (*Grüne Liga*) has counted 78 lost communities and over 25,000 resettled people in the primary Lusatian mining regions between Cottbus and Dresden.⁴⁵ The Sorb cultural society *Domowina* estimates that a total of 123 villages, settlements, and farming estates (*Gehöfte*) have disappeared in all Lusatian territories since 1924. Of this number, 71 community relocations and the displacement of 22,000 inhabitants occurred during the “proletarian dictatorship” (*Diktatur des Proletariats*) of the GDR.⁴⁶

It is impossible to determine how many people may have additionally left these regions after private farms had been collectivized in the 1950's, or whenever an area was consigned to lignite mining. 2,686,942 people, more than one-seventh of the eastern German population, emigrated or fled to the west before the last border crossing points were closed in Berlin on August 13, 1961.⁴⁷ In addition, however, strong migratory currents prevailed within the GDR. Many inhabitants were wartime refugees from present-day Poland who had no traditional ties to any one region.

The lignite industry itself provided employment opportunities for many of those forced to abandon their homesteads. In the present day, by contrast, the mines and power plants are highly automated operations requiring comparatively few workers (2.6).

In Middle Germany, mining has destroyed 120 communities and displaced an estimated 47,000 individuals,⁴⁸ although the actual figure may be higher due to factors identified above. In the region south of Leipzig alone, 66 villages or parts thereof have been devastated since 1924, necessitating the resettlement of more than 23,000 inhabitants.⁴⁹

On a positive note, many resettled individuals gladly exchanged the tedium of socialistic rural life for the conveniences of urban settlements that included shopping centers, schools, sport facilities, restaurants, cultural centers, and medical services. These apartment complexes of prefabricated concrete panels (*Plattenbausiedlungen*) were sometimes deprecated as “retort settlements” (*Retortensiedlungen*), “worker storage lockers” (*Arbeiterschließfächer*), “residential silos” (*Wohnsilos*), or “vertical slums”. Since cooking gas and steam from local power plants were piped in, however, residents were spared the otherwise common drudgery of hauling several tons of briquettes each year into their living quarters for cooking and heating. The rationally planned suburbs in the GDR and other Eastern European countries were scarcely picturesque, but they established cost-effective standards of comfort and convenience that have seldom been surpassed.

In the Rhineland, the German section of Friends of the Earth (*Bund für Umwelt und Naturschutz Deutschland*, or *BUND*) has identified over 50 villages devastated before 1985, with 30,000 persons resettled.⁵⁰ RWE intends to resettle 18 additional communities with nearly 8,000 inhabitants for the Garzweiler II mine by 2045.⁵¹

On the basis of published figures, a total of more than 300 communities have already been destroyed and well over 100,000 people displaced by German lignite mining. While these encroachments cannot be undone, the extensive lignite deposits in uninhabited areas and the ecologically favorable alternative of generating electricity using wind power and biomass make it questionable to resettle any additional communities against the will of the inhabitants.

However, this policy would challenge not only established planning practices but also the vocational attitudes that have prevailed among miners presumably

since the Bronze Age. Finite resources of coal and mineral deposits are considered expendable for sustaining the mining guild, whose tradition of self-confident rationalization has been captured in a slogan that resounds throughout the industry: “I am a miner. Who is more?” (*Ich bin Bergmann. Wer ist mehr?*). This robust profession is outfitted with suitable artifacts of masculine sensual gratification, from churning machinery and billowing smokestacks to the violent disfigurement of landscape that is reminiscent of World War I battlefields.⁵² The unconstrained virility implicit to penetrating the bowels of the Earth was captured by Friedrich von Hardenberg in his “Song of the Miner” (*Bergmanslied*) in 1802: A miner, the “Lord of the Earth” (*Herr der Erde*), becomes passionately enflamed in the depths of the mine, as if that were his bride (*Und wird von ihr entzündet, als wär sie seine Braut*).

On December 4th, the feast day of the miners’ patron St. Barbara, votive candles were formerly lit in the mining shafts. The branch of a fruit tree would be cut and placed in a glass of water in the pious expectation that a Christmas bloom promised good fortune. In German mining districts, these commemorations have since been secularized and transferred to expansive festival halls. Prominent politicians, sometimes including the presiding minister (*Ministerpräsident*) of the respective state or the reigning chancellor (*Kanzler*) himself, are invited to an evening of speeches, dining, self-fortification, and cajolery, and to accept the title of an honorary miner (*Ehrenbergmann*) conferred in recognition of government support of the industry. In appreciation of the high voter potential behind such awards, elected public officials invariably submit to industry demands for the continued destruction of villages to enhance mining output (5). The required legislation may be passed under a rule of internal compulsion (*Fraktionszwang*) intended to prevent any assemblyman from voting against majority will of his party.⁵³

2.6. The “Mining Curse”

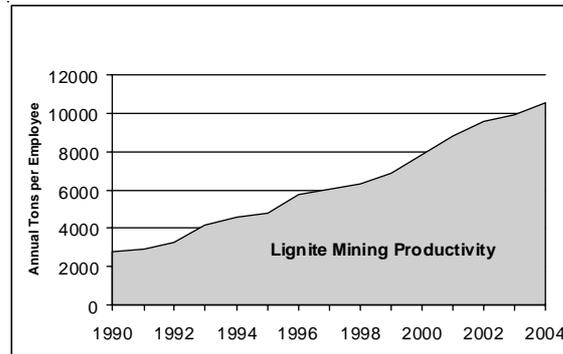
In earlier centuries, a number of historically decisive innovations emerged to enhance the efficiency and safety of mining operations. As indicated in the following table, however, mining no longer provides any scientific or economic impetus commensurate with the environmental and societal detriments it imposes.

Various international assessments have likewise demonstrated that extractive industries (mining as well as non-reproductive forms of forestry, agriculture, fishing, and trapping) provide rapid economic growth but countervail its permanence.⁵⁴ One of the most prominent investigators in this field, Prof. Thomas Michael Power of the University of Montana, has aptly noted: “The concept of

Decline of Mining Benefits		
	Historically	Present and Future
Crucial Innovations	Standardized coinage, tunnel engineering, pump technology, steam engine, Stirling motor, fuel cell, wire-gauze safety lamp, power shovel, platinum catalytic converter for motor vehicles	Spoil surface reclamation, fossil fuel optimization
Economic Contribution	Essential to the industrial revolution	Declining percentage of gross national product
Employment	Extensive occupational perspectives for rural populations	Above-average jobless rates in mining regions
Energy Supply	Fossil fuels as an enduring substitute for wood	Predicted exhaustion of geological reserves
Environmental Status	Renewed growth of deforested regions in the Coal Age	Global climate change
Resource Necessity	Indispensability of domestically mined products to manufacturing	Alternatives provided by global trade, chemical synthesis, recycling, renewable energy

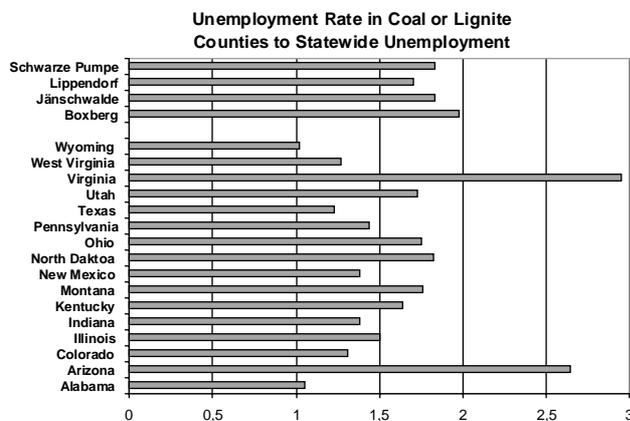
the ‘ghost town’ entered American parlance because of the short-term character of much of the mining development.”⁵⁵

Because of improved mining efficiency, regional demographic erosion may emerge even before natural resources have been exhausted. This development is particularly apparent in eastern Germany, where lignite mining productivity has increased fourfold since 1990, while total tonnage declined during the same period by over two-thirds. The



corporate mining divisions in the east now employ less than 9,000 people, compared with nearly 140 thousand in the late 1980's.⁵⁶ The surrounding communities that once supported burgeoning working populations have become retirement settlements for housing, nursing, and ultimately interring the last full generation of mining pensioners. Although spared a classical ghost town destiny by the continuation of social services, they have already become phantoms of their former selves.

Technological innovation, improved operational efficiency, and worker safety programs have contributed to reducing the number of people required on mining payrolls. The opportunities for alternative regional development are curtailed by the preemptive dedication of land resources to extractive industries. In consequence, high local unemployment prevails as an invariable side effect of mechanized mining practices throughout the world, from Germany through the United States of America to Australia.



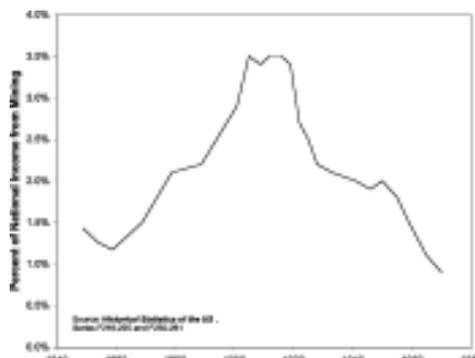
In the US coal industry, for instance, mining counties exhibit above-average unemployment rates (which would lie below a ratio of 1 on the graph). In eastern Germany, the four regions that host Vattenfall lignite power plants⁵⁷ have likewise been stricken by a “mining curse” with jobless rates significantly higher than in other re-

gions, including those in which lignite was formerly produced.

A considerable decline in employment opportunities ensued throughout eastern Germany in the 1990's, as lean production superseded inefficient factory combines. Many regions have adapted to this transition using strategies of diversification. However, broad-based vocational profiles are largely incompatible with rationalized mining and power plant operations.

Despite the proverbial “energy hunger” of established industrial countries, the contribution of mining output to national income invariably diminishes as material wealth accumulates. This tendency has been well documented the USA, as indicated by the curve on the following page.⁵⁸ The service sector dominates many areas of the North American economy.

In eastern Germany, by contrast, five of the ten largest companies produce, import, and/or distribute energy products.⁵⁹ As the only company among these



corporations with local resource extraction operations, Vattenfall benefits from the lack of alternative investment in the very devastated landscapes it propagates. The low property values intrinsic to these regions reduce the costs of mine land acquisition, compensation for the resettlement of communities, and mining reclamation.

2.6.1. Lignite Industry Employment in Eastern Germany

In June 2004, Vattenfall Europe Mining & Generation AG & Co. KG had 8,490 employees,⁶⁰ comprising approximately half of the Vattenfall Europe organization. This number included 704 apprentices, a reflection of the high retirement rate in the industry. A reduction to 7,860 employees by the end of 2006 has been announced. The mining division at Vattenfall had 5,015 regular workers and 375 apprentices on its payroll at the end of 2003, leaving a workforce of about three thousand⁶¹ at power stations and other generating facilities such as pumped storage plants.

The MIBRAG mining corporation listed 2,148 employees in March 2004, including 130 apprentices.⁶² In contrast to Vattenfall and other energy utilities, MIBRAG has been able to expand its staff incrementally by diversifying its commercial activities, which include consulting services to other companies.

ROMONTA GmbH, a manufacturer of lignite wax (*Montanwachs*) for industrial and consumer products in Amsdorf north of the city of Halle, listed 357 employees, including 33 apprentices, at the end of 2003.⁶³ In that year, 529,500 tons of the special grade of lignite found at this location (and 5.14 million tons of overburden) were excavated, less than 3% of total mining output in Middle Germany.

Apart from lignite mining and electrical power generation, the mine land reclamation corporation LMBV (*Lausitzer und Mitteldeutsche Bergbau-Verwaltungsgesellschaft mbH*) has 800 regular employees and 200 apprentices.⁶⁴ The company was founded by the federal government in 1992 for the reclamation of 32 lignite mines in eastern Germany that ceased operation after reunification.

The number of indirect jobs ascribable to subcontractors and service companies is open to speculation. The estimates included in the following table are based on public statements made in support of the eastern German lignite industry, supplemented by data from the industry association *Statistik der Kohlenwirtschaft* in Cologne. All figures refer to the end of 2003, except for data on MIBRAG and

Estimated Lignite Industry Employment in Eastern Germany, 2003/2004				
	Direct			Indirect
	Regular	Apprentices	Total	Subcontractors
Vattenfall Mining	5,015	375	5,390	3,142
Vattenfall Generation	2,771	329	3,100	1,807
MIBRAG	2,018	130	2,148	1,252
ROMONTA	324	33	357	208
Other			1,639	955
Subtotal Production	10,128	867	12,634	7,364
LMBV	800	200	1,000	5,000
Totals Direct/Indirect	10,928	1,067	13,634	12,364
Total Employment				25,998

Vattenfall Generation issued for the first half of 2004. The subcontractors designated for Vattenfall and for ROMONTA have been extrapolated from figures supplied the economics ministry of Saxony for MIBRAG operations.⁶⁵ LMBV publications assume 5,000 indirect places of employment associated with its reclamation activities.

As indicated, less than 13,000 persons are directly employed in eastern German lignite mining and power production. Somewhat more than 7,000 additional places of employment may be related to the industry. Reclamation bolsters this figure significantly due to the many labor-intensive activities involved. However, over four-fifths of the reclamation projects financed by the federal government have already been completed,⁶⁶ so that activities in this sector will be declining significantly in the future.

Excluding reclamation, the total employment ascribable to the eastern German lignite industry may be estimated not to exceed 20,000. This figure does not include lignite users or distributors such as briquette dealers.

2.6.2. Unfulfilled Employment Promises

It is instructive to compare current employment levels in eastern Germany with the projections originally made for the continuation of lignite power production. In 1992, the presiding minister of Saxony-Anhalt, Werner Münch, justified the use of lignite at the Schkopau power station in order to guarantee “10,000 permanent jobs”.⁶⁷

In the following year, the Energy Program of Saxony estimated that 6,800 places of employment would be maintained by the MIBRAG mining corporation⁶⁸ to serve both Schkopau and Lippendorf, the second large power station intended for construction in Middle Germany. At Lippendorf alone, “2,500 jobs in mining and in the power station (including maintenance)” were predicted along with 8,000 additional jobs “in subsidiary industry, in the service sector, etc.” Combining these prognoses, well over 15,000 places of steady employment were promised once the two power stations had been completed.

By contrast, fewer people are employed today by the entire lignite power industry in eastern Germany than were originally projected for these two projects alone. Vattenfall Mining has only 2,015 professional miners on its payroll,⁶⁹ while the remainder of the workforce is engaged in administration, technical services, consulting, and sales. Applying this same proportion to all other operations, less than 3,300 actual miners would appear to be in the employ of Vattenfall, MIBRAG, LMBV, and ROMONTA.

Thomas Michael Power has observed that mining companies “offer communities a prize that is very difficult to refuse: family-wage jobs that support blue collar access to a middle class lifestyle”.⁷⁰ However, this enhancement of occupational status is enjoyed only by a very small segment of the population. The net benefits are neutralized by the overall increase of regional unemployment.

For instance, 320 people are employed at the Lippendorf power station,⁷¹ which is operated by Vattenfall a few kilometers south of Leipzig. A figure of 380 workers has been quoted in newspaper reports for the adjacent MIBRAG United Schleenhain mine.⁷² By contrast, 8,982 jobless persons were registered by the local federal employment agency⁷³ for the month of March 2004, constituting an unemployment rate of 24.3%.⁷⁴ The table on next page summarizes the hypothetical prospect of reducing this figure to the average percentage in Saxony or to that of Germany as a whole by eliminating the lignite industry from the region entirely.

As shown, the places of employment provided by Vattenfall and MIBRAG at Lippendorf would be greatly surpassed if regional development were merely comparable with other parts of Saxony (1,702 additional jobs) or with Germany as a whole (4,475 jobs).

Potential for Improving Employment in the Lippendorf Region (Spring 2004)				
Employees at the Lippendorf Power Station and Schleenhain Mine				700
	Jobless rate	Number of jobless	Potential Reduction	Potential Improvement
Lippendorf Region	24.3%	8,982		
Saxony	17.8%	6,579	2,402	1,702
Germany	10.3%	3,807	5,175	4,475

Unemployment continues to rise while job opportunities decline. In March 2004, a statistical average of 77 unemployed persons was registered for each job opening posted around Lippendorf. By November, this figure had risen to 109.⁷⁵ The local director of the federal employment agency, Judith Röske, noted at the end of the year that there had been “no increase in employment” in the region during 2004.⁷⁶ County commissioner Petra Köpping complained of “a great deficit of intellectual potential” that was preventing new companies from being founded by people from “the class of intelligence” (*Schicht der Intelligenz*). This verdict confirms the deficiency of innovative aspirations in economies dominated by mechanized surface mining and highly rationalized power plants under foreign ownership.

Such economically depressed regions in effect constitute a “lignite platform” (4) analogous to oil and gas rigs in the North Sea. Under the “lighthouse policy” (*Leuchtturmpolitik*) of regional development pursued in the new German states, financial and civil administrative resources are channeled into large-scale projects. In many instances, only diffuse synergy mechanisms remain for promoting small businesses.

Other countries such as India are likewise streamlining licensing procedures in order “to encourage private participation in the mining sector”.⁷⁷ This decision may intensify economic distinctions between a professional minority and an indigenous army of the unemployed. The example of eastern Germany indicates that such a possibility cannot be excluded even in former socialist societies.

2.6.3. Lignite Industry Employment in Western Germany

In contrast to the eastern German power industry, RWE Power AG employs a variety of fuels to generate electricity. Many jobs are thus not critically related to the level of lignite production. On the other hand, reclamation projects are included within RWE operations, rather than being implemented by a separate company as in the new German states. A number of manufacturing industries for power generation equipment surround lignite operations in the Rhineland.

Statistik der Kohlenwirtschaft lists 12,781 employees of western German lignite mining corporations and utility power plants in 2003.⁷⁸ This compares closely with the figure of 12,634 for eastern Germany (2.6.1). Assuming the same proportion of indirect subcontractors, approximately 20,000 places of employment may be estimated for lignite mining and power production in the west.

2.6.4. Economic and Innovative Neglect

While the monolithic structure of mining proves detrimental to the economic development of many regions throughout the world, the “curse” of the eastern German lignite industry is largely self-inflicted.

The cost of mining lignite has remained essentially unchanged, and generation is highly rationalized. However, the resulting cost benefits are denied local customers. Instead, the price of generated electricity follows posted market conditions at the European Energy Exchange (EEX) in Leipzig. Greater profits are realized by charging the same price for electrical power from lignite as from imported fossil fuels, the cost of which has more than doubled in recent years.

In the USA, by contrast, all coal-producing states offer lower-cost electricity to attract investment. In April 2004, electrical power cost an average of only 4.29 US cents/kWh (about 3.3 euro cents/kWh) in Kentucky, 4.75 cents/kWh in Wyoming, 5.41 cents in West Virginia, and 5.57 cents in North Dakota, compared with 11.17 cents/kWh in New York.⁷⁹ As the prices for natural gas and oil rise, the coal-mining states will be able to offer even greater cost benefits to their customers.

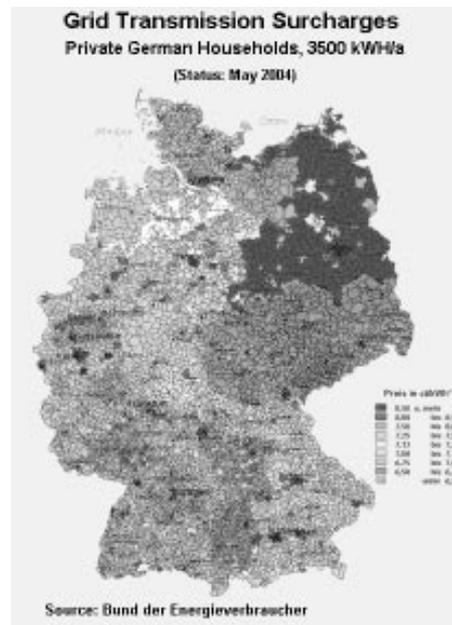
The German lignite regions have been denied such economic advantages. Power utility tariffs are in fact generally higher than in western Germany due to the excessive grid transmission fees levied by Vattenfall.⁸⁰

Since all eastern German generating equipment was renovated or newly installed in the 1990's (4.2.6), more advanced power plant designs are now being realized in Western Europe and other parts of the world. Under the Clean Coal Power Initiative in the United States, fully 97% of the projects by value involve techniques of coal or lignite gasification.⁸¹

Of particular interest is the planned refurbishment of the 615 MW Leland Olds lignite power plant operated by the Basin Electric Power Co-operative in Stanton, North Dakota. A hybrid process using lignite charcoaling and synthetic gas will be employed in modernizing the facility. The lignite deposits in Western North Dakota have been estimated at 351 billion tons,⁸² more than four times German resources and eight times its economically recoverable reserves.⁸³

North Dakota possesses the largest single deposit of lignite anywhere in the world. At the same time, its wind energy potential would theoretically be capable of fulfilling about one-third the electricity requirements in the entire United States.⁸⁴ Both Basin Electric and the Central Power Electric Cooperative are installing wind turbines to complement existing lignite generation.⁸⁵ Power plants using lignite gasification could be readily adjusted to changing wind conditions and to load variations, reducing fossil fuel consumption and carbon dioxide emissions while maintaining supply reliability.

In two of the new German states, Mecklenburg-Western Pomerania and Brandenburg, as much as 25% of electrical power consumption is covered using local wind energy. However, combined wind and lignite initiatives comparable to those in the North Dakota plains have not been announced.



3. Lignite Power Generation

3.1. Characteristics of Lignite Power Plants

Due to its low calorific value, three times the quantity of mined lignite must be burned to achieve the same thermal energy as hard coal, or four times the amount required with fuel oil. A lignite-fired boiler for driving a steam generating turbine is correspondingly more than three times as voluminous as a plant employing oil, or over 50% larger than a coal-fired design.⁸⁶

Rudimentary lignite power plants are burdened by a number of environmental and efficiency deficits. The sulfur contained in lignite oxidizes during combustion to produce sulfur dioxide. Inorganic ash substances are drawn into the furnace draft and expelled as particulates through the flue. As much as 20% of the thermal energy released during combustion may be lost to water evaporation if the lignite received from the mine has not been previously dried. Since the combustible matter in lignite consists primarily of carbon, the carbon dioxide emissions exceed those of any other commercially used fuel.

To mitigate these problems, a portion of the energy contained in lignite is required to:

- reduce airborne contaminants to a prescribed level using DeSO_x filters for SO₂ and electrostatic precipitators for particulate matter,
- partially dry the crude lignite to increase its calorific value before burning,
- and – as a future prospect – drive voluminous compressors for capturing and liquefying CO₂ for underground storage.

Before firing, the lignite is ground into fine granulates to promote uniform oxidation. Fuel oil is injected into the firebox to ignite the damp fuel until self-sustained combustion is attained. Lignite power plants are generally intended for steady-state operation, providing continuous (“base-load”) performance that is similar to that of a nuclear reactor from the viewpoint of the grid operator. This continuous operation is necessary to inhibit the thermal fatigue of plant components that would arise in intermittent duty, but it means that power is often produced during periods of reduced market demand.

3.2. Lignite Power Plants in Germany

The following table provides an overview of German lignite power plants in operation at the end of 2003. Of particular note are the different ratios of generating capacity to mining output, expressed in Megawatts per Megatons (MW/Mt), in the three primary mining regions. This specification serves as a rough indicator of relative generating efficiency, since only small quantities of lignite are used in other applications.

The high ratio of Megawatts per Megaton of lignite in Middle Germany is a result of both calorific value and advanced power plant designs. In Lusatia, the largest power station Jänschwalde consists of six refurbished 500 MW plants constructed in the GDR using Soviet K 500-166 turbines. Its generating efficiency is rated at 35%, compared with 42.5% at the Lippendorf power station (commissioned in the year 2000) and 40% at Schkopau (1995). The Boxberg facility in Lusatia contains two 500 MW plants from the same era as those in Jänschwalde, plus one 900 MW plant completed in 2000 that delivers an efficiency of 41.8%.

After filter technology retrofits, 18,000 tons of SO₂ are now emitted annually at the Jänschwalde power station,⁸⁷ representing a reduction of over 95% com-

LIGNITE POWER GENERATION IN GERMANY. Status: December 31, 2003				
REGION	Plant Site	Owner	State (Bundesland)	Capacity MW*
LUSATIA	Klingenberg	BEWAG AG (Vattenfall)	Berlin	185
	Jänschwalde	Vattenfall Europe AG**	Brandenburg	3,000
	Schwarze Pumpe	Vattenfall Europe AG**	Brandenburg	1,600
	Cottbus	Cottbuser Stadtwerke AG	Brandenburg	80
	Frankfurt/Oder	Stadtwerke Frankfurt GmbH	Brandenburg	49
	Senftenberg	Gesellsch. f. Montan- u. Bautechnik mbH	Brandenburg	11
	Brottewitz	Südzucker GmbH	Saxony	26
	Boxberg	Vattenfall Europe AG**	Saxony	1,900
	Bautzen	ESAG	Saxony	35
	Neugersdorf	Stadtwerke Oberland GmbH	Saxony	8
	Total MW			6,894
	Mining output Mt			57.4
MW/Mt			120.1	
MIDDLE GERMANY	Amsdorf	ROMONTA GmbH	Saxony-Anhalt	45
	Dessau	DVV GmbH	Saxony-Anhalt	57
	Deuben	MIBRAG IKW GmbH	Saxony-Anhalt	86
	Könnern	Diamant-Zucker KG	Saxony-Anhalt	29
	Phönix	MIBRAG IKW GmbH	Saxony-Anhalt	110
	Schkopau	E.ON Kraftwerke GmbH Saale Energie GmbH	Saxony-Anhalt	980
	Wähltitz	MIBRAG IKW GmbH	Saxony-Anhalt	37
	Zeititz	Südzucker GmbH	Saxony-Anhalt	20
	Chemnitz	Stadtwerke Chemnitz AG	Saxony	185
	Lippendorf R	Vattenfall Europe AG**	Saxony	937
	Lippendorf S	EnBW AG / E.ON Kraftwerke GmbH	Saxony	937
	Total MW			3,423
Mining output Mt			22	
MW/Mt			155.6	
RHINE-LAND	Fortuna-Nord	RWE Power AG	North Rhine-Westfalia	93
	Ville / Berrenrath	RWE Power AG	North Rhine-Westfalia	107
	Frechen	RWE Power AG	North Rhine-Westfalia	201
	Frimmersdorf	RWE Power AG	North Rhine-Westfalia	2,413
	Goldenbergwerk	RWE Power AG	North Rhine-Westfalia	171
	Neurath	RWE Power AG	North Rhine-Westfalia	2,219
	Niederaußem	RWE Power AG	North Rhine-Westfalia	3,864
	Weisweiler	RWE Power AG	North Rhine-Westfalia	2,294
	Köln/Merkenich	GEW Rhein-Energie AG	North Rhine-Westfalia	63
	Osnabrück	Kämmerer GmbH	North Rhine-Westfalia	15
	Zülpich	Kappa Zülpich Papier GmbH	North Rhine-Westfalia	6
	Kreuzau	Niederauer Mühle GmbH	North Rhine-Westfalia	4
	Elsdorf	Pfeifer & Langen KG	North Rhine-Westfalia	13
	Euskirchen	Pfeifer & Langen KG	North Rhine-Westfalia	6
	Duisburg	Sachtleben-Chemie GmbH	North Rhine-Westfalia	15
	Düren	Papierfabrik Schöllershammer	North Rhine-Westfalia	10
	Total MW			11,494
Mining output Mt			97.5	
MW/Mt			117.9	
HELM-STEDT	Buschhaus	BKB AG	Lower Saxony	387
HESSIA	Kassel 2 - FKK	E.ON Kraftwerke GmbH, Kasseler FW GmbH	Hessia	38
BAVARIA	Arzberg	E.ON Kraftwerke GmbH	Bavaria	112
GERMANY	Total MW			22,348
	Mining output Mt			179.1
	MW/Mt			124.8

* Includes the internal power required for emissions controls.

** Vattenfall power plants are operated by Vattenfall Europe Generation AG & Co. KG.

pared with former emissions levels of up to 400,000 tons. As a result, Jänschwalde is ranked as the 79th most intensive point source of SO₂ emissions in Europe. The six generating plants at this site emit 17,000 tons of nitrous oxides, but 25 million tons of CO₂ per year. The Lippendorf power station is the 92nd most prominent source of SO₂ with 16,000 tons annually, while CO₂ emissions of over 13 million tons place it seventh among all greenhouse gas point sources in Germany (after Niederaußem, Jänschwalde, Frimmersdorf, Weisweiler, Neurath, and Boxberg).

In the Rhineland, the first advanced lignite generating plant with a hitherto unachieved electrical efficiency of over 43% was dedicated in Niederaußem on September 9, 2002. This *BoA* power station (*Braunkohlekraftwerk mit optimierter Anlagentechnik*, or lignite power plant with optimized system technology) exhibits a rated capacity of 965 MW, replacing six outdated 150 MW plants with an efficiency of only 31%. A licensing application has now been made for a second *BoA* plant at Neurath. A number of similar plants are to be erected over the next two decades, since more than 40,000 MW of fossil-fuel generating capacity and all nuclear reactors in western Germany must be either replaced or substituted by energy conservation measures.

In the 1990's, the eastern German Vereinigte Energiewerke AG (VEAG, the predecessor to Vattenfall) began working on a new generation of ultra-efficient lignite generating plants in cooperation with the Brandenburg Technical University and the Zittau/Görlitz University of Applied Sciences. In one process, a whirlpool of steam dries the lignite fuel prior to combustion, raising its effective caloric value. At the beginning of 2005, Vattenfall announced the construction of a new 660 MW advanced power plant in Boxberg.⁸⁸

4. Eastern Germany: A “Lignite Platform”

4.1. The Supremacy of Lignite in the New German States

In western Germany, more electrical energy is produced using hard coal and nuclear power than from lignite, while gas generation likewise commands a considerable market share. Electrical power production in turn supports a highly diversified manufacturing industry, making Germany the third leading export nation in the world.

By contrast, energy production and distribution dominate the industrial economy of the new German states in relation to investment volumes, sales turnover, the number of employees, and the preference for domestic fuel resources. Over 90% of all electrical energy distributed by Vattenfall in eastern Germany is generated using lignite, with surplus power exported to Western Europe and Poland.

In view of the increasingly restricted deliveries of most fossil fuels anticipated for the 21st Century, the eastern German power industry merits particular consideration for a number of reasons.

- The history of the 20th Century would have been altogether different without the contribution of lignite to Germany's wartime industries.
- The extensive lignite deposits in eastern Germany convey the impression of relatively secure energy supplies. Yet the exploitation of domestic resources evokes numerous external costs that were routinely disregarded by former dictatorial

regimes. The adherence to mining policies from those eras severely compromises the integrity of the natural environment, human settlements, and historic infrastructures of inestimable archeological value.

□ As lignite is employed in Germany to compensate for nuclear phase-out, the available geological deposits correspondingly diminish. Unless adequate follow-on strategies are established on the basis of renewable energies, nuclear power could ultimately be established at the locations of current lignite power production as well at former reactor sites operated by the GDR at Lubmin (presently a nuclear storage facility) and planned at Stendal, Leuna, Buna, Lippendorf, and Delitzsch.⁸⁹

□ The economic transformation after national reunification from centralized state planning to free enterprise has often culminated in the reflexive submission of fledgling democratic institutions to multinational corporations, reflecting a prevailing deficiency of local financial resources and managerial expertise. The development of the energy sector in other post-communist countries could follow a similar pattern, reducing the prospects for equitable market competition.

□ The lignite industry in eastern Germany is largely controlled by two foreign corporations, Vattenfall AB and MIBRAG B.V. Unlike RWE in the west, the parliamentary accountability of these offshore companies is not a commanding issue for German politics, inherently lowering their commercial risks.

The eastern German lignite industry essentially constitutes a colonial extractive enterprise, although mining equipment continues to be manufactured by the former GDR combine (*Kombinat*) TAKRAF in Leipzig and Lauchhammer (now a part of the western German MAN corporation). Most power system equipment is procured from specialized companies in the Rhineland and other parts of Western Europe.

4.2. Historical Prelude

Vattenfall operates the high-voltage transmission grid and, with the exception of Schkopau, all of the large-scale lignite power plants in the new German states. This region was the geographic center of the German empire (*Deutsches Reich*) until the end of World War I. At that time, Germany extended from the western tip of present-day Lithuania to Alsace-Lorraine in eastern France. Its midpoint was the city of Spremberg, where the predecessor to the Schwarze Pumpe power station was erected at Trattendorf in 1915.⁹⁰ The condensed steam rising from the cooling towers of lignite power plants in Lusatia are today visible in nearby Polish cities.

4.2.1. The Emergence of the Lignite Industry

Beginning in the Middle Ages, lignite was often employed as a fuel for glass, brick, and salt production. The lignite was extracted from deep mines like hard coal, or scooped out from shallow pits with hand tools. Railroad expansion in the 19th Century radically increased the demand for coal and lignite. In eastern Germany, lignite was also used to fire stationary steam engines employed throughout the sugar beet industry.

In 1891, the demonstration of electrical power transmission at Frankfurt/Main over a distance of 150 kilometers meant that electric motors could be driven from centralized generating plants, rendering steam engines in agriculture superfluous. In 1915, the *Elektrowerk Golpa-Zschornowitz* power station went into operation near the city of Bitterfeld, ushering in the age of large-scale generation and grid power transmission.

After 1890, bucket-wheel excavators were introduced that dramatically increased mining production. By the turn of the century, there were already 174 lignite operations in the province of Saxony alone. The introduction of steam lignite presses in 1893 enabled briquettes to be distributed for space heating, domestic laundering, and home baths. Coal and lignite were likewise gasified. The Junkers

factory in Dessau was established to produce wall-mounted gas boilers known as calorimeters, invented by the company's founder, Hugo Junkers (1859 – 1934). In Bitterfeld to the east, the electrochemical production of chlorinated lime, aluminum, and magnesium had become established by 1900. This aluminum would later be delivered to Junkers for manufacturing the Ju 52 transport aircraft and Ju 87 *Stuka* dive bomber in World War II.

The energy products sector relied crucially on domestic fuel resources. Carl Adolf Riebeck (1821 – 1883) had invented processes for producing mineral oil and paraffin from lignite. The *A. Riebeck'sche Montanwerke* in Halle established the region southeast of Berlin as a center of the oil and chemical industry. In the 1990's, this tradition was continued by the acquisition of refining and manufacturing facilities by Elf Aquitaine of France and the US Dow Chemical Company.

Germany never accrued the colonial possessions that provided the raw materials of industrialization to other European countries. The German term *Ersatz* (substitute) became a common reference to synthetic goods that originated within the industrial economy, ranging from coal-based rubber to artificial foodstuffs and coffee made from roasted grain.

A prime incentive for domestic research was provided by non-participation of Germany in the International Patent Union before 1903, effectively protecting the chemical industry against foreign competition.⁹¹ The worldwide dominance of innovative products that were protected by German patent laws was so extreme that it would later be considered the major commercial cause of World War I.

Textile manufacturing both in England and Germany benefited from the production of aniline dyes from coal tar, which superseded natural plant substances and seashells for imparting color to clothing. Wilhelm Ostwald (1853 – 1932) developed a systematic approach to physical color classification (*Farbenlehre*) during World War I. He was not prominently involved with military research, commissioning a Dresden cannon factory only to fabricate a wind turbine for his country laboratory, known as *Haus Energie* in Grossbothen.⁹² Yet his endeavors would crucially enhance Germany's capability for waging warfare.

While a professor at the University of Leipzig, Ostwald had developed a process for the catalytic production of saltpeter (potassium nitrate KNO_3 , an ingredient of gunpowder) from ammonia. In 1909, he was awarded the Nobel Prize in Chemistry (the first accorded a German) for his studies of catalytic processes.

The physical chemist Fritz Haber (1868–1934) pursued the synthesis of ammonia itself by circulating nitrogen and hydrogen over a catalyst at a pressure of 150–200 atmospheres, maintained at a temperature of about 500°C. Haber's investigations were scaled up to an industrial dimension at the *Badische Anilin- und Soda-Fabriken* (BASF) by Carl Bosch (1871–1940) and Alwin Mittasch (1869–1953). In thousands of experiments, an ideal iron catalyst was finally found that included small amounts of the oxides of aluminum, calcium, and potassium. The resulting Haber-Bosch process was patented in 1910. In September 1913, the first manufacturing plant in Oppau near the BASF headquarters at Ludwigshafen on the Rhine River produced up to five tons of ammonia daily.

4.2.2. Lignite as a Wartime Ingredient

With the outbreak of World War I in August 1914, the English blockade interrupted deliveries of saltpeter from the Atacama Desert in Chile. During the invasion of Belgium, the German army seized 20,000 tons of saltpeter in the harbor of Antwerp, but munitions manufacturing could not be sustained for a prolonged period without domestic resources. A second ammonia synthesis plant using the Haber-Bosch process was erected in Leuna south of Halle in 1916. The abundant lignite deposits at this location provided both the oxidizing agent necessary for extracting nitrogen from the air and the energy required for manufacturing. Nitric acid was employed to make nitroglycerin and trinitrotoluene (TNT).

Ammonium sulfate ((NH₄)₂SO₄), ammonium nitrate (NH₄NO₃) and calcium cyanamide (CCaN₂) were produced in subsidiary facilities as fertilizers. Lignite also provided a ready source of carbon for the organic chemical industry.

The Nobel Prize in Chemistry was conferred on Fritz Haber in 1918 in recognition of the benefits that ammonia synthesis provided for manufacturing agricultural fertilizers. By the time he accepted the award in 1919, however, his name was already included on the list of German war criminals. Under construed arguments for circumventing the Haag Convention on land warfare, Haber had developed Germany's war gas program for use on the western front.⁹³ One-fourth of all German artillery projectiles would ultimately contain poisonous gases.⁹⁴

The Treaty of Versailles deprived Germany one-third of its coal mines after World War I. In 1923, rampant inflation likewise made it impossible to pay war indemnities with German currency. It therefore became necessary to meet reparation obligations by delivering hard coal to France.⁹⁵ Lignite was increasingly employed to satisfy domestic energy requirements. The first lignite mine employing large-scale excavators in combination with a conveyor bridge was begun at Böhlen south of Leipzig in 1921, where the Lippendorf power station is presently located.

Production facilities were established or expanded in the Middle German "Chemical Triangle" (*Chemiedreieck*) that extended from Leuna/Lützkendorf/Schkopau near Halle to Bitterfeld/Wolfen, Piesteritz near Wittenberg, and Eilenburg north of Leipzig. The lignite found in this region was formed 23 to 45 million years ago and contains numerous tar and bituminous compounds that make it suitable for lignite chemical manufacturing (*Karbochemie*). The inherent alleviation of foreign trade deficits contributed to economic recovery and later to programs of self-sufficiency in the Third Reich and the GDR.

Derivate lignite products included various "Buna rubbers", plastics, dyes, paraffin, methyl alcohol, nitric acid, calcium carbide, and celluloid for the Agfa photographic film manufactured in Wolfen since 1909. The chemical triangle expanded to the southeast, where hydrogenation plants for synthetic fuel were built in Böhlen (1935) and Zeitz (1937). The operator, *Braunkohle-Benzin AG* (*BraBag*), was a subsidiary of the commercial cooperative *Interessen-Gemeinschaft Farbenindustrie AG* (*IG Farben*) that relied in part on technology obtained in the early 1930's from Standard Oil of New Jersey. The nearby lignite processing plant at Espenhain produced briquettes, cokes, and tar. This area was less accessible to Anglo-American bombers than Germany's Rhine and Ruhr regions, and many factories remained unscathed during World War II. However, 11,000 bombs were dropped on the Böhlen facility to disable aviation fuel production.

Lignite power generation and transmission had been elevated to a strategic military status in 1935 by the Law for Promoting the Energy Economy (*Gesetz zur Förderung der Energiewirtschaft*), the declared purpose of which was the "promotion of wartime capabilities (*Wehrhaftmachung*) of German industry". This legislation favored the takeover of small utilities by large power companies. A second law, the Mining Act (*Berggesetz*) of 1935, allowed entire communities to be evicted for the purpose of excavating lignite. Despite the demise of the Third Reich and the solemn pledge of Allied leaders to remove all Nazi laws from the books, the spirit of these wartime expediencies prevails in many energy regulations to this day.

Long-range power transmission assumed military importance with the Vockerode power plant on the Elbe River, constructed between 1937 and 1942 to supply Berlin from a distance of 120 kilometers in anticipation of air raids on the capital city. An array of six boilers and turbines provided 220 Megawatts (MW) of electrical power. River water was used for steam condensation, precluding the need for cooling towers. The nearby industrial cities of Dessau, Bitterfeld and Wolfen were provided with electrical power and later (in Dessau) with district

heat. The Vockerode plant was later dismantled by the Soviets as a postwar reparation, but rebuilt by the GDR in the 1950's. Its four 140 meter smokestacks, a familiar sight from the Elbe River Bridge on the Leipzig–Berlin *Autobahn*, were a notorious source of regional air pollution.

4.2.3. Lignite in the GDR

After World War II, a severe crisis of material supply prevailed in eastern Germany. Entire factories, power plants, and even railroad tracks had been dismantled by Soviet military authorities. After a Marxist government had been formed in 1949, programs of industrial reconstruction were instituted to a) eradicate wartime damage and destruction, b) replace the factory hardware removed to the Soviet Union, c) substitute foreign sources of supply that had become less accessible due to international impediments, and finally d) achieve the highest possible level of material self-sufficiency, particularly after the Berlin Wall had been erected in 1961.

In the course of industrial modernization, the lignite industry inherited from the Third Reich was recognized as a technological anachronism. A systematic strategy was instituted in the 1970's to replace all lignite furnaces at factories and other major installations with oil-fired units. Brigades of the Free German Youth were dispatched to the Soviet Union to aid completion of the Friendship (*Drushba*) pipeline system that extended to the refineries in Schwedt on the Polish border and to the Chemical Triangle. The prices for Soviet gas and oil shipments were set at the average of world market prices over the previous five years. As long as international trading prices continued to rise, the GDR paid less for fuel imports than its western competitors.

These policies appeared vindicated at the end of 1973, when an OPEC boycott temporarily crippled the fuel sector of western industrial nations while circumventing the eastern German economy. The phase of comparative socialist prosperity that followed, however, was inescapably succeeded by higher five-year historical prices. The GDR was forced to abandon its ambitious fuel conversion effort even before the new oil burners had been put into service. Rigid directives were issued to achieve the highest possible deployment of lignite. In some cases, more energy was expended for transporting crude lignite than the fuel itself contained. Lignite and briquette distribution throughout the country accounted for one-third of all railroad freight volumes. This energy policy was to make the GDR the largest producer of lignite worldwide, but also the greatest source of SO₂ and CO₂ emissions per capita.

OPEC price increases in 1979–80, precipitated by revolution in Iran and the Soviet invasion of Afghanistan, further entrenched lignite as the major fuel. Deliveries of Soviet oil to the GDR were reduced from 19 to 17.1 million tons annually,⁹⁶ since international sales against hard currency had become more lucrative for the USSR.

By the same token, some of the oil received by the refinery at Schwedt was converted to secondary products such as lubricants for export to Western Europe. The stability of centralized state planning dictated a high international credit rating so that needed raw materials and high-quality manufactured products could be procured abroad. Meat and other agricultural products, metal castings, and a wide variety of consumer goods were exported – often below cost – to bolster hard currency reserves. The dramatic growth of lignite mining output from 258 million tons in 1980 to 310 million tons in 1988⁹⁷ (an increase of 20%) enabled both the reduction of energy imports and the “virtual export” of energy in products sold to other countries.

The two largest power plants were completed in this era: Boxberg (built in stages between 1965 and 1980) and Jänschwalde (1977–1988). Approximately 70% of the GDR's entire energy supply depended on lignite,⁹⁸ and two-thirds of all in-

dustrial investments were dedicated to this sector. Of the over 300 million tons of crude lignite mined annually, about half was burned directly in power and heating plants. Another 100 million tons were compressed to produce 50 million tons of briquettes a year. Three-quarters of this production was used for space heating, the remainder was distributed to lignite distilleries for manufacturing industrial and municipal gases, lignite high temperature (*BHT*) cokes, tar, oils, and phenol compounds.⁹⁹ Two-thirds of the town gas (*Stadtgas*) production was concentrated at Schwarze Pumpe. The gas was distributed via a 6,000 kilometer high-pressure pipeline network to all 14 administrative districts in the GDR for cooking and water heating.

Of the some seven million private apartments and homes, about one-fourth were provided with district heat from local power stations or heating plants. Nearly all other dwellings employed furnaces or ovens fired with briquettes, which were manufactured using steam presses at 49 locations throughout the mining regions.

The factory combines worked multiple shifts and often maintained operations on weekends to increase equipment utilization. The average production machine in the GDR ran 17 hours a day. The industrial complex was therefore crucially dependent on continuously available, base-load electrical power. Meeting this requirement imposed excessive demands on mining, generation, and distribution capacities, particularly during the winter months when the lignite froze in the quarries and again during transport.

When annual lignite production rose to over 300 million tons in the 1980's, ageing generating plants were kept on line despite their inordinately high fuel consumption and poorly regulated turbine speed. The frequency stability of AC current was so inconsistent that mains-powered electric clocks were unknown. Due to frequent overloading of the power grid, TV receivers were connected to the wall socket through a regulating transformer equipped with a large control knob, which allowed the viewer to stabilize the picture by adjusting the mains voltage. Electrical power was euphemistically termed "alternating current" owing to the living room calisthenics required for watching television.

4.2.4. Nuclear Forays

In July 1986, the GDR technical journal *Energietechnik* described a plan that foresaw the construction of 17,000 MW of nuclear generating capacity.¹⁰⁰ Lignite power generation was to be phased out, while conventional district heating plants would continue to serve residential and industrial complexes. Ultimately, however, modified nuclear submarine reactors from the Soviet Union were intended to replace even these facilities.

Such visionary proposals were used by system apologists to explain the neglected modernization of existing lignite power plants and briquette factories. It was apparent, however, that these ambitious objectives could not be realized within the foreseeable future. Germany's first atomic reactor had been erected in Rheinsberg north of Berlin in 1966, but its generating capacity of only 70 MW essentially fulfilled the purpose of a demonstration project. A major nuclear facility near Greifswald was established at Lubmin on the Baltic Sea, where a series of eight 440 MW atomic power plants was planned. By 1989, however, only four had been put into service, with a fifth under construction.

An interview conducted by the Stockholm daily *Dagens Nyheter* with Erich Honecker on June 24, 1986, reflected the fear of a Soviet-type reactor catastrophe near the Swedish coastline.¹⁰¹ While the water-moderated WWER reactors in Lubmin differed from the RMBK graphite design employed at Chernobyl, the units possessed inherent design weaknesses.¹⁰² The reactors were not equipped with a containment structure indispensable to the safety of nuclear power plants in western countries, leaving them inadequately protected against inordinate

internal pressure and against aircraft penetration. The emergency cooling pumps had all been located in a single room. The cables for power, control, and safety devices were often fed through the same conduits. When a worker inadvertently set off an electrical fire in a cable bundle of Reactor Block I on December 7, 1975 (other reports speak of 1976), the pumps for the emergency cooling system were disabled.¹⁰³ Fortunately, one of the twelve pumps had been connected to the electrical power supply of the adjoining reactor during a maintenance routine. Only this accidental circumstance prevented a core meltdown from occurring.

The protests of western German environmentalists against nuclear energy rarely influenced public attitudes toward atomic power in the GDR. Nuclear generation was perceived as an environmentally preferable alternative to lignite. Moreover, eastern Germany was the cradle of European uranium mining, which provided employment to thousands of workers in the Ore Mountains (*Erzgebirge*) southwest of Dresden. Uranium ore had been called pitchblende (*Pechblende*) by miners in former centuries, conveying the dual meaning of *Pech* as “black pitch” (the color of the ore) and “bad luck” when exploring for silver. *Pechblende* was declared the “ore of peace” (*Erz des Friedens*) by communist ideologists for helping to maintain the nuclear balance with NATO forces.

The prospect of nuclear annihilation generally appeared more threatening than any imaginable malfunction of an atomic power plant. It was not until after the Chernobyl catastrophe, the publication of the novel *Accident: A Day's News* by Christa Wolf,¹⁰⁴ and the circulation of Michael Beleites' samizdat study *Pechblende*¹⁰⁵ by the Lutheran Research Center (*Kirchliches Forschungsheim*) in Wittenberg that widespread concerns over nuclear technology arose among eastern Germans.

4.2.5. Dissolution and National Reunification

The GDR was the self-acclaimed “First State of Workers and Farmers on German Soil” (*Erster Arbeiter- und Bauernstaat auf deutschem Boden*) founded on October 7, 1949 by the Marxist-oriented Socialist Unity Party of Germany (*Sozialistische Einheitspartei Deutschlands*, or *SED*). Erich Honecker, who had participated in the postwar communist takeover as youth secretary of the central committee, was leading the country four decades later under the protection of over 400,000 Soviet occupational troops. On the 40th anniversary of the regime in October 1989, however, Soviet premier Mikhail Gorbachev noted that “life will punish him who comes too late”. For the eastern German population, this commentary constituted a thinly concealed renouncement of ruling SED septuagenarians who had come early but stayed too long.¹⁰⁶

When the Berlin Wall fell on November 9, 1989, political reunification was not a foregone conclusion. The GDR remained committed to its military obligations under the Warsaw Pact and to economic agreements of the COMECON (Council for Mutual Economic Assistance, or *RGW, Rat für gegenseitige Wirtschaftshilfe*). Public discussion ensued over the possibility of a socioeconomic Third Path (*dritter Weg*), since neither of the current world orders particularly appealed to most eastern Germans at that time.

Yet as one Russian scientist had noted concerning the recurrent setbacks of *glasnost* and *perestroika*, making a fish soup from an aquarium is immensely less complicated than reversing the process. The intractable fallacies of Marxist state planning could not be reformed, but only eliminated by reinstating private property rights and expanding commercial trade. The eastern German workforce possessed many of the professional qualifications essential for participation in the international division of labor. Under this consideration, the Treaty of Unification (*Einigungsvertrag*)¹⁰⁷ signed late summer 1990 tacitly implied that economic harmonization with Western Europe could be achieved within half a decade. Chancellor Helmut Kohl's assurance that “no one will be doing worse, and many will be doing better” engendered a mindset of imminent prosperity despite the visible deficiency of most essential macroeconomic prerequisites.

Availed of public subsidies for infrastructure renewal, communities were encouraged by western German enterprises to build industrial parks and sewage treatment plants that greatly exceeded demographic requirements.¹⁰⁸ Two and a half times the amount of the retail floor space per capita in western Germany were soon available in Leipzig. Real estate prices for downtown property often surpassed those in Munich or Düsseldorf. An annual economic growth of 6% to 8% was predicted in early political analyses.¹⁰⁹ The German Institute for Economic Research (*Deutsches Institut für Wirtschaftsforschung*) estimated that total energy consumption would commensurately be rising from 130 million hard-coal equivalent tons (*Steinkohleneinheiten*, or *SKE*) in the GDR to between 145 and 150 million tons by 1995.¹¹⁰

Western bank institutes generously provided loans to individuals and newly formed companies despite questionable credit references.¹¹¹ Within a year, 400,000 used automobiles – all without catalytic converters because of the lack of unleaded gasoline in the GDR – had been purchased from private owners or deliriously grateful car dealers in western Germany.¹¹² Chancellor Helmut Kohl and other government leaders refrained from informing their “dear eastern compatriots” (*liebe Landsleute*) that they would be soon subject to the highest motor vehicle tax rates because of excessive tailpipe emissions as soon as the applicable federal laws applied in the east.

While most tax regulations, together with consumer prices and insurance fees, were rapidly harmonized between both parts of the formerly divided nation, the aspiration of economic unity was to prove illusionary for a variety of reasons. After the currency union (*Währungsunion*) with the Federal Republic became effective on July 1, 1990, the influx of western German products and standards accelerated the decline of local manufacturing capacities. Trade agreements between the GDR and Eastern Europe likewise vanished in 1991 with the dissolution of the COMECON.¹¹³ Few private citizens had been able to accumulate sufficient wealth to start their own business. Little advantage was perceived by most foreign investors to make productive commitments in the new German states, while hundreds of thousands of highly qualified workers commuted to jobs in the west, if indeed they did not permanently resettle. Of the many corporations that had transferred their headquarters from eastern Germany to the Federal Republic in the 1950's to avoid dispossession by the Marxist regime,¹¹⁴ those that returned established only branch offices. As a result, business taxes (*Gewerbesteuern*) have never become a significant source of public revenue.

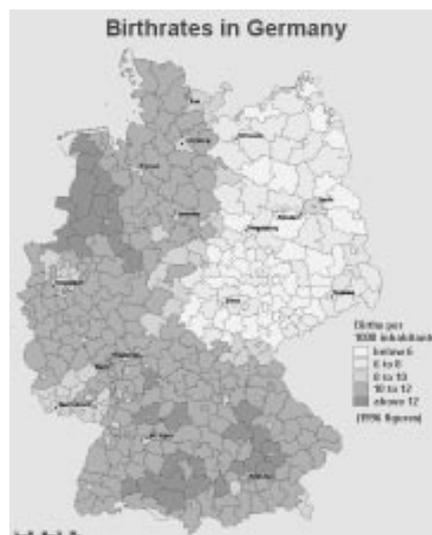
One of the few successful industrial revitalization projects was undertaken in the Chemical Triangle. By 1999, over 15 billion euro of public funding and additional billions of private capital had been expended in the region.¹¹⁵ A former chairman of the Buna chemical works, however, noted that the same expenditure would have been adequate to purchase any of the largest global corporations in the industry, including Dow Chemical or BASF with more than 100,000 employees and far greater turnover.

Despite innumerable Cold War declarations on the unbroken validity of German unity, the federal government had never formulated even rudimentary economic guidelines for its implementation. The production of gas and oil furnaces, water heaters, and radiators might otherwise have been assigned to eastern German companies for replacing briquette ovens. Instead, the required components were delivered by western German factories, which needed only to ramp up production to make immediate delivery. Natural gas continued to be supplied through the *Drushba* pipeline. As a consequence, the fulfillment of space heating requirements has required unremitting currency transfers to western Germany and Russia.

Payment for imported equipment and fuel has been insured in turn by economic transfers to the new German states totaling more than 1.25 trillion euro.¹¹⁶ This figure includes reconstruction subsidies, public contracts, unemployment benefits, wages earned in western Germany, and retirement pensions. Despite mas-

sive aid provided by the federal government and the European Union, the former economics minister of Saxony-Anhalt, Katrin Budde, has noted the number of industrial centers can still be counted on the fingers of one hand.¹¹⁷ Economic equality with the west, initially predicted to take no more than five years, could now require two generations to be culminated. Under this circumstance, wage harmonization with the Czech Republic and Poland appears a more immediate prospect.

In 2005, the unemployment quota in the new German states rose to over 20%.¹¹⁸ In some mining and rural regions, one fourth of the workforce is jobless.¹¹⁹ At the same time, the number of potentially qualified workers continues to dwindle because of early retirement, a lack of occupational perspectives particularly for women (most of whom were gainfully employed in the GDR), and the migration of young people to other regions in Europe. Due to continuing economic insecurity, far fewer children are being born. At the birthrate of 1.04 per female inhabitant that was registered in 2000, eastern Germany's population has been calculated to drop from 15 million to 7.65 million by 2050.¹²⁰ Yet even if this birthrate were doubled, the population would still fall below 13 million by 2050 because of post-reunification declines in maternity that are now causing hundreds of schools to close for lack of adequate pupil registration.



As a result of population decline, 1.2 million apartments are already unoccupied, necessitating the demolition of 50,000 dwellings in 2004 alone for reducing maintenance costs and stabilizing rental income.¹²¹ The Berlin-Institute for World Population and Global Development has concluded that, in view of divergent economic and demographic trends, “Germany remains divided”.¹²²

4.2.6. The Post-Reunification Transition of the Lignite Industry

Five new states (*fünf neue Länder*) were constituted under the terms of reunification to reinstate the historic eastern German provinces that had most recently existed for a short period after the war. East Berlin became part of the united capital city. The collective designation as the “region of annexation” (*Beitrittsgebiet*), however, indicates that eastern Germany was essentially considered a misplaced piece of property with only limited claims on the conditions of its former sovereignty.

The electrical power industry was commensurately organized as an appendage of seven major western German utility corporations,¹²³ which founded the United Energy Works (*Vereinigte Energiewerke AG*, or *VEAG*) to succeed former state-owned power combines (*Energiekombinate*).

The total generating capacity in the GDR amounted to about 23,000 MW.¹²⁴ Apart from 1,830 MW nuclear and about 1,800 MW of hydroelectric capacity (consisting largely of pumped storage plants), electrical power production depended primarily on lignite-fired steam generators using three standardized turbine types:

- 28 plants with 100 MW turbines at Lübbenau (10), Vetschau (12), Hagenwerder (2), and Lippendorf (4).
- 16 plants with 210 MW turbines at Thierbach (4) and Boxberg (12).
- 10 plants with 500 MW turbines at Boxberg (2), Hagenwerder (2), and Jänschwalde (6).

None of these facilities met applicable air quality standards. For each kilowatt-hour of electricity generated, 30 to 50 grams of sulfur dioxide were released into the atmosphere, while western power plants produced less than 0.75 g/kWh. Suitable modification of the 100 MW and 210 MW turbine blocks, erected between 1964 and 1975, was considered uneconomical. Their generating efficiency of only 20% to 25%¹²⁵ would have been diminished even further by the addition of emissions control devices. The Hagenwerder power station near the city of Görlitz at the Polish border was decommissioned, since the lignite resources at that location would have been adequate only until 2006. This left the 500 MW plants at Boxberg and Jänschwalde to be retrofitted with desulfurization equipment, extending their service life for another quarter century. The GDR's five nuclear reactors, which had formerly accounted for 10.5% of electrical power consumption, were removed from service shortly after reunification.

The federal economics ministry ascertained that the predicted economic growth could not be supported by existing electrical generation capacities. Four high-voltage transmission lines, each with a capacity of 6,000 MW, were therefore planned for supplying additional power from Western Europe.

Annual lignite production was expected to stabilize at about 200 million tons, or two-thirds of former output. The mining operations in Lusatia were sold by the federal government's *Treuhandanstalt* (trusteeship agency) to the newly formed Lausitzer Braunkohle AG (LAUBAG), a company owned by a consortium of western Germany power utilities, RWE/VEW and Viag/Veba. These corporations have since regrouped to form RWE AG, with headquarters in Essen, and E.ON AG in Düsseldorf.

On the other hand, western German power companies refused to assume ownership of any mines in Middle Germany because of the excessively high sulfur content of lignite in the Chemical Triangle. A new 900 MW combined heat and power station in Schkopau at the site of the former Buna rubber works was instead projected for hard coal by Veba-Kraftwerke Ruhr AG (VKR) in Gelsenkirchen. However, nearly 60,000 workers had previously been employed in the Middle German lignite industry. In an effort to save at least some of these jobs, the federal government intervened to modify the project design. Public subsidies of 600 million deutschmarks (about 307 million euro) were provided to finance the larger boilers required for employing lignite, raising the total cost of the Schkopau power station to 2.7 billion marks (1.38 billion euro).

The nearby lignite mines were sold at the end of 1993 in equal parts to the British utility PowerGen plc and to two American companies, the Morrison Knudsen Corporation and NRG Energy, Inc.¹²⁶ The consortium members assumed joint ownership of the holding corporation MIBRAG B.V. in Amsterdam, which in turn founded the Middle German Lignite Corporation (*Mitteldeutsche Braunkohlengesellschaft mbH*), or MIBRAG. PowerGen and NRG Energy already owned a 41.1% interest in the Schkopau power station through their German subsidiary Saale Energie GmbH. For the first time in history, foreign companies had gained direct control over part of the German power industry by accepting the challenge of poor lignite quality. Morrison Knudsen later changed its name to Washington Group International, Inc., while PowerGen divested its interest in both Schkopau and in the mining operations to NRG Energy before being taken over by E.ON AG in 2001.

All existing large power plants in eastern Germany were sold by the *Treuhandanstalt* to the Vereinigte Energiewerke AG (VEAG), which had been formed by the same corporations in possession of LAUBAG. Older plants with a total capacity of 6,500 MW were decommissioned during the course of the decade. Boxberg, Jänschwalde, Lippendorf, and the lignite complex at Schwarze Pumpe became the pillars of the new corporation. In contrast with western Germany, where the major utilities also control distribution, VEAG owned only the high-voltage transmission grid. A number of regional distributors were formed to sell me-

dium-voltage power to communal utilities and to rural customers. Western German power companies assumed a controlling interest in most of these corporations and in the municipal utilities of major eastern German cities.

The MIBRAG consortium elected to terminate lignite operations in the region around Bitterfeld and Halle altogether, concentrating instead on long-term deliveries from the Profen mine near Zeitz. Some five million tons of crude lignite a year were delivered by rail to the Schkopau power station and another million tons to a 185 MW plant operated by the Chemnitz municipal utilities (until the termination of contract at the end of 2004). Smaller quantities were supplied to other municipal power companies and commercial enterprises, as well as to MIBRAG's own three power plants and two briquette factories. The latter have since been closed due to lack of adequate turnover.

The operation of only one mine was recognized as inadequate to justify investments in administration and training. The Profen operation was capable of producing only 9 – 11 million tons (Mt) of lignite per year, compared with 60 Mt/a in Lusatia and 100 Mt/a in the Rhineland. The Schleenhain mine south of Leipzig was therefore modernized to serve power generation at Lippendorf.

In an unpublished letter to the ministry of economic affairs in Saxony on March 2, 1994, VEAG management stressed its reservations over the high sulfur content of the lignite from Schleenhain as a major impediment to competitive power production. However, in acquiescence to political considerations, VEAG and two southern German power companies, Bayernwerk AG (later part of E.ON AG) and Energie Baden-Württemberg AG (EnBW), finally agreed to erect “two 800 MW plants” at Lippendorf. The lignite required by this facility would be sufficient “to save the MIBRAG and the jobs associated with it”.

4.2.7. Unfulfilled Turnover Expectations

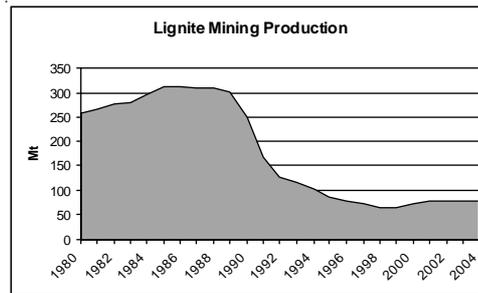
Under the prevailing assumption that eastern Germany would rapidly be transformed into the world's most modern industrial society, only a modest decline in power consumption was anticipated during the phase of industrial reconstruction. One early assessment published in an eastern German journal predicted a reduction in demand from 119 Terrawatt-hours (TWh)¹²⁷ in 1990 to between 105 and 110 TWh in 1992/93.¹²⁸ Thereafter, electrical power generation was expected to increase at an annual rate of 3% to 130 TWh in the year 2000. An additional 5 TWh was projected for operation of the desulfurization equipment mandated for all lignite power plants after 1996.

Yet these former levels of power production would never again be attained. By 1995, the German Institute for Economic Research (*Deutsches Institut für Wirtschaftsforschung*) calculated an output of only 75.6 TWh in the year 2000 for local power stations in operation or under construction, with another 6.2 TWh generated by the second Lippendorf plant owned by two western German utility companies.¹²⁹ An increasing amount of excess power is available from lignite generating plants and wind turbines, while regional supply shortages appear likely for western Germany due to rising demand and nuclear phase-out. Vattenfall therefore intends to erect a 380 kV transmission line from Halle through the Thuringia Forest to Schweinfurt in Franconia (Northern Bavaria), a reversal of post-reunification planning.¹³⁰

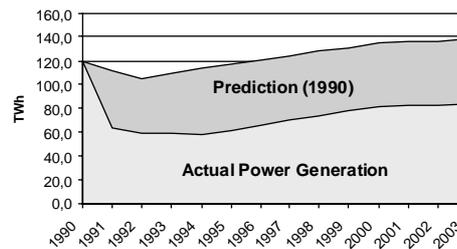
About 95% of eastern German lignite is employed in power plants serving the national grid. In 1992, the Federal Ministry for the Economy estimated that annual lignite mining output in the east would be declining from its pre-1990 level of over 300 million tons to below 120 million tons by 2000.¹³¹ In the following year, the State of Saxony presented a more detailed prognosis: 102 million tons in 2000, 91 million tons five years thereafter, and 88.6 million tons in 2010.¹³²

Mining output has since stabilized at around 80 million tons a year.¹³³ This figure does not represent a direct decline from higher tonnage. Instead, lignite

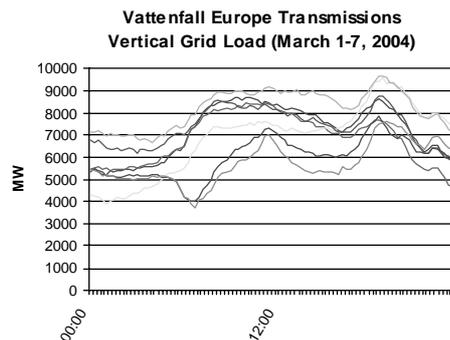
use dropped to the unprecedented low level of 64.1 million tons in 1998 because of greatly diminished power demand. Many industrial installations and cooperative farms had been shut down. The surviving factories, businesses, and private households soon purchased efficient machinery and appliances to replace outdated equipment. Buildings were insulated using federal loan programs and tax rebates, further lowering energy requirements. Commercial enterprises restricted operation to regular business hours, making night shifts and weekend production schedules the exception rather than the rule. The demand for base-load power therefore declined radically. With the exception of Schkopau, however, all newly designed power plants are intended for continuous generation at least 7,500 hours per year.



The load data of the high-voltage grid, operated by Vattenfall Europe Transmission GmbH, clearly indicate a reduced demand for base-load power between 9 PM and sunrise as well as on weekends (the lowest curves on the graph) in a typical week.¹³⁴ The grid load varies by approximately a factor of two within the course of a 24-hour period. The average load registered in the week shown in the graph was highest on Thursday (8,198 MW) and lowest on Sunday (5,745 MW).



As indicated in the table below, the available capacity of all base-load lignite power plants (7,834 MW) often exceeds grid demand. A number of additional smaller plants as well as pump storage facilities contribute to insure adequate supply capacities at all times.



BASE-LOAD LIGNITE POWER STATIONS IN EASTERN GERMANY. ¹³⁶ Status: 2005						
Installation	Location	Owner	Generator Capacity	Grid Capacity	Grid Energy	CO ₂ Emissions ¹³⁷
			MW	MW	TWh/a	MT/a
Jänschwalde	Brandenburg Lusatia	VattenfallEurope	3,000	2,712	21.6	24.87
Boxberg ¹³⁸	Saxony Lusatia	VattenfallEurope	1,900	1,712	13.8	13.75
Schwarze Pumpe	Brandenburg Lusatia	VattenfallEurope	1,600	1,426	12.0	12.83
Lippendorf Block R	Saxony Middle Germany	VattenfallEurope	920	865	7.3	5.53
Subtotal (Vattenfall)			7,420	6,715	54.7	56.98
Schkopau	Saxony-Anhalt Middle Germany	E.ONSaale Energie	980	358 ¹³⁹	3.6	4.85
Lippendorf Block S	Saxony Middle Germany	E.ONEnBW	920	865	7.3	5.53
Total	Eastern Germany		9,320	7,938	65.6	67.36
	Germany (2003)				596.0	836.6
Ratio	Lignite East/Total				11.0%	8.1%

Some of the figures in the table constitute estimates based on varying and occasionally contradictory data issued by utility companies, government agencies, research institutes, and environmental organizations. This circumstance is of particular significance with respect to the data on CO₂ emissions. The corresponding figures have been drawn from the preliminary edition of the National Allocation Plan (NAP) for emissions trading¹³⁵ and do not entirely correspond with published information on the quantity of lignite being fired in individual plants. It remains to be seen what CO₂ levels will ultimately be accepted as a fair basis of emissions trading.

The figures on grid energy output have been extrapolated from a variety of sources. Data released by Vattenfall at the middle of 2004 have essentially confirmed these estimates.¹³⁶ A total of 58.745 TWh had been generated in the previous year. Lignite accounted for 91.2% of this figure, or 53.75 TWh.

A significant difference prevails between the power generated and the capacity available to the grid. For instance, the six 500 MW turbines at Jänschwalde equate to a total capacity of 3,000 MW. However, some of this electricity is consumed by dust precipitators and for removing sulfur dioxide from plant flue gases. Additional power is required to drive the mechanized equipment used for delivery and pre-drying of the lignite, which at some plants contains up to 55% water when received from the mine.¹³⁷ Due to internal auxiliary consumption, the grid power capacity at Jänschwalde is only 2,712 MW. The corresponding discrepancy is lower in all other eastern German plants due to their more advanced design. In total, however, more than 15% (1,423 MW) of the available generating capacity is required for drying, dust filtering, and desulfurization (DeSO_x). One-seventh of the lignite mined in eastern Germany is therefore being employed to remove water from the lignite and to prevent the impurities it contains from being emitted with the flue gases.

4.2.8. The Transition from VEAG to Vattenfall

The modernization and new construction of VEAG lignite power plants entailed expenditures of nearly 20 billion deutschmarks, or approximately 10 billion euro. To assist loan repayment, a lignite protection clause (*Braunkohleschutzklausel*) was instituted by the federal government in 1998 as part of its revised Energy Industry Act.¹³⁸ This legislation restricted the accessibility of extraterritorial power traders to customers in eastern Germany until the end of 2003. VEAG and the regional utilities were able to set tariffs in effective disregard of third-party competition. Due to the decline of industrial production in eastern Germany, however, sales turnover proved inadequate for servicing existing debt obligations. Denied further loans from its credit institutes, VEAG declared at the beginning of 2000 that its annual deficit of 1.5 billion deutschmarks (about three quarters of a billion euro) would have to be subsidized either by the corporate owners or the federal government.¹³⁹

By the summer of that same year, the four largest shareholders had merged to form Germany's two major power suppliers, RWE AG and E.ON AG. The Federal Cartel Office (*Bundeskartellamt*) immediately required the VEAG holdings to be relinquished in the interest of fair competition.¹⁴⁰ HEW AG (*Hamburgische Electricitäts-Werke AG*) in Hamburg, a regional power utility owned by Vattenfall, successfully bid for these assets against a number of foreign competitors, including the US-owned Mirant Corporation in the final round.

The German subsidiary Vattenfall Europe AG was incorporated on January 16, 2002, to integrate four formerly independent operations: VEAG, the Berlin utility BEWAG AG & Co. KG (from its earlier name *Berliner Städtische Elektrizitätswerke Aktiengesellschaft*), HEW, and the eastern German lignite mining corporation LAUBAG (*Lausitzer Braunkohle AG*). In exchange for partial debt relief from the federal government, Vattenfall committed itself to selling at least 50 TWh of electrical energy a year from lignite (until 2011) and to insuring employment

and apprentice training in the eastern German power industry.¹⁴¹

Apart from its own municipal utilities in Hamburg and Berlin,¹⁴² Vattenfall conducts its business in Germany primarily through three subsidiaries. Lignite is excavated by Vattenfall Europe Mining AG and delivered to power plants operated by Vattenfall Europe Generation AG & Co. KG. These separate companies are often amalgamated in the public media to become Vattenfall Europe Mining & Generation AG & Co. KG.

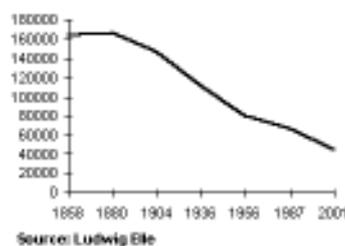
Electrical power is conducted through the high-voltage transmission grid owned by Vattenfall Europe Transmission GmbH, from which sales are made to regional utility companies and to participants of the European Energy Exchange (EEX) in the city of Leipzig. This arrangement differs from that of western Germany, where the major power utilities RWE AG, E.ON AG, and EnBW AG (*Energie Baden-Württemberg AG*) directly serve final customers. These corporations, as well as Vattenfall Europe AG, maintain holdings in both regional and municipal utilities in eastern Germany. BEWAG provides power and district heat to Berlin. Except for HEW serving Hamburg, Vattenfall operations are thus concentrated in eastern Germany.

Although Vattenfall Europe is legally a German stock company (*Aktiengesellschaft*, or AG), it is a subsidiary of the Swedish state corporation Vattenfall AB with only minor third-party shareholders. Vattenfall is the third largest utility company in Germany, after RWE and E.ON, but before EnBW. Power is generated at a number of locations between the region of Hamburg, where the company operates two nuclear power plants, and the Polish border. Lignite accounts for about three-quarters of power production within the corporation. One remaining briquette factory with a yearly output exceeding 500,000 tons is operated at Schwarze Pumpe, a suburb of Spremberg on the Spree River.

4.2.9. Local Mining Populations

Schwarze Pumpe (“black pump”) refers to an episode at the end of the Thirty Years’ War, when the residents of Spremberg allegedly painted their wells black to frighten pillaging Swedish soldiers into believing that the water had been infested by the Plague. The name was later adopted by a local tavern. The byname *Ěorna Pumpa* is used by persons of Slavic extraction, the Sorbs or Wends, whose existence is fatefully intertwined with the Lusatian lignite industry. The Sorbs have cultivated and defended the plains southeast of Berlin along the Spree River since the 7th Century. However, their scrupulous work ethic has been harnessed by the lignite industry to destroy of the very ground they walk upon. Bucket-wheel excavators scoop out megatons of earth in this otherwise inviolate cultural region. For some Sorbs,¹⁴³ this allegiance to *deus ex machina* represents an opportunity to stem the population decline that commenced with industrialization and social mobilization at the end of the 19th Century.

Sorb Population in Germany



At the 4th national congress of the Sorb culture organization *Domowina* in 1957, a resolution was passed to support the construction of the GDR *Kombinat Schwarze Pumpe*.¹⁴⁴ In recent years, however, the ecological and social effects of lignite use have drawn increasing criticism from leaders and literary figures of this dwindling Slavic minority. The Sorbs were ideologically ostracized during the Third Reich and forbidden to use their language in schools or newspapers. These rights were restored by constitutional mandate in the GDR, yet a high number of Sorb settlements were subsequently destroyed by intensified lignite mining (2.6). Vattenfall has shown no willingness to preserve any remaining villages beneath which commercially viable lignite deposits have been determined.

Middle Germany consisted largely of farmland and mercantile centers before the advent of lignite mining. The population of the region increased significantly due to industrial resettlement programs, refugee immigration after World War II, and the intensification of lignite use in the GDR. Since 1990, the reverse process of depopulation has characterized the mining regions. In the city of Borna, for instance, the number of inhabitants declined from about 24,000 in the early 1980's¹⁴⁵ to 17,535 at the end of 2004.¹⁴⁶

5. Destroying Villages for Profit

5.1. Foreign Invasions in Eastern Germany

The history of violent intrusions in the lignite regions begins with prehistoric glaciers that twice swept in from the north and left numerous boulders (called *Findlingen*) of Swedish granite strewn throughout the landscape. The frequent raids of Vikings, or Northmen, in the early Middle Ages were succeeded by peaceful trade and ruling alliances after Christianity had taken hold. Yet irreconcilable religious differences ushered in a new age of horror. In 1415, the Prague professor Jan Hus was summoned by the Council of Constance to defend his criticism of the sale of indulgences,¹⁴⁷ only to be burned at the stake for heresy. His Hussite adherents and the more radical Taborites¹⁴⁸ took up arms against the Roman Catholic Church. Under the leadership of Jan Zizka¹⁴⁹ and Andreas Prokop, the rebels conquered most of Central Europe between Danzig and Vienna, including Brandenburg and Saxony. After the more moderate factions had returned to the Catholic faith, however, the Taborites were finally defeated in 1434.

Renewed opposition to the Church of Rome emerged in 1517, when Martin Luther dispatched 95 theses disputing Papal authority to Albert of Hohenzollern, the Archbishop of Mainz.¹⁵⁰ Soon after Luther's death on February 18, 1546, Middle Germany became a field of battle between the Protestant Schmalkalden Alliance (*Schmalkaldischer Bund*) and the Catholic troops of Charles V, ruler of the Holy Roman Empire. Luther's widow Katharina von Bora fled before the advancing armies, skirting crop failures and pestilence. Escaping the Wittenberg plague in 1552, she plunged into a roadside canal at the fortress city of Torgau¹⁵¹ as the horses of her wagon bolted. Crippled and infirm, her rapid death was mourned by many critics who had detracted her in life. Neither her renouncement of institutionalized humility as a cloistered nun nor her inheritance of Luther's estate harmonized with the ideals of submissive humility propagated for women of the time.

During the Thirty Years' War a century later, Germany became the field of armed conflict between Swedish Lutherans and Bavarian Catholics. To this day, Swedish soldiers are recalled in nursery rhymes as pitiless invaders who ravaged the countryside from the Baltic to Switzerland. "Pomerania is burned up" (*Pommernland ist abgebrannt*) is a widely recited allusion to the scorched earth policy of these marauding troops. "The Swedes came", begins another poem by Franz Magnus Böhme, "and took everything with them. They smashed the windows, took out the lead, cast bullets from it, and shot the farmers dead."¹⁵² Chronicles of the time contain frightening accounts of pillaging, the forceful billeting of soldiers, epidemics, famine, and the annihilation of village fortifications with most of their male defenders. Peasants in southwest Germany fled to sand bars on the Rhine, setting up housekeeping for months while battles raged on the

river plain and in the nearby hills of the Black Forest. In Pomerania and Brandenburg, 50% to 70% of the inhabitants did not outlive the Swedish occupation.

The Swedish army overwhelmed the military forces of the Catholic League in two decisive clashes at Breitenfeld near Leipzig in 1631¹⁵³ and at the nearby town of Lützen the following year. The Swedish king Gustavus II Adolphus, was mortally wounded as he led a regiment into the second battle. His soldiers, enraged by the loss of their sovereign, fought on to victory. A boulder of glacial Swedish stone (called the *Schwedenstein*) engraved with the inscription "GA 1632" was rolled by 13 local farmers to the place believed to be the spot the king had been slain.¹⁵⁴ After a more probable location was later established forty paces closer to the town, an appropriate tract of farmland was cordoned off to keep the site inviolate.



Städten zur Schlacht bei Lützen (16. Nov. 1632).

A cast iron shrine would later be erected next to the boulder in 1837 and a chapel constructed in 1907.¹⁵⁵ Two wooden Swedish-style houses were added to the commemorative site in 1932 and 1982. The memorial at Lützen radiates an aura of inviolate solitude that not only casual visitors, but even the GDR's Marxist government have respected. The final resting place of any fallen soldiers remains hallowed ground to the nation in whose service they fell. Swedish patriots would thus likely find it troubling that 349 million tons of lignite have been registered beneath the locality of Lützen by the mining administration of Saxony-Anhalt.¹⁵⁶

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5.2. Mining Plans on Historic Ground

The MIBRAG mining corporation, which operates the nearby Profen mine, has already announced the intention of building an additional power plant of up to 1,000 MW in the region, but without disclosing the intended source of the 200 million tons of lignite required for 40 years of operation.¹⁵⁷ Lignite extraction at Lützen would be rendered difficult by an intervening stratum of quartzite up to six meters thick. Yet that mineral might be sold for road construction, making excavation a viable commercial perspective. Even if the King Gustavus memorial were somehow preserved, it could be surrounded by the lunar landscapes that are the arenas of lignite extraction.

Any defilement of this historic battlefield would make the Swedish public aware of the destructive power not only of mammoth bucket-wheel excavators, but also of the legal precedents that are capable of subordinating a national heritage to commercial interests. Qualified independent treatments are indispensable to evaluating the cultural, architectural, and environmental relevance of any region before mining activities are licensed. Yet of the few reports available, almost none of them have appeared in the Swedish or English language. In consequence, Vattenfall and MIBRAG shareholders can scarcely discharge the appropriate responsibility of ownership, except to delegate it to company representatives in Germany under the premise of mutually respected values and sensitivities. The validity of that assumption has yet to be demonstrated in a reassuring manner.

5.3. Divestment and Compensation

Lignite mining is conducted according to the Federal Mining Act (*Bundesberggesetz*),¹⁵⁸ which was revised in 1980 under the impression of international oil shortages and the Soviet invasion of Afghanistan that previous year. The fine patchwork of settlements throughout most of Germany might render surface mining impossible without expeditious regulations on divestment and compen-

sation. In Article 79, the compulsory relinquishment of private property to mining companies is prescribed by eminent domain whenever public welfare (*Wohl der Allgemeinheit*, or *Gemeinwohl*) is served, particularly for providing the market with raw materials, securing employment in the mining industry, stabilizing regional economies, or promoting sensible and orderly mining procedures.

Many of these grounds are open to contradictory interpretations. For instance, a proportional relationship is implied between long-term employment and the quantity of lignite mined, since turnover volumes and debt amortization are enhanced by the economies of scale. However, the use of larger machinery lowers the number of jobs in relation to total production tonnage. As has been shown (2.6), mining regions are invariably burdened with above-average unemployment. Smaller mines would reduce the negative effects on the job market, yet the necessary licensing procedures, administrative costs, and selective excavation procedures might render lignite production uneconomical.

At the same time, it is often argued that mining conducted on the widest scale possible will provide the greatest hydrological drainoff for replenishment of water tables and the creation of lakes in former mining regions. This advantage is counterbalanced, however, by the intensified groundwater depletion of the new and generally deeper quarries.

The table below summarizes the effects of mining encroachment on eastern German communities since 1990. The consequences are neither uniform nor in all cases desirable. Three such latter cases, Horno, Lakoma, and Heuersdorf, are treated in sections 5.4 – 5.6.

Eastern German Communities Affected by Lignite Mining Since 1990		
Community	Plan or Pretext	Result
Breunsdorf (Saxony)	Resettlement initiated before 1990	Forced resettlement, dissolution of communal bonds
Dreiskau-Muckern (Saxony)	Resettlement initiated before 1990	Cancellation of MIBRAG mining plans, publicly subsidized village renovation
Geisendorf (Brandenburg)	Resettlement initiated before 1990	Consensual resettlement to Neupetershain
Grießen (Brandenburg)	Circumvented devastation	Peninsular isolation at the Neiße River
Grötsch (Brandenburg)	Partial devastation necessary	Metal protective barrier erected through the community
Großgrμμα (Saxony-Anhalt)	Resettlement initiated before 1990, renovation deemed as costly as resettlement	Publicly subsidized, consensual resettlement to Hohenmölsen
Haidemühl (Saxony)	Consensual resettlement anticipated for 2017	Earlier consensual resettlement to Sellessen due to mining encirclement and isolation
Heuersdorf (Saxony)	Devastation essential to prevent MIBRAG bankruptcy	Disruption of communal bonds, threatened destruction of protected buildings
Horno (Brandenburg)	Devastation essential for Jänschwalde power station	Destruction of architecturally protected village ensemble, forced resettlement to Eulo
Kausche (Brandenburg)	Resettlement initiated before 1990	Consensual resettlement to Drebkau
Lakoma (Brandenburg)	Devastation essential for Jänschwalde power station	Threatened destruction of a Flora-Fauna Habitat
Mühlrose (Saxony)	Circumvented devastation	Isolation from adjacent communities
Schleife (Saxony)	Consensual devastation of parts of Rohne and Mulkwitz suburbs anticipated in 2020	Resettlement in other suburbs
Trebendorf (Saxony)	Consensual devastation of Hinterberg suburb anticipated in 2017	Resettlement in other suburbs
Werbelin (Saxony)	Devastation mandated before 1990	Destruction of architecturally protected village ensemble, followed by cancellation of MIBRAG mining plans

Village resettlements are implemented by providing monetary compensation equivalent to the current market value of properties intended for devastation. This indemnification, which is regulated by Articles 84–90 of the Federal Mining Act, leaves a number of disparities unconsidered.

- Real estate values invariably decline as a result of landscape disfiguration, the effects of environmental degradation and contamination, the unsuitability of mining areas for investment by other commercial enterprises, and the unemployment that persists under these conditions. No compensation is provided to property owners, either in the affected villages or in surrounding communities, to compensate for this enduring loss of equity, nor are adequate programs instituted to alleviate the conditions of excessive unemployment.
- Private individuals may lack the financial resources necessary for a proper legal defense of their property rights, particularly if the required background research entails greater expenditures than those compensated under Paragraph 84 of the Mining Act.
- Resettled families are customarily provided newly constructed housing by the mining companies. This perceived advantage may induce resentment among third parties not availed of similar opportunities.
- With the exception of mining employees, the acceptance of indemnification cannot be construed as personal endorsement of lignite policy.

Property divestment and the resettlement of communities are invariably billed by the lignite industry and its political supporters as victories of human reason and conciliation over inveterate obstinacy. This viewpoint disregards the innate irregularities of the Federal Mining Act itself and the enduring losses it propagates.

5.4. Horno (Rogow) – Ruination of a Sorb Showcase

Horno (*Rogow* in the Sorb language), a village east of Cottbus near the Polish border, was devastated by Vattenfall in 2004 to meet delivery commitments for the Jänschwalde power station. While the deposits of lignite at this location represent only a small fraction of total mining output, the regional lignite committee as well as the Vattenfall predecessors VEAG and LAUBAG maintained that the viability of regional power generation depended crucially on clearing Horno from the path of excavating equipment as it moved north.

Upon recommendation of the responsible state authorities for historic preservation (*Denkmalschutz*), the town council of Horno declared the entire village a protected communal ensemble in April 1993. According to the Constitution of Brandenburg,¹⁵⁹ the integrity of this “established area of settlement” (*angestammtes Siedlungsgebiet*) for the Sorb ethnic minority was likewise “guaranteed” (*gewährleistet*). The Brandenburg State Assembly (*Landtag*) nevertheless passed the controversial “Brown Coal Act”¹⁶⁰ in 1997 that foresaw the destruction of the entire village with resettlement of its 380 inhabitants.



An initial compendium of infringements on communal self-determination was prepared in 1995 by the English author Michael Gromm, an honorary citizen of Horno.¹⁶¹ He subsequently created the website “Vattenfall Watch”¹⁶² to inform the English-speaking international public of the threat to the village. Noting that Sweden has enjoyed “an enviable reputation for environmental protection and the furtherance of human and minority rights”, the Swedish government was cautioned that Vattenfall operated as a state-owned enterprise “whose global activities, in violation of its own ethical principles, are injurious to Swedish interests”.

Because of the lignite protection clause (*Braunkohleschutzklausel*) of 1998 (4.2.8), electrical power tariffs could be set according to internal cost calculations. For that reason, it was rationally impossible to justify the destruction of Horno as necessary for the survival of lignite mining. Yet no opportunity remained for arguing this viewpoint in legal action against the government of Brandenburg.

The state constitutional court had already reaffirmed the legality of the Brown Coal Act in 1998. The European Court of Human Rights in Strasbourg likewise dismissed Horno's claims for preserving existing ethnic integrity in the year 2000.¹⁶³ Finally, the Federal Administrative Court (*Bundesverwaltungsgericht*) rejected a suit filed by the *Grüne Liga* in 2002 that would have required environmental impact assessments of the Jänschwalde and Cottbus North mines to be conducted before any villages could be forcefully resettled.¹⁶⁴ The state mining agency (*Landesbergamt*) successfully defended the standpoint that both mines had been opened by the GDR and therefore required no subsequent environmental impact analyses under terms of the Treaty of Unification.

The *Domowina* continued to demand the preservation of Horno and other settlements. However, many Sorbs are Vattenfall employees for whom devastation enhances job security, albeit at the expense of cultural integrity. Resettled individuals will more likely be assimilated into the German population, weakening and frequently obliterating their ethnic ties. This intractable conflict grimly confirms the acuity of a local proverb: "God created the Lausitz, but the Devil put lignite below it."

In 1987, the Sorb author Jurij Koch had protested at the X. Authors' Congress of the GDR against the unrelenting devastation of landscape and human sensibilities by lignite mining: "With every calorie of warmth that we extract from the earth to waste it thoughtlessly", Koch declared, "it becomes colder around us." A petition signed in the year 2000 for the rescue of Horno by 50 of Germany's most renowned literary and artistic figures, including Christa Wolf, Volker Braun, Nobel laureate Günter Grass, Klaus Staeck, and Daniela Dahn, was disregarded by a German public accustomed to hearing of human rights infringements only on other continents. Yet the former first representative of the Federal Republic to the GDR in the 1970's, the publicist Günter Gaus, had rendered his signature to reprimand the commercial partiality of his own Social Democratic Party (SDP).¹⁶⁵

"If it makes any sense at all to interfere publicly, then one must contemplate visible, concrete objects. This village is one of them. I have therefore once more deviated from my established practice of not signing anything, and have signed. If that bothers the leader of my party, it will make me all the happier. Even if there are economic grounds that are more profitable (that is, if lignite surface mining is allowed to roll over Horno), even if that should be true, one must nevertheless say: Life cannot be ruled entirely by economic imperatives. One must finally stop at some point."

Repeated visits of Swedish parliamentarians and feature articles in newspapers throughout Europe have evoked no change of energy policy in Lusatia. On July 7, 2000, the Czech-Sorb Alliance (*Spolek cesko-luzický*) dumped a handful of lignite in front of the German embassy in Prague as a symbolic donation for "impoverished Germany".¹⁶⁶ Alliance chairman Richard Bigl condemned the economic growth of affluent countries that depended on the destruction of Nature. Ambassador Hagen Lambsdorff (the brother of former German foreign minister Otto Graf Lambsdorff) expressed his gratitude for the peaceful demonstration and promised to inform his ministry in Berlin of the matter. It is not known whether packages of Czech lignite were subsequently part of his diplomatic baggage.

Michael Gromm has shown that initial employment prognoses in the Jänschwalde region were inflated to guarantee the dominant status of lignite power generation, after which occupational opportunities progressively declined.¹⁶⁷

“Firstly, the lie was propagated – and immediately raised to the status of the common weal – that only the destruction of Horno would save jobs in the mining industry. ‘Horno or 30,000 jobs!’ was the battle cry at the end of 1993; a year later, after privatisation: ‘Horno or 12,000 jobs!’; and in 1997, when the Horno Bill was passing through Parliament: ‘Horno or 4,000 jobs!’. The truth is, that more than 90% of jobs in Lausitz brown coal mining in 1990 have since been lost in a never-ending process of rationalization, which has had nothing to do with Horno. In 2005/6, of 57,000 jobs in Lausitz brown coal mining in 1990 just 2,200–2,400 will remain in the Lausitz as a whole, after Vattenfall’s Lars Josefsson has achieved his intended ‘synergie effects’.”

According to Gromm’s chronicle, Chancellor Helmut Kohl initially promised in a speech on the marketplace in Cottbus that no further villages would be resettled in the lignite regions. Brandenburg’s presiding minister, Manfred Stolpe, reaffirmed this policy during a personal visit to Horno in 1991. His environmental minister and successor Matthias Platzeck vehemently defended the village in an interview two years thereafter. Yet the LAUBAG and the IGBCE (Mining, Chemical and Energy Industrial Union, *Industriegewerkschaft Bergbau, Chemie, Energie*), strengthened by the influx both of western capital and of immigrated union officials such as Ulrich Freese (who would be elected to the Brandenburg state assembly in 1994) persuaded the federal government to revoke its earlier promises.

After repeated legal defeats, the people of Horno were resettled to the suburb of Eulo at the nearby city of Forst in 2003. All families were compensated for the loss of property with new homes and land. The subdivision had been laid out to emulate the street layout in Horno, but with modern houses substituted for historic architecture. The Horno church tower was transferred like an Egyptian obelisk captured by a victorious Roman army to the settlement, where it now stands in mute testimony to the broken resistance against the mining corporation. The churchyard graves of villagers and 64 German soldiers killed in futilely defending the western bank of the Neisse River in April 1945 were “rebedded” (*umgebettet*) along with the emotions of their surviving relatives.

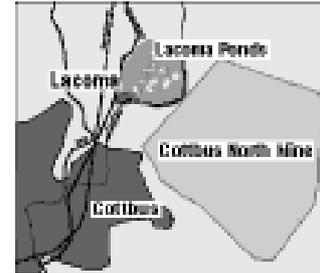
Only one farming couple, Werner and Ursula Domain, and their tenant Michael Gromm elected to remain in Horno. The president of the state mining agency (*Landesbergamt*) threatened to enlist the aid of the German border police to exact forced eviction. Werner Domain was formally dispossessed by the agency on June 9, 2004, with Gromm losing his rights as a lodger. Both filed suit against the decision with the administrative court (*Verwaltungsgericht*) in Cottbus as the village was devastated around them.

A museum dedicated to Lusatian lignite is planned for the “New Horno” (*Neu-Horno*) subdivision in Eulo.¹⁶⁸ This historic project, which was originally intended by residents and the *Domowina* in Horno itself to enrich the cultural life of the village, has now been taken over by the city of Forst and Vattenfall. The corporation is providing financial support of 800,000 euro to realize the project. The museum organizers aspire to document communal destruction and resettlement throughout the lignite regions. By pressing a button at a map of dioramic proportions, the visitor will be able to illuminate each of the 120 villages eliminated by mining since 1924. The chronicle is said not even to omit the darkest pages of this human epic. Included in the planned documentation are the ten suicides recorded in Deutsch-Ossig (a village near Görlitz slated for devastation in the GDR) as the excavating machinery approached. Despite this unflinching dedication to reality, however, the history of resettlement practices will remain incompletely chronicled without the transcripts of telephone conversations between leading politicians and mining executives over the resettlement of Horno.

5.5. Lakoma (Lacoma) – Nature at the Brink of Extermination

Lakoma is a small country settlement six kilometers distant from Cottbus and about 120 kilometers southeast of Berlin. Its name is generally spelled *Lacoma*, implying things sweet or sensually stimulating in Sorb etymology. A waterway dug in 1450 by Franciscan monks to provide water for a forge is appropriately called the *Hammergraben*, the Hammer Ditch. By the end of the 18th Century, an array of manmade ponds (*Teiche*) had been established to provide a livelihood from carp farming, since agriculture yielded only meager harvests on the sandy soil. These artificial wetlands have since become a refuge for a variety of amphibious and land animals rarely found in other parts of Brandenburg. Water birds frequently alight on the twinkling ponds, which are strewn like a handful of gems over this dreamy wooded landscape.

Due to the anticipated devastation by the Cottbus North mine, most of the 143 residents were evacuated and several farmhouses torn down between 1987–90. After lignite power generation had declined in the aftermath of reunification, however, a group of young people reoccupied the remaining buildings. The newly founded Lacoma Society (*Lacoma e.V.*) reached an agreement on inhabitancy rights with LAUBAG, but the contract was defaulted by Vattenfall after the corporation had assumed ownership of mining operations.



In October 2003, a 21-ton Liebherr 912 Litronic excavator rolled into Lacoma escorted by 50 police shock troops (*Bereitschaftspolizei*) and a detachment of firemen. The policemen had been ordered to prevent local residents and demonstrators from interfering with the destruction of the “cultural barn” (*Kulturscheune*) used by the society and local artisans.¹⁶⁹ As additional buildings were torn down, it became apparent that Vattenfall intended to culminate its plan of devastation without waiting for the resolution of outstanding legal and environmental issues.

Draining the Lacoma Ponds would exterminate Brandenburg’s most important population of the red-bellied toad (*Bombina orientalis*), which is Red Listed in Germany as a highly protected species. Due to the ornithological significance of this aquatic biotope, Germany’s largest nature conservation organization NABU (*Naturschutzbund*) has classified it as an Important Bird Area.¹⁷⁰ In all, over 170 endangered plant and animal species are indigenous to the ponds and their surroundings.¹⁷¹

In August 2003, a stable population of rare hermit beetles (*Osmoderma eremita*) was discovered inhabiting several old trees on the banks of the Hammer Ditch. The larvae of this species live in tree hollows and require several years to develop, thus explaining their being overseen in earlier surveys. Being more endangered than even the red-bellied toad, the hermit beetle is listed as a “priority species” in Annex II of the EC Flora-Fauna-Habitat (FFH) Directive.¹⁷² Due to this discovery, the State of Brandenburg was compelled retroactively on December 16, 2003, to register Lacoma for possible inclusion into the Natura 2000 Network that was being established throughout Europe.

Neither the government of Germany nor that of Brandenburg had originally proposed the Hammer Ditch or the Lacoma Ponds for consideration. NABU, the Green League, and the European parliamentarians Elisabeth Schroedter (Germany) and Inger Schörling (Sweden) alerted the European Commission to the impending destruction of the region. In her response to an inquiry received from the parliamentarians,¹⁷³ EC Commissioner Margot Wallström conceded in November 2003 that protection of the endangered toad species was indeed a relevant point of consideration.¹⁷⁴ However, the Commission had finally decided that the region “would not have provided any additional longer-term value to Natura 2000 whatsoever” even if the German government had submitted a pro-

posal for its inclusion. Lignite mining was judged to be primarily in the public interest, and alternative solutions deemed unavailable. Furthermore, Vattenfall had promised to offset the loss of the ponds by compensation measures (*Ausgleichsmaßnahmen*) integral to renaturalization of the Spree River.

The Lacoma Society and the Green League fundamentally oppose this approach. Since lignite is already being transported by rail from other mines to supply the Jänschwalde power station, the shipments could easily be increased to preserve Lacoma. European power generation capacities greatly exceed demand. Under these circumstances, the destruction of the ponds cannot be considered necessary for the public welfare.

It is likewise questionable whether this biotope, which required several centuries to evolve, could be ecologically superseded by the intended reclamation of a 12-kilometer stretch of the Spree River north of Cottbus.¹⁷⁵ The Green League has already noted that the 30,000 square meters of loose stonework planned for stabilizing the riverbed would inherently “denaturalize” it. The deficiency of water in the Spree has resulted from decades of lignite mining, obligating the industry to reinstate the environmental integrity that it has itself compromised. The measures proposed by Vattenfall to compensate for the destruction of Lacoma, however, would reinforce commercial practices detrimental to groundwater and natural habitats.

As a viable alternative to devastation, the Lacoma Society has shown in a comprehensive study¹⁷⁶ that the community could be maintained as a center for the construction of experimental wooden buildings. No compelling necessity is discernible in this plan for establishing such activities specifically over deposits of lignite. The current inhabitants of Lacoma could also hardly claim protection for an indigenous culture that they themselves had transported to the settlement. On the other hand, the inhabitants have successively qualified themselves as guardians of its natural surroundings.

In any potentially protected area, European FFH regulations prohibit measures that might impair ecological quality. Vattenfall operations were already being conducted without a water use permit, which could be issued only after a “water-rights plan assessment process” (*wasserrechtliche Planfeststellungsverfahren*) had been completed by the state mining agency (*Landesbergamt*) at the end of 2004. An environmental impact assessment conforming to EU standards is required as part of this procedure. Yet in disregard of both FFH and water planning regulations, Vattenfall continued uprooting trees and draining groundwater in preparation for mining. In revealing contrast to the earlier compulsory eviction of Lacoma activists, however, not a single policeman now appeared to enforce German and EU laws on protecting endangered wildlife. It is upsetting for the Green League that its most prominent founding member, Matthias Platzeck, has been transfigured from a rugged *Paulus* of the GDR environmental movement to a *Saulus* submissive to the lignite industry as presiding minister of Brandenburg.

In speaking for the Lacoma Society at the Vattenfall stockholders’ meeting on June 17, 2004, Green League chairman René Schuster noted that about 2,000 private citizens had submitted demurrers (*Einwendungen*) critical of the planning assessment.¹⁷⁷ It became necessary for Brandenburg authorities to schedule a three-day public hearing in the industrial exhibition hall of Cottbus to review the numerous complaints received. Adapting the project to accommodate these points might raise the cost of ecological compensation to more than 20 million euro, well over twice the figure originally declared to stockholders the previous year.

Hundreds of property lines would have to be crossed to renaturalize the river and its surroundings. Since precise coordinates of the affected plots were initially unknown, it was necessary to submit appropriately revised plans for subsequent public review (*Auslegung*) between September 9 and October 8, 2004.¹⁷⁸

A number of property owners subsequently formed an interest group to protect the existing landscape. Preparations are being made to file suit against the plans submitted by Vattenfall, should they be approved. The decisions of local authorities may depend on findings of the European Commission concerning the project.

The potential revocation of existing mining plans in order to protect the hermit beetle in its natural environment compounds the uncertainties of regional lignite mining. However, Vattenfall management has remained unapproachable on evaluating lower-risk alternatives.

A unique historic precedent in the United States indicates the wisdom of exploring such opportunities. An imposing statue on the main street of Enterprise, Alabama, depicts a young woman raising an artistically enlarged insect with both arms over her head in veneration. This southern boll weevil (*Anthonomus grandis*) was a prolific insect smaller than a fingernail that ravaged cotton crops from Mexico to Virginia at the beginning of the 20th Century. Rather than surrender to financial ruin, however, the farmers near Enterprise began to cultivate peanuts on their croplands. They were soon able to repay their debts and regain financial security. Cotton farming was not banished from the American Southeast, but the economic prospects of rural regions were greatly improved through diversification.

The people of Enterprise expressed their gratitude to this scourge of agriculture by erecting the boll weevil monument in 1919, said to be the only memorial to an insect pest anywhere in the world. It is possible that Lacoma may one day similarly be indebted to a tiny hermit beetle triumphing over 1,200 ton Vattenfall excavators. Like the scarabs venerated in ancient Egypt,¹⁷⁹ this etymological family would have again demonstrated the mystical power of indefatigable persistence.

5.6. Heuersdorf – A Historic Bastion

Following World War II, the synthetic fuel plant at Böhlen (4.2.2) south of Leipzig was reconstructed and merged in 1952 with mining and power generation to form the socialist *Kombinat* “*Otto Grotewohl*”. Organic chemical manufacturing was continued on the basis of lignite and later petroleum. After German reunification, the plant was purchased by the Buna Sow Leuna Olefinverbund GmbH (BSL), a fully owned subsidiary of the Dow Chemical Company, and established as a site of ethylene production.

At the processing plant in nearby Espenhain, 580 million tons of lignite had been mined between 1937 and 1994, when the facility was closed. The village of Mölbis downwind from the plant had attained a dubious honor in the GDR as the most contaminated locality in Europe. The present district president of Leipzig, Walter Christian Steinbach, and the Mölbis pastor Karl-Heinz Dallmann founded the solidarity fund “One Mark for Espenhain” (*Eine Mark für Espenhain*) to subsidize smokestack filters. By 1990, approximately 80,000 eastern German marks had been donated to the cause by environmentally oriented sympathizers.¹⁸⁰

In 1989, the lignite industry of the Leipzig southern region (*Südraum*) comprised eight large mines, 16 briquette factories, and six major power plants with a total 54,000 employees.¹⁸¹ A century of mining and manufacturing had transformed the area from a pastoral countryside into a bewildering array of quarries, lignite railways (*Kohlebahnen*), power and briquette plants wreathed in clouds of pungent yellow smoke, pipelines snaking through the landscape for supplying district heating to nearby towns, high-voltage transmission lines, ash dumps grown to mountainous proportions, blackened rivers foaming with phenol waste – but also colorful vegetable greenhouses and fish farms that made use of surplus heat from the power plants.

The massive expenditure of lignite energy inherent to these operations was secured at the expense of 65 communities and suburbs uprooted between 1924 and



1990. Appropriately revised lignite planning could have prevented further devastation. The village of Dreiskau-Muckern, largely depopulated by resettlement, was finally rescued by the cessation of operations at Espenhain. Farther south, however, the historic agricultural community of Breunsdorf was demolished by MIBRAG in 1995 for the Schleenhain mine. The government of Saxony designated the neighboring town of Heuersdorf as the next “special sacrifice” (*Sonderopfer*) required in the interest of regional development.

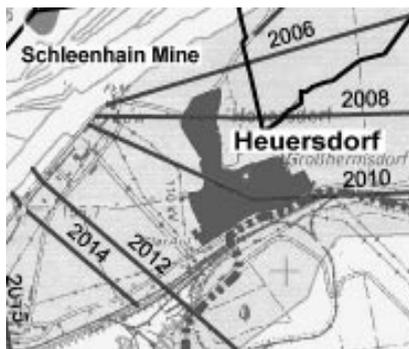
Heuersdorf lies some 30 kilometers south of Leipzig. Over half the 303 inhabitants registered in 1995 have left the village with indemnification provided under the Heuersdorf Agreement,¹⁸² a contract formulated between the Free State of Saxony and MIBRAG in 1995. In addition to the depressed market value of buildings and land, a bonus of 76,694 euro (formerly 150,000 deutschmarks) is provided for each private home that is vacated. This benefit cannot be bequeathed to heirs living outside the village, however. As a result, citizens nearing death have frequently sold their homesteads to the impending monetary advantage of younger relatives. The construction of new houses in Heuersdorf has been prohibited by state authorities, thus constituting another potential factor of resettlement.

Should Heuersdorf ultimately be spared devastation, it would prevail as a community of incalculable historic value. The original settlement was established before 1297, when the existence of the Emmaus Church at the north end of the village was first chronicled. This rugged stone edifice, one of the oldest buildings in Saxony, was constructed with only a few windows near the roofline to serve as both a church and a fortification. More than 40 structures in all, including the 19th Century Tabor Church at the southern edge of the town and farmhouses representing several distinctive historic periods, have been registered by the State Office for the Preservation and Protection of Historic Monuments (*Landesamt für Denkmalschutz*).

Katharina von Bora was born in Lippendorf and lived for a time after Martin Luther’s death in the neighboring hamlet of Zöllsdorf. The Emmaus Church would have been visible south of her farm manor, just as it can be discerned today from the nearby MIBRAG observation point. Zöllsdorf was destroyed in 1981 by the Schleenhain mine, named after a village it had already engulfed in 1964.¹⁸³ Several farmers displaced from Schleenhain moved to Heuersdorf, which endured as a resettlement community even as a second mine advanced toward the opposite end of the town to supply local briquette factories.

The Schleenhain mine was modernized in 1995–99 and expanded to unite three quarries with a total capacity of about 445 million tons connected by conveyor belt to the Lippendorf power station.¹⁸⁴ According to geological surveys, Heuersdorf is situated on a 52 million ton subterranean lignite peninsula at the southern end of the mine. These fuel resources, thermally equivalent to about 19 million tons of hard coal,¹⁸⁵ would permit operation at Lippendorf to be extended by four years, to about 2040.

MIBRAG maintains that the exclusion of Heuersdorf from excavation would bankrupt the company, and that power generation at Lippendorf would have to



be terminated in consequence.¹⁸⁶ Deprived of its district heat, the city of Leipzig would become an icy abode during the winter months. Yet such a development appears highly improbable. Vattenfall could scarcely avoid purchasing the mining operations, immediately reducing fuel costs at Lippendorf by the profit margin and administrative costs currently realized by MIBRAG.

The village council has stressed that preservation of the historic infrastructure (in-

licated by the darkened area on the map) would still allow more than half of the contested lignite to be excavated from the surrounding fields. Measured over the four decades that the United Schleenhain mine is to be operated, the Heuersdorf lignite represents only 2% of total MIBRAG turnover.¹⁸⁷ By contrast, the price for power sold at Lippendorf has already increased by more than 20%.¹⁸⁸

New technologies, such as gas or biomass co-firing at the power station (7.2) or a wind farm of appropriate size, could reduce lignite use and reduce greenhouse gas emissions. If lignite gasification were to be employed at the newly constructed 1,000 MW lignite power plant currently planned by MIBRAG,¹⁸⁹ a coal gas pipeline could be laid to Lippendorf. Since this power plant would require landscape excavation and the possible devastation of additional villages, however, any legal precedent established by the successful opposition of Heuersdorf to mining policy could impede project financing.

VEAG management stated in 1994 that Lippendorf would not be built unless Heuersdorf were resettled.¹⁹⁰ This claim proved to be a fabrication. The completed power station was officially dedicated by German chancellor Gerhard Schröder on June 22, 2000, while Heuersdorf awaited a court judgment that was to overturn the Heuersdorf Law (*Heuersdorfgesetz*) that permitted the village to be “used for the purpose of resource and energy supplies (lignite extraction)”.¹⁹¹

The presiding minister of Saxony at the time, Kurt Biedenkopf, had written to the villagers in 1994 to stress the “public interest in affirming state energy policy”.¹⁹² Yet after presiding over the parliamentary debate on the Heuersdorf Law on March 19, 1998, he disappeared from the assembly chamber. He was later seen in the adjoining cafeteria while the delegates voted on sealing the fate of the town.¹⁹³

On the day before the Heuersdorf Law was passed, MIBRAG chief executive officer David O. Snyder was awarded the Federal Cross of Merit (*Bundesverdienstkreuz*)¹⁹⁴ for conducting operations in the public interest. Any assemblyman still undecided on whether Heuersdorf should be devastated would now be able to recognize where his patriotic duty lay.

Another Cross of Merit was awarded to Snyder’s successor, Bruce DeMarcus, on October 28, 2002.¹⁹⁵ Five days previously, DeMarcus had launched a massive public information campaign for the resettlement of Heuersdorf.¹⁹⁶ The English translation of the MIBRAG press release explained that receiving the Federal Cross of Merit is equivalent to being knighted, although the status of nobility (*Ritterstand*) is not actually conferred. For many inhabitants of Heuersdorf, this implicit reference to medieval robber barons (*Raubritter*) is nevertheless appropriate to their experience with the company.

The claims imposed by MIBRAG on private property have put older villagers in mind of the compulsory collectivization of their farms by the GDR, which was resisted vehemently at the time. In 1958, SED party officials at the nearby Deutzen briquette factory issued a broadside entitled “Do Socialist Perspectives Exist in Heuersdorf?”¹⁹⁷ Many present-day arguments for divesting the villagers of their property seem to have originated during that era. Except for a few party loyalists, it was complained, most comrades were not even participating in the discussion on transforming Heuersdorf into a socialist village. All resources had to be mobilized. Only by proper behavior could manipulation and propaganda by the enemy be refuted, opening the way for progress. The farmers and residents of Heuersdorf were admonished to emulate their neighboring community of Breunsdorf, where socialist agriculture continued to ascend in its development.

Breunsdorf has since been erased from the map by MIBRAG excavating equipment, bolstering the reputation of CEO DeMarcus in managing an efficient but relentless mining enterprise with the best safety record in the industry. The latter achievement was recognized by the State of Saxony-Anhalt in the year 2004 with the Work Safety Prize (*Arbeitsschutzpreis*).¹⁹⁸ Yet the corresponding MIBRAG press release unwittingly revealed a central unresolved issue between

the mining company and the Heuersdorf: “Today, MIBRAG is an example that shows that the promises made by the investors to the privatization agency (Treuhandanstalt) were fully kept.” The substance of these promises and the contract terms imposed by privatization have never been revealed. It can only be assumed that Washington Group International and NRG Energy bought – or thought they were buying – sufficient excavation rights (*Schürfrechte*) for MIBRAG to make deliveries to customers.

The sale was closed by the *Treuhandanstalt* in representing the federal government, but the states of Saxony and Saxony-Anhalt were left responsible for fulfilling crucial terms of contract. The span of four years between the Biedenkopf letter and the Heuersdorf Law verifies that the privatization contract contained neither a legal basis nor a clear concept for resettlement of the village. In consequence, the regional planning authorities and professionally inexperienced local public officials were ultimately entrusted with insuring the profitability of this multinational capital investment.

Under the terms of the devastation law, Heuersdorf was incorporated into the neighboring city of Regis-Breitingen. When the law was overturned by the Constitutional Court of Saxony (*Verfassungsgerichtshof*) on July 14, 2000, the community regained its full sovereignty. The court declared that lignite planning had been performed without fully considering the liberalization of the European power market.¹⁹⁹ The government of Saxony had used a closed-market model to justify the devastation of Heuersdorf. “This model is not tenable”, the court concluded.

Instead of conceding defeat, however, Kurt Biedenkopf immediately announced that a new Heuersdorf Law would be formulated to eliminate the mistakes of the first version. It is notable that a democratic majority of the state assembly had conferred legal status to these blunders. After lengthy hearings and the expenditure of over 300,000 euro for studies on removing the village,²⁰⁰ the revised Heuersdorf Law was passed on April 22, 2004. The town council voted on September 23, 2004, to file suit against this act, a few days before Heuersdorf was again incorporated into Regis-Breitingen.

In November 2003, the High Administrative Court of Saxony (*Oberverwaltungsgericht*) had already upheld a second suit filed by Heuersdorf that contested the legality of the lignite plan (*Braunkohlenplan*). The verdict referred only to formal errors (*Formfehler*) committed by the regional planning authority,²⁰¹ thus leaving objective questions unresolved.²⁰² The revised lignite plan now requires an environmental impact assessment (*Umweltverträglichkeitsprüfung*, or *UVP*). This obligation had previously not been imposed, since the Schleenhain mine was deemed the continuation of a GDR project. The UVP may touch upon various sensitive issues, including hydrological disruption and the storage of excess gypsum at Lippendorf.

A series of scandals forced Kurt Biedenkopf to resign as presiding minister in 2002, but the routine disregard of ethical, social, cultural, and environmental values in the Heuersdorf conflict has been perpetuated by his successor, Georg Milbradt. On September 6, 2004, Milbradt was awarded a “Climate Killer Oscar” by Friends of the Earth for his policies on lignite and his “ruthlessness against a village in Saxony”.²⁰³ The continuation of these practices appears insured by the appointment of Thomas Jurk, a member of the IGBCE miners’ union, to the position of economics minister.

For years, an American flag has flown on the soccer field in Heuersdorf with the blue star-studded field (“union”) turned upside down. According to the official flag code of the United States of America,²⁰⁴ the homeland of both MIBRAG owners, this inverted banner warns of “dire distress in instances of extreme danger to property”, inflicted in this case by two American bearers of the Federal Cross of Merit.

6. Hidden Detriments of Lignite Power Production

6.1. External Costs

Advanced techniques of lignite mining and power generation have been adopted in eastern Germany without exhaustive counter-examinations of possible alternatives. Although a fundamental transition to hard coal was initially planned, it was soon rejected as incongruous with employment priorities in the mining regions. Gas generation has remained restricted to municipal utilities and certain factories, while oil is used for a limited number of smaller installations.

The operation of mine-mouth generating plants has proved to be of competitive advantage over increasingly expensive imported coal, oil, and natural gas. Lignite power stations employing condensation towers for cooling also provide a greater margin of reliability than nuclear power plants along European rivers during hot, dry summer periods. Yet these economic benefits are realized at very high cost.

Comprehensive investigations have identified lignite, hard coal, and oil as the fuels most detrimental to the environment.²⁰⁵ Oil accounts for less than one percent of electricity generation in Germany. Hard coal is either extracted from deep shaft mines or imported, leaving landscapes essentially intact. Therefore, the most extensive ecological burdens are imposed by lignite mining and power generation. These “external costs” (*externe Kosten*) are not factored into market prices, even though they result in the highest societal expenses for producing power.

The European Commission has calculated the following financial impacts on environment and human health due to the various types of power generation employed in Germany.

External Costs of German Power Generation in Cents/kWh (European Commission) ²¹¹							
Coal and Lignite	Oil	Gas	Nuclear	Biomass	Hydro-Electric	Photo-voltaic	Wind
3 - 6	5 - 8	1 - 2	0.2	3	-	0.6	0.05

In 2002, the IER energy research institute at the University of Stuttgart issued a more detailed comparison of external costs for various types of German power generation that distinguished between incurred damages and the costs of prevention. Stuttgart is located in the state of Baden-Württemberg, which has no

External Costs of German Lignite Power Generation in Cents/kWh Compared with Other Energy Sources (IER Stuttgart) ²¹²							
<i>Damage Costs</i>							
Human health	0.81-0.87	1.13-1.20	0.41	0.10-0.11	0.61-0.79	0.07-0.18	0.06-0.10
Grain production	0.01-0.02	-0.002 (cost reduction)	0.031	0.000	-0.003	-0.001	0.000
Material	0.01	0.01-0.02	0.006	0.002	0.01	0.002	0.002
Greenhouse effect	0.19	0.24-0.25	0.09	0.004	0.05-0.08	0.01	0.007
<i>Prevention Costs</i>							
Acid rain Eutrophication	0.44-0.47	0.52-0.55	0.20	0.06	0.39-0.48	0.04-0.11	0.04-0.06
Greenhouse effect	1.50-1.59	1.86-2.00	0.73	0.03	0.37-0.63	0.06-0.11	0.05-0.06
Total	1.45-2.96	1.89-3.77	0.74-1.38	0.16-0.29	1.05-1.92	0.13-0.40	0.11-0.21

domestic fossil fuel resources but a number of nuclear power stations.

In the case of nuclear power, little or no indemnity appears to have been ascribed to the potential dangers of accidents or terrorist attacks. The greenhouse gas emissions produced during uranium mining, fuel processing, and radioactive waste disposal are also incompletely reflected, since only damages within Germany have been considered.

A study²⁰⁶ released by the German environmental ministry in October 2004 has indicated that hidden costs make lignite far more expensive than previously recognized. Lignite power production has been traditionally exempt from taxes levied on gas generating plants, and mining is likewise not subject to fees for groundwater depletion. The aggregate of fiscal benefits resulting from both explicit and implicit subsidies for lignite approaches one billion euro per year. Indirect costs due to environmental and health detriments have been estimated at a minimum of 3.5 billion euro annually. The total financial burdens could lie as high as 35 billion euro per year after the comprehensive effects of climate change have been included.

Cluster	Subsidies (in a broader sense) ^a
1. Support of re-locations	n.q. ^b
2. Support of investment by direct financial aid, tax reductions etc. - Explicit subsidies - Implicit subsidies (compared to electricity production with natural gas): - New lignite fired power plants - Existing power plants Total subsidies:	min. 12 million euro/yr 2.67 euro/MWh electricity ^c 590 million euro/yr min. 602 million euro/yr
3. Conditions of privatization and support of investment in favour of East-German lignite industry (support <i>only</i> for East-German lignite): - Lignite fired power plants of VEAG - Lignite mining companies and other lignite fired power plants etc.	min. 150 million euro/yr ^f n.q. ^d
4. Indirect support of sales (mainly East-Germany)	n.q. ^d
5. Expenditure for public administration and regulation of lignite industry	n.q. ^e
6. Use of finite resources free of charge or at reduced rates	min. 202 million euro/yr
SUBTOTAL (without external effects)	minimum: ca 960 million euro/year^g plus items not quantified
7. External effects	mimimum: 3,520 million euro/yr plus effects not quantified
TOTAL	minimum: ca 4,500 million euro/year^g plus items not quantified

Of course the support of lignite industry creates significant public and social benefits, as for example new jobs, increase of the national product, tax payments and the demand for materials and services. These aspects are not subject of this short study.

^a Further details and explanations on the subsidy concept followed are to be found in Chapters 2 and 3 of the study. All details and data sources are documented in Annex A to this short study.

^b We were not able to quantify this item due to time and budget restrictions and the nature of this short study. There are also methodological problems to define the share of subventions.

^c The absolute volume of the subsidies depends on the number and size of future new power plants.

^d We were not able to quantify this item due to time and budget restrictions and the nature of this short study. However, all examples found were finished in the past. They are still having influence but in general are not to be changed any more in the future.

^e The total maximum is at about 3.75 million euro/year. However the share of subsidies and a possible relative benefit of lignite mining industry because of relatively high administrative costs could not be determined in the course of this short study.

^f From this support benefits only East-German lignite industry.

^g 150 million euro/year of this are accountable for East-German lignite industry only. Most of these are not to be changed any more in the future.

Source: own calculations / Wuppertal Institute 2004.

These compilations translate to indirect costs of 2.2–21.7 cents/kWh,²⁰⁷ to which subsidies of 0.6 cents/kWh would have to be added. The IER figures have thus essentially been confirmed as a conservative estimate, while substantially greater financial burdens are indicated for coming generations. The table on previous page, reproduced from the English abstract of the study, summarizes the cost appraisals made and notes remaining areas of uncertainty.

According to calculations of the German Institute for Economic Research (*Deutsches Institut für Wirtschaftsforschung, DIW*), the costs of climate change in Germany due to natural catastrophes could accumulate to 137 billion dollars by the year 2050.²⁰⁸ The worldwide financial burdens would have attained a level of approximately two trillion dollars by the same time. At present, it is impossible to foresee what program or agenda might insure the equitable distribution of indemnity throughout the international community of nations. Emissions from point sources are difficult to translate to diffuse interactions within the biosphere, particularly when human complacency prevails as a crucial factor of incurred damages.

If the 834 million tons of CO₂ registered for Germany in 2004 were to be emitted in each subsequent year, the total contribution to atmospheric CO₂ concentrations between 2004 and 2050 would amount to nearly 40 billion tons. Under the prevailing assumption that CO₂ emissions make up 87% of the total greenhouse gas contribution,²⁰⁹ a corresponding damage quota in 2050 of 119 billion dollars is indicated. Every ton of CO₂ introduced by Germany into the Earth's atmosphere could therefore be predictive of three dollars, or about 2.5 euro worth of catastrophic damages due to weather aberrations and other climate-related developments.

The myriad correlations between Germany and other countries for both produced emissions and ensuing damages would be difficult to establish. Possible legal action against industrialized countries and individual corporations could become entangled in controversy over the routine public licensing of emissions sources, and over the verifiable relationships between natural and anthropogenic influences on climate events. A comprehensive global accounting system could not neglect the milder climates and longer growing seasons beneficial to particular regions, yet humanitarian transfers of newly gained wealth to impoverished nations would be audacious to presume.

6.2. The Contribution of Lignite to Climate Change

Since lignite emits more of CO₂ during combustion than any other fossil fuel (2.3), it is pertinent to determine its effects on global warming and other alterations of the natural climate. The specific CO₂ emissions produced by lignite (the amount of carbon dioxide emitted per unit of thermal energy) are moderately higher than those of oil products and of other varieties of coal. Natural gas, by comparison, releases only half the CO₂ of lignite when burned. However, natural gas consists largely of methane (CH₄), a volatile gas with 21 times the global warming potential (GWP) of carbon dioxide. In the case of undetected or tolerated emissions during production, transmission, or storage, the specific climate effects of natural gas rapidly increase and may exceed those of all other fuels.

In consequence, no substantial grounds exist for singling out lignite as a particularly insidious source of greenhouse gases. Most power plants are located next to the mines, avoiding the CO₂ emissions that would otherwise be produced in fuel transport. Lignite contributes to less than 3% of commercial energy consumption worldwide (1.1), therefore excluding it as a major direct cause of global warming.

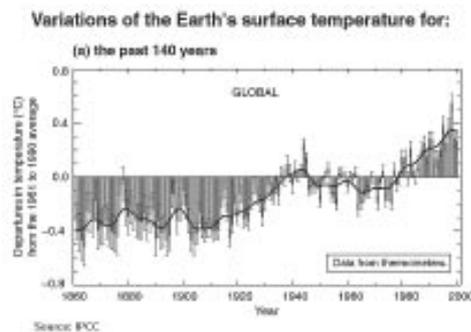
On the other hand, the lignite industry propagates numerous impediments to climate protection policy. As has been shown (4.2.7), the base-load power plants in eastern Germany often generate electrical power at times during which no adequate market demand prevails. Even when with the generating efficiency of

over 40% attained by modern plants, less than one-third of the energy contained in crude lignite may ultimately reach the customer in the form of electricity.²¹⁰ Two-thirds of the CO₂ emissions are thus ascribable to energy that is wasted. Until this remarkably ineffective use of resources is remedied, it can encourage imitative negligence in other sectors of the economy and in other countries.

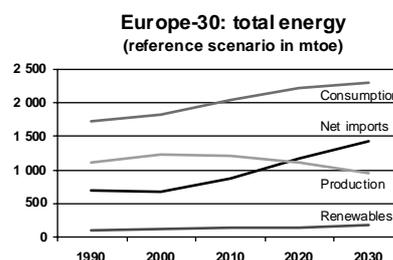
6.3. Cumulative Effects of Greenhouse Gas Emissions

A geophysical mechanism of atmospheric temperature regulation was postulated two centuries ago by the French physicist Jean-Baptiste Fourier in his “General Remarks on the Temperature of the Terrestrial Globe and Planetary Spaces”.²¹¹ The “greenhouse effect” he metaphorically described was widely regarded as a prospective improvement over the cool European climate of the day. Near the end of the 19th Century, the Swedish scientist Svante Arrhenius investigated the expectable temperature increase of the Earth’s atmosphere caused by doubling carbon dioxide concentrations from fossil fuels.

Arctic ice core samples and annual tree rings indicate a general, while not altogether consistent, correlation between CO₂ concentrations in the Earth’s atmosphere and prevailing temperatures at ground level. As shown in the graph from the Intergovernmental Panel on Climate Change (IPCC) of the United Nations, the average surface temperatures over land and water have been increasing steadily since the beginning of the Industrial Age.²¹² This trend corresponds with increased emissions produced by the combustion of fossil fuels, suggesting a likely causal relationship. Further corroborations of global warming are provided by receding glaciers in low-latitude regions, altered migratory bird habits, earlier growing seasons, and unusually severe weather conditions. Even the moderate change of average atmospheric temperature near the Earth’s surface to date – about 0.6°C – constitutes a significant increase of the terrestrial energy balance.

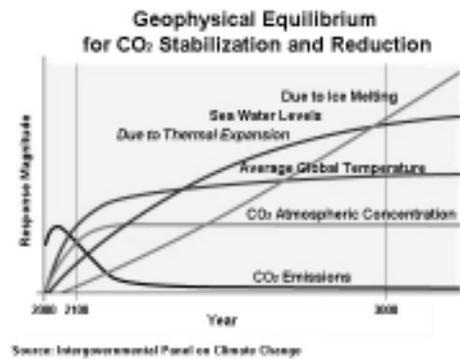


The most recent assessments indicate that global emissions will be increasing by 15% per decade if present trends of energy use continue, doubling to 16 billion tons of carbon (or nearly 60 billion tons of CO₂) in the atmosphere by 2050.²¹³ Even the European objective of attaining a 20% renewable energy quota by 2020,²¹⁴ if adopted worldwide, would be insufficient to counteract the predicted increases in fossil-fuel use. The corresponding development for Europe alone, in which comparatively modest increases in consumption are expected, is indicated in the diagram. In the ideal case that all emissions could be immediately curtailed, global temperatures would still continue to rise due to greenhouse gases that had already entered the atmosphere. Blocking the sun’s rays using suspended aerosols or reflectors in outer space, as has been variously proposed, could induce new conditions of human inequity due to the effects on agriculture and water supplies.



Worldwide observations on climate-induced environmental degeneration have been corroborated by computer modeling.²¹⁵ Within the boundaries of scientific confidence, the enduring effects of anthropogenic CO₂ emissions can be readily extrapolated from the growing international dependency on fossil fuels. Only in the 22nd Century could the combination of resource shortages and renewable

energy technologies, as well as possibly nuclear power and CO₂ capture (sequestration) finally cause carbon dioxide emissions to decline significantly. By that time, however, enough carbon will have been released by fossil fuel combustion to cause prolonged warming of the Earth's atmosphere for well over a millennium. Under these conditions, any reduction of anthropogenic greenhouse gases will be ineffective against continually rising sea levels and melting glacial ice.



While the global repercussions of increased CO₂ concentrations will endure indefinitely, the half-life (*Halbwertszeit*) expressing the decay of added amounts of carbon dioxide in the Earth's atmosphere has been determined by the IPCC to be only 120 years. An equilibrium model derived by Peter Dietze at the University of Würzburg has reduced this figure to a mere 38 years.²¹⁶ Under the latter assumption, the concentration of current additional amounts of atmospheric CO₂ will already have been reduced to 44% by the year 2050. Nevertheless, the prevalence of these exponentially diminishing quantities over a time-span of four decades will exert a greater differential influence on the progress of global warming than all further additions of CO₂ in the years to come, which can begin to act only after they have first entered the ecosystem. Since only future emissions could be taxed or otherwise regulated, the contribution of earlier carbon discharges into the atmosphere would remain unaffected by climate change policy.

By extrapolating present temperature trends, the continued use of coal, natural gas, and oil could severely endanger the conditions of survival for many higher-order animal species. A recent study of the International Rice Research Institute has likewise indicated that the productivity of rice fields may decline by 15% due to an increase of one degree Celsius in mean daily temperature.²¹⁷

Ocean coastlines and areas of sparse vegetation are already imperiled by rising sea levels and regional declines in precipitation. Faced with the prospect of irreversible global warming, industrial societies are pursuing various strategies that include emissions mitigation, land use and water management, crop adaptation, and disaster defense. The widespread adoption of these approaches appears to represent the only means of countering global warming on an appropriate scale.

□ Great Britain intends to reduce its CO₂ emissions by 60% by the year 2050.²¹⁸ New discoveries of North Sea gas and oil have fallen behind production levels, so that most fossil fuel resources will be depleted in the course of this century. The effects of global warming are inducing dramatic changes in the natural environment. Migratory birds return days earlier from their winter habitats, if indeed they leave the islands at all. Other bird populations are disappearing from certain regions due to dislocations of their food chains. Tuna may soon be as common as codfish off the Scottish coast. Within 60 years, English forests will likely be dominated by new tree species presently indigenous to southern Europe.

□ In North America, the governors of the six New England States and the premiers of the five Eastern Canadian Provinces have passed a joint action plan on climate protection stipulating a CO₂ reduction of 10% by 2020 (compared with 1990) and 75% to 85% long-term.²¹⁹ Instrumental to the resolution has been the predicted climate-related disappearance of sugar maple trees, which are the foundation of the indigenous maple sugar industry and also provide Canada with its national symbol, the maple leaf. Several states and private individuals have filed suit against the United States government for the failure to reduce greenhouse

gas emissions, thus enhancing the likelihood of climate-related economic losses. The State of New Jersey has formally declared carbon dioxide an air pollutant.

□ The Australian Climate Group, an alliance of scientists, the finance sector, and the World Wide Fund For Nature (WWF), has warned that “Australia will increasingly suffer from water problems, extreme weather events, and natural disasters such as floods and droughts if it fails to cut its greenhouse gas emissions – amongst the highest in the world – by 60 per cent by 2050”.²²⁰ Nevertheless, Australia has not ratified the Kyoto Protocol, while it is the world’s largest coal exporter. The government has implemented a compensatory zoning plan to enhance protection of the Great Barrier Reef, parts of which have already been destroyed by warming trends and the acidification of ocean water by atmospheric carbon dioxide. Coral reefs are the most diverse marine ecosystems on the planet with up to nine million plant and animal species.²²¹

As the effects of climate change begin to imperil the existence of industrial economies, responsible governments can only hope to persuade other countries by good example into a strategy of beneficial participation. Germany is withdrawing from meeting this challenge, in part due to the reliance on lignite power production.

6.4. True Lies – German Climate Protection Policy

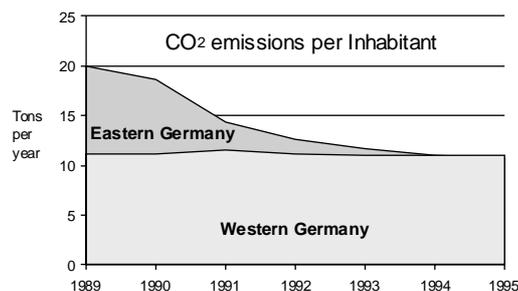
By 1979, global warming had been acknowledged a serious threat to human civilization at the first World Climate Conference in Geneva. The anticipated changes in the biosphere were quantified in 1985 at an international UNEP conference on the greenhouse effect. Alarmed by these findings, the German Parliament assigned an Enquête Commission in 1987 to study preventative measures for protecting the Earth’s atmosphere (expressed in its title *Vorsorge zum Schutz der Erdatmosphäre*). When it had completed its work in 1990, the federal cabinet declared a 25% reduction target for energy-related CO₂ emissions by 2005, with 1987 serving as the reference year. Since this resolution was issued on June 13, it applied only to western Germany. The GDR was still a sovereign power at that time, while the terms of national reunification continued to be negotiated with the Four Allied Powers.

After unification had been enacted on the 3rd of October, the climate protection resolution was extended on November 7 to include the new German states. With about 20 tons of CO₂ per inhabitant, emissions in the GDR had been nearly twice those per capita of the former Federal Republic.²²² The reduction target for western Germany by 2005 was modified to “25% to 30%”. Unspecified but far greater CO₂ emissions reductions were declared for eastern Germany.

The almost immediate decline of many manufacturing enterprises in the east led to a rapid drop in emissions levels. Surviving companies and new businesses installed energy-efficient furnaces using either natural gas or oil. Insulated windows and central heating systems were installed in the majority of private homes and apartment complexes, often with low-interest loans provided by the Credit Institution for Reconstruction (*Kreditanstalt für Wiederaufbau*) under its climate protection program.

In view of the unabated diminishment of fossil fuel consumption in eastern Germany, the fulfillment of national CO₂ reduction goals by 2005 appeared to be an almost effortless task. Numerous opportunities for enhancing resource efficiency in the west were habitually ignored. The energy researchers Martin Jänicke and Lutz Mez have

termed this paralytic state a “self-destructive success” (*sich selbst zerstörender*



Erfolg)²²³ that forestalled and ultimately prevented the fulfillment of Germany's self-imposed climate protection goals.

After 1995, CO₂ emissions from both parts of the country were added together in compiling the federal statistics. A 25% reduction target now applied for all of Germany, with the reference year advanced to 1990. This policy masked the fact that little progress had been made in reducing energy consumption in the former Federal Republic, while the use of carbon-based fuels in the new German states had declined to approximately the level prevailing in the west. The original intention of pursuing different strategies appropriate individually to Eastern and Western Europe was thus abandoned in favor of combined CO₂ bookkeeping. While a "vanguard role" (*Vorreiterrolle*)²²⁴ continued to be claimed for climate protection policy, this mixed-history approach was no longer appropriate for any other national situation, with the possible exception of a unified Korea.

The failure to implement the energy conservation measures originally intended in 1990 for western Germany has since become a precedent for neglecting technological options under the rules of global emissions trading. The practice of combined bookkeeping is being propagated internationally under joint implementation procedures without consideration of the technological impediments it fosters wherever comparatively moderate, but nevertheless considerable emission levels remain tolerated. Since it is likely that countries will aim for the highest levels of fossil fuel consumption compatible with anticipated economic sanctions, appropriate strategies of resource conservation will not be realized.

Germany's former ruling coalition of Christian Democrats (CDU), Free Socialists (CSU) and Free Democrats (FDP) under Chancellor Helmut Kohl entrusted nuclear energy with one-third of electrical power generation. The correspondingly low industry-wide levels of CO₂ per kilowatt-hour (kWh) masked the particularly high emissions of carbon dioxide (roughly one kilogram per kWh) inherent to lignite generating plants, which provide nearly the same electrical energy to the national grid as nuclear power.

In 1998, the newly elected government of Social Democrats (SPD) and the Green Party (*Bündnis 90/Die Grünen*) adopted a coalition agreement that included the termination of nuclear power generation. Intensive negotiations with plant operators resulted in the passage of legislation in 2002 that foresaw a graduated nuclear phase-out over a period of about two decades.²²⁵ This circumstance presented an unprecedented challenge to climate protection policy. It would now be necessary to replace all 19 atomic plants in operation by equivalent energy services, but without increasing CO₂ emissions.

A wide variety of measures were instituted for limiting the production of greenhouse gases, including the ecological reform of the tax system (*ökologische Stueuerreform*), the Law on Combined Heat and Power (*Kraft-Wärme-Kopplungs-Gesetz*), the Energy Conservation Ordinance (*Energieeinsparverordnung*), a public funding program for reducing CO₂ emissions in buildings, and improved feed-in legislation for renewable energies (the most recent version of which is called the Renewable Energies Act, or *Erneuerbare-Energien-Gesetz EEG*). Feed-in laws have firmly established Germany as the world leader in renewable energy technologies. By the end of 2004, 16,543 wind turbines²²⁶ and a solar photovoltaic capacity exceeding 600 MW²²⁷ provided tangible evidence of popular support for climate protection policy, particularly since most of these installations had been realized by private investors.

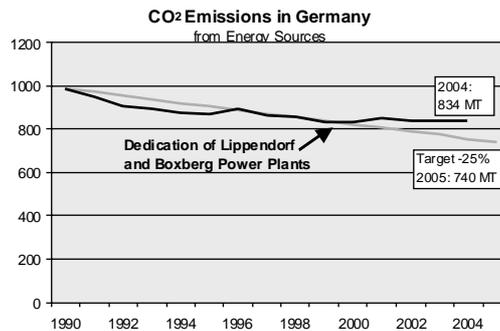
Germany remained on target in meeting its national CO₂ reduction goal only until 1999. In the following year, emissions levels increased dramatically because of new lignite generating capacities in eastern Germany. Two identical plants, each with a generator power rating of 920 MW, went into operation in Lippendorf near Leipzig. Block R (Region) is owned by Vattenfall, while Block S (South) belongs to two western German utilities, E.ON and EnBW. In Boxberg, a 900 MW

plant was added to the two Vattenfall 500 MW blocks already in operation. Two 800 MW precursor plants at Schwarze Pumpe had already been commissioned at the end of 1997, while the Schkopau power station with a total of 980 MW was dedicated in 1995.

As a rough guide, a 900 MW plant requires up to six million tons of lignite a year in base-load operation. The combustion of one ton of lignite produces about one ton of carbon dioxide (2.3), or somewhat more for the high-carbon lignite in Middle Germany. Germany's greenhouse gas diverged dramatically from meeting emissions targets when the new plants at Lippendorf and Boxberg almost simultaneously went on line.

In the years following 2000, CO₂ emissions levels have stabilized, leaving no prospect of meeting the 25% reduction target in 2005.²²⁸

The decisive contribution of the Lippendorf and Boxberg plants to this result has prompted no energy or climate policy changes. In June 2002, the government in fact continued to maintain that "carbon dioxide emissions are to be reduced by 25% in the period between 1990 and 2005."²²⁹



A year later, however, the opposition parties CDU and CSU petitioned the federal government to state its official position on the progress and costs of CO₂ reduction. The convoluted response²³⁰ issued by the environmental ministry included no admission of recent failures. Instead, the climate protection strategy of the former CDU/CSU/FDP administration was in effect declared a miscalculation, even though the corresponding emissions goal had been adopted and pursued by the new government itself for the previous four-year legislative period. "The CO₂ reduction target formulated by the chancellor of the time, Dr. Helmut Kohl", the ministry declared, "complies neither in its temporal dimension nor in reference to greenhouse gases with international and European climate protection policy."²³¹ Yet the government had acceded to less ambitious goals, rather than surpassing the objectives of the former administration. International requirements now required a mixture of six greenhouse gas emissions to be reduced in Germany by only 21% by 2008 to 2012, compared with 1990.

The lack of interest of the public media for this departure from the climate protection baseline confirmed its ultimate irrelevance to energy policy. All federal administrations since 1990 had relied on the assurances of industry to reduce CO₂ emissions voluntarily to a sufficient degree. Germany had initially pursued its climate protection initiatives without any guarantee that other nations would follow. There could now be no credence to the argument that it was legitimate to relax domestic efforts once international accords had been achieved. On the contrary, the competitive disadvantages of a "sole initiative" (*Alleingang*) had been alleviated by these multilateral commitments. Nevertheless, the director of emissions trading at the federal environmental ministry, Franzjosef Schafhausen, declared at the beginning of 2005 that "it is not certain that Germany will meet its target".²³² In the years 1999–2002, the annual CO₂ emissions of the energy sector had actually increased by 22.4 million tons.

The IPCC has estimated that even complete attainment of the Kyoto objectives would diminish the Earth's temperature by only 0.15 degrees Celsius (°C). Compared with the forecast rise of 1.4 to 5.8°C by 2100, this result is essentially negligible, delaying the incidence of critical global warming thresholds at most by only a few years. At the same time, the long-term nature of commitments made under the agreement will likely impede more effective measures for counteracting the effects of climate change.

6.5. Early Actions after the Fact

In order to minimize the costs of achieving CO₂ reductions using free market mechanisms, the European Parliament instituted the Emissions Trading System (ETS) beginning in 2005 for all fossil fuel generators over 20 MW.²³³ An emissions ceiling is set by issuing an appropriate quantity of free emissions allowances to each of the participating facility operators. The distribution quantities are contained in the National Allocation Plan that each member state has been required to submit to the EU.

As long as any state has not yet fulfilled its reduction obligations, its allowances are successively diminished. Additional trading rights must therefore be purchased to continue full operation of all facilities. Older plants with the highest emissions per generated kilowatt-hour will likely be taken out of service when fewer allowances become available, since the allowances themselves can be sold at greater profit.

According to the parliamentary directive, investments made in CO₂ reduction or in efficiency measures before trading begins may receive consideration as early actions. Benchmarks have been derived from reference documents that reflect the best available technologies for that purpose. In this way, companies that have invested in reducing emissions ahead of schedule will not be penalized with lower allowances.

In the cabinet resolution on the German National Allocation Plan, the criteria for recognizing these measures were originally specified in Section 4.1 as follows:²³⁴

“A compliance factor of 1 may, on application, be applied to existing installations which have been modernised and to newly built installations if (re-)commissioning occurred between 1 January 1996 and 31 December 2002. Existing installations qualify as early action installations if they can demonstrate a predefined reduction in specific CO₂ emissions, provided that these reductions were not achieved simply by decommissioning plant and/or a decline in productive output. Moreover, measures to reduce specific emissions will not be ranked as early action measures if they were substantially funded by public means or if they would have been required in any case due to legal stipulations.”

Since all lignite power stations in eastern Germany had been refurbished or replaced by state-of-the-art designs, Vattenfall negotiated with the federal environmental ministry for their full recognition as early actions. At first, this effort met with only partial success.

On April 8, 2004, it was reported that additional allowances would have to be purchased at a cost of 160 million euro to keep the power plants running during the trading period from 2005 to 2012.²³⁵ Of that amount, 88 million euro were required at Jänschwalde and Boxberg for the eight refurbished 500 MW plants at these two locations. Another 50 million euro would be needed for the modern facilities at Boxberg, Schwarze Pumpe, and Lippendorf.

These costs appeared justified under the National Allocation Plan. The 500 MW plants at Jänschwalde and Boxberg had been modernized in 1994, previous to the time frame set for early actions. Both these and all new plants at the remaining locations complied with standards that “would have been required in any case due to legal stipulations”. This circumstance had been unambiguously stipulated by the German Treaty of Unification in 1990:²³⁶

“(I)t is the task of the lawmakers to (...) promote the unity of ecological conditions of existence at a high, but at least equal level to that which has been achieved in the Federal Republic of Germany.”

It therefore would have been impossible for a substandard lignite power plant to be licensed in eastern Germany.

Strict interpretation of the National Allocation Plan provided Vattenfall no for-

mal reason to object to the necessary purchase of CO₂ emissions allowances. In the eight years beginning with 2005, furthermore, these plants would be delivering 466 billion kilowatt-hours of electricity to the national grid.

While the 138 million euro quoted is an appreciable sum, it represents less than one percent of the turnover Vattenfall should be realizing from power sales at the current grid price for base-load power of more than 3 cents/kWh. Since other power utilities will likewise be burdened by emissions trading, no unilateral disadvantage for Vattenfall is apparent. After subsequent negotiations, however, the German government extended the time frame of early actions to include all measures after January 1, 1994.²³⁷ This revision eliminated the need for Vattenfall to purchase any allowances during the first trading period of 2005–2007.²³⁸ Furthermore, Vattenfall Europe's head of media relations, Peter Poppe, expressed the hope that modernization efforts would be recognized for the second period between 2008 and 2012: "Under the current plan we would have to buy additional CO₂ credits for around 20 million euro per year in the second period despite the fact that Vattenfall has already cut more CO₂ than our rivals face for the period to 2012."

In essence, Vattenfall did not desire to participate in CO₂ emissions trading at all. It instead intended to plead for immunity from any climate protection restrictions until the end of 2012, with the exception of new plant construction. Even in that case, special considerations were expected. At the annual stockholders' meeting on June 17, 2004, Vattenfall Europe board chairman Dr. Klaus Rauscher announced the investigation of an additional lignite power plant block in Boxberg as well as a new coal power station near Hamburg.²³⁹ Yet the realization of these projects was to depend on an appropriate "political framework", indicating the intention to construct the power plants only if not competitively burdened by emissions trading.

The political concessions provided to Vattenfall under the National Allocation Plan remain questionable for a number of reasons.

1. *Ex post facto* status of "early action". During the 1990's, the predecessor company VEAG did not include CO₂ emissions ceilings into considerations of new plant construction. On the contrary, an additional power plant was projected for Boxberg in 1991,²⁴⁰ where the GDR's largest (3,520 MW) power station had been in operation. A 700 MW coal-fired plant was also planned in Stendal at the abandoned construction site of a Soviet-type nuclear power plant. The realization of both these projects would have raised annual CO₂ emissions by about 13 million tons. VEAG also considered the construction of a gas-powered power plant at Lubmin.

2. Disregard of the Treaty of Unification. As previously noted, the Treaty of Unification requires environmental conditions in eastern Germany to be at least equivalent to those of the former Federal Republic. Therefore, the new construction or modernization of Vattenfall power plants in no case should qualify as an early action, since they could not otherwise have been commissioned. The same holds true for other power plants in the new German states. Their operators, such as the Leipzig Municipal Utilities (*Stadtwerke Leipzig GmbH*), applied for recognition of early actions only after Vattenfall had been accorded special consideration for its power plants.²⁴¹

3. Political Collusion. The power stations planned by VEAG in 1991 were supported unanimously by federal and state governments. No political conditions were imposed to restrict the use of lignite in eastern Germany despite the climate protection targets valid at the time. In western Germany, CO₂ emissions per capita (assuming a stable population) were supposed to be declining from 11.1 tons in 1990 to 8.3 tons in 2005, a 25% reduction. Eastern Germany was expected to achieve even lower CO₂ levels. Its least stringent target would likewise have been 8.3 tons per inhabitant, or roughly 140 million tons entirely, in

minimum conformance with the Treaty of Unification. Yet VEAG and other power plant operators were able to disregard this objective without penalty. Had the emissions targets been strictly enforced, the 100 million tons of lignite intended for use in 2005 by RWE would have produced one-fifth of permissible western German CO₂ emissions. In eastern Germany, over 85 million tons of lignite (today's 80 million tons, plus the additional power plant planned for Boxberg) would be accounting for fully two-thirds of the carbon dioxide targeted for that part of the country. Under these circumstances, the use of alternative energy technologies would have been unavoidable. By condoning this implicit violation of its own climate protection policy, however, the federal government forestalled an appropriate innovative development in the new German states.

4. Neglect of CO₂ Reduction Opportunities. The dominance of lignite base-load power generation has caused particular technological options to remain underrated in avoiding CO₂ emissions. The high potentials of combined heat and power (CHP) and of biomass applications have been pursued only in isolated cases, and under the condition that jobs associated with lignite power generation would not be endangered.

5. Funding of lignite power plants "by public means". To insure the continued viability of lignite power production in the new German states, a lignite protection clause (*Braunkohleschutzklausel*) was included in the revised Energy Industry Act (*Energiewirtschaftsgesetz*) of 1998.²⁴² Under this provision, at least 70% of the electricity in eastern Germany had to be generated with lignite. Grid operators could refuse transmission access to other power companies to enforce this policy, severely restricting the liberalized market conditions that the new energy law was intended to guarantee. Eastern German customers were instead subjected to excessive local tariffs by legislative mandate to help fund the lignite power plants. This measure assumed the same stature as a public subsidy for the owners of these facilities. The lignite industry also routinely benefits from a number of indirect subsidies and the exclusion of indirect costs from power tariffs (6.1). Germany has delayed implementation of a directive of the European Commission to eliminate all taxes on electrical power by the end of 2003, although its implementation is imminent.

Varying Efficiency of Lignite Use. A primary objective pursued by the EU Directive on emissions trading is "to encourage the use of more energyefficient technologies, including combined heat and power technology, producing less emissions per unit of output".²⁴³ Generating plants that utilize the waste heat of combustion while producing electric power employ their fuel more efficiently. The directive implies that they will be provided with greater CO₂ emissions allowances than plants not utilizing this heat. The following table indicates that Vattenfall power stations currently employ lignite energy to considerably different degrees of efficiency, ranging from 39% to 55%.

EFFICIENCY OF VATTENFALL LIGNITE POWER STATIONS ²⁵¹			
Location	Electrical Efficiency	Heat Utilization	Fuel Utilization
Boxberg 2x500 MW	35%	4%	39%
Boxberg 900 MW	41.8%	2.2%	44%
Jänschwalde	35%	1%	36%
Lippendorf	42.6%	3.4%	46%
Schwarze Pumpe	41%	14%	55%

If all these power plants are to be treated equally despite using different amounts of fuel to deliver equivalent energy services, no specific encouragement will exist to produce "less emissions per unit of output".

These inconsistencies constitute potential grounds for legally contesting the National Allocation Plan by operators and communities put to disadvantage by its

provisions. The plan presents no principle contradiction to the standards imposed in 1990 for eastern German power plants. Its implementation, however, has diverged from a literal interpretation of several fundamental provisions. One obvious reason for this deviation has been the consideration accorded the corporate interests of Vattenfall Europe. There would have been no other reason to change the year in which modernization would qualify as an early action from 1996 to 1994.

7. Reducing CO₂ Emissions

7.1. Fossil Fuels in Power Generation

The high electrical efficiency of lignite power stations erected or refurbished after 1990 is regarded by Vattenfall to justify preemptive immunity from CO₂ emissions trading until other power utilities have attained a comparable level of technical realization. However, the utilization of base-load power generation in the new German states remains deficient, since power demand itself fluctuates greatly, and because the heat of combustion is not employed to the greatest extent technologically possible.

This issue is of crucial importance, since 19 nuclear power plants in western Germany must be substituted within two decades without increasing greenhouse gas emissions. In 2003, nuclear energy accounted for 165 TWh of electrical power generation. The first reactor at the city of Stade was retired on November 15th of that same year. Wind energy is the only other energy source free of CO₂ emissions that could economically be expanded as a substitute for nuclear power. By the end of 2005, over 18,000 MW of land-based wind turbines will be in operation. However, six times this capacity would be required to replace Germany's nuclear generating capability, assuming the present average wind utilization factor of 0.17. This condition is equivalent to erecting three additional 5 MW wind turbines per day over the next 20 years, even though most of the favorable generation sites on land have already been occupied.

More productive offshore wind farms, estimated by the federal government to attain a rated power of maximally 25,000 MW by 2030,²⁴⁴ could conceivably provide up to one-third of the needed replacement power if generation and demand were closely matched. However, seasonal output fluctuations and the weak grid infrastructure of many coastal regions narrow the perspectives for offshore wind generation as a nuclear substitute. No net reduction of CO₂ emissions would be achieved by this strategy even if fully implemented.

At the same time, electrical power demand has been increasing steadily by more than 1% a year, as shown by the following table.

	1997	1998	1999	2000	2001	2002	2003
Nuclear	170.3	161.6	170.0	169.6	171.3	164.8	165.0
Lignite	141.7	139.4	136.0	148.3	154.8	158.0	159.0
Coal	143.1	153.4	143.1	143.1	138.4	135.0	146.0
Gas	48.1	50.8	51.8	49.2	55.5	54.0	57.5
Wind	3.0	4.5	5.5	9.5	10.5	15.9	19.0
Other	46.1	47.6	49.9	55.4	53.6	53.5	50.5
Total	552.3	557.3	556.3	575.1	584.1	581.2	597.0
Consumption	549.9	556.7	557.3	578.1	582.8	581.9	589.0

With consumption approaching 600 TWh/a, the equivalent of one additional 800 MW power plant operating 7,500 hours is required each year. The six-fold expansion of wind power between 1997 and 2003 represents less than half the total increase in electrical power generation during the same period.

Most of the fossil fuel power stations in western Germany are scheduled to be retired by 2020. While efficient replacement plants will enable greater amounts of electrical energy to be produced with the same quantities of fuel, this increased capacity will by no means compensate for the nuclear power plants taken out of service. The designs include the “brown coal power station with optimized generating technology”, abbreviated BoA (*Braunkohlekraftwerk mit optimierter Anlagentechnik*), with an efficiency exceeding 43%.²⁴⁵

No major shift from coal and lignite to low-carbon natural gas (CH₄) and renewable energies has been announced to reduce greenhouse gas emissions. However, the appropriate investments should become more attractive as the price of electricity generated from lignite increases due to CO₂ emissions trading. Vattenfall is already constructing two 380 kV transmission lines in Thuringia and Mecklenburg-Western Pomerania to accommodate wind power being fed into the grid.²⁴⁶ The company is likewise pursuing a number of smaller biomass and wind generation projects.

7.2. CO₂-Reduction Technologies

RWE and Vattenfall have depicted the construction of new lignite power plants as an international model for the coal industry. Installing the same technology worldwide, it is claimed, would prevent the annual emission of 1.4 billion tons of CO₂ at a cost of less than 20 euro per ton.²⁴⁷ However, even greater reductions could be achieved using various methods for enhancing the net yield of available fuel resources. In many instances, other countries have taken the lead in implementing the appropriate technologies.

1. Co-Firing of Low-Carbon Fuel. At the Schwarze Pumpe power station, preparations have been made to fire synthetic gas from the adjacent recycling facility *Sekundärrohstoff-Verwertungs-Zentrum* (SVZ).²⁴⁸ Up to 800,000 tons of lignite, or more than 6% of the total fuel required annually, could be saved by this means. The project appears in doubt due to the insolvency of the SVZ,²⁴⁹ but the process might be employed in other plants using natural gas or waste gases from industrial processes to reduce CO₂ emissions. A number of techniques for co-firing biomass have likewise been proven in practice.²⁵⁰ Their realization requires considerable investments both for low-residue combustion technology and for insuring reliable fuel supplies from agriculture or forestry. Since the respective net CO₂ emissions are reduced to nearly zero, however, these additional costs might be compensated by the sale of trading rights. Certain waste products are already being eliminated in a cost-effective manner. Since 1999, the Boxberg power station has been burning more than 100,000 tons of sewage sludge per year.²⁵¹ Vattenfall has reached an agreement with the refuse disposal corporation *Entsorgungs- und Verwertungsgesellschaft* (EVG) in the city of Rostock to co-fire highly calorific organic waste at Jänschwalde, thereby reducing the amount of lignite required at this location.²⁵² The annual co-firing of up to 385,000 tons of sewage sludge was licensed at Lippendorf in 2004.²⁵³ MIBRAG accepts sludge for combustion at its 110 MW lignite power plant in Mumsdorf.²⁵⁴

2. Improvement of Power Plant Technologies. Vattenfall has cited various technological developments that would be capable of increasing the generating efficiency of lignite power plants and thus lowering CO₂ emissions produced per generated kWh.²⁵⁵ It is expected that the steam can be raised to the unprecedented high pressure of 375 atmospheres and to temperatures approaching 720°C, increasing the effective calorific value of the lignite. By integrating the lignite drying stage into a pressurized cyclone combustion process, an efficiency of 53% to 55% could be achieved by 2015. Adding a combined gas and steam

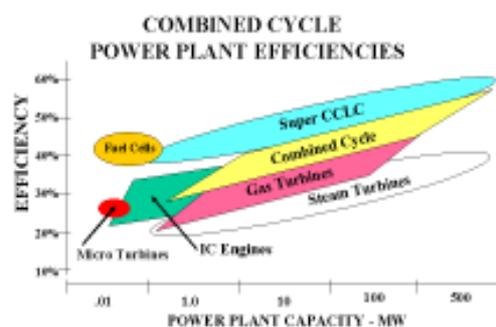
turbine to the lignite plant would raise the efficiency to 62%, a technique considered achievable by 2010. Instead of using natural gas, the lignite could itself be gasified using the IGCC (Integrated Gasification Combined Cycle) process, allowing an efficiency of 55% to be attained by 2015 in an appropriately designed power station.²⁵⁶ As a short-term measure, Vattenfall has begun modernizing its eight 500 MW plants at Jämschwalde and Boxberg.²⁵⁷ The effective capacity of each turbine is being increased by 12 MW, corresponding to a yearly reduction of 113,000 tons of lignite per block. In the RWE Weisweiler power station, 190 MW gas turbines are being added to two 640 MW lignite generating blocks.²⁵⁸ The surplus heat produced by the turbines will be used to preheat the water fed to the lignite plants, raising their capacity to 720 MW.

CO₂ Capture and Storage (CCS). The Chalmers University of Technology in Göteborg, Sweden, has investigated the feasibility of removing CO₂ from the flue gas emissions of large power plants using an O₂/CO₂ combustion process.²⁵⁹ The Lippendorf power station served as a reference facility for calculations. It was determined that an increased power demand of 175 MW was imposed on each of the two blocks by cryogenic air separation and CO₂ compression, reducing the net generation capacity from 865 MW to 690 MW. The rated efficiency correspondingly declined from 42.6% to approximately 34%. These figures do not include the additional energy required to transport the resulting liquid carbon dioxide by freight trains departing every half-hour from the plant to underground storage repositories, which could be possibly saline aquifers within Germany or North Sea oil or gas fields. The alternative employment of a CO₂ pipeline from each power plant to the storage location assumes predictable trading prices for emissions to insure amortization of the high capital expenditures involved. If the carbon dioxide were pumped into offshore oilfields, the recovery level could be enhanced by 15%.²⁶⁰ However, this oil would emit additional greenhouse gases when burned, negating the benefit of underground sequestration for climate protection. Vattenfall has concluded that if “CO₂ capture and storage is developed to a viable option and avoidance costs can be brought down to 20 euro per ton of CO₂, the technology can be introduced commercially under the upcoming trading scheme within 10–15 years”.²⁶¹ However, the German Öko-Institut sets the cost at around 40 to 60 euro per ton.²⁶² A survey of the Ruhr University has indicated even greater costs for the aggregate tasks of CO₂ elimination by technical means, as indicated in the table below.²⁶³ According to this analysis, forestation presents the most economical method of mitigating the emissions produced by the combustion of carbon-based fuels, while the bound carbon must be prevented from escaping into the atmosphere by using it in building construction or for some similar purpose. If burned as a substitute for fossil fuels, the biomass would release the amount of carbon during combustion it had previously captured in photosynthesis. To date, only a few appropriate closed-loop energy systems using energy plantations have been established because of the high labor costs of biomass harvesting. However, rising oil and gas prices could make their operation profitable.

CO₂ Elimination Costs (Ruhr University)	
Process	Euro per Ton of CO₂
CO₂ capture in power plant	15 - 65
CO₂ transport	
rail	2 - 10 liquid, > 10 dry ice
pipeline	1 - 11
Storage	
oil or gas reservoirs	5 - 10
deep saline aquifers	15 - 20
deep sea storage	60 - 80
Alternative Compensation	
forestation	5 - 20

The Australia Institute has found that end-use efficiency, gas-fired generation, and wind power will exhibit lower costs than coal-fired generation with CO₂ capture and storage.²⁶⁴ The study concedes that sequestration could become a long-term option if radical emissions reductions became necessary. However, neglecting or excluding low-emission technologies in favor of coal with CCS would constitute an unnecessarily high-cost approach. The United States, which like Australia has not ratified the Kyoto Protocol, nevertheless considers carbon sequestration an important energy policy option. According to researchers at the Department of Energy (DOE), appropriate techniques could account for 45% of total domestic emissions reductions by 2050 “should GHG (greenhouse gas) stabilization be deemed necessary”.²⁶⁵ Terrestrial ecosystems and non-CO₂ emission controls would contribute another 15%. These perspectives have ascended to international significance through the formation of the Carbon Sequestration Leadership Forum (CSLF) on June 25, 2003, by the USA, thirteen additional countries, and the European Union. The possible avenues of CO₂-storage can be examined more comprehensively by this group than any one nation may have done on its own. The vision of technologies being implemented several decades in the future is already being used by governments to counter public criticism on current CO₂ levels, even though the realization of such possibilities cannot be predicted with confidence.

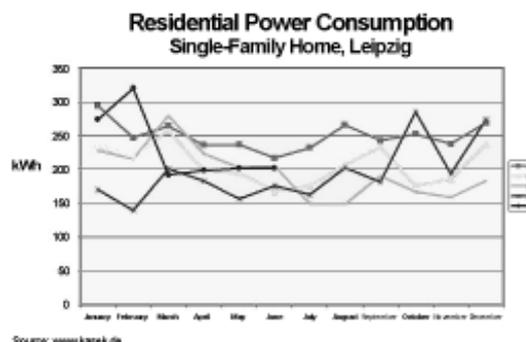
3. Rankine Cycle. The average electrical efficiency of power stations worldwide has been estimated at 40%, so that 60% of the energy contained in the fuels employed remains unused.²⁶⁶ To achieve greater fuel utilization, some of the surplus heat of combustion may be employed by cogeneration plants for industrial processes or for space heating. However, it is also possible to vaporize a highly volatile liquid such as ammonia or propane to drive a turbine, thereby realizing additional electrical power generation. The corresponding thermodynamic process known as the Rankine cycle is widely used in chemical plants. It likewise enables electrical power to be generated from geothermal and solarthermal energy sources, which generally do not develop the high temperatures required (at least 450°C) for steam turbine operation. With one Rankine technology, the Cascading Closed Loop Cycle (CCLC) developed by WOW Energies of Houston, Texas USA, a turbine employs the flue gases of a gas or steam turbine plant.²⁶⁷ As indicated in the diagram, significant efficiency improvements over conventional power plants may be achieved. Contaminants can be removed more easily from the cooled flue gases. Alternative approaches could use surplus plant heat to drive a Stirling engine. In the USA, the electricity produced by such techniques already qualifies as green power in Nevada, North Dakota, and South Dakota, because no additional fuel is required for generation.²⁶⁸



4. Automated Meter Reading. In Sweden, Vattenfall AB is in the process of equipping all of its customers with Automated Meter Reading (AMR) to allow continuous reporting of power consumption.²⁶⁹ This capability enables time-of-use rates and real-time pricing to be implemented. (8.3) The tariffs are raised during periods of highest power demand to motivate a reduction of consumption. When excess power generation capacity is available, such as in the late evening, lower prices stimulate increased demand and thus better utilization of available generating capacities. In this manner, cost benefits may be realized by both the grid operator and its clientele. The experience of the USA, where millions of remote-reading automated meters are already installed, indicates that average power consumption can be reduced by increasing the transparency of use information, particularly to high-demand non-residential customers.²⁷⁰ Re-

search conducted in Norway has also shown that comparisons between private customers can provide an additional impetus to conserve energy.²⁷¹ Approximately “three fourths of the Norwegian respondents said they would be motivated to reduce their electricity use if they were using more than the average household in their comparison group”. Despite the higher cost of electricity than in either the United States or Norway, electrical power meters are read in German homes only once a year. Green invoicing procedures comparable to Energy Star Billing in the USA are thus rendered unfeasible by the lack of suitable metering technology and invoicing procedures. Consumption is instead governed by practices largely unchanged since the dawn of electrification. AMR technology may likewise be employed for automatic control of energy-intensive devices in response to changing load conditions on the grid, thus implementing an Advanced Metering Infrastructure (AMI). In a case study conducted by the California Public Utilities Commission, remote power metering was found to yield cost benefits of nearly \$40 per year in administration and reliability after meters that could cost less than \$150 had been installed.²⁷² In view of the prevalence of automated meter reading in the United States, personal computers of the near future could conceivably include capabilities for monitoring and regulating electrical power consumption.

5. Distributed Generation. After the widespread replacement of electrical appliances and office equipment in the early 1990’s, many eastern German households and businesses now use less than 10 kWh of electricity per day. A variety of integrated approaches are available for providing decentralized generation and automated control appropriate to this level of consumption. The low population densities of rural regions would allow such infrastructures to be established as prerequisites of economic planning. It is technologically feasible to create semi-autonomous energy supply systems employing wind or solar power with hydrogen as a storage medium, or alternatively to employ biomass to fulfill the same purpose. An electronic information network with real-time monitoring would allow generation to be adjusted to demand, promoting the efficient use of energy resources and capital investments.²⁷³



If these options in combination with renewable energies are not vigorously pursued, nuclear power might be considered indispensable to future climate protection strategies. The generation and distribution infrastructure of lignite would favor such a development, since both lignite and nuclear power plants operate continuously in base-load mode. The dwindling supplies of fossil fuels would likely preclude any general commitment to natural gas as a CO₂-reduced lignite substitute.

The eastern German lignite power industry would be equipped to implement a transition to nuclear generation. Vattenfall operates several reactors in Sweden and in western Germany. MIBRAG co-owner Washington Group International, Inc. is active in reactor decommissioning and waste disposal. The second MIBRAG owner, NRG Energy, Inc., is the fourth largest producer of electricity worldwide. The owners of Block S at Lippendorf, E.ON and EnBW, operate most of Germany’s nuclear power plants.

Vattenfall management has successfully bargained with the federal government on maintaining the present level of CO₂ emissions within the framework of the National Allocation Plan (6.5). This strategy promises to prove counterproduc-

tive to German economical development and to the attainment of international climate protection targets on a number of counts.

Effects of Political Concessions to Vattenfall Europe on CO ₂ Emissions	
Vattenfall Position	Consequences
Vattenfall Europe Mining and MIBRAG have sufficient lignite reserves, the mining costs of which are predictable well into the future without being dependent on world market prices. ²⁸³	The cost of lignite power has always been increased in step with power trading prices, but without the added profits being invested in additional climate protection measures.
Lignite mining stabilizes regional employment.	Unemployment in lignite mining regions will continue to exceed the national average.
The current level of lignite power generation promotes corporate viability.	Despite increased profits, the number of employees in the mining and generation division will be reduced from currently 8,490 to 7,860 by the end of 2006.
Vattenfall power plants already in operation represent the highest technological standard.	More progressive technologies will be realized in western Germany and other parts of the world.
All power plants erected or modernized in eastern Germany after 1994 constitute early actions.	Undue compromise of NAP principles. ²⁸⁴

Lignite base-load generation cannot be throttled in response to reduced demand. Instead, surplus power is used to pump water into high mountain basins for subsequent release through hydroelectric turbines. Since these storage capacities are limited, however, the excess power produced during off-peak periods is sold to energy-intensive industries at a highly discounted rate. In these factories, it becomes more economical to buy power than to invest in energy conservation. Not surprisingly, the Energy Program 2004 in Saxony has reported that industrial energy efficiency lies 13% below the German average.²⁷⁴ This result is particularly disconcerting in view of the comprehensive modernization of the manufacturing and business sectors in the 1990's.

Despite the efficiency enhancements to be achieved by decentralization, small-scale generator manufacturers with decades of experience such as the Dieselmotorenwerk Leipzig (DML) have been forced into bankruptcy due to the lack of a regional customer base.²⁷⁵ The offensive marketing policies of energy suppliers has been exemplified at the Reudnitzer Brewery in Leipzig. Despite the need for both heat and electricity, a modern combined heat and power plant was decommissioned in favor of separate power and gas deliveries adjusted in price by local utilities to provide operational savings. Investigations of paper factories in Saxony have revealed that three times the amount of electrical power is consumed per ton of produced newsprint compared with the most efficient operations in the industry.²⁷⁶ The electricity purchased from regional utilities has been produced at lower efficiency (such as from lignite) compared with the onsite generation, but it is available at reduced cost. When the high carbon content of lignite is included into the equation, several times the amount of CO₂ may be emitted as a result.

7.3. Vattenfall and Advanced Energy Technologies

Many sites of former lignite operations have become progressive regional business centers. One of the largest is at Großräschen in Lusatia.²⁷⁷ After two briquette factories and a power plant had been decommissioned, 346 new jobs were created in steel construction, wood recycling, and kitchen catering. A mechanical-biological waste treatment plant with 12 additional employees will be dedicated near the end of 2005. However, the briquette and power plant closures have reinforced the impression of surplus energy resources, promoting the neglect of international market opportunities for advanced generation and application technologies.

The conciliation of lignite generation with wind power is indispensable for efficient grid operations, since a number of regions along the Baltic Sea and on the plains of Brandenburg are largely supplied by renewable energies. In extreme cases, as much as 3,500 MW of thermal generating capacity are said to be neces-

sary to compensate for variations in wind turbine output.²⁷⁸ A network of weather stations nevertheless enables power plant operators to prepare for changes in wind output up to 48 hours in advance.

Vattenfall has routinely underscored operational difficulties presented by wind power in order to justify tariff increases.²⁷⁹ Starting at the end of 2004, however, the company's New Energy subsidiary in Cottbus began managing renewable energy projects.²⁸⁰ While some research into new power plant technologies is also being supported,²⁸¹ a wide-sweeping reduction of CO₂ emissions appears decades away. By responding only feebly to the global challenge of greenhouse gas abatement, the eastern German power industry is falling behind technological developments in other countries. International research efforts, actively coordinated by the Co-operative Research Centre for Clean Power from Lignite in Victoria, Australia, have not become prominent points of reference for energy policy in eastern Germany.²⁸²

8. Ethical Conflicts

8.1. Germany's Ecological Divide

8.1.1. *Environmental Degeneration in the GDR*

Before 1990, the ideological division of Germany was mirrored by differing priorities on the utilization of domestic resources. The Federal Republic was the world's third largest mercantile economy after the United States and Japan, allowing raw materials to be freely procured for product manufacturing. The GDR, by comparison, was able to sustain economic viability only by maintaining a state accounting system for material supply. Since the apportionment of imported resources was commensurately restricted, exemplary recycling practices evolved.²⁸³ To compensate for the premium imposed on imported materials, natural resources such as air and water, highly subsidized energy from lignite, and many agricultural products were treated as being infinitely available.²⁸⁴ The net income realized from this policy remained chronically inadequate to finance needed investments in efficiency.

In western Germany, power plants and industrial installations were equipped with effective filter technologies in compliance with the Large Thermal Plant Ordinance (*Großfeuerungsanlagen-Verordnung*) of 1983.²⁸⁵ Strict regulations on contaminants in automobile exhaust gases made catalytic converters virtually mandatory. The construction of nuclear reactors and reprocessing plants was abandoned soon after the Chernobyl catastrophe of April 26, 1986. Following the Sandoz chemical accident in the Swiss city of Basel that killed most aquatic life in the upper Rhine Valley, the German federal environmental minister Klaus Töpfer swam downstream across the river in 1988 to demonstrate the rigorous enforcement of pollution regulations.²⁸⁶

Any similar demonstration by GDR government officials might have necessitated a change of leadership on medical grounds. Eastern German waterways contained a morbidly vivid spectrum of lignite processing waste, toxic chemicals, radionuclides, heavy metals, salt from potash mines, raw sewage, pesticides, fertilizers, and nitrate runoff from industrial-scale livestock production. The operating budgets of factories routinely included penalty fees rendered for the illegal discharge of pollutants.

Air contamination was even more pervasive owing to the unfiltered combustion of lignite and to ammonia effluents from collective farms. To reduce local SO₂

concentrations, it was customary to increase the length of smokestacks to disperse the flue gases. The official “high smokestack policy” (*Hochschornsteinpolitik*) culminated in a 300-meter tubular design erected for a power plant in the city of Chemnitz, known at that time as *Karl-Marx-Stadt*. Extensive tree damage in the Ore Mountains (*Erzgebirge*) near the border to Czechoslovakia necessitated countermeasures ranging from limestone seeding of the acidified forest floor to planting so-called “smoke resistant” saplings. The use of the German term *Waldsterben* to denote dying forests, however, was prohibited as being incompatible with Marxist benevolence. Undisputable environmental degradation and health detriments were instead rationalized as the inevitable result of fulfilling domestic societal obligations while concurrently preserving world peace by military buildups.

The country’s technical universities and institutes developed a number of specialized techniques for reducing toxic emissions from power plants and agricultural operations. One boiler complex of the Vockerode power station was selected for the first large-scale experiment with a dry desulfurization process. With a SO₂ separation efficiency of only about 30%, however, there was little prospect of complying with international accords on diminishing sulfur effluents. The GDR had agreed to a 30% SO₂ reduction by 1993 in the 1979 Convention on Long-Range Transboundary Air Pollution, based on emissions levels in the year 1980. Lignite mining output, however, grew from 258 million tons in 1980 to 311 million tons in 1989. The only viable path to target fulfillment was to falsify emissions data, making the transboundary convention itself incredulous. The official SO₂ emissions level for 1980 was raised precisely to five million tons (5 Mt) and remained essentially at this level in 1985 (5 Mt), 1987 (4.99 Mt) and 1988 (4.85 Mt), even though lignite production increased by one-fifth during this same period.²⁸⁷ The 1980 figure had been boosted to an unrealistically high level to allow lower values to be published in the years to follow.

International concerns over forest degradation, water contamination, and the enduring effects of Chernobyl fallout promoted the coordination of transnational environmental strategies. On July 6, 1989, an agreement of cooperation was signed between the Federal Republic and the GDR for model projects to combat pollution in the Elbe River and to reduce sulfur dioxide emissions from eastern German power plants.

8.1.2. Continuing Hydrological Imbalances

The Treaty of Unification guaranteed in Article 34 the “unity of ecological conditions of life” in eastern Germany at least equal to those achieved in the Federal Republic. The commensurately high standards for filter technology, however, have concealed persistent disparities in the lignite industry. Environmental impact investigations are not prescribed for mines inherited from the GDR. Lignite extraction fosters widespread groundwater depletion that makes ecological unity an illusion.

Due to the combination of intensive mining, manufacturing, and agricultural operations, the GDR had the most restricted water resources of any industrial country in the world. Average precipitation barely compensated for runoff, seepage, and evaporation. While rain and snowfall was adequate in the mountains of Thuringia and Saxony, certain regions farther north were beset with recurrent water shortages. Animal fodder was often transported over hundreds of kilometers to maintain livestock production during particularly dry summers. The use of heavy agricultural equipment on wide-ranging farmlands compressed the ground, reducing its absorptive capacity and increasing surface runoff. The Elbe River flood of 2002 was due in part to this continuing practice.

Lignite mining in the 1980’s depleted about one and a half billion cubic meters of groundwater per year. For each ton of lignite excavated today, as much as six cubic meters of water is first pumped off, depressing the water table in an in-

verted cone that extends far beyond the licensed mining boundaries. Since lignite production in eastern Germany has fallen to a fourth of its former level, fewer aquifers are now affected by ongoing mining. However, subterranean water removal thus proves inadequate for both filling previous open-cast pits and sustaining existing water courses.

Between the Lusatian cities of Senftenberg and Hoyerswerda, 70 square kilometers of new lakes are being created under direction of the LMBV using water pumped from active mines.²⁸⁸ The network of canals and waterways²⁸⁹ that will be stretching halfway between Berlin and Dresden within the next 20 years has already been called the Eastern German Adriatic.²⁹⁰ Farther west, the largest artificial lake in Germany with a surface of 18 square kilometers is currently being filled at the former Geiseltal mine near Halle.

Idyllic farmlands with willow-lined village ponds have been reincarnated in the aftermath of mining devastation as “lakescapes”, creating the impression of vastly augmented water resources. The resulting impression of an aquatic paradise, however, is in many ways illusionary. After the bucket-wheel excavators burrowed hundreds of meters deep into pristine terrain, most of the evacuated space was subsequently filled with overburden devoid of the water it formerly had hosted. The resulting aquifer depletion has increased hydrological deficits to a total volume of 4.5 billion cubic meters in Lusatia alone.²⁹¹

The president of the State Environmental Agency (*Landesumweltamt*), Matthias Freude, informed the state assembly in 2004 that the groundwater level (*Grundwasserspiegel*) in Brandenburg had dropped by an average of one meter over the last 70 years.²⁹² With a surface area of 29,477 square kilometers, a deficit of 30 billion cubic meters is thus indicated in this state alone, due not only to surface mining, but likewise to farming, industrialization, and public works projects. Total groundwater depletion in Germany is estimated at 80 billion cubic meters, twice national freshwater consumption per year.

Under intensified conditions of global warming, the Lusatian landscape may resemble a Hungarian steppe by the middle of this century. Investigations of the Green League have indicated that vital data relating to water resources are often ignored or diluted.²⁹³ The mean temperature in Brandenburg has already risen by 1.5°C in the last 40 years, thereby increasing evaporation rates. Precipitation levels lie at 20% below the German average, while groundwater restoration rates have declined by 50% since 1960. The draining of agricultural lands, a common practice since Frederic the Great, hastened the process of dehydration in the GDR. Remedial programs for farmland have now begun to increase soil moisture in some areas. Lignite mining and the creation of lakes, on the other hand, create enduring aquatic deficits that are compensated using water piped in from Saxony.

Sporadic reports of drying farm wells in neighboring Poland have yet to be corroborated. In the Rhineland, however, the hydrological deficits of wooded marshlands in the Maas-Schwalm-Nette Nature Park at the border to the Netherlands are well documented.²⁹⁴ The area consists of a linkage of wetlands with exceptionally high biological diversity. The Garzweiler II mine will eventually extend to within a few kilometers of this area, imperiling trans-border water supplies.

In eastern Germany, comparable threats are encountered along the lower courses of the Spree River, which emerges in three springs near the Czech border before weaving its way through Lusatia to Berlin. Fully 85% of the water used to transform former quarries into artificial lakes is drawn from the Spree. The river attains a total length of 382 kilometers before confluencing with the Havel in the western Berlin suburb of Spandau. During the particularly dry summer of 2003, the Spree reversed its course in the direction of the lignite mines, flowing backwards next to the *Reichstag* building where German energy and climate protection legislation is frequently debated.

The expenditures required for reinstating hydrological stability in the Spree region have been estimated by the government of Brandenburg to exceed 30 million euro over the next ten years. Due to the insufficient volume of available water, the river is to be rerouted through a number of reactivated shallow meanders, thus increasing its velocity. At present, more water evaporates from the northern part of the slow-moving waterway than is replenished by rainfall, tributaries, and the remaining lignite mines.

The city of Cottbus southeast of Berlin receives only about one-third of the mean precipitation registered in Germany. The headquarters of generation and mining at Vattenfall were transferred here from Senftenberg in early 2004. The nearby North Cottbus mine that supplies part of the lignite required by the Jänschwalde power station is being expanded despite endangering the Lacomaer Ponds (5.5) just north of the city.

The water in the lakes of former Lusatian mines is generally highly acidic (pH 2.5–3.2) due to sulfur and mineral compounds leached from the lower parts of the quarries.²⁹⁵ The water is incapable of supporting fish or other higher-order aquatic life, but at best simple bacterial strains.²⁹⁶ No realistic perspectives for tourism or recreation can be developed in these dead water zones. Alkalinization measures and consistent monitoring are capable of inhibiting, but not of forestalling microbial activity and the propagation of fungal biomass. The intensive research conducted at the Brandenburg Technical University in Cottbus on the rehabilitation of mining lakes exemplifies the complexity of interweaving biologically inert reservoirs into the ecological fabric of the region.

In Middle Germany, the water pumped from the two MIBRAG mines is almost chemically neutral, exhibiting a pH value of 7.2 at Profen and 6.2 at Schleenhain.²⁹⁷ Filling the abandoned quarries in the region at a minimum rate of two meters per year inhibits the seepage of acidic groundwater, allowing natural lake cultures to evolve.

Reclaimed mining landscapes generally exhibit a higher degree of biological diversity than the former collectivized farmlands designed for horticultural monotony. Yet spoil surfaces consist of disordered mixtures of excavated soil. Humus decomposition, sand admixing, and the truncation of groundwater currents may greatly diminish agricultural productivity.

Wherever lignite ash or processing waste has been deposited in former quarries, artificial greening is necessary to promote surface stabilization. Although unsuitable for building or cultivation, some waste areas are now being employed for solar farms. A 5 MW array erected in 2004 on the lignite waste heap at Espenhain south of Leipzig qualified as the world's largest photovoltaic power station until overtaken by other projects. In Lusatia, a farming corporation in Finsterwalde plans to erect a 30 MW solar plant on the site of the former Kleinleipisch mine.²⁹⁸ Both of these locations are characterized by exceptionally high solar irradiation. The groundwater depletion of lignite mining may be diminishing the concentration of airborne water vapor, reducing the diffusion of the sun's rays at the solar modules and thus increasing their output. Whatever the cause, however, the average duration of sunshine in Brandenburg has already increased by 18 to 36 minutes per day.

8.2. Uncomfortable Legacies

Since national reunification, unemployment has risen to record postwar levels in Germany. Under this condition, ethical standards may be relaxed in an attempt to accelerate economic recovery.

On the occasion of the tenth anniversary of the LMBV, the German parliamentarian Stephan Hilsberg asserted that several billion euros had been expended over the previous years for mine land reclamation “without scandals and under the constant supervision of state auditors (*Rechnungshöfe*)”.²⁹⁹ Yet gifts and

endowments of the lignite industry remain invaluable for securing the loyalty of public officials. Towns and villages located near mines and power plants customarily receive school computers, motor vehicles, and monetary stipends for enhancing community services. Charitable donations and sponsorships have become regular entries in the budgets of non-profit organizations.

Town brass bands attired in simulated military uniforms recall the long-standing national importance of the mining industry.³⁰⁰ MIBRAG is today a major sponsor of the annual Borna Music Summers (*Bornaer Musiksommer*)³⁰¹ chaired by Brigitte Steinbach, the wife of the Leipzig district administrative president. The Neukieritzsch-Regis orchestra is sustained with MIBRAG support. Concerts are regularly financed in village churches surrounding the mines. The company provides good-will funding of social services and supported reconstruction efforts after the Elbe River floods. In 2004, it pledged 350,000 euro to make possible community investments in Regis-Breitingen, a city rendered insolvent by the deficiency of commercial perspectives around the Schleenhain mine.

Vattenfall supports organizations and activities of singular human edification. The miners' orchestra founded in 1959 at Schwarze Pumpe was renamed the Lusatia Lignite Orchestra (*Orchester Lausitzer Braunkohle*) when Vattenfall assumed ownership of the LAUBAG in 2003. A focal point of corporate good will activities is the cultural forum at the Geisendorf Estate (*Gut Geisendorf*), a 17th Century manor miraculously spared destruction by the nearby Welzöw South mine. Vattenfall emphasizes on its corporate website that this "protected monumental legacy (*das denkmalgeschützte Erbe*)" is being maintained as a venue for the social and cultural identity of the people in the mining district.³⁰² Yet its remorseless destruction of Horno (5.4) has now made any historic edifice appear fair game for Swedish profit interests.

Cultural singularities in the mining regions are superceded by landscape homogenization, a process exemplified in 1975 when the entire city of Most in Northern Bohemia³⁰³ was destroyed by the Czechoslovakian lignite industry. At the end of the 1980's, GDR excavators began etching away at suburban Leipzig to provide fuel for local power plants.³⁰⁴ Future generations may regard architectural sacrifices unavoidable if solar energy does not supplant fossil fuels in due time.

Once political culture has become aligned with the long-term objectives of the mining industry, administrative officials often prove disinclined to support either alternative energy strategies or the protection of historic edifices. As has been shown, the German federal government has already acceded to industry demands in the area of climate protection (6.5).

However, it remains unproven whether public and commercial interests can be best served under circumstances of dubious democratic legitimacy. In eastern Germany, many mining executives, public relations personnel, security officers, and virtually all older miners are former employees of GDR energy combines (*Energiekombinate*). Bureaucrats who had once been mistrusted and occasionally vilified as *Apparatschiks* or *Bonzen*³⁰⁵ have been able to continue their careers in the tranquility of ostensibly reformed government agencies. The "lignite committee" (*Braunkohlensausschuss*) responsible for approving mining operations to serve the Jämschwalde power station was chaired between 1990 and 1994 by the deputy mayor of Cottbus, Werner Labsch. This one-time chief foreman at the "Grand Construction Site of Friendship" (*Großbaustelle der Freundschaft*) of the plant had also been vice-chairman of the GDR Society for German-Soviet Friendship (*Gesellschaft für Deutsch-Sowjetische Freundschaft*).³⁰⁶

As objects of national security, factories, power plants, and lignite mines in the GDR were "shielded and watched"³⁰⁷ by the *Stasi*, the secret police force operated by the Ministry of State Security (*Ministerium für Staatssicherheit*). The *Stasi* was officially enlisted to protect the "people's own factories" (*volkseigene Betriebe*, or *VEB*) from sabotage and infiltration by agents of the capitalist "en-

emy of the working class” (*Klassenfeind*). Information culled from international journals and blueprints in espionage work were sold to factories at low cost to save research expenditures.

In the purported interest of productive efficiency, the *Stasi* was likewise able to veto appointments and promotions. Collaborators (*inoffizielle Mitarbeiter*, or *IM*'s) were recruited by persuasion or blackmail to obtain information on the “class attitude” (*Klassenstandpunkt*) of fellow employees. Workers with access to critical factory information were ranked as “bearers of secrets” (*Geheimnisträger*) and prohibited from maintaining contact with relatives or associates from western Germany and other economies in the non-socialist world (*nicht-sozialistisches Wirtschaftsgebiet*, or *NSW*).

The activities of waste disposal companies in the GDR were routinely coordinated by *Stasi* operatives. Particular classes of refuse (nonferrous metals, illicit electronic equipment, and contraband) found in collected garbage were of relevance to state security. Western Germany availed itself of low-cost disposal services negotiated by the INTRAC Handelsgesellschaft mbH in East Berlin.³⁰⁸ Up to one million tons of toxic waste per year were shipped to the Schönberg landfill at the inner-German border near Lübeck,³⁰⁹ and an incinerator was built for industrial waste from West Berlin in Schöneiche east of the city.

Managers and supervisors who routinely cooperated with the Ministry of State Security have continued their professional careers in the energy and waste industries. Unlike politicians and civil servants, the employees of private enterprises are not required to lay open their past. The GDR's 6,000 lawyers were even permitted to “cleanse” their professional dossiers before donning the cloak of respectability in the new political system.

Continuing a habitual practice in the GDR, many statements issued by the lignite industry predicate a self-conferred license to subjugate ecological integrity and human dignity to declared economic objectives. Citizens and public figures who oppose the devastation of landscapes and settlements are portrayed as incorrigible adversaries of the local work force. These individuals may be identified by name to encourage public reproach, or they can be depersonalized to emphasize their purported insignificance. The press releases and brochures issued by MIBRAG against the village of Heuersdorf are replete with examples of both techniques, recognizably authored by employees versed in the subtleties of humiliation.

It would be naïve to assume that the cessation of political repression in eastern Germany had been followed either by collective penitence or the renouncement of special privileges to which *Stasi* agents were accustomed. Unprecedented opportunities for influence and affluence have instead become available that the former dictatorship was incapable of providing.³¹⁰ While the biographies of some operatives close with a final chapter of personal redemption, many others reflect an impartial allegiance to both the Marxist GDR and to the capitalist Federal Republic, its ideological antithesis, through common motives of professional dedication and personal welfare.

The most prominent public figure considered to be a former *Stasi* collaborator is Manfred Stolpe, a member of the Social Democratic Party of Germany and presiding minister of Brandenburg between 1990 and 2002. He currently serves as Federal Minister of Transportation, Building, and Eastern German Reconstruction. In his position as a high-ranking administrative official of the Lutheran Church in the GDR, Stolpe routinely cooperated with government authorities to regulate humanitarian issues. While he claimed never to have signed a commitment as an operative, he received a GDR medal of merit (*Verdienstorden*) on order of *Stasi* director Erich Mielke in 1978 “for great achievements, high personal preparedness for duty, and exact execution of the complex tasks assigned for the protection of our socialist fatherland against enemy attack and for safe-

guarding the peace”.³¹¹ Many eastern Germans shrug off such ceremonies as innately insignificant. Stolpe was officially honored on October 7, after all, the national state holiday on which medals were distributed “like candy” to citizens from all walks of life.

Yet the Stolpe case exemplifies the routine manner in which the *Stasi* gleaned information from public representatives, members of the medical profession, teachers, factory foremen, and indeed anyone using the telephone or postal service. Manfred Stolpe has been specifically accused by eastern German civil rights advocates of conspiring with the communist regime against the political opposition of the GDR.³¹² He was allegedly given the alias “Secretary” (*Sekretär*) and registered as Unofficial Operative number IV/1192/64.

Not having shared these experiences, most western Germans remain insensitive to the system of stratified tyranny that extended into all critical industries in the GDR. After the State of Brandenburg had been founded, Manfred Stolpe and other presiding ministers imparted the status of democratic legitimacy to the inherited symbiosis between state economic planning and the power industry, effectively eclipsing the continuing deficient responses of the industry to the imperilment of the global environment.

The Lutheran ecological movement,³¹³ which had provided a significant impetus for anti-lignite sentiments under the Marxist regime, has withdrawn from public interference. Many of its prominent members are now parliamentary delegates, public administrators, or researchers who excel in conforming with the new political system. Church leaders have demonstrated largely uncritical reverence of lignite policy since 1990, condoning even the destruction of sacral buildings whenever claimed necessary for mining employment. Many Christians in the GDR risked open confrontation with the former dictatorship in the name of preserving Divine Creation (*Wahrung der Schöpfung*) on the very same parcels of land that have since been relinquished to mining destruction. Christian Führer, the forthright pastor of the St. Nicholas Church in Leipzig,³¹⁴ has noted that the maximization of commercial profits has left the economically underprivileged in eastern Germany only to “reap the harvest of materialism”.³¹⁵

8.3. Selective Corporate Standards

The state-owned Swedish Vattenfall AB prevails as majority shareholder of Vattenfall Europe AG with about 90% of corporate ownership. However, Swedish government regulations are not always reflected in the policy of its German subsidiary.

□ On May 1, 2004, Sweden introduced an electricity certification system requiring power companies to produce certain percentages of their electricity from renewable energy sources.³¹⁶ Instead of qualifying for certification, Vattenfall AB has elected to pay penalties for non-compliance.³¹⁷ In Germany, no such system has been announced.

□ The Swedish government also presented its Energy Policy Bill to the parliament (*Riksdag*) in March 2004 with proposals that included the introduction of monthly meter readings. On June 17, 2003, Vattenfall AB had already signed an agreement with Actaris Electricity of France for the delivery of 150,000 Automatic Meter Reading systems.³¹⁸ All customers will be ultimately provided with these devices.³¹⁹ According to Actaris, the inclusion of appropriate communications capabilities will promote greater efficiency and more sophisticated programs of load management.³²⁰ However, these benefits are not being provided to private customers and smaller businesses in Germany, whose bills are based on manual meter reading conducted once a year.³²¹

According to the Vattenfall international website, “care for the environment is a primary consideration” in all corporate activities.³²² Yet the lack of consequence in adopting Swedish environmental directives for its German operations reflects

the limited compatibility of lignite and (in Hamburg) nuclear power generation with these policies. While the technical advantages of advanced power plant designs cannot be dismissed, they simultaneously conceal the deficiencies of monolithic corporate institutions in responding to the changing requirements of energy services.

As shown in research on corporate ethics conducted by Friends of the Earth Europe (FoEE), Vattenfall committed itself to the values of UN's Global Compact and to OECD guidelines for multinational corporations by signing the Swedish state initiative *Globalt Ansvar* in the spring of 2002.³²³ The company also endorses the sustainable development principles of the International Chamber of Commerce (ICC), presented under "our responsibility" (*Vårt ansvar*) at Vattenfall's Swedish website. As FoEE has noted, however, the ICC is an industry association that actively lobbies against UN norms for business. The alleged goals of sustainable development are frequently incompatible with the rejection of binding rules for companies.

Both Vattenfall and MIBRAG present themselves as responsible corporations dedicated to community welfare. The American parent companies of MIBRAG, Washington Group International and NRG Energy, nominally observe codes of corporate conduct identified as the companies' CORE values. Washington Group addresses six such principles, one of which is "Accountability and Responsibility". NRG professes to adhere to the STRIVE program, which is:

"a framework for all of our strategies, decisions and behavior. They are more than words on a page or noble ideals; they are the standards by which we STRIVE to conduct our daily business, work with one another, and interact within the communities in which we operate."

One of the STRIVE values is designated the "Respect for Individuals, Community and the Environment". Yet this principle is compromised in treating the village resettlement issue whenever understandings between corporate management and high government officials curtail individual property rights. Company statements criticizing and even defiling the standpoints of private individuals are not retracted even after their untenable basis has become obvious.

In December 2004, the MIBRAG company magazine *Spektrum* accused Horst Bruchmann, the presiding councilman in Heuersdorf, of "ignorance and isolationism" (*Ignoranz und Ausgrenzung*) toward those citizens who had already left the village.³²⁴ Bruchmann and his lawyers, it was maintained, had prevented any joint resettlement and "forever divided the village community". The magazine refrained from noting that MIBRAG itself has been employing financial incentives since 1995 to coerce individual families to move to whatever destination they desired.

8.4. Political Conflicts of Interest

At the World Economic Forum in Davos in January 2005, Vattenfall AB and MIBRAG co-owner Washington Group International joined the *Partnering Against Corruption Initiative*. In all, 62 corporations declared a "zero-tolerance policy" for combating corruption and bribery.³²⁵ This resolution, however, did nothing to dissolve the symbiotic relationships with government administrations that provide corporations with continuing opportunities to manipulate parliamentary processes.

The domination of commercial interests over democratic institutions was condemned by US President Franklin Delano Roosevelt more than half a century ago: "The liberty of a democracy is not safe if the people tolerate the growth of private power to the point where it becomes stronger than the democratic state itself. That in its essence is fascism – ownership of government by an individual, by a group or any controlling private power."

The financial inability of scientific research institutes, NGOs, foundations, and other independent organizations to develop technically detailed strategies equivalent to those presented by power companies predisposes these commercial enterprises to exert decisive control over the formulation of national energy policy. In the case of the lignite industry, the potential opportunities for corporate dominance of German democracy are too numerous to be ignored.

Avenues of Influence on Democratic Processes by the Lignite Industry	
Circumstance	Possible Result
In contrast with the 27% contribution of lignite to average German power generation, the corresponding dependency of Saxony and Brandenburg is over 80%.	Concessions are made to the lignite industry that would be detrimental to economic development in other German states (e.g., licensing of large-scale excavation) and to climate protection strategies.
Power or heating shortages are threatened in the event of insufficient political support. ³³⁷	Rational analyses by independent energy agencies are neglected.
Non-nuclear power is produced with lignite.	Security from terrorist attacks is intimidated. ³³⁸
Lignite is developed as the main domestic energy resource.	Enhanced security from fossil fuel imports is claimed.
High unemployment persists.	Job security in the lignite industry is exchanged for liberal interpretation of environmental laws.
Certain provisions of mining laws (e.g., forced resettlement of affected populations) from former dictatorships are maintained.	Lignite mining practices do not fully conform with international ethical standards.
Politicians hold positions on supervisory boards in the lignite industry.	Impartial interest cannot be insured in lawmaking.
Mangers, politicians, and lawyers with a dishonorable past in the GDR.	Concessions to forestall blackmail.

Even if compromising arrangements should not exist in individual cases, institutionalized impediments to public transparency favor their occurrence. The fundamental aspiration of political domination was articulated in 1945 by the arch communist Walter Ulbricht: “It must look democratic, but we must have everything in our hands.”³²⁶ The disclosure of individual cases of corruption invariably brings additional instances to light. Numerous illicit benefits provided by corporations to German parliamentarians were revealed in late 2004 only after Hermann-Josef Arentz, delegate to the state assembly of North Rhine-Westphalia, admitted to the annual receipt of 60,000 euro from RWE AG, which was paid without his providing any services to the company.³²⁷

It is common practice in Germany to include high-ranking politicians on corporate supervisory boards. By contrast, such potentially compromising arrangements are expressly prohibited in the United States of America. Laws at the state level specify the separation of all private and commercial interests by elected government officials. In many cases, the regulations extend to family, relatives, and business associates. Many states additionally disallow holdings in stocks and corporate bonds. The restrictions likewise apply to planning and zoning commissions as well as to public institutions such as universities. In the State of Idaho, for instance, a pertinent regulation specifies that a “member or employee of a governing board, commission, or joint commission” for zoning or planning “shall not participate in any proceeding or action when the member or employee or his employer, business partner, business associate, or any person related to him by affinity or consanguinity within the second degree has an economic interest in the procedure or action”.³²⁸ The world headquarters of Washington Group International, Inc. are located in the capital city of Boise, Idaho. The company is thus aware of the legal regulations that it is at liberty to violate in its overseas operations at MIBRAG.

The German lignite industry operates on the premise of overt political influence. Wilfried Schreck is both a supervisory board (*Aufsichtsrat*) member of Vattenfall Europe and a delegate to the German parliament. Another federal

delegate, Reinhard Schultz, had been given seats on the boards of both the former lignite mining corporation LAUBAG and of VEAG in apparent recognition of consulting services rendered to HEW in Hamburg.³²⁹

In February 2004, a prominent assemblyman in North Rhine-Westphalia, Fritz Kollorz, admitted neglecting to report his position as vice-chairman of the Vattenfall supervisory board since its inception.³³⁰ Kollorz explained he had acted in a “scatterbrained” manner (“*aus Schussligkeit*”) in not mentioning the activity, for which he receives more than 80,000 euro a year. Both he and Wilfried Schreck are likewise high officials of the miners’ union IGBCE, while Schreck has served as chairman of the VEAG/Vattenfall workers’ board (*Betriebsrat*) since 1991.

At MIBRAG, the supervisory board includes Bernhard Worms, the honorary chairman of the Senior Party Members of the Christian Democratic Union (*Senioren Union der CDU*) and of the Seniors’ Union of Europe.

The district administrative president (*Regierungspräsident*) of Leipzig, Walter Christian Steinbach (formerly SPD, now CDU), has been a member of the MIBRAG supervisory board since its inception. His agency, the *Regierungspräsidium Leipzig*, issues permits for lignite mining and power plant operations in West Saxony. It has allowed Vattenfall to store gypsum on location in contradiction to licensing regulations, and it initially supported the operator’s claim that water vapor emitted continuously from the power station’s two cooling towers would be obscuring incident sunlight for only 30 hours a year. When challenged on this issue by households repeatedly deprived of sunshine, the *Regierungspräsidium* declared itself powerless to remedy the problem, since “artificial cloud shadows” (*künstliche Wolkenschatten*) did not qualify as power plant immissions.³³¹

Only Social Democrats (SPD) and the CDU are represented on eastern German lignite company supervisory boards, thus defeating the premise of impartial control of corporate management. This organized complicity of political parties with the extractive industry is mirrored in the customary disinclination of ministry officials and legislators to question its ecological and regional economic consequences.

8.5. Corporate Irregularities

The profits accrued by the eastern German lignite industry may enhance corporate credit ratings beyond the substance of reason, as evidenced by the temporary insolvency of both MIBRAG owners.³³² In the case of Washington Group International, operations in Germany remained unaffected by bankruptcy proceedings of the parent company. Long-term lignite delivery contracts in fact contributed the financial security necessary for founding a new corporation with an unchanged name. Insurance companies, pension funds, private citizens, and even former employees lost over half a billion dollars of securities held in the original corporation. Washington subsequently issued new stock to all primary creditors to settle its outstanding debts. Upper management was provided generous retainer benefits in 2001 to inhibit termination of employment during Chapter 11 bankruptcy proceedings, which allowed the company to continue business operations.

In the following year, the second MIBRAG owner NRG Energy was unable to cover installment payments on 10.2 billion dollars of outstanding obligations. Its creditor banks demanded the sale of sufficient domestic and foreign assets to restore financial viability. Bids were henceforth solicited for the 50% MIBRAG partnership, a fact that remained concealed from the local population until publicized by Heuersdorf. The sale of other facilities and new stock issues for creditors ultimately enabled NRG to regain operational stability in 2004.

In both instances, MIBRAG owners had overextended their credit lines in ill-fated strategies of corporate expansion. The inadequacy of German constitutional guarantees on private property rights was demonstrated by continuing

political campaigns for the resettlement of Heuersdorf throughout these insolvency procedures.

State authorities showed no misgivings about sacrificing this historical community to help compensate for the financial mismanagement of two US corporations. The state government of Saxony thus effectively abetted the destruction of private shareholder fortunes in the United States by offering to devastate a village under its administration in Germany.

8.6. Underbidding the Third World

Few developing countries have any significant fuel reserves. The World Energy Council sees imported coal “making a significant contribution to eradicating energy poverty”, thereby “continuing to grow as a low-cost foundation for economic and social development”.³³³ Siphso Nkosi, chief executive of the South African Eyesizwe Coal (Pty) Ltd, believes that “coal will bring energy to the poor”.³³⁴

Due to persistent criticism over project financing in developing nations, however, the World Bank Group (WBG) commissioned the Extractive Industries Review³³⁵ to analyze the criteria appropriate to sustainable and ethical development. The findings were published in November 2003 in the comprehensive report *Striking a Better Balance*. The advisory stressed the “obligations under international law to promote, respect, and protect all human rights”. As indicated below, however, many of the principles ascertained in this investigation are being violated or disregarded by the German lignite industry.

Sustainable and Ethical Mining Principles	
World Bank Group	Eastern German Lignite Industry
Require integrated environmental and social impact assessments.	Before 2004, no environmental impact analyses conforming with EU regulations had been performed.
Update and fully implement the natural habitat policy.	In Lacoma, endangered species have been threatened by local extinction through mining preparations in a potential Flora-Fauna Habitat.
Engage in consent processes leading to free prior and informed consent before resettlement takes place. This means projects would only result in voluntary resettlements, not forced ones.	Forced resettlements are ultimately imposed if voluntary consent cannot be achieved.
There should be an independent and impartial Information Ombudsman to monitor disclosure policy implementation.	Matters of resettlement and environmental protection are not referred to impartial mediators mutually selected by participant parties.
Develop sector-specific guidance for tailings disposal, waste management, and the use of toxic substances	The Law on Material Recycling and Refuse Disposal is being compromised by the storage of gypsum from desulfurization at power plants.
Develop guidelines for integrated closure planning.	Communities and private individuals must often bear the costs of collateral damage due to abandoned mining sites.
Establish good lines of communication for warning local communities, sufficient recognition of potential impacts, and adequate monitoring and maintenance.	The effects of micro-particle effluents from surface mines and from power plants are not items of general knowledge in mining regions.
Establish a targeted program aimed at restoring degraded lands, improving the life of the poor who are affected by previous project closures, and generating employment and skills training.	Lignite mining regions remain economically depressed.

The systematic disregard in Lusatia and Middle Germany of the criteria listed in the table translates to competitive disadvantages for developing nations. The commercial posture of the Third World will therefore be undermined whenever World Bank funding is denied on ethical and environmental grounds for projects that are already commonplace in Germany. The recommendations of the Extractive Industries Review are still under consideration both by the World Bank and by certain governments.

9. NGOs and the Lignite Industry

The numerous questionable practices surrounding lignite mining and power generation indicate the necessity of conducting impartial investigations of the industry. Ideally, a portion of power sales revenues might be dedicated to financing independent studies of recurrent economic, social, political, and environmental issues. Until this practice is established, however, the findings of non-governmental organizations (NGOs) will continue to represent a major source of information on the corresponding topics.

In the past, such independent organizations and citizens' groups have frequently conducted scientific research and measured incident pollution levels in responding to the negligence of government authorities. Like many official agencies themselves, however, the organizations are subject financial and manpower limitations. No general provisions exist for the exchange of data among different groups, while funding or membership rivalry may actually inhibit such lateral transparency.

Aside from these limitations, however, the knowledge accumulated by independent interest organizations often exceeds the information available from established democratic institutions. NGO positions on lignite have revealed factors of public relevance that might otherwise have been ignored in parliamentary deliberations.

1. ROBIN WOOD in Hamburg has placed the lignite mining industry into an international context corresponding with activities developed in the interest of the Third World. At the annual meeting of Vattenfall Europe on June 17, 2004, ROBIN WOOD board member Alexandra Keßler relegated the company to "the five leading producers of air pollution in Europe" due to CO₂ emissions from lignite power production.³³⁶ Since Vattenfall power plants are all equipped with state-of-the-art filter technology, this criticism only underlined the fact that carbon dioxide is not yet formally classified as an air contaminant. As Ms. Keßler noted, scientific evidence has unequivocally established the contribution of carbon dioxide to climate change. Lignite power generation produces the highest levels of CO₂ in relation to energy consumption. The organization has therefore demanded the abandonment of lignite, yet without specifying an appropriate substitute strategy.

2. The Green League (*Grüne Liga*)³³⁷ is the only environmental organization operating entirely within eastern Germany, having been founded in the GDR on February 3 – 4, 1990. Its activities are directed toward securing the conditions for sustainable development, to which lignite mining presents the penultimate contradiction when natural resources and human settlements are unnecessarily destroyed. Under this perspective, the *Grüne Liga* prepares studies and distributes public information on threatened landscapes and villages. It has been decisively responsible for the enforcement of EU regulations on nature protection and water rights in Lacoma that had been ignored by both Vattenfall and regional authorities, who had instead confirmed their irresponsibility in observing the letter of outdated national laws. The Green League has emphasized that ecological rectitude cannot be achieved until qualified NGOs have been accepted as equal partners in multilateral negotiations.

3. The Lutheran Church (*Evangelische Kirche*) has largely withdrawn from advocating the preservation of Creation (*Wahrung der Schöpfung*) that had formerly served as a moral point of reference in the GDR. In September 1984, the Synod of the United Lutheran Church had declared that "high material expecta-

tions" (*hohe materielle Ansprüche*) were a "particularly deep-seated cause of environmental destruction" (*besonders tiefsitzende Ursache der Umweltzerstörung*).³³⁸ Such introspection largely evaporated after German reunification. Industrial production had largely been transferred to other countries, where environmental standards could no longer be evaluated. At the same time, prominent environmental activists such as the Wittenberg theologian Hans-Peter Gensichen determined that, in contrast to the GDR, it had now become possible to choose between a number of environmentally favorable options.³³⁹ Yet this selection was generally aimed at securing the lowest consumer prices rather than minimal ecological detriments. As the experience of Horno has confirmed, the material interests of mining employees and corporations are accorded greater consideration by church officials than the Christian communities and houses of prayer threatened by excavation. Remembering that the GDR was an atheist state, and that church buildings were often desecrated in other parts of Eastern Europe, the continuing existence of these congregations appears to be a miracle in itself. Yet religious belief is being deprived of its distinguishing attribute of anticipatory retrospection. There is no question that future generations will lament the destruction of church edifices that could have been avoided using renewable energies. The Synod resolution of 1984 instead invites scornful rebuttals for its central appellation: "We thereby assume that a simple lifestyle, the prudent management of material goods, and voluntary renouncement can bring joy and be liberating."³⁴⁰ The Lutheran pastor of Heuersdorf, Thomas Krieger, has detected an essential flaw in the present reasoning of his superiors: "They act as though the coal was going to be there forever. But that is not the case."³⁴¹ In fact, the lignite deposits assumed to be adequate for another two centuries may not even be exhausted before many gifts of Creation have already turned to dust. Vanishing Alpine glaciers and declining water tables certainly qualify as the manifestations of an epochal Biblical prophecy.

4. WWF (*WWF Deutschland*), the German section of the Worldwide Fund for Nature, has traditionally been concerned with eastern Germany mainly as a setting for nature conservation projects. However, in 2003 it presented a study entitled *PowerSwitch*³⁴² that adapted analytical techniques employed in the USA³⁴³ and at a European level³⁴⁴ to the German electrical power industry. The feasibility and the effects of five indicators for developing a sustainable energy power sector were analyzed:

- Reduction of CO₂ emissions in the power sector (reference year 1990) by 50% in the year 2030 as the intermediate stage of an 80% reduction target for 2050.
- A contribution of 25% to 30% from new renewable energy sources by the year 2030, and at least 20% by 2020.
- Improvement of energy efficiency by 20% to 25% for fossil-fuel power generation by the year 2020/2030.
- Renouncement of new investments in coal and lignite power stations.
- Ambitious measures in the areas of energy efficiency and energy conservation when using electrical power.

An extraordinary restructuring effort would be required to fulfill these objectives simultaneously, as indicated by the proposed expansion of renewable energy capacities and particularly by the exclusion of coal and lignite for any new plant construction. At the same time, three potentially significant options have been ruled out for providing any contribution to this strategy, since their utilization by 2030 cannot be predicted with confidence:

- Hydrogen produced by solar energy.
- Imported power generated by renewable energy technologies in distant regions such as the Mediterranean, North Africa, and Russia.
- Carbon separation from fuels or flue gases with storage in geological formations.

Under these constraints, a high degree of cooperation, political coordination, and commercial self-discipline would be necessary to lower fossil-fuel consumption using improved CO₂-reduced generation technologies, fuel switching, and coordinated demand-side management. Remarkably, however, even the dramatic price increases for imported oil and gas within the year following appearance of this proposal have not materially enhanced the prospect of their implementation. With coal and lignite excluded as fuels, the WWF strategy depends critically on expensive natural gas for lowering CO₂ emissions. Nonetheless, German utility companies have already determined that customers will likewise accept higher prices for power generated from lignite. Federal economics minister Wolfgang Clement has publicly expressed his belief that CO₂-free power stations may be realized by 2020.³⁴⁵ Under these propitious circumstances, Vattenfall and MIBRAG have announced the construction of additional lignite and coal-fired plants. RWE has likewise not altered its intention to modernize lignite power generation in the Rhineland. Therefore, coal and lignite are not being abandoned as assumed in the WWF strategy. At the same time, no prospect exists for significantly exceeding the 48,000 MW of wind energy projected by WWF for 2030. This prognosis assumes the stagnation of land-based wind capacity at 21,000 MW and the realization of 27,000 MW of offshore generation. Additional capacities only appear plausible if fuel costs and CO₂-trading prices rise to levels that preclude the economic viability of any alternative energy path. In all other cases, however, the expectations of WWF regarding an intermediate stage of sustainable power generation by 2030 remain largely unsubstantiated.

5. BUND, the League for Environment and Nature Protection in Germany (*Bund für Umwelt und Naturschutz Deutschland*), is the national section of Friends of the Earth (FoE). The League is an umbrella organization of BUND chapters in each of the German states. BUND North Rhine-Westphalia (NRW) has developed a high level of proficiency in evaluating the ecological consequences of lignite use, summarizing particular findings in the flyer “Lignite Mining in the Rhineland”.³⁴⁶ Its scientific and sociological treatises analyze the destruction of communities and natural biotopes, water table degradation, and the health detriments that result from air contamination, airborne mining dust, and the increased radioactivity detected in regions of mining excavation.³⁴⁷ In eastern Germany, Heuersdorf has been a communal member of BUND Saxony since 1996. The village hosted the FoE Carbon Dinosaur on September 4th, 2004, during its tour of more than 50 European cities. The BUND Energy Task Force (*Arbeitskreis Energie*) has recommended the termination of lignite use in the Rhineland within 30 years and in the new German states in 35 years.³⁴⁸ BUND has provided numerous proposals that are reflected in current German energy policy regarding combined heat and power generation, renewable energy, nuclear phase-out, and energy efficiency.

6. BEE, the Federal League for Renewable Energy (*Bundesverband Erneuerbare Energie*), calculated in 2003 that conventional energy production in Germany was being effectively subsidized for a total amount of 35 billion euro.³⁴⁹ While annual public funds amounting to several billion euro have been routinely expended in western Germany for domestic hard coal operations in competing with less expensive imports, the federal government has always maintained that lignite power production is “free of subsidies” (*subventionsfrei*). BEE countered this contention with calculations on the necessary expenditures for mine land reclamation, for the compensation of ecological damages, and for the destruction of villages in the path of lignite excavation. The federal environmental ministry took the matter under advisement and commissioned the study *Braunkohle – ein subventionsfreier Energieträger?* (Lignite – A Fuel Free of Subsidies?), which subsequently corroborated these contentions (6.1).

7. NABU, the Nature Protection League of Germany (*Naturschutzbund Deutschland*), is critical of nuclear power and of inadequate measures for reducing greenhouse gases. It has issued no specific strategies for diminishing lignite

use but favors ecological taxes on fossil-fuel energy. It opposes wind turbines erected near nature preserves or at any other location presenting a danger to birds and wildlife.

8. Greenpeace has issued a number of studies that treat the feasibility of converting the entire energy supply to renewable technologies by 2100. Public attention has been drawn to lignite policy through various studies and media events.

- In 1997, the Greenpeace chapter in Leipzig calculated that poorly insulated buildings in that city alone would be requiring an additional 60 million tons of lignite to be fired in the Lippendorf power station, thus exceeding the quantity of lignite beneath the village of Heuersdorf.
- In 1998, Horno became the first German village to participate in the Greenpeace “Power Change” (*Stromwechsel*) campaign for switching to electricity from renewables and combined heat and power (CHP).
- In operating its own green energy power company, Greenpeace has noted that the grid transmission fees charged for renewable power are often twice as high as for electricity from conventional power sources.
- During the Renewables 2004 conference in Bonn, a group of 50 activists symbolically hijacked a 96-meter long RWE bucket-wheel excavator in the nearby Hambach mine, painting it a “pink pig” color and flying a protest balloon over the structure.³⁵⁰
- Greenpeace terms the federal government’s propagated vision of CO₂-free coal and lignite power stations a “fig leaf to legitimize lignite” (*ein Feigenblatt zur Legitimation der Braunkohle*),³⁵¹ underscoring the fact that present climate protection strategies presuppose the realization of long-term technologies that may never be adequately implemented.

German environmental organizations have exhibited both scientific accuracy and creative ingenuity in analyzing the strengths and deficiencies lignite policy. However, these efforts have often been uncoordinated due to differing areas of primary interest. An encouraging development has thus been the common climate declaration of several organizations in September 2004, including the umbrella organization **DNR**, the German Nature Protection Ring (*Deutscher Naturschutzring*).³⁵² Under the participation of BUND, Greenpeace, NABU, and WWF, criticism was leveled at the allocation of CO₂ emissions allowances that provided industry with blanket concessions to the disadvantage of small businesses and private consumers. If this cooperative practice is maintained, environmental organizations may speaking with one voice on many critical energy issues in the future.

10. Conclusion

The lignite industry has been elemental to German history throughout most of the Industrial Age. Rather than originally presaging ecological disaster, it preserved many European forests from destruction as an inexpensive and abundant fuel resource. Lignite power generation and carbon chemistry sustained economic prosperity, cultural enrichment, and social welfare in the mining regions.

Nuclear phase-out and the prospect of diminishing global oil and gas supplies have become pretexts for sustaining and possibly intensifying lignite mining operations. Under this condition, the exercise of eminent domain over private property rights could be elevated to a precept of national security, reinstating the wartime priorities under which resettlement policies were first established. Constitutional principles might ultimately be compromised to enhance fuel price stability.

However, many premises of fossil fuel deployment cannot be extrapolated into the future. The release of carbon emissions into the atmosphere is endangering the conditions of existence in many parts of the world. Limitations of gas and oil availability may lead to wide-scale substitution and motor fuel synthesis from coal and lignite, depleting available resources at an accelerated rate. Yet human survival cannot ultimately be secured by exploiting the remaining global deposits of non-renewable resources.

Cumulative environmental degradation remains an irrevocable debt bequeathed to future generations. The efficiency benefits of technologically advanced lignite generation are respectable, but landscape disfigurement remains their unalterable prerequisite. Wide expanses of countryside impoverished by generations of mining activities appear to confirm Friedrich Nietzsche's remark that the dead indeed rule the living.

Vattenfall Europe AG has become the main executor of a potentially insidious strategy to create a "lignite platform" over wide expanses of landscape in eastern Germany that have been depopulated by the deficiency of occupational alternatives. An increasingly microscopic workforce stimulates the migration of unemployed skilled workers and the consolidation of government support for lignite as a prominent economic mainstay. The ranks of the indigenous non-employed have proved variously susceptible to both political apathy and parliamentary radicalism, the latter manifest in the election of right-wing parties to the assemblies of all three eastern German lignite states.

In 1990, the eastern German population consensually adopted a broad-based market economy to supplant centralized state planning. Majority ownership of the power industry was soon transferred to offshore corporations. This divestiture of public property has rendered the judicious use of lignite assets illusory, since energy policy is now determined by foreign earnings and not local resource conservation. At the same time, essential tax revenues elude the domestic economy, while enhanced profits are channeled to private shareholders, to corporate acquisition programs, and to the development and installation of progressive energy technologies in other parts of Europe and the world.

Lignite power generation materially contributes to deep set socioeconomic and environmental changes that have become essentially irreversible, inasmuch as they exceed the resources available to prevent or correct them:

- ❑ Chronic deficiencies of employment perspectives in the mining regions.
- ❑ Hydrological imbalances, diminishment of rainfall, soil degradation, and steppification.
- ❑ Eradication of unique historic settings.
- ❑ Detachment from international efforts on energy resource diversification.
- ❑ Restricted transparency of public information and democratic participation.

These factors are of elemental concern to the future development of eastern Germany and of Central Europe. It is imprudent and hence politically irresponsible to treat them as negligible or to expect that they will be benignly corrected by geophysical processes and human adaptability.

As irreplaceable natural resources are extracted from the Earth, alternative replacements must be derived from the financial proceeds of power generation for the use of future generations. If commercial corporations do not exercise this prerogative of their own volition, pluralistic democracies must institute appropriate measures by law in the interest of self-preservation. CO₂ emissions trading may provide a financial impetus sufficient to overcome the prevailing impediments to effective climate protection strategies. The heedless use of lignite power, however, only substantiates the observation of Albert Einstein that “serious problems cannot be dealt with at the level of thinking that created them”.

Fossil fuel power generation is diminishing the options of global existence and could very well make certain areas of the Earth uninhabitable. If the use of electricity were poisoning local drinking water supplies, governments would take immediate corrective action against the power companies. The proliferation of environmental detriments affecting civilization as a whole, however, is habitually condoned.

Democratic society must regain control of the options it has neglected or relinquished to commercial enterprises. Unless binding requirements are imposed on the future conditions of human existence, one course of action may appear as good as another. In the 19th Century novel *Alice in Wonderland* by Lewis Carroll, a bewildered Alice comes to a fork in the road and encounters the Cheshire cat.

“Which road do I take?” she asked.

“Where do you want to go?” responded the Cheshire cat.

“I don’t know,” Alice answered.

“Then,” said the cat, “it doesn’t matter.”

Endnotes

- ¹ Peat is produced from organic matter by biochemical processes near the surface of the earth, whereas the subsequent formation of lignite and coal occurs geochemically under the influence of subterranean heat and pressure.
- ² Bernd Westphal, *Bericht I/2002. Industriegruppe Braunkohle* (Hannover: Industriegewerkschaft Industrie, Bergbau, Chemie, February 2002), p. 2.
- ³ Konferenz der Evangelischen Kirchenleitung in der DDR, *Energie und Umwelt* (Berlin: Bund der Evangelischen Kirchen in der DDR, 1989), p. 33.
- ⁴ Anton Zischka, *Die alles treibende Kraft. Weltgeschichte der Energie* (Heidelberg: Energie-Verlag, 1988), p. 218.
- ⁵ World Resources Institute, *A Guide to the Global Environment 1992 – 93* (Oxford: Oxford University Press, 1992), pp. 314 – 315. The graph depicts relative mining output in the late 1990's.
- ⁶ *Braunkohle in der Übersicht* (Essen: Statistik der Kohlenwirtschaft e. V, 2004).
- ⁷ *Mitteldeutschland* is sometimes translated as “Central Germany”.
- ⁸ Hard coal is mined in the Ruhr region to the northeast of the Rhineland and in the Saar Basin in seams that extend into French Lorraine.
- ⁹ *Unsere Braunkohle* (Cologne: DEBRIV Bundesverband Braunkohle, 1999), p. 10, 11.
- ¹⁰ *Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge (Bundes-Immissionsschutzgesetzes – BimSchG)* (Bonn: Deutscher Bundestag, May 14, 1990).
- ¹¹ The last German installation among the 100 highest emitters of sulfur dioxide in Europe, the 30-year-old lignite power plant at Lippendorf (600 MW), was shut down in March 2000.
- ¹² “Verlässlicher Beitrag zur sicheren Stromversorgung”, (Cologne: DEBRIV Bundesverband Braunkohle, January 18, 2005).
- ¹³ Udo Leuschner, *Energie-Chronik* (February 2004, www.u-do-leuschner.de).
- ¹⁴ *Energiebericht Sachsen 2003* (Dresden: Sächsisches Staatsministerium für Wirtschaft und Arbeit, 2004), p. 11.
- ¹⁵ Act on Orderly Termination of Atomic Energy Use for the Commercial Generation of Electricity (*Gesetz zur geordneten Beendigung der Kernenergienutzung zur gewerblichen Erzeugung von Elektrizität, BGBl I 2002 Nr. 26*) (Berlin: Deutscher Bundestag, April 22, 2002).
- ¹⁶ Michael Schlesinger, *Die Rolle der Braunkohle in einer wettbewerbsorientierten nachhaltigen Energiewirtschaft* (Basel: Prognos AG, May 8, 2003), p. 17.
- ¹⁷ “Neue Tagebaue in der Lausitz würden mehrere Dörfer bei Cottbus zerstören” (Berlin: Grüne Liga e.V., February 23, 2005).
- ¹⁸ “Mibrag bohrt nach Kohle”, *Leipziger Volkszeitung* (January 25, 2005).
- ¹⁹ “Deutschland bleibt Windkraft-Standort Nr. 1”, *Die Tageszeitung taz* (January 25, 2005).
- ²⁰ A Joule (J) is the amount of energy expended by a Watt (W) of power for one second. One kilojoule (kJ) equals one thousand Joules, or one kilowatt-second. A kilowatt-hour (kWh) is thus 3,600 kilojoules (kJ) or 3.6 Megajoules (MJ).
- ²¹ Herbert Pätz, Jochen Rascher, Andreas Seifert, *Kohle – Ein Kapitel aus dem Tagebuch der Erde* (Leipzig: BSB B. G Teubner Verlagsgesellschaft, 1986), p. 32.
- ²² Walter G. Steblitz, *The Mineral Industry of the Czech Republic*, in: *International Minerals Statistics and Information* (Washington: U.S. Geological Survey, 1999), p. 11.2.
- ²³ Ernst Neef, Vera Neef, *Sozialistische Landeskultur. Umweltgestaltung. Umweltschutz* (Leipzig: VEB F. A. Brockhaus Verlag, 1977), p. 440.
- ²⁴ Herbert Pätz, Jochen Rascher, Andreas Seifert, op. cit., p. 28.
- ²⁵ Helmut Elfenberger, *Dampferzeuger* (Leipzig: VEB Deutscher Verlag für Grundstoffindustrie, 1989) p. 40.
- ²⁶ “Aus Braunkohle wird Energie. Kraftwerk Lippendorf”, (Berlin: Vattenfall Europe AG, June 2004, www.vattenfall.de).
- ²⁷ “Strom und Dampf sauber aus Schkopau”, *StromThemen* (7/1996), p. 5

- ²⁸ The thermal energy produced by burning pure carbon is 32.8 MJ/kg, or 9.1 kWh/kg.
- ²⁹ *Konzeption für die Entwicklung der Umweltpolitik* (Bonn: Ministerium für Naturschutz, Umweltschutz und Wasserwirtschaft, March 19, 1990), Appendix (*Anlage*) 1/1.
- ³⁰ *Flue Gas Desulfurization By-Products* (Palo Alto: Electric Power Research Institute, 1999).
- ³¹ “Aus Braunkohle wird Energie. Kraftwerk Lippendorf” (Berlin: Vattenfall Europe AG), op. cit.
- ³² “Vermarktung von REA-Gips und Aschen aus Braunkohlekraftwerken” (Berlin: Vattenfall Europe AG, www.vattenfall.de).
- ³³ *Kreislaufwirtschafts- und Abfallgesetz*, Article 5.4 (Bonn: Deutscher Bundestag, October 7, 1986).
- ³⁴ “Stralsunds Hafen wird attraktiver”, *Ostsee-Zeitung* (June 5, 2004); “Umschlagrekord im Seehafen”, (Stralsund: Stadtwerke Stralsund GmbH, December 3, 2002).
- ³⁵ “Gipskarst im Südharz”, *Naturfreunde Niedersachsen* (Göttingen: Koordinationszentrum Natur und Umwelt e.V, 2001, www.naturschatz.org).
- ³⁶ *Fauna Flora Habitat Directive 92/43/EWG* (Brussels: European Commission, May 21, 1992).
- ³⁷ Helmut Elfenberger, op. cit., p. 37.
- ³⁸ Private communication of Karin Wichterey, Bundesamt für Strahlenschutz, May 13, 2004.
- ³⁹ Dirk Jansen, Dorothea Schubert, *Feinstaub und Radioaktivität aus Tagebauen* (Düsseldorf: Bund für Umwelt und Naturschutz Deutschland Landesverband Nordrhein-Westfalen e.V., April 2004, www.bund-nrw.org/files/bundaktuell-feinstaub-4-2004.pdf).
- ⁴⁰ Herbert Pätz, Jochen Rascher, Andreas Seifert, op. cit., pp. 106, 119.
- ⁴¹ Wolfgang Stinglwagner, *Die Energiewirtschaft der DDR* (Bonn: Gesamtdeutsches Institut, 1985), p. 37.
- ⁴² T. Login, Letter to the editor: “I observe that, in a discussion at the Civil Engineers Institution, the total excavation of the Suez Canal, is stated to be 70,000,000 cubic metres.”, *Nature* (November 4, 1869). Later references speak of 74 million cubic meters.
- ⁴³ “Klage gegen den Tagebau Hambach / Oberverwaltungsgericht Münster lässt Berufung zu”, (Düsseldorf: Bund für Umwelt und Naturschutz Deutschland Landesverband Nordrhein-Westfalen e.V., June 28, 2004).
- ⁴⁴ Under normal conditions, it is unlawful to disturb the habitat of any organism included in the Red List (*Rote Liste*) of endangered species.
- ⁴⁵ René Schuster, “Lebensrecht für die Rotbauchunke” (Potsdam: Grüne Liga Brandenburg e.V., June 2004).
- ⁴⁶ Yvonne Jennerjahn, “Bald rollen die Bagger in Horno” (Berflin: Evangelische Pressedienst, December 30, 2003).
- ⁴⁷ *Die Mauer und ihr Fall* (Berlin: Presse- und Informationsamt des Landes Berlin, 1996).
- ⁴⁸ Klaus-Dieter Bilkenroth, David O. Snyder, *Der Mitteldeutsche Braunkohlenbergbau - Geschichte, Gegenwart und Zukunft* (Theißen: Mitteldeutsche Braunkohlengesellschaft mbH, 1998), p. 29.
- ⁴⁹ “Durch den Bergbau verlorene Orte südlich von Leipzig” (Für Heuersdorf e.V., www.heuersdorf.de).
- ⁵⁰ Bund für Umwelt und Naturschutz Deutschland, Landesverband Nordrhein-Westfalen e.V., www.bund-nrw.de/braunkohle.
- ⁵¹ “Aus Dörfern werden Mondlandschaften”, *Die Tageszeitung taz* (October 23, 2004).
- ⁵² The wartime epic *Enemy at the Gates* was filmed in the rugged mining landscapes of Lusatia.
- ⁵³ “Fraktionszwang” (<http://de.wikipedia.org/wiki/Fraktionszwang>).
- ⁵⁴ Thomas Michael Power, *Lost Landscapes and Failed Economies* (Washington: Island Press, 1996).
- ⁵⁵ Thomas Michael Power, *Digging to Development? A Historical Look at Mining and Economic Development* (Boston: Oxfam America, September 2002), p. 19.

- ⁵⁶ Statistik der Kohlenwirtschaft e.V., op. cit.
- ⁵⁷ All four Vattenfall lignite power stations are located in the same counties (*Landkreise*) as the mines that serve them. Germany has been ranked here as a state in the European Union for the purposes of comparison, since its geographical dimensions are comparable to those of many US states.
- ⁵⁸ Thomas Michael Power, Oxfam America, op. cit., p. 13.
- ⁵⁹ According to a list published by the daily newspaper *Die Welt*, the ten largest corporations operating in eastern Germany in 2003 were: 1. Vattenfall Europe AG, Berlin; 2. Volkswagen Sachsen GmbH, Zwickau; 3. Verbundnetz Gas AG (VNG), Leipzig; 4. Dow BSL Olefinverbund GmbH, Schkopau; 5. Total Raffinerie Mitteldeutschland GmbH, Spergau; 6. Envia Mitteldeutsche Energie AG, Chemnitz; 7. Jenoptik AG, Jena; 8. Bombardier Transportation Deutschland, Berlin; 9. Edis AG, Fürstenwalde; 10. Opel Eisenach GmbH.
- ⁶⁰ “Kraftwerk Boxberg wächst”, *Sächsische Zeitung* (June 29, 2004).
- ⁶¹ “Vattenfall Europe optimiert ostdeutschen Kraftwerkspark”, *Lausitzer Rundschau* (July 1, 2004).
- ⁶² “Despite difficult conditions - production record for brown coal” (Theißen: Mitteldeutsche Braunkohlengesellschaft mbH, March 26, 2004, www.mibrag.de).
- ⁶³ “Das Geschäftsjahr 2003” (Amsdorf: ROMONTA GmbH, 2004, www.romonta.de).
- ⁶⁴ “Bundesunternehmen LMBV hat Geburtstag” (Berlin: Lausitzer und Mitteldeutsche Bergbau-Verwaltungsgesellschaft mbH, August 2, 2004).
- ⁶⁵ “Heuersdorf: Gesetzentwurf wird in Landtag eingebracht” (Dresden: Sächsisches Staatsministerium für Wirtschaft und Arbeit, October 21, 2003).
- ⁶⁶ “LMBV: Vier Fünftel der Bergbausanierung geschafft”, *Mitteldeutsche Zeitung* (May 5, 2004).
- ⁶⁷ “Veba baut für 2,7 Milliarden Kraftwerk in Schkopau”, *Leipziger Volkszeitung* (November 6, 1992).
- ⁶⁸ *Energieprogramm Sachsen* (Dresden: Sächsisches Staatsministerium für Wirtschaft und Arbeit, 1993), pp. 131 – 132.
- ⁶⁹ “Our Operations. Welzow-Süd open cast mine” (Berlin: Vattenfall Europe AG, www.vattenfall.de).
- ⁷⁰ In an Internet forum of the Wisconsin Stewardship Network (www.wsn.org).
- ⁷¹ “Lippendorfer Werk zieht Menschen wie Magnet an”, *Leipziger Volkszeitung* (June 21, 2003).
- ⁷² “Zwischen Kohle und Heimatgefühl”, *Sächsische Zeitung* (January 27, 2005).
- ⁷³ The *Bundesagentur für Arbeit* in the city of Borna.
- ⁷⁴ “Arbeitslosen-Zahl verringert sich im März um 146”, *Leipziger Volkszeitung* (April 4, 2004).
- ⁷⁵ “Kaum Besserung im November”, *Leipziger Volkszeitung* (December 3, 2004).
- ⁷⁶ “Anhaltend hohe Arbeitslosigkeit”, *Leipziger Volkszeitung* (January 5, 2005).
- ⁷⁷ “Single-window clearance for mining being mooted”, *Financial Express* (November 21, 2004).
- ⁷⁸ “Beschäftigte im Braunkohlenbergbau des Bundesgebietes in den Jahren 1950 bis 2003” (Statistik der Kohlenwirtschaft e.V., 2004, www.kohlenstatistik.de).
- ⁷⁹ *U.S. Electric Utility Sales, Revenue and Average Retail Price of Electricity* (Washington: Energy Information Administration, www.eia.doe.gov/cneaf/electricity/page/sales_revenue.xls).
- ⁸⁰ “Vattenfall-Preiserhöhung: Tiefschlag für die neuen Länder” (Berlin: Bund der Energieverbraucher e.V., July 13, 2004).
- ⁸¹ “US focus shifts to gasification”, *Modern Power Systems* (September 1, 2004).
- ⁸² Ed Murphy, “Mineral Resources of North Dakota: Coal”, (Bismarck: North Dakota Geological Survey, May 21, 2003).
- ⁸³ Germany has 78 billion tons of known lignite deposits, of which over 40 billion tons are considered extractable using available surface mining technology at current prices. See: *Unsere Braunkohle* (Cologne: Bundesverband Braunkohle, 2000), p. 10.
- ⁸⁴ The wind generation potential in North Dakota has been estimated at 1,210 TWh/a, or roughly 100 times the annual output of the Schwarze Pumpe power plant. See: *An*

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- ⁸⁵ “Wind Energy Turbines Dedicated in North Dakota”, *Business Wire* (November 6, 2002).
- ⁸⁶ Helmut Elfenberger, op. cit., pp. 27 – 28.
- ⁸⁷ Mark Barrett, *Atmospheric Emissions from Large Point Sources in Europe* (Göteborg: Swedish NGO Secretariat on Acid Rain, October 2004), p. 32.
- ⁸⁸ “Vattenfall Europe will für 1,3 Mrd EUR zwei Kraftwerke bauen”, *Dow Jones Newswire* (January 18, 2005).
- ⁸⁹ Michael Hänel, *Das Ende vor dem Ende*, (Alberta: Occasional Papers in German Studies, March 1998), p. 7.
- ⁹⁰ Trattendorf was the first power station in Lusatia, and in 1915 the largest in Europe. It was constructed to provide electrical power to Berlin.
- ⁹¹ Walter Greiling, *Chemie erobert die Welt* (Berlin: Wilhelm Limpert-Verlag, 1943), pp. 149–150.
- ⁹² Ostwald recognized the significance of the “galvanic gas battery” - the fuel cell - conceived in 1839 by the Welshman William Robert Grove (1811-1896). Ostwald predicted in 1894 that this device would one day overshadow the invention of the steam engine.
- ⁹³ Haber personally witnessed the first use of poisonous gas on the Western Front near the Belgian town of Ypres on April 22, 1915. Chlorine gas was released from 5,730 steel cylinders, killing or debilitating thousands of French Algerian and territorial provincial soldiers. Haber’s wife, Clara Immerwahr (1870–1915), declared gas warfare a “perversion of science”. She committed suicide on May 2, 1915 using her husband’s service pistol after a dinner celebrating the Ypres attack. The Peace Prize of the German section of the International Physicians for the Prevention of Nuclear War (IPPNW) bears her name.
- ⁹⁴ Because of his work in gas warfare, Haber was appointed National Commissioner for Pest Control in 1919. He had soon founded a company that developed Zyklon B (hydrocyanic or prussic acid), which released hydrogen cyanide gas that was used as a fumigating agent. It was later to be employed by the Nazi regime for programs of mass execution, in which a number of Haber’s relatives would perish.
- ⁹⁵ Fritz Haber pursued another approach to paying war reparations. From 1920 to 1926, he attempted unsuccessfully to develop a method of extracting gold from sea water, even analyzing samples at various locations of the ocean. Disappointed by his failure, he subsequently devoted himself to more diversified research and to reestablishing relations between Germany and the international scientific community.
- ⁹⁶ Wolfgang Stinglwagner, op. cit., p. 54.
- ⁹⁷ *Statistisches Jahrbuch der DDR 1989* (Berlin: Staatliche Verwaltung für Statistik, 1989), p. 146.
- ⁹⁸ Jeffrey H. Michel, “What it will cost” *Acid News*, No. 3/1991 (October 1991); Jeffrey H. Michel, “Eastern Germany. Air Quality Improved ... Possibly”, *Acid News*, No. 3/2000 (October 2000).
- ⁹⁹ Bundesministerium für Innerdeutsche Beziehungen. *DDR-Handbuch*. Cologne, 1985, p. 383, 384.
- ¹⁰⁰ Martin Jänicke, Lutz Mez, Jürgen Pöschk, Susanne Schön, Thomas Schwilling, *Alternative Energiepolitik in der DDR und in West-Berlin* (Berlin: Institut für ökologische Wirtschaftsforschung, April 2, 1987), p. 23.
- ¹⁰¹ “Interview Erich Honeckers für ‘Dagens Nyheter’”, *Berliner Zeitung*, No. 148/1986 (June 25, 1986), p. 4.
- ¹⁰² *Erster Zwischenbericht zur Sicherheitsbeurteilung des Kernkraftwerks Greifswald* (Cologne: Gesellschaft für reaktorsicherheit mbH, February 15, 1990).
- ¹⁰³ “Alles tot”, *Der Spiegel*, No. 4/1990, pp. 85 – 87.
- ¹⁰⁴ Christa Wolf, *Störfall. Nachrichten eines Tages* (Berlin: Aufbau-Verlag, 1987).
- ¹⁰⁵ Michael Beleites, *Pechblende. Der Uranbergbau in der DDR und seine Folgen* (Wittenberg: Kirchliches Forschungsheim, 1988).
- ¹⁰⁶ Erich Honecker had been born on August 25, 1912.
- ¹⁰⁷ *Vertrag über die Herstellung der Einheit Deutschlands - Einigungsvertrag (BGBl. 1990 II)* (Bonn: Deutsche Bundesregierung, August 31, 1990).

- ¹⁰⁸Kruschel & Franz, public sanitation engineers in Berlin, have estimated a total sewage treatment capacity for 80 million inhabitants, or roughly the entire German population.
- ¹⁰⁹*Ökologische Modernisierung der Energieversorgung der DDR: Ziele, Instrumente, Kooperationsmöglichkeiten* (Bonn: Friedrich-Ebert-Stiftung, 1990), p. 5.
- ¹¹⁰*Wochenbericht 49/91* (Berlin: Deutsches Institut für Wirtschaftsforschung, 1991).
- ¹¹¹The rate of loan defaults has remained several higher than that of western Germany to this day.
- ¹¹²Jeffrey H. Michel, “Mobilmachung im Osten”, *fairkehr* (February 1991), p. 12.
- ¹¹³The COMECON accorded individual member states exclusive rights to manufacture particular products under a policy termed the Basic Principles of the International Socialist Division of Labor. Heavy trucks were produced in the Soviet Union, Rumania, and Czechoslovakia, forklift trucks in Bulgaria, buses in Hungary, and certain farming equipment and railway cars in the GDR.
- ¹¹⁴For instance, the legally registered corporate headquarters of the Dresdner Bank have been located in Frankfurt am Main after being transferred from Dresden in 1950.
- ¹¹⁵Reinhard H. Brummer, “Das ostdeutsche Chemiedreieck braucht mehr Produktion”, *Die Welt* (March 24, 1999), p. U3.
- ¹¹⁶An estimate of the news magazine *Der Spiegel* in the spring of 2004.
- ¹¹⁷“Es fehlen die Märkte”, *Junge Welt* (July 2, 2004).
- ¹¹⁸Bundesagentur für Arbeit, www.arbeitsagentur.de.
- ¹¹⁹“Arbeitslosigkeit steigt in Borna dramatisch an”, *Leipziger Volkszeitung* (edition Borna/Geithain, February 3, 2005).
- ¹²⁰Hermann Adrian, *Die Entwicklung der Bevölkerung in Deutschland und ihre Auswirkungen auf Wirtschaft und Gesellschaft* (Mainz: Johannes-Gutenberg-Universität, October 2000), p. 13.
- ¹²¹“Mehr als eine Million Wohnungen im Osten leer”, *Sächsische Zeitung* (June 7, 2004).
- ¹²²Steffen Kröhnert, Nienke van Olst, Reiner Klingholz, “Germany 2020 – The Demographic Future of the Nation”, Main Results (Berlin: Berlin-Institute for World Population and Global Development, April 2004), p. 5.
- ¹²³PreussenElektra and RWE, each with a 26.25% share, Bayernwerk (22.5%), and HEW, VEW, EVS, and BEWAG, each with 6.25%.
- ¹²⁴*Ökologische Modernisierung der Energieversorgung der DDR: Ziele, Instrumente, Kooperationsmöglichkeiten* (Bonn: Friedrich-Ebert-Stiftung, 1990) pp. 20 - 25.
- ¹²⁵“DDR braucht eigenes Strom-Netz”, *Die Welt* (February 22, 1990).
- ¹²⁶“Privatisierung der Mibrag sichert Bergbau in der Region”, *Leipziger Volkszeitung* (December 9, 1993), p. 6.
- ¹²⁷One Terawatt-hour (TWh) equals a billion kilowatt-hours, 1000 Gigawatt-hours, or 3,600 trillion Joules.
- ¹²⁸W. Riesner, M. Kubessa, “Energiesparpotentiale in der ehemaligen DDR - zeitliche Erschließbarkeit und Maßnahmenvorschläge”, *Wissenschaftliche Berichte*, No. 26 (December 1990), pp. 12 - 13.
- ¹²⁹Manfred Horn, “Ostdeutsche Stromversorgung in einem schwierigen Umfeld”, *Wochenbericht*, No. 25/95, (Berlin: Deutsches Institut für Wirtschaftsforschung), p. 452.
- ¹³⁰“Hochspannungsleitung durch Thüringen”, *Freies Wort* (February 11, 2005).
- ¹³¹*Energiepolitik für das vereinte Deutschland* (Bonn: Bundesministerium für Wirtschaft, March 1992), p. 35.
- ¹³²*Energieprogramm Sachsen*, op. cit., p. 78.
- ¹³³*Braunkohle in der Übersicht*, op. cit. In 2003, 79.4 million tons of lignite were mined in eastern Germany, while total German production was 179 million tons.
- ¹³⁴*Vertikale Netzlast* (Berlin: Vattenfall Europe Transmission GmbH, March 2004, http://transmission.vattenfall.de/files/Netzkennzahlen/Netzlast/xls/200403_vert_Netzlast.xls).
- ¹³⁵Law on the National Allocation Plan for Greenhouse Gas Rights in the Allocation Period 2005 - 2007 (*Gesetz über den Nationalen Zuteilungsplan für Treibhausgasemissionsberechtigungen in der Zuteilungsperiode 2005 bis 2007 [Zuteilungsgesetz 2007 - ZuG 2007]*) (Berlin: Deutscher Bundestag, May 28, 2004).
- ¹³⁶“Vattenfall Europe optimiert ostdeutschen Kraftwerkspark” (Berlin: Vattenfall Eu-

- rope AG, July 1, 2004).
- ¹³⁷As much as 20% of the energy contained in the lignite may be employed for drying the fuel during the milling process that is prerequisite to combustion. See: *Energies for the New Millenium* (Essen: RAG Aktiengesellschaft, June 2002), p. 36.
- ¹³⁸Law on the Electricity and Gas Industries (*Gesetz über die Elektrizitäts- und Gasversorgung EnWG – Energiewirtschaftsgesetz*) (Bonn: Deutscher Bundestag, April 29, 1998).
- ¹³⁹“Banken wollen Ost-Versorger Veag keine neuen Kredite einräumen”, *Berliner Zeitung* (January 24, 2000).
- ¹⁴⁰“Hintergrundinformation zur Fusion RWE/VEW”, (Bonn: Bundeskartellamt, June 13, 2000).
- ¹⁴¹“Energiebericht des BMWi: Perspektiven nachhaltiger Energiepolitik aufgezeigt” (Berlin: Bundesministerium für Wirtschaft und Arbeit, July 2002), p. 3.
- ¹⁴²Beginning in 2006, these operations will be renamed Vattenfall Europe Berlin and Vattenfall Europe Hamburg.
- ¹⁴³Ludwig Elle, “Territorium, Bevölkerung, demografische Prozesse im deutsch-sorbischen Gebiet”, *Projekt Rastko - Luzica* (www.rastko.org.yu).
- ¹⁴⁴*Lexikon Städte und Wappen der Deutschen Demokratischen Republik* (Leipzig: VEB Bibliographisches Institut Leipzig, 1984), p. 429.
- ¹⁴⁵*Ibid*, p. 60.
- ¹⁴⁶“Borna verliert mehr als 1000 Einwohner im Jahr”, *Leipziger Volkszeitung* (edition Borna/Geithain, January 25, 2005).
- ¹⁴⁷Priestly confessors would impose heavy obligations of prayer and pilgrimage on persons who had committed serious sins. These spiritual debts could be transferred to proxies, however, by paying monasteries to perform the required acts of penance.
- ¹⁴⁸The Taborites were named after the town they had founded in 1420 in Southern Bohemia as an egalitarian peasant commune. Their spirit is commemorated in Smetana’s Song of Freedom.
- ¹⁴⁹Zizka was an innovative general whose armed farm carts were a precursor to the modern tank.
- ¹⁵⁰The purported posting of Luther’s theses on the door of the Castle Church (*Schlosskirche*) in Wittenberg is only a romantic embellishment, although it was common at the time to announce propositions for public debate in this manner.
- ¹⁵¹Torgau was the city on the Elbe River where converging American and Soviet troops linked up on April 25, 1945.
- ¹⁵²“Die Schweden sind gekommen, haben alles mitgenommen, habens Fenster eingeschlagen, habens Blei davon getragen, haben Kugeln draus gegossen, und die Bauern totgeschossen”. Quoted in: “Die Schlacht bei Lützen”, *Die Geschichte der Stadt Luetzen* (www.jale-online.de).
- ¹⁵³The battlefield at Breitenfeld is near the present-day site of the Leipzig Trade Fairgrounds.
- ¹⁵⁴The body of the king had been brought to Wolgast on the Baltic Sea and returned by ship to Sweden.
- ¹⁵⁵Called the *Gustav-Adolf-Gedenkstätte*.
- ¹⁵⁶*Übersichtskarte Tiefliegende und Energierohstoffe in Sachsen-Anhalt* (Magdeburg: Landesamt für Geologie und Bergwesen Sachsen-Anhalt, 2004, www1.mw.sachsen-anhalt.de/gla/daten/gis/uek/energie_400_2.htm).
- ¹⁵⁷“Mibrag liebäugelt mit Kraftwerkbau”, *Mitteldeutsche Zeitung* (March 27, 2004).
- ¹⁵⁸*Bundesberggesetz, BGBl I 1980, 1310* (Bonn: Deutscher Bundestag, August 13, 1980).
- ¹⁵⁹*Verfassung des Landes Brandenburg*, Article 25, Paragraph 1 (Potsdam: Landtag Brandenburg, August 20, 1992).
- ¹⁶⁰*Braunkohlengesetz* (Potsdam: Landtag Brandenburg, June 11, 1997).
- ¹⁶¹Michael Gromm, *Horno – ein Dorf in der Lausitz will leben* (Berlin: Dietz Verlag, 1995).
- ¹⁶²www.vattenfall-watch.de.
- ¹⁶³Christoph Dieckmann, “Ein Dorf fährt in die Grube”, *Die Zeit* (October 2, 2003).
- ¹⁶⁴“Bundesverwaltungsgericht bestätigt Zulassung für Braunkohlentagebaue” (Potsdam:

- Grüne Liga Brandenburg e.V., June 12, 2002).
- ¹⁶⁵Günter Gaus: “Wenn es überhaupt noch Sinn macht, sich öffentlich einzumischen, dann muss man sich überschaubare, konkrete Gegenstände denken. Dieses Dorf ist so einer. Deshalb bin ich noch einmal von meiner festen Gewohnheit abgewichen, nichts zu unterschreiben und habe unterschrieben. Wenn es meinen Parteivorsitzenden ärgert, soll es mich umso mehr freuen. Selbst wenn es wirtschaftliche Gründe gibt, die sich besser rechnen, (wenn man also den Braunkohletagebau über Horno hingehen lässt), selbst wenn das so sein sollte, muss man doch sagen: Das ganze Leben kann nicht regiert werden von wirtschaftlichen Geboten. Irgendwann muss man mal Halt machen.” Quoted in: Marina Achenbach, “Das erstaunliche Dorf”, *Freitag* (August 24, 2001)
- ¹⁶⁶Martin Völkel, “Das Jahr 2000 bei den Sorben” (Bautzen: DOMOWINA – Bund Lausitzer Sorben e.V., March 2001).
- ¹⁶⁷Michael Gromm, *Sorb settlements. The wholesale destruction of the Sorb settlement through strip mining* (www.vattenfall-watch.de).
- ¹⁶⁸“Buttern und backen wie vor 100 Jahren”, *Sächsische Zeitung* (October 4, 2004).
- ¹⁶⁹This episode has been documented by the Rainbow Network at www.netzwerk-regenbogen.de.
- ¹⁷⁰IBA international code DE402.
- ¹⁷¹“Zerstörung der Lacomaer Teiche durch Tagebau nicht erforderlich” (Potsdam: Grüne Liga Brandenburg e.V., June 29, 2004).
- ¹⁷²*Council Directive 92/43/EEC of 21st May 1992 on the conservation of natural habitats and of wild fauna and flora*. Approximately 900 European species are listed in Annex II.
- ¹⁷³Elisabeth Schroedter, “Braunkohle bedroht europäisches Naturerbe”, inquiry on the European Commission of September 16, 2003 (www.elisabeth-schroedter.de).
- ¹⁷⁴*Reply of Ms. Wallström in the Name of the Commission, E-2865/03DE of November 11, 2003*.
- ¹⁷⁵“Umweltschützer setzen Hungerstreik für Lakoma fort” (Berlin: Evangelischer Pressedienst, March 17, 2004).
- ¹⁷⁶*Eine Vision für Lacoma* (Lacoma: Lacoma e.V., December 18, 2003).
- ¹⁷⁷René Schuster, “Ein Tagebau verursacht länger Kosten, als er Kohle – im doppelten Sinne – bringt!” (June 17, 2004, www.kritischeaktionaere.de).
- ¹⁷⁸“Neues aus dem Planfeststellungsdschungel: Spreeauenkonzept längst nicht sicher”, *blicklicht* (September 2004).
- ¹⁷⁹The scarab, more mundanely known as the dung beetle, was considered by the Egyptians to illustrate daily self-renewal by rolling a ball of dung in emulation of the Sun’s transit across the heavens.
- ¹⁸⁰Hans-Peter Gensichen, *Umweltverantwortung in einer betonierten Gesellschaft* (www.tun-lassen.de).
- ¹⁸¹“‘Neuseeland’ statt Kohle-Moloch”, *Sächsische Zeitung* (March 17, 2001).
- ¹⁸²*Heuersdorf-Vertrag* of June 19, 1995, www.mibrag.de. Heuersdorf was foreseen as a third signatory but refused to accept the terms of resettlement.
- ¹⁸³The Schleenhain mine was opened in 1949.
- ¹⁸⁴The United Schleenhain surface mine (*Tagebau Vereinigtes Schleenhain*) comprises the Schleenhain, Peres, and Grotzschers Dreieck quarries.
- ¹⁸⁵The lignite beneath Heuersdorf has an energy content of about 11 Megajoules (MJ) per kilogram, compared with the coal equivalent (*Steinkohleneinheit*) of 29.3 MJ/kg, or 8.141 kWh/kg that applies to hard coal.
- ¹⁸⁶“Mibrag denkt ans Hinschmeißen”, *Leipziger Volkszeitung* (January 22, 2004).
- ¹⁸⁷Only about 20 million tons of lignite are located under the settled areas of Heuersdorf. Total MIBRAG lignite resources in two mines amount to about 800 million tons, while additional turnover is realized through power sales and other activities.
- ¹⁸⁸Base-load power traded at about 2.7 euro/kWh in May 2003 and had increased to 3.2 euro/kWh a year later.
- ¹⁸⁹“Mibrag liebäugelt mit Kraftwerkbau”, *Mitteldeutsche Zeitung* (27.03.2004).
- ¹⁹⁰VEAG managing board to the economics minister of Saxony, Kajo Schommer, concerning the possible unavailability of “coal quantities in the area of Heuersdorf” (*Kohlenmengen im Bereich Heuersdorf*), on March 2, 1994: “The power station will not be erected under these circumstances.” (*Das Kraftwerk wird unter diesen Umständen nicht errichtet.*)

- ¹⁹¹ *Heuersdorfgesetz*, Article 1: “Das Gebiet der Gemeinde Heuersdorf kann zum Zwecke der Rohstoff- und Energieversorgung (Braunkohlenabbau) in Anspruch genommen werden.” (Dresden: Sächsischer Landtag, April 8, 1998).
- ¹⁹² In his letter of August 1, 1994, to Heuersdorf, Biedenkopf referred to the *öffentliche(s) Interesse an der Durchsetzung der staatlichen Energiepolitik* in order to secure or create thousands of jobs (*Tausender von Arbeitsplätzen*).
- ¹⁹³ Biedenkopf had been party leader of the CDU in North Rhine-Westphalia in 1986 – 87, where RWE has its headquarters. He was likewise no stranger to lignite operations in the east. His father Wilhelm had served as wartime business manager (*Wehrwirtschaftsführer*) of the Buna Chemical Works in Schkopau, a position that his son would demote to “technical director” (*technischer Leiter*) in a later interview. Kurt attended school in Merseburg and received his apprenticeship training in the chemical plant, where slave laborers made up an important part of the work force. His father assisted in the planning of Buna operations in Auschwitz. These formative circumstances at the cauldrons of Nazi oppression have been antiseptically avoided in most Biedenkopf literature. The primary Buna contractor, Phillip Holzmann AG, was commissioned after 1990 to construct the housing subdivision for the displaced population of Breunsdorf as well as the underground garage of the state assembly building in Dresden.
- ¹⁹⁴ The *Bundesverdienstkreuz* is the highest award conferred on civilians. Over three thousand citizens annually are approved by the federal president (*Bundespräsident*) to receive it.
- ¹⁹⁵ “Federal Cross of Merit for Bruce DeMarcus, Chief Executive Officer of MIBRAG” (Theißen: Mitteldeutsche Braunkohlengesellschaft mbH, October 28, 2002).
- ¹⁹⁶ “MIBRAG Starts Information Initiative” (Theißen: Mitteldeutsche Braunkohlengesellschaft mbH, October 23, 2002).
- ¹⁹⁷ “Gibt es in Heuersdorf sozialistische Perspektiven?” (Deutzen: SED-Betriebsparteiorganisation, VEB Braunkohlenwerk Deutzen, April 1958).
- ¹⁹⁸ “Arbeitschutzpreis 2004’ für Staufenbiehl und MIBRAG”, *Mitteldeutsche Zeitung* (September 30, 2004).
- ¹⁹⁹ *Urteil des Sächsischen Verfassungsgerichtshofs vom 14.07.2000 zum Verfahren der Normenkontrolle gegen das Heuersdorf-Gesetz vom 08.04.1998, (Vf. 40-VIII-98)* (Leipzig: Sächsischer Verfassungsgerichtshof, July 14, 2000).
- ²⁰⁰ “Drucksache 3/7740. Kleine Anfrage der Abgeordneten Andrea Roth, PDS-Fraktion, ‘Kosten des Heuersdorf-Verfahrens’”, Aktenzeichen 43-4714.30 (Dresden: Sächsisches Staatsministerium für Wirtschaft und Arbeit, March 6, 2003).
- ²⁰¹ Regionaler Planungsverband Westsachsen.
- ²⁰² “Nichtigkeit des Braunkohlenplanes ‘Vereinigtes Schleenhain’” (Berlin: Becker Büttner Held, November 12, 2003).
- ²⁰³ “Umweltschützer vergeben ‘Klima-Killer-Oscar’ an Milbradt”, *ddp Nachrichtenagentur GmbH* (September 6, 2004).
- ²⁰⁴ *The Flag Code*, Title 4, United States Code, Chapter 1, originally adopted by the National Flag Conference, Washington, D.C., June 14-15, 1923.
- ²⁰⁵ U. Fahl, U. Remme, M. Blesl, A. Voß, *Analyse nachhaltiger Entwicklungen der Energieversorgung in Deutschland und ihre regionalen Auswirkungen auf Bayern mit besonderer Berücksichtigung der Konsequenzen des Kernenergieausstiegs* (Stuttgart: Universität Stuttgart, Institut für Energiewirtschaft und Rationelle Energieanwendung, April 2003), p. 31.
- ²⁰⁶ Stefan Lechtenböhrer, Kora Kristof, Wolfgang Irrek, *Braunkohle – ein subventionsfreier Energieträger?* (Wuppertal: Wuppertal Institut für Klima, Umwelt, Energie GmbH, 2004).
- ²⁰⁷ *Ibid*, p. 48.
- ²⁰⁸ Claudia Kemfert, “Die ökonomischen Kosten des Klimawandels”, *Wochenbericht*, No. 42/2004 (Berlin: Deutsches Institut für Wirtschaftsforschung, 2004).
- ²⁰⁹ Franzjosef Schafhausen, “Die politische Umsetzung von Kyoto in der EU und in Deutschland”, *UmweltMagazin*, No. 4/5-2004.
- ²¹⁰ Energy is wasted due to power plant generating inefficiency, poor fuel quality, transmission line losses, and the use of pump generators to store electrical energy during off-peak hours.

- ²¹¹ First published in 1824 in the *Annales de chimie et de physique*.
- ²¹² *Climate Change 2001: The Scientific Basis. Summary for Policymakers* (Geneva: Intergovernmental Panel on Climate Change, 2001). p. 3.
- ²¹³ “Emissions could double: report”, *The Age* (September 6, 2004).
- ²¹⁴ “New European Renewables Target: ‘20% by 2020’” (Brussels: European Renewable Energy Council, January 21, 2004); “Renewable energy: Commission calls for a stronger commitment of Member States to achieve the 2010 targets” (Brussels: European Commission, May 26, 2004).
- ²¹⁵ Fred Pearce, “Kyoto protocol is just the beginning”, *New Scientist* (October 6, 2004).
- ²¹⁶ Peter Dietze, “Der Klima-Flop des IPCC” (Würzburg: Universität Würzburg, July 22, 1998, www.wuerzburg.de/mm-physik/klima/cmodel.htm).
- ²¹⁷ “Rice harvests more affected than first thought by global warming” (Manila: International Rice Research Institute, June 29, 2004).
- ²¹⁸ *Energy White Paper. Our energy future – creating a low carbon economy* (London: Secretary of State for Trade and Industry, February, 2003), p. 8.
- ²¹⁹ *Climate Change Action Plan* (Boston: The Committee on the Environment and of the Conference of New England Governors and Eastern Canadian Premiers, New England Secretariat, New England Governors’ Conference Inc., August 2001), p. 7.
- ²²⁰ “Australia faces severe water crisis unless CO₂ emissions are dramatically reduced” (Sydney: Institute of Environmental Management and Assessment, July 6, 2004).
- ²²¹ Mark Lynas, *High Tide* (New York: Picador, 2004), p. 107.
- ²²² Hans-Joachim Ziesing, “Energieverbrauch und CO₂-Emissionen in Deutschland in der ersten Hälfte der neunziger Jahre”, *Wochenbericht*, No. 4/1996 (Berlin: Deutsches Institut für Wirtschaftsforschung, 1996). Of all the major industrial countries, only Canada and the USA registered higher carbon dioxide emissions per inhabitant than the GDR.
- ²²³ Martin Jänicke, Lutz Mez, “Umweltpolitik in der BRD”, in: Uwe Andersen, Wichard Woyke, *Handwörterbuch des politischen Systems der Bundesrepublik Deutschland* (Bonn: Bundeszentrale für politische Bildung, Bonn, 2000).
- ²²⁴ Germany was one of the initiators of the United Nations Framework Convention on Climate Change held in Rio de Janeiro in 1992.
- ²²⁵ The Act on Orderly Termination of Atomic Energy Use for the Commercial Generation of Electricity (op. cit) of April 22, 2002, became law on April 26, the 16th anniversary of the Chernobyl catastrophe.
- ²²⁶ Bundesverband WindEnergie e.V., www.wind-energie.de.
- ²²⁷ Unternehmensvereinigung Solarwirtschaft e.V., www.solarwirtschaft.de.
- ²²⁸ The curves indicate total CO₂ emissions produced from fossil fuels. The carbon dioxide additionally emitted by industrial processes contributes less than 3% to the total CO₂ emissions registered in any year. See: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. National Allocation Plan for the Federal Republic of Germany 2005-2007. Berlin, March 31, 2004, p. 14.
- ²²⁹ “Klimaschutz – Die größte umweltpolitische Herausforderung der Menschheit” (Berlin: Deutsche Bundesregierung, June 19, 2002).
- ²³⁰ “Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Dr. Peter Paziorek, Karl-Josef Laumann, Dagmar Wöhrle, weiterer Abgeordneter und der Fraktion der CDU/CSU – Drucksache 15/1542 – Klimaschutz und CO₂-Vermeidungskosten”, Document (*Drucksache*) 15/1851, 15. Wahlperiode (Berlin: Deutscher Bundestag, October 28, 2003).
- ²³¹ According to the Kyoto Protocol, the emission of greenhouse gases is to be reduced among the signatory nations by 5.2% in 2012 compared with 1990. Germany’s comparatively high target of 21% reflects the CO₂ reductions already realized in eastern Germany.
- ²³² Franzjosef Schafhausen, *Emissionshandel als Instrument der Klimaschutzpolitik – Stand und Perspektiven* (Berlin: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, January 22, 2005).
- ²³³ Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

- ²³⁴ *National Allocation Plan for the Federal Republic of Germany 2005-2007* (Berlin: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, March 31, 2004), p. 14.
- ²³⁵ "Vattenfall droht Millionenlast durch Emissionshandel", *Lausitzer Rundschau*, April 8, 2004.
- ²³⁶ *Vertrag zwischen der Bundesrepublik Deutschland und der Deutschen Demokratischen Republik über die Herstellung der Einheit Deutschlands vom 31. August 1990 (Einigungsvertrag)*, Article 34, Paragraph 1, (*Umweltschutz*), (Bonn: Deutsche Bundesregierung, August 31, 1990).
- ²³⁷ "Änderungen des Nationalen Allokationsplans (NAP) durch das NAP-G" (Berlin: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, April 27, 2004).
- ²³⁸ "Vattenfall Europe well equipped for CO₂ trade start", *Reuters Power News* (April 23, 2004).
- ²³⁹ "Vattenfall Europe prüft Investitionen in neue Kraftwerke" (Berlin: Vattenfall Europe AG, June 17, 2004).
- ²⁴⁰ "Westkonzerne verstromen Ostdeutschland", *Badische Zeitung* (September 7, 1994).
- ²⁴¹ "Betriebsrat der Stadtwerke kritisiert Emissions-Pläne", *Leipziger Volkszeitung* (May 22, 2004).
- ²⁴² *Gesetz zur Neuregelung des Energiewirtschaftsrechts*, Article 4, Paragraph 3 (Bonn: Deutscher Bundestag, April 28, 1998).
- ²⁴³ *Directive 2003/87/EC, Preamble (20)* (Brussels: European Commission, 2003).
- ²⁴⁴ *Strategie der Bundesregierung zur Windenergienutzung auf See* (Berlin: Deutsche Bundesregierung., 2002), p. 7.
- ²⁴⁵ Frank-Detlef Drake, "Die BoA-Kraftwerkslinie - Stand und Ausblick" (Essen: 7. Fachkongress Zukunftsenergien, February 12, 2003).
- ²⁴⁶ "Vattenfall Europe prüft Investitionen in neue Kraftwerke" (Berlin: Vattenfall Europe AG, June 17, 2004).
- ²⁴⁷ "Argumentationspapier zur Entwicklung der Kohlenkraftwerkstechnik unter Berücksichtigung der Klimavorsorge", *Quartalsbericht der Vattenfall AB Jan-März 2003* (Berlin: Vattenfall Europe AG, April 9, 2003), p. 2.
- ²⁴⁸ "Neues Gutachten spricht für SVZ", *Sächsische Zeitung* (February 5, 2004).
- ²⁴⁹ "Dresdner Anwalt sucht Käufer für Sero-Zentrum", *Sächsische Zeitung* (April 27, 2004).
- ²⁵⁰ Gerhard Moritz, Josef Tauschitz, "Mitverbrennung von Biomasse in Kohlekraftwerken" (Vienna: Verbund Austrian Thermal Power AG, 2001).
- ²⁵¹ "Klärschlamm-Verbrennung im Kraftwerk Boxberg" (Berlin: VEAG-PowerConsult, March 30, 1999). Each of the 500 MW plants is equipped to burn 16 tons of sewage sludge an hour.
- ²⁵² "Mehr Mengen für die Anlage", *Norddeutsche Neueste Nachrichten* (February 2, 2005)
- ²⁵³ "Amtlich: Kraftwerk darf Klärschlamm verbrennen", *Leipziger Volkszeitung* (April 2, 2004).
- ²⁵⁴ "Mummsdorf Power Plant" (Theißen: MIBRAG, www.mibrag.de).
- ²⁵⁵ Reinhardt Hassa, "Beantwortung ausgewählter Fragen zur Anhörung vor der AG 'Kohle' des Rates für Nachhaltige Entwicklung am 4. April in Essen", German Council for Sustainable Development (*Rat für Nachhaltige Entwicklung*), April 4, 2003, p. 1.
- ²⁵⁶ The gasification of lignite would enable broader strategies of exceptionally efficient power plant technologies to be mounted. The restriction of such considerations to natural gas has impeded their implementation due to increased import dependency. See: Daniel Vallentin, "Die Berücksichtigung klimapolitischer Aspekte bei der Erneuerung des deutschen Kraftwerksparks am Beispiel der Auseinandersetzung um das GuD-Kraftwerk Hürth-Knapsack" (Berlin: Otto-Suhr-Institut, 2004).
- ²⁵⁷ "Vattenfall Europe optimiert ostdeutschen Kraftwerkspark", *Lausitzer Rundschau* (July 1, 2004).
- ²⁵⁸ "Gas macht der Kohle Dampf", *Kölner Stadt-Anzeiger* (February 3, 2005).
- ²⁵⁹ Klas Andersson, Filip Johnsson, Lars Strömberg, "An 865 MWe Lignite-fired Power Plant with CO₂ Capture – A Technical Feasibility Study" (Cologne: VGB Conference "Power Plants in Competition – Technology, Operation and Environment", March 2003).

- ²⁶⁰Julia Pierce, “Carbon dating”, *The Engineer* (September 10, 2004).
- ²⁶¹Lars Strömberg, “CO₂ Capture and Storage for coal base power generation – technology and economics” (Trondheim: Third Nordic minisymposium on Carbon Dioxide Capture and Storage, October 2 – 3, 2003), p. 38.
- ²⁶²Dierk Baunknecht, Veit Bürger, *Energiewirtschaftliche Bewertung Braunkohletagebau Garzweiler I/II* (Freiburg im Breisgau: Öko-Institut, February 2004), p. 34.
- ²⁶³Viktor Scherer, “Leitprojekt II. CO₂-armes Kraftwerk”, (Bochum: Ruhr-Universität Bochum, December 2002).
- ²⁶⁴Hugh Saddler et. al., “Geosequestration. What is it and how much can it contribute to a sustainable energy policy for Australia?” (Canberra: The Australia Institute, September 2004).
- ²⁶⁵US Department of Energy. Carbon Sequestration. Technology Roadmap and Program Plan – 2004, April 2004, p. 2.
- ²⁶⁶Gary Beck, “Waste Heat - the ‘sleeping giant’ of all energy”, *Energy Pulse*, May 13, 2004.
- ²⁶⁷Ken Silverstein, “Wasted Energy”, *Issue Alert*, March 31, 2004; Wolf-Dieter Roth, “Die ultimative Gasturbine”, *Telopolis*, May 29, 2004.
- ²⁶⁸Information provided by Ormat Nevada Inc., a manufacturer of Rankine cycle products and geothermal power plants, in *Issue Alert*, April 12, 2004.
- ²⁶⁹“Sweden, California weigh time of use pricing”, *Restructuring Today* (October 17, 2003).
- ²⁷⁰*San Diego Regional Energy Infrastructure Study. Demand-Side Options* (San Diego: City of San Diego, January 2003) p. 5-9.
- ²⁷¹“Testimony of Ms. Anita Eide Regarding Comparative Electric Utility Billing Information” (Montreal: Helios Center. Regroupement national des Conseils régionaux de l’environnement du Québec, Régie de l’énergie’s, Docket R-3439-2000), p. 9.
- ²⁷²Patti Harper-Slaboszewicz, ““Sweden, California weigh time of use pricing”, *Issue Alert* (August 10, 2004).
- ²⁷³Jeffrey H. Michel, *Virtuelles Kraftwerk Heuersdorf* (Heuersdorf, 1998).
- ²⁷⁴*Energieprogramm Sachsen 2004* (Dresden: Sächsisches Staatsministerium für Wirtschaft und Arbeit, 2004), p. 14.
- ²⁷⁵The Dieselmotorenwerk Leipzig (DML) with 65 employees had developed Diesel motors particularly suited for generating heat and electricity using biogas from sewage treatment plants. It filed for bankruptcy in December 1997.
- ²⁷⁶Stefan Schroeter, “Das unbekannte Energiespar-Potenzial” (June 2004, www.stefanschroeter.de).
- ²⁷⁷“Sonne geht wieder auf”, *Sächsische Zeitung* (September 25, 2004).
- ²⁷⁸Kurt Häge, *Strommarkt im Umbruch - Entwicklung von Strompreis-Vorhersage-Modellen*, (Berlin: Vattenfall Europe AG, April 19, 2004), p. 16.
- ²⁷⁹“Vattenfall lehnt Preisstopp für Strom ab”, *Der Tagesspiegel* (September 18, 2004).
- ²⁸⁰Initial projects are the biomass power plant for the resettlement of Haidemühl residents in Sellessen and wind turbines near Cottbus. See: “Später Zwilling in Boxberg”, *Sächsische Zeitung* (September 16, 2004).
- ²⁸¹Various techniques for improving of eastern German lignite power generation are being investigated at the University of Stuttgart, the Brandenburg Technical University (BTU) at Cottbus, the Deutsches Brennstoffinstitut Freiberg, and the Chalmers University of Technology in Göteborg.
- ²⁸²The Co-operative Research Centre has established “solid links, exchanges and collaborative research” with the USA, Japan, western Germany, China, the United Kingdom, and Indonesia. See: *Generation Connection* (January 2004), p. 4.
- ²⁸³A deposit payment was levied on glass food containers and most beverage bottles. Apartment complexes delivered aluminum, paper, and other raw materials from domestic refuse to factories.
- ²⁸⁴Foodstuffs, water and heat, and rent were heavily subsidized to foster the illusion of their immunity from global resource shortages. Bread was often fed privately to domestic farm animals, since it was sold at a lower price than the grain from which it had been made.
- ²⁸⁵*13. Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes - 13. BImSchV* (Bonn: Deutsche Bundesregierung, February 23, 1983).
- ²⁸⁶Klaus Töpfer remained an advocate of nuclear energy despite the potential dangers,

particularly of Soviet nuclear reactors scattered throughout Eastern Europe. The atomic reactors in eastern Germany were decommissioned after Chancellor Helmut Kohl declared on October 4, 1990, that it had been irresponsible for the GDR to operate them after Chernobyl. Yet their safety standards exceeded those in other Eastern Bloc countries.

- ²⁸⁷ *Statistisches Jahrbuch der DDR 1989*, op. cit. p. 155.
- ²⁸⁸ “LMBV: Vier Fünftel der Bergbausanierung geschafft”, *Mitteldeutsche Zeitung* (May 5, 2004).
- ²⁸⁹ www.lausitzerseenland.de.
- ²⁹⁰ “Lausitzer Kohlegruben werden zur Adria”, *Leipziger Volkszeitung* (February 11, 2004).
- ²⁹¹ “Der träge Fluss”, *Berliner Zeitung* (June 23, 2004).
- ²⁹² “Seenland wächst in der Lausitz”, *Der Prignitzer* (September 15, 2004).
- ²⁹³ Peter Meerheim, “Wasserdefizit durch Bergbau - Versteppung in Brandenburg 2004!”, *Rundbrief* (Berlin: Grünen Liga e.V., February 3, 2004), pp. 2-5.
- ²⁹⁴ Bund für Umwelt und Naturschutz Deutschland, Landesverband Nordrhein-Westfalen e.V., www.bund-nrw.de/braunkohle.
- ²⁹⁵ Jeanette Schlieff, Michael Mutz, “Mikrobielle laubassozierte Prozesse in extrem sauren Tagebaugewässern,” p. 93, in: Deneke, R. / Nixdorf, B. (Hrsg.), *Gewässerreport (Nr. 7): Tagungsband zum Workshop ‘Biogene Alkalinitätsproduktion und Neutralisierung als ergänzende Strategie für die Restaurierung von extrem sauren Tagebauseen’*, BTUC-AR 3/2002, ISSN 1434-6834 (Cottbus: Brandenburgische Technische Universität, 2002).
- ²⁹⁶ “Lausitzer Seenland droht zu versauern”, *Lausitzer Rundschau* (November 30, 2004).
- ²⁹⁷ “Flutungswasser aus MIBRAG-Tagebauen”, *Südraum Blatte*, No. 14 (November 2002), p. 15.
- ²⁹⁸ “Lausitzer Bauer plant größten Solarpark”, *Lausitzer Rundschau* (April 14, 2004).
- ²⁹⁹ “Bundesunternehmen LMBV hat Geburtstag” (Berlin: LMBV, August 2, 2004).
- ³⁰⁰ European band music and American military marches are rooted in the German-Bohemian mining regions.
- ³⁰¹ “MIBRAG sponsert mehr als ein lustiges Intermezzo” (Theißen: MIBRAG, August 27, 2004).
- ³⁰² “Gut Geisendorf – Das Kulturforum der Lausitzer Braunkohle” (Berlin: Vattenfall AG, www.vattenfall.de).
- ³⁰³ In a unique engineering feat, the Gothic Church of the Holy Assumption in Most was moved 841 meters on a treaded platform to sidestep the approaching excavating equipment. The name of the city refers to the bridges over the swamps on a trading route from Prague to Germany. The lignite originating in ancient marshlands at this location ultimately caused the city to be destroyed.
- ³⁰⁴ The Cospuden mine at the Leipzig city limits was closed soon after reunification and converted into an attractive lake for recreational purposes.
- ³⁰⁵ *Bonzen*, a term originally referring to Buddhist priests, was collectively applied to all higher state officials and factory managers in the GDR. The express trains that whisked them to consultations in Berlin were known as *Bonzenschleuder*, or slingshots for bureaucrats.
- ³⁰⁶ Michael Gromm, *Der Braunkohlenaussschuß des Landes Brandenburg. Eine Verkohlung der Demokratie*, Hornoer Blätter No. 1 (Horno: Edition Horno Dreieck, 2000), p. 20.
- ³⁰⁷ Karl Wilhelm Fricke, *Die Staatssicherheit* (Cologne: Verlag Wissenschaft und Politik, Berend von Nottbeck, 1984), p. 107. Fricke himself was kidnapped in West Berlin by the *Stasi* in 1955 and sentenced to four years of solitary confinement for “attacking and slandering” the German Democratic Republic in his journalistic publications. See: Karl Wilhelm Fricke, *Akten-Einsicht: Rekonstruktion einer politischen Verfolgung* (Berlin: Christoph Links Verlag, 1996), pp. 41–106.
- ³⁰⁸ Matthias Baerens, Ulrich von Arnswald, *Die Müll-Connection* (Munich: Verlag C. H. Beck, 1993).
- ³⁰⁹ Stoppt die Deponie Schönberg e.V., www.stoppt-deponie-schoenberg.de. It was a stroke of historic justice that western Germany would ultimately be reunited with its most prominent waste dump in the east.
- ³¹⁰ That is, once the wealth of the former overthrown class had been irrevocably squandered.

- ³¹¹Order no. K 3612/78 E. Mielke, October 7, 1978, documented by Verein Spurensuche e.V., Munich.
- ³¹²Gerold Hildebrand et. al., “Public Letter to the Federal Chancellor and the Federal Government,” (*Offener Brief an Bundeskanzler und Bundesregierung*) (Berlin, October 22, 2002, www.stephan-hilsberg.de/Download/offener_brief.pdf).
- ³¹³The Church Research Center (*Kirchliches Forschungsheim*) at Wittenberg and the Environmental Library (*Umweltbibliothek*) in the Zion Church (*Zionskirche*) of Berlin distributed politically critical newsletters in the 1980’s that carried the notice “For internal church use only” (*Nur für den innerkirchlichen Gebrauch*) to avoid state repressions.
- ³¹⁴In 1989, the traditional Monday prayers for peace (*Montagsgebet*) led by Pastor Führer became an instrumental catalyst for the peaceful revolution in the GDR. The *Nikolaikirche* was the first church in Leipzig to install photovoltaic modules on its roof in 1997.
- ³¹⁵“Bischof mahnt bei Friedensgebet zur Besonnenheit – und erntet Widerspruch”, *Leipziger Volkszeitung* (August 31, 2004).
- ³¹⁶Swedish Ministry of Industry, Employment and Communications, untitled article, June 18, 2004.
- ³¹⁷“Konzern kauft sich frei”, *Die Tageszeitung taz*, August 9, 2004.
- ³¹⁸“Vattenfall and Actaris sign an Automatic Meter Reading system contract” (Stockholm: Vattenfall AB, June 18, 2003).
- ³¹⁹“Sweden, California weigh time of use pricing”, *Restructuring Today* (October 17, 2003).
- ³²⁰www.actaris.com/sys/intro.shtml.
- ³²¹Although Vattenfall Europe AG primarily generates electricity, it has access to the customer base as a shareholder of various regional utilities.
- ³²²“Environment” (Stockholm: Vattenfall AB, www.vattenfall.com).
- ³²³www.vattenfall.se/om_vattenfall/var_verksamhet/om_oss/vart_ansvar.
- ³²⁴“Unruhe in der Belegschaft”, *Spektrum*, No. 6/2004 (December 2004), p. 2.
- ³²⁵“62 companies commit to a zero-tolerance policy to combat corruption and bribery” (Davos: World Economic Forum, January 28, 2005).
- ³²⁶*Es muß demokratisch aussehen, aber wir müssen alles in der Hand haben.* Quoted by Ulrich’s former comrade Wolfgang Leonhard in his book on postwar eastern Germany: *Die Revolution entläßt ihre Kinder* (Cologne: Kiepenheuer & Witsch, 1981), p. 317.
- ³²⁷“Diener zweier Herren”, *Der Spiegel*, No. 3/2005 (January 17, 2005), pp. 22 – 27.
- ³²⁸“Conflict of interest prohibited”, *Idaho Code*, Paragraph 67-6506 (Boise, 1996).
- ³²⁹“Politiklobby - wem gehört der neue Bundestag?”, *Monitor*, No. 494 (Cologne: Westdeutscher Rundfunk, September 26, 2002).
- ³³⁰“Fritze geheim im Aufsichtsrat”, *Die Tageszeitung taz Ruhr* (February 17, 2004).
- ³³¹As noted in the *Bornaer & Geithainer Rundschau* of January 25, 2001.
- ³³²Jeffrey Michel, “Stärkung der MIBRAG durch Insolvenz und Umsiedlung” (www.heuersdorf.de).
- ³³³“Study on Coal’s Role in Sustainable Global Energy Development released by World Energy Council” (London: World Energy Council, September 7, 2004).
- ³³⁴“Welt-Energiebedarf wird mit Kohle gedeckt”, *Lausitzer Rundschau* (September 7, 2004).
- ³³⁵*Extractive Industries Review*, www.eireview.org.
- ³³⁶Alexandra Keßler, “ROBIN WOOD fordert bei Vattenfall-Hauptversammlung Ausstieg aus der Braunkohleverstromung” (Berlin: ROBIN WOOD, June 17, 2004).
- ³³⁷The Green League goes by the name Ecological Lion (*Ökolöwe*) in Leipzig.
- ³³⁸*Christliche Verantwortung für die Schöpfung*, Lutheran Church leadership resolution (*Beschluss der Bundessynode*) 1984 in Greifswald.
- ³³⁹Hans-Peter Gensichen, *Tun-lassen* (Halle: Projekte Verlag, 2004), from the introductory text.
- ³⁴⁰In the German original: “*Dabei gehen wir davon aus, daß ein einfacher Lebensstil, ein sorgsamer Umgang mit materiellen Gütern und ein freiwilliger Verzicht Freude machen und befreiend wirken können.*”

- ³⁴¹“Die kirchliche Gemeinschaft ist zerschlagen”, *Leipziger Volkszeitung* (edition Borna/Geithain, October 2, 2004).
- ³⁴²Regine Günther et. al., *PowerSwitch – Umschalten auf saubere Energien* (Berlin: World Wildlife Fund, May 2003).
- ³⁴³Alison Bailie et. al., *The Path to Carbon-Dioxide-Free Power: Switching to Clean Energy in the Utility Sector* (Washington: Tellus Institute & The Center for Energy and Climate Solutions, April 2003).
- ³⁴⁴Mirjam Harmelink et. al., *Low carbon electricity systems* (Utrecht: Ecofys bv, 2003).
- ³⁴⁵“Ein Lob auf die heimische Braunkohle”, *Sächsische Zeitung Online* (July 24, 2004).
- ³⁴⁶“Lignite Mining in the Rhineland” (Düsseldorf: Bund für Umwelt und Naturschutz Deutschland Landesverband Nordrhein-Westfalen e.V., September 2002, www.bund-nrw.org/files/lignite-mining.pdf).
- ³⁴⁷Dirk Jansen, Dorothea Schubert, *Feinstaub und Radioaktivität aus Tagebauen* (Düsseldorf: Bund für Umwelt und Naturschutz Deutschland Landesverband Nordrhein-Westfalen e.V., April 2004, www.bund-nrw.org/files/bundaktuell-feinstaub-4-2004.pdf).
- ³⁴⁸“Braunkohle. Abbau sozialverträglich beenden. Zukunftsorientierte Arbeitsplätze schaffen” (Berlin: Bund für Umwelt und Naturschutz Deutschland e.V., June 2001, www.bund-nrw.org/files/braunkohleabbau-beenden.pdf).
- ³⁴⁹“BEE: Clement verschweigt 35 Milliarden Subventionen für konventionellen Strom” (Paderborn: Bundesverband Erneuerbare Energie e.V., August 27, 2003).
- ³⁵⁰“Braunkohle zerstört das Klima!” (Hamburg: Greenpeace e.V., May 27, 2004).
- ³⁵¹“Der Traum von der klimaneutralen Kohle”, *Die Tageszeitung taz* (August 13, 2004).
- ³⁵²“Umwelt-Halbzeit bei Rot-Grün – Verbände fordern konsequente ökologische Reformen vom 16.09.2004” (Bonn: Deutscher Naturschutzring, September 16, 2004).

Lignite, or brown coal, is the main domestic fuel resource in Germany. The accessible geological deposits are sufficient for generating more than one-fourth of the country's electrical power over the next two centuries. However, lignite is ultimately a very costly to employ because of factors not reflected in market prices.

This study includes a historical treatment of German lignite use and discusses many of the hidden costs involved – excessive greenhouse gas emissions, depletion of groundwater resources, and destruction of hundreds of villages. Special consideration is paid to eastern Germany, where lignite accounts for up to 85 per cent of electrical power consumption in some regions.

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The Swedish NGO Secretariat on Acid Rain

The essential aim of the Swedish NGO Secretariat on Acid Rain is to promote awareness of the problems associated with air pollution, and thus, in part as a result of public pressure, to bring about the needed reductions in the emissions of air pollutants. The aim is to have those emissions eventually brought down to levels – the so-called critical loads – that the environment can tolerate without suffering damage.

In furtherance of these aims, the secretariat

- Keeps up observation of political trends and scientific developments.
- Acts as an information centre, primarily for European environmentalist organizations, but also for the media, authorities, and researchers.
- Produces information material.
- Supports environmentalist bodies in other countries in their work towards common ends.
- Participates in the lobbying and campaigning activities of European environmentalist organizations concerning European policy relating to air quality and cli-

mate change, as well as in meetings of the Convention on Long-range Transboundary Air Pollution and the UN Framework Convention on Climate Change.

The work of the secretariat is largely directed on the one hand towards eastern Europe, and on the other towards the European Union and its member countries.

As regards the eastern European countries, activity mostly takes the form of supporting and cooperating with the local environmentalist movements. Since 1988, for instance, financial support has been given towards maintaining information centres on energy, transport, and air pollution. All are run by local environmentalist organizations.

The Secretariat has a board consisting of one representative from each of the following organizations: Friends of the Earth Sweden, the Swedish Anglers' National Association, the Swedish Society for Nature Conservation, the Swedish Youth Association for Environmental Studies and Conservation, and the World Wide Fund for Nature Sweden.

Almost all areas of western Germany have some industry. The main industrial areas are the Ruhr district in North Rhine-Westphalia, the traditional center of German coal, steel, and heavy industry; the concentration of industry around several large cities, such as Hanover, Munich, Frankfurt am Main, and Stuttgart; the chemical production areas that stretch mainly along the Rhine River in Baden-Württemberg and farther north; and the automotive manufacturing centers, increasingly concentrated. It is uncertain which eastern German industries will survive, but the firms in the southern part of the region appear to have better chances than those farther north. Even before unification, more industry was concentrated in the south than in the north. The German lignite industry's perspectives of the year 2004 are discussed in Lignite Day 2004 in Cologne. It is stated that lignite industry is extremely fixed to a given location and many external and international influences are decisive factors for success or failure. Lignite made a significant contribution towards reaching the carbon dioxide reduction goal for Germany. It was suggested that politics have to focus on securing the competitiveness of German energy-producing industry instead of continually putting burdens on it. Citations (0). References (0). They enjoy an official status equal to German in Lusatia. Road signs are usually bilingual. Sorbs try to protect their typical culture shown in traditional clothes and the style of village houses. Lusatia is the second largest of the three German lignite regions in terms of output (61.8 million tonnes in 2014) as well as power plant capacity (currently 6.7 GW at three locations). Within Lusatia, the lignite industry is mainly centred on the districts of Spree-Neiße, Bautzen, Görlitz, as well as in the outskirts of the city of Cottbus. The health impacts and external costs of the lignite-fired power plants in the German Lausitz (Jämschwalde, Schwarze Pumpe, Boxberg) as well as two Polish lignite-fired power plants in the proximity of the border (Turów, Dolna Odra) can be considered high.