How Will Europe Fill Its Huge Energy Gap in the 21st Century?

by Lothar Komp

The latest power blackouts have made it manifest, that by 2020, more than 200 Gigawatts of electricity capacity must be replaced in the European Union countries, due to the aging of existing power facilities; this is the equivalent of about 150 very large conventional nuclear reactor units. The same countries must, in the same two decades, make very large additions to existing capacity levels, which are clearly inadequate. The necessity for Europe, in total, is nearly comparable to replacing the entire electricity-generation capacity of the United States, over the coming quarter-century.

The constant availability of energy in plentiful quantity and of high quality, is one of the most important bases of every economy. Without electricity and gas, the private household sits freezing in the dark, and can neither cook nor wash. Without electricity and fuel, the traffic of roads and rails comes to a stop. Industry depends entirely on energy supplies in manifold forms: electricity, heat, especially process heat. And even in the service sector, without electricity, whether in the finance sector or at the travel bureau on the corner, chaos immediately breaks out.

No country can gamble away its own energy sufficiency through short-sighted austerity policy or ideologically-grounded experiments, without paying for it by the loss of jobs, income, and living standards. That is true in particular degree for the German economy, in which every third job depends immediately upon the export of high-value industrial goods, and in which high technology-dependent production reacts very sensitively to quantitative or qualitative disturbances in the supply of energy.

In spite of all this, in Germany as in all leading industrial countries, dramatic upheavals are taking place in energy policy, which are already producing devastating consequences, and without speedy steps to reverse them in the near future, can lead to economic catastrophe.

The great majority of the powerplants and other energy infrastructure of the western industrial countries was built in the first three decades after the Second World War. But in the three subsequent decades, investments in energy production were constantly driven down, and long ago fell below the level demanded simply for the maintanence of existing production capacity. Behind this development is the spread of a series of utopian ideologies inimical both to industry and to the general economic welfare, which can collectively be called "eco-liberal, eco-free trade fundamentalism."

Dereg Brings 'Privilege of Blackouts' to the West

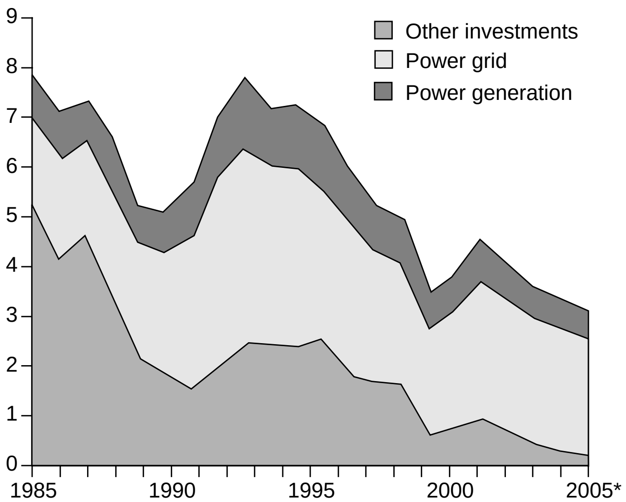
In the past, persistent electricity outages affecting millions of households were a privilege of the underdeveloped countries, or a sacrifice to communist scarcity economies. But thanks to the success of radical free-trade ideologies in the 1980s—according to which the supply of electricity or water was no longer supposed to come under the principle of the general welfare, but rather under the principle of profit-maximization of private firms—widespread blackouts, or price explosions brought about by energy scarcities, have also multiplied since then in the West. And first in the headlines for this, have been the "Anglo-Saxon states" which carried out electricity deregulation on a rush basis.

Three years after Canada's deregulation of the electricity sector, the parliament of the Canadian province of Alberta, in 1997, had to introduce electricity rationing. In January 1998, the electricity supply completely broke down for millions of people in southeastern Canada, so that in mid-Winter, two-thirds of the households of Quebec lacked heat. The collapse of electricity networks in Quebec and eastern Ontario led to instabilities in the electric grid of the rest of the country. As a result, in Montreal, one out of every two water-purification plants and oil refineries had to shut down. The result: no drinking water, no heat, no traffic in the public streets.

At the beginning of 1998, the electricity supply of the New Zealand metropolis of Auckland almost entirely broke down, and transformed the economic center of the country into a Third World-like region of crises. The mayor advised the inhabitants to leave the city, and even the corporations cut and ran. Only after three weeks did the privatized provider Mercury Energy, which had ruined the system by failing to invest, succeed in making the rotten infrastructure function, to an extent. In the city of Brisbane, with its one million inhabitants in the Australian state of Queensland, the energy supply broke down for several days in February 1998.

In the early Summer of 1998, an ordinary heatwave on the East Coast and in the Midwest of the United States led to an energy shortage, which forced up the price of energy in the Greater Chicago area by 300 times the normal price by the end of June. In the year 2001, energy chaos broke out in California, because the energy traders, with the help of a bottleneck in supply, forced up the price of energy by 1000% for a time; and, as a result, the most important provider, Pacific

FIGURE 1
Investments by German Power Utilities
(Euro Billions)



*After 2002, Planned Investments.

Sources: IFO Institute; *EIR*.

Gas and Electric, announced bankruptcy.

In the meantime, since the energy infrastructure in all the Western industrial countries is more or less intensely wrecked by years of deregulation, they have been subject to power outages in extended areas since the beginning of 2003, almost every day: In Italy, Norway, the Northeast of the United States, in particular New York; in London, Helsinki, Copenhagen, and in southern Sweden; at times, millions of people have remained in the dark for hours, or even days.

No one should be surprised at this. For deregulation of the energy sector, and privatization of the supply, has led to a state of affairs in which available financial resources are expended almost solely for the participants in worldwide corporate takeover battles. Business investments in the delivery and development of power plants or distribution networks bite the dust. Especially hit, are the expensive reserve capacities for periods of peak requirements, which have been drastically reduced for the purpose of cutting costs. In Germany, the annual investments of the German energy providers have been cut in half since the middle of the 1980s, from just short of 8 billion euros, to 4 billion euros, and show a tendency to fall farther (**Figure 1**).

According to the principle of maximization of business profits, it is simply far more advantageous for the provider—at least for the short-term—to economize on business investments at first, and to wait until, sooner or later, the inevitable bottleneck in supplies occurs, allowing the associated explosion in prices.

They hardly need fear competition. For, contrary to the stated purpose of the energy liberalization, countless smaller and middle-sized providers, thanks to the deregulation, have been swallowed up or pushed out by the market, such that today the "seven brothers"—EdF of France, Eon and RWE of Germany, ENEL of Italy, the Swedish-German Group Vattenfall, Endesa of Spain and Electrabel of Belgium—already control 60% of the European market.

A reregulation of the European energy market, together with actions to supply the financial means of investment, is a fundamental prerequisite for the security of the European energy supply. This regulation must express the obligation of the company to invest in such a way, as is required for long-term security of the public supply. Moreover, the energy suppliers must be required to hold a certain percentage of their capacity, around 10%, in reserve, to increase the security of the public supply.

Electricity: Gigantic Need for New Power Plants

According to the declarations of the European Union of Power Plant Operators and Producers, VGB PowrTech, more than 200 gigawatts—200 billion watts—in power plant capacity must be replaced in Europe, due to old age, by the year 2020. This is equivalent to around 150 large nuclear power plants. In Germany alone, 40 gigawatts of old sites must be replaced.

In addition, there are arising urgent, necessary investments in the modernization of the energy infrastructure in the ten nations that have applied for EU membership. In Poland, Czechia, and Hungary alone, far more than half of the coal power plants, with their total capacity of 42 gigawatts, are already today more than 35 years old. In addition to this, the present per-capita consumption in these nations is only about half that of Western European levels. An increase in productivity and living standards to current western standards, requires a supplemental doubling of the existing electrical generating capacity, in order to replace these antiquated installations.

According to new estimates by the European Commission, the need for new power generation investments is, in fact, far larger. In the report *European Energy and Transport—Trends to 2030,* the European Commission says that on top of replacing over-aged power plants, the 15 European Union member states will have to expand their power generation capacity from the present 578.6 Gigawatts (in 2000) to 951.0 Gigawatts by the year 2030, to meet rising demand. In the 10 new European Union countries, power generation capacity will have to be more than doubled from 76.8 Gigawatts (2000) to 180.6 Gigawatts by 2030.

In the face of this enormous need for investments in power plants, the members of the European Union will have to make a far-reaching decision in the next few years. Either they allow the European power supply—and with it, at the same time, productivity and the living standard, to descend to the level

TABLE 1

European Union Installed Electric Capacity in 2000 vs. Demand Forecast in 2030

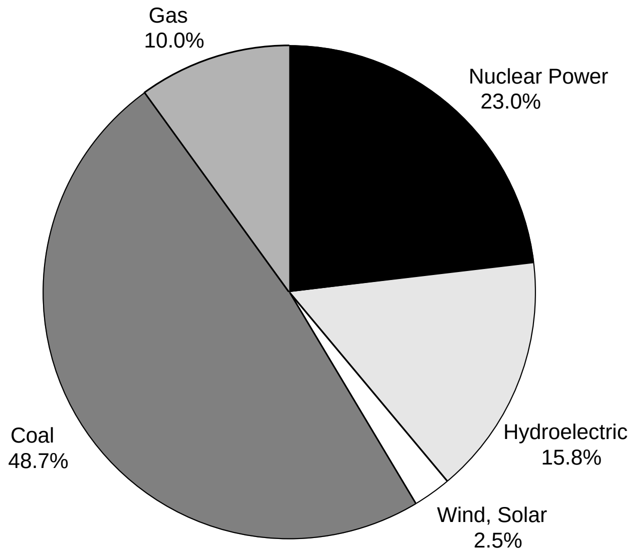
(Gigawatts)

Member Country	2000	2030
Belgium	14.6	20.4
Denmark	13.2	17.4
Germany	121.7	166.7
Finland	17.2	22.2
France	115.0	171.9
Greece	11.0	24.3
Great Britain	79.3	159.6
Ireland	4.8	11.0
Italy	68.8	99.6
Luxembourg	0.1	1.0
Netherlands	22.8	43.1
Austria	17.8	29.3
Portugal	10.3	21.3
Sweden	33.2	50.9
Spain	49.2	112.2
EU Members	578.6	951.0
New Members	**2000**	**2030**
Estonia	2.7	3.0
Latvia	1.9	4.5
Lithuania	5.2	7.5
Malta	0.5	1.6
Poland	33.1	99.1
Slovakia	7.8	13.2
Slovenia	2.9	4.4
Czechia	13.3	28.5
Hungary	8.2	16.2
Cyprus	1.0	2.6
New EU Members	76.8	180.6

Source: European Commission

FIGURE 2

Electricity Production in the European Union, 2000



Source: EIR.

of today's Third World nations; or, they undertake, very soon, investments at an enormous level.

On Sept. 24, the chief economist of the International Energy Authority (IEA), Fatih Birol, estimated the volume of necessary investments in energy infrastructure until 2030, for the European Union, at approximately $2 trillion. That allots $600 billion to new power plants and $500 billion to the expansion of the energy grid. The majority of the European power plants are now more than 30 years old, so that by 2030, altogether, 290 gigawatts of capacity must be replaced.

However, at the same time, the need for energy will increase further; so that, all told, 600 gigawatts in production capacity must be newly built, by the year 2030, approximately as much as is presently in operation.

The modernization of the natural gas supply will require further investments of $450 billion, according to IEA estimates, of which about half will be for distribution grids, and the remaining half for the extraction of natural gas. But the rising investments which must be undertaken in the meantime in Russia, Africa, and in the Near East, with which the needed future overall amounts of natural gas can be achieved in the European Union, are not included in this amount.

Fossil-Fuel Energy Sources

Nowadays, coal, oil and natural gas make up about 60% of primary energy use, primarily for heating and transportation (see **Figure 2**). Because gas-powered plants of the aircraft-turbine type can be relatively quickly produced, and investments in them amortize rapidly, natural gas for electricity production has also risen to significance in recent years. It is expected that the portion of natural gas in energy usage will rise in the future. But dependence upon imported energy resources will thereby rise more dramatically. Many of the countries of origin of the fuel lie in potentially unstable regions. In addition, a high risk of price spikes will be encountered as a result of supply bottlenecks.

In Germany, imports account for about 80% of natural gas use. Oil, which produces 54% of the energy for the transportation sector and 30% for the heating market, must be imported in its entirety. For coal, meanwhile, the imported portion is 43%. Instead of using the relatively expensive coal from domestic mining, many steel firms meet their coal requirements primarily by imports from South Africa, Australia, Colombia, or Poland.

In general, Germany today has to import 60% of its energy sources; and by 2020, it is foreseeable that this will rise to 75%. The situation becomes even more dangerous with the trend to smaller fuel inventories in industry. Shocks to the national economy are pre-programmed. The best strategy to prevent this is to conclude treaty agreements for long-term supply with the nations of origin—for example, Russia—and to strengthen the current interdependence of their economies through great projects of building industries and infrastructure there.

'Renewable' Energy Sources

Today, about one-fifth of the worldwide power supply is generated from so-called "renewable energy" sources. Certainly 96% of this occurs from water power. The potential of that source is largely fully utilized in Germany and in the remainder of Europe. The share of solar power is dwindling—because of its low energy density and extremely high cost, around 25 times higher than electricity from conventional power plants—to a trifle (0.1% in Germany). This will hardly change in the foreseeable future.

At the present time, in contrast, wind energy plays a role worth mentioning in the energy supply plans, owing not least to its subsidy by governments. Underneath these subsidies, lie production costs two to three times those of conventional power sources.

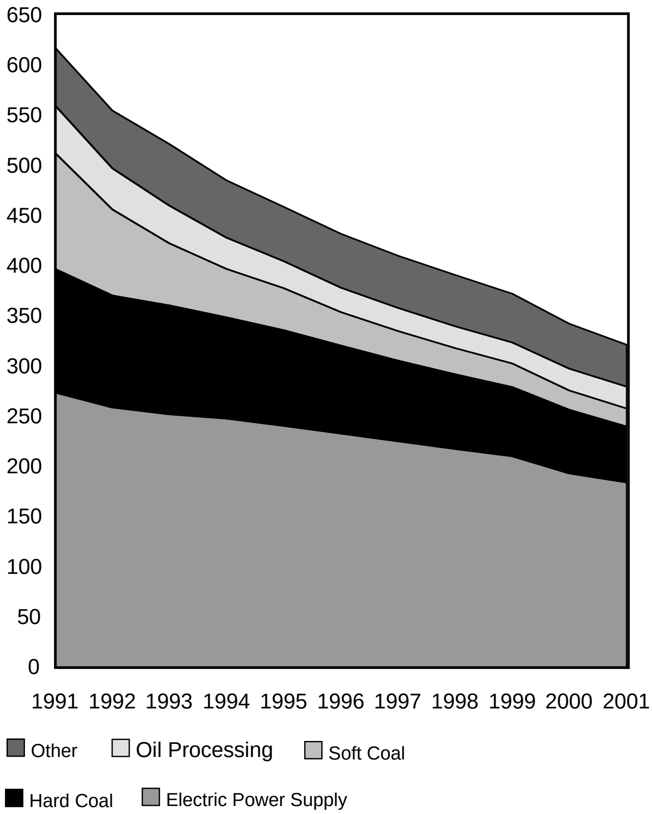
However, the basic facts of electricity production and use also make wind power a liability. With each new electric fan that is put into operation, the danger of uncontrolled power outages increases. This is because electric current is a commodity like no other. Electric current, once it has been generated, can only be stored to a very limited extent. On the other hand, just so much continuous current must be fed into the grid at all times, as the exact amount needed to be taken from it and used, in order that the electromagnetic frequency of the grid traffic remain constant at about 50 Hertz. If there are significant under- or overloads, deviations in frequency occur, which lead to production failures in sensitive industrial areas, and can, at the same time, unleash breakdowns—blackouts—over a broader extent.

Since the performance of a windmill obviously varies, in practice, in an unpredictable manner, one must, for each magawatt in installed windpower, still hold in reserve an additional megamatt from a reliable power generation installation! Thus, one can just as well forget wind installations. The same naturally goes for solar energy, too. Therefore, wind and solar are unfit for the electrical energy supply. They could in the future, at best, play a role in those industrial processes which do not depend upon permanent availability—something like the production of hydrogen, which could one day replace benzine as automobile fuel.

At present, there are about 13 gigawatts of windpower installed in Germany. The planned further development is supposed to occur chiefly on the coast of the North Sea. A pilot project with a rotor blade over 100 meters long is currently being developed. Despite using 500 tons of concrete and other materials, it produces the ridiculous sum of five megawatts of power. About 5000 of these installations would have to be anchored on the North Sea and the Baltic Sea, in order to satisfy the actual objectives of the German government. And already the environmentalists question the consequences for the seashore.

The VGB-President, Dr. Gerd Jäger, summarized the situation to the Copenhagen *Power Plants 2003* Congress on Sept. 15, 2003: "To herald regenerative energy as the main girder of tomorrow's energy supply is a hopeless, exaggerated, and false representation." It were urgently necessary to mercilessly expose these "one-sided ideologies," Jäger said, for "the overestimation of the potential of regenerative energy goes along with a disastrous underestimation of the economic and political consequences." He noted that there are now instigators of these ideologies, going about driving up the price of power to the sky by every means—because only then do solar, wind, and biomass have any chance. This is "tremendously dangerous; neglecting development [threatens] fundamental aspects of the social economy, such as competition, and along with that, maintaining places of employment" (see **Figure 3**).

FIGURE 3
Employment in the German Energy Sector
(Thousands)



Nuclear Fission

Germany's nuclear power plants handle about one-third of the nation's electricity production, and, because of their strong reliability record, about one-half of the country's base load. Germany's nuclear reactors are among the world's safest. Yet despite this, in the Summer of 2000, the government and energy suppliers agreed on a complete moratorium on any new nuclear energy capacity. All German nuclear power plants are now to be taken out of production, in phases, between the years 2010 and 2025—regardless of the plants' expected life-spans. So, if we also include the requirement for replacing normally aging power plants, this purely ideologically-motivated moratorium means that hundreds of billions of deutschemarks of investment are now required.

No less disastrous, is the resulting loss of scientific know-how and skilled personnel in one of the most important fields of future technology. Because if we look beyond the misty realms of romantic emotions spreading across the German countryside, it has long been a foregone conclusion, that nuclear power is on the threshold of a new worldwide renaissance. For, who will deny such countries as India and China their right to raise their population's living standard to a modern level—a goal which, among other things, absolutely requires a quadrupling of their electricity supplies? Such goals cannot be achieved through fossile fuels alone, and certainly not with solar or wind power. Great water projects will have their role, but the real hope for many billions of people in Asia and elsewhere, lies in nuclear energy.

The economic insanity of Germany's nuclear moratorium must be reversed, and the Summer 2000 agreement is not an insurmountable obstacle in that regard. It is true that energy industry representatives have recently stated that they feel bound to adhere to the agreement. But the moment that a different government—without a Green coalition partner—moves into Berlin, they would of course be prepared to begin talks on a "moratorium on the moratorium."

In addition to maintaining the existing power plants, whose useful life could be extended ionto the mid-21st century with only modest investments, a technology exporter such as Germany must also play a major role in the development of the next generation of nuclear power plants.

One particular area of future work, will be the development and later mass production of smaller reactor modules, each with a few hundred megawatts of output, based on the "pebble bed" high temperature reactor (HTR). This revolutionary technology, which was first developed in Germany, and which today is being pursued full-throttle in other countries, especially China and South Africa, guarantees a nation's "inherent security" in a way that conventional nuclear power plants can not. By virtue of the physical characteristics of the process, even if all security systems failed, and even if service personnel were completely negligent in their duties, there would be no possibility that radioactivity would be released into the environment.

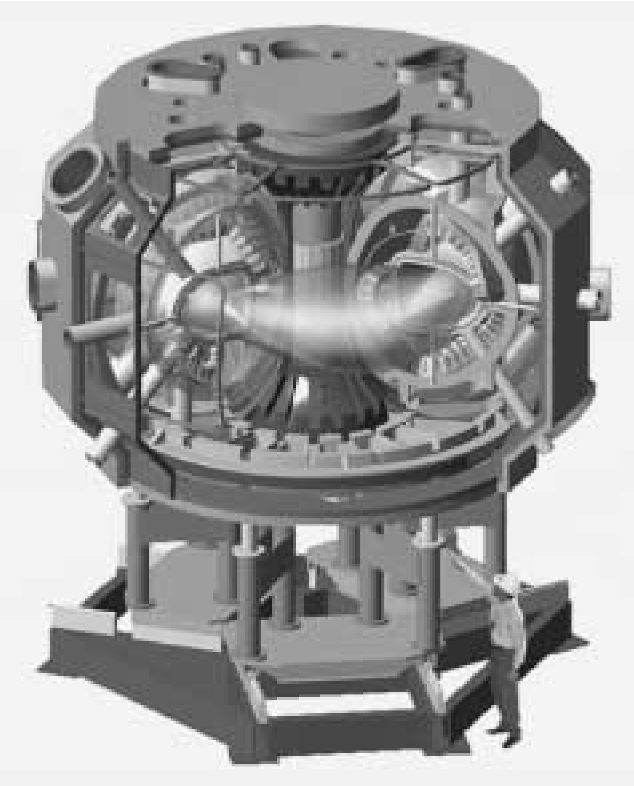
The "Pebble Bed" design for small, highly-efficient and safe gas-cooled nuclear reactors was developed in Germany, but production is being developed in South Africa and (here) in China. Even if all security systems failed, there is no possibility of radioactivity release. And the HTR produces not only electricity, but also process heat, at temperatures of 950°C, for industry or heating of buildings.

Moreover, the HTR produces not only electricity, but also process heat, at temperatures of 950°C, for industry or heating of buildings. Thus, HTRs could potentially supply the entire heating market, and, in an emergency, could substitute for the greater part of our oil and coal requirements. Also, the use of HTR-produced process heat to refine coal into other materials, offers new opportunities for the coal-mining industry, because coal is too valuable a raw material just to be burned for heat.

Because HTR modules can largely do without the expensive security techology required for normal nuclear power plants, they are an ideal type of reactor to export to under developed countries. One strategy for their mass production that has been proposed, is floating plaforms, whereby the reactors are built while they are moored on the coastline, and then the turnkey plant is transported overseas to its final location. These HTRs could be deployed not only for electricity production, but also as an energy source for seawater desalination plants.

Nuclear Fusion

Within a couple of decades, the fusion of hydrogen into helium—i.e., emulating the same process which holds our Sun together, and which bombards the Earth in billionfold weaker form as "solar energy"—will become humanity's most important energy source. Its energy flux density surpasses that of nuclear fission by two orders of magnitude: i.e., in order produce the same quantity of energy, only a fraction of raw materials are required, in comparison to the technologies currently in use. And the raw material hydrogen



The "stellerator" design for a nuclear fusion-electric facility, being designed at the Max Planck Institute, Germany's nuclear fusion center in Greifswald.

is the most plentiful element in the universe, and is available in virtually unlimited quantities, such as in seawater.

In order to go beyond energy breakeven in nuclear fusion, hydrogen plasmas must be raised to temperatures of many millions of degrees at high pressure, and must be then be kept stable for sufficient durations by means of magnetic fields. New materials must likewise be developed, which can withstand as much contact with the plasma as cannot be entirely avoided.

The currently best-researched configuration for a nuclear fusion reactor, is the tokamak. Europe, Canada, Russia, Japan, and (since the beginning of 2003) China and the United States, are participating in the construction of the International Thermonuclear Experimental Reactor (ITER), which represents the final stage before the construction of an commercially functioning fusion power plant. Up to now, France, Spain, Canada, and Japan have been vying for the reactor site. The final decision on the site, and thus also for becoming the world's center of fusion energy research, is expected to be made in early 2004. Germany, with its nuclear fusion center in Greifswald, has remained out of the competition, because of resistance from Social Democratic and Green party Neanderthals in Rostock and Berlin.

But Greifswald is nevertheless very much in the race for the energy of the future. At the Max Planck Institute for Plasma Physics located there, an alternative fusion concept, the so-called stellerator, is being researched. This method uses a special configuration of magnetic fields, making it possible to ignite fusion reactions at significantly lower temperatures of—150 million° Centigrade—as opposed to 450°C million in the tokamak. Also unlike the tokamak, a stellarator can be in continuous operation. The world's most advanced stellerator, Wendelstein 7-X, is currently being built in Greifswald, and will be ready for testing in 2006.

If, by our current measurements, significantly more time has been required to achieve commercial nuclear fusion than had been earlier assumed, this was in no small part because expenditures on nuclear fusion research have been so drastically cut in recent decades. A complete turnaround in this regard is the utmost urgency. If Europe is to spend $2 billion for new energy infrastructure in any case, then at least 1% of that sum should be set aside for our most promising future energy technology. And since it remains to be seen which of the many proposed fusion methods will turn out to be the best, the broadest possible support for plasma and fusion research must be one of the main pillars of any farsighted energy policy.

Superconductors

What nuclear fusion is to electricity production, so superconductivity is to electricity distribution. Today, cables made out of copper or aluminum are the rule for electricity distribution grids. Their electrical resistance results in the transformation of a portion of the electrical energy into heat. Approximately 10% of the originally generated energy is wasted in this way—which, in terms of Germany's power grid, for example, means a net "normal" loss of the amount of energy producted by two large nuclear reactors.

And there are still other negative effects: The heating up of electrical cables is a nuisance, and can lead to disruptions, as the heated cables interact with the surrounding air.

Since the beginning of the 20th Century, it has been known that certain materials, when subjected to extremely low temperatures, suddenly take on a different state called superconductivity, whereby they no longer have any resistance to electronic current flowing through them. Theoretically, then, electricity could even be stored for long periods of time in superconducting rings. On the other hand, it is extremely expensive to keep these materials at temperatures very close to Absolute Zero.

In 1986, the German researchers Karl Alexander Müller and Johannes Georg Bednorz succeeded in developing so-called high-temperature superconductors (HTSC), whereby liquid nitrogen could be utilized as the coolant. In 2001, an entire neighborhood of the city of Detroit was supplied electricity over an HTSC cable. These cables are significantly lighter than copper or aluminum ones, and they can handle much greater current flux densities. An entirely new class of industrial materials is being born here, with countless potential applications, ranging from power grids, to medical instruments, to magnetically levitated rail transport.