Lusatian lignite is extracted free of subsidies in opencast mines. In nearby power plants it is converted into electrical energy, safely, efficiently and environmentally friendly.

**Deposit and geology**
The Welzow-Süd deposit lies in the State of Brandenburg, west of the river Spree and the town of Spremberg. At present, the second Lusatian lignite seam is being mined. It lies at a depth of 90 to 130 metres below the surface level and is between 10 to 16 metres thick. In Welzow-Süd opencast mine, approx. 20 million tons of raw lignite is mined annually.

**Mining preparation and water management**
It is a prerequisite for safe opencast mining that the deposit is kept free from water. Once the foreside has been cleared, filter wells are drilled and more than 100 m³ of groundwater is pumped per minute to the surface with submersible pumps. After the water is purified and it is fed into the Spree river and in wetlands considered worthy of protection, stabilising the regional water balance. Part of the pumped groundwater goes to the Schwarze Pumpe power plant where it is used as cooling or feed water for steam generation.

**Overburden removal and dumping**
Once the soil layers have been sufficiently drained, overburden excavators start their operation and remove sand, gravel, and clay covering the lignite seam. In the Welzow-Süd opencast mine, one bucket-wheel excavator and one bucket-chain excavator are operated in the pre-cut of the overburden conveyor bridge and remove soil layers which the conveyor bridge complex cannot handle due to its limited capacities. Conveyor belts with a width of 2.5 metres transport the pre-cut overburden to the mine’s dumpsite which has already been excavated. Spreaders dump this soil material and thus shape the relief of the future post-mining lands- cape. Lignite is exposed with an overburden conveyor bridge, type F 60 – an equipment complex consisting of two highly efficient bucket-chain excavators, type Es 3750, and a more than 500-metre-long belt conveyor bridge. Conveyor bridges belong to the biggest mobile technical equipment systems in the world. They enable the transport of overburden over the shortest route across the mine to the dump side where it is deposited.

**Raw coal extraction and transport**
Pit operation runs directly under the overburden conveyor bridge. This is where lignite is exposed, being mined using bucket-wheel and bucket-chain excavators in high- and deep cut. Different coal qualities are selectively won. A two-metre-wide belt conveyor system transports lignite to the coal loading station or to the ditch bunker on the surface level. From there, the coal is supplied to consumers by train. Every day, up to 90,000 tons of lignite are extracted from the Welzow-Süd opencast mine. The main consumers are the Schwarze Pumpe power plant and the refining plant.

**What about the environment?**
For those involved in the mining business it is a particular challenge to compensate for necessary interfer- ences in the environment as quickly as possible and to prevent or limit to a minimum the impact of such measures on man by using state-of-the-art technology. Mining claims land and, at the same time, creates new land. Mining of lignite is always followed by recultivati- on of the mine-site area. Indigenous tree species like pine, oak, maple, alder and beech are used for affo- restation. Recultivation aims at creating new cultural landscapes for forestry and agriculture as well as for nature conservation, leisure-time and recreation. Interesting post-mining landscapes have already been created with mixed forests and recultivated areas such as the hill ‘Wolkenberg’, the project ‘Hünenwasser’, the ‘Stratower Höhe’ as well as the ‘Energy forest’.

**Key figures**
- Raw coal quality
  - Calorific value: approx. 9,000 kJ/kg
  - Water content: approx. 56 %
  - Subbit. Ash: approx. 5 %

**History**
1965 Beginning of coal extraction 1972 Commissioning of the overburden conveyor bridge, type F 60

**Mining output**
- Overburden removal
  - Bucket-wheel excavator Es 3750: approx. 14,000 m³/h
  - Bucket-wheel excavator Es 3150: approx. 5,680 m³/h
  - Overburden conveyor bridge F 60: approx. 18,000 m³/h
- Coal extraction
  - Bucket-wheel excavator SBr 1301: approx. 1,800 t/h
  - Bucket-wheel excavator SBr 710: approx. 1,000 t/h

**Overburden-to-coal ratio**
- approx. 6:1

**Recultivated** (until 03/2014)
- approx. 4,740 hectares
Swarze Pumpe lignite-fired power plant

Energy is generated from Lignite

Site and overview

The Swarze Pumpe power plant is located near the town of Spremberg in Brandenburg, approx. 30 kilometers to the south of Cottbus. The foundation stone was laid in Autumn 1993. Almost four years later, the first 800 MW unit went into operation. The second 800 MW megawatt unit was commissioned half a year later. The Swarze Pumpe power plant is a lignite double-block system as well as the first of a new generation of lignite-fired power plants setting a new benchmark with regard to environmental protection standards on a national as well as international level.

Coal supply to the power plant

At Swarze Pumpe power plant, raw lignite mainly from the Welzow-Süd as well as the Nochten opencast mine is converted into electricity. Lignite is transported by rail from the opencast mine to the bunker area at the power plant. At full capacity about 38,000 tons of lignite are needed per day for the power plant. About one kilowatt-hour can be generated from one kilogram of lignite.

Combustion in the steam generator

After the lignite has been crushed, pre-dried and ground into fine pulverised lignite in a precisely dosed air flow the heat generated during the coal combustion process is taken up by the feed water, which is kept in a kilometre long piping system, built into the steam generator. The steam generated from water has been overheated, it is fed into the turbine under high pressure. The water mainly comes from the de-watering system of the opencast mines. In the power plant it is specially treated for the use in boilers. The dry and wet ash resulting from the combustion process is disposed of on a storage site for valuable materials provided for the purpose.

Energy conversion in the generator

Steam expands as it travels across each blade of the turbine. Its energy is converted into kinetic energy. As both the turbine and the generator are mounted on one single shaft, the rotating motion is transmitted to the inductor of the generator which like a dynamo of a bicycle - converts kinetic into electrical energy. The 3,000 rotations per minute in the turbine are equivalent to 50 Hertz, the frequency of alternating current. The electrical energy is led to the substation at Graustein via overhead lines and at a voltage of 380 kilovolt from where it is fed into the high-voltage system of the company 50Hertz Transmission GmbH. The electrical energy is fed to the consumer no longer necessary. The heat unused is extracted from the process and used to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production.

And what about the environment?

As with other fossil fuels, the combustion of lignite produces flue gas. The combination of highly efficient measures such as low nitric oxide combustion, flue gas dedusting by electrical filters and flue gas desulfura- tion with limestone suspension - a chemical process in which gypsum is produced - efficiently reduces emissions. Irrespective of the load that Swarze Pumpe power plant operates at, it always remains below the limits stipulated in the regulations to protect the environ- ment.

Energy conversion

Chemically bound energy (lignite as raw material)

- Thermal energy of the steam (steam boiler)
- Rotation energy/kinetic energy (turbine)
- Electrical energy (generator)

District heat and process steam

Part of the heat produced during electricity generation is extracted from the process and used to supply district heat to the towns of Hoyerswerda, Spremberg and Swarze Pumpe. Moreover, process steam from the power plant is supplied to the neighbouring industrial area for briquette, paper and corrugated cardboard production. The heat is used, to dry the lignite in the production of briquettes, pulsed into corrugated cardboard production. This raises the fuel utilisation ratio in the power plant making separate heat generation for the consumer no longer necessary.

Environment

Environmental protection reduction of emissions by environmental technology on site

- by 97 % for SO2
- by 99 % for dust
- by 80 % for NOX

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<tr>
<th>Key figures</th>
<th>Net efficiency approx.</th>
<th>ca. 40 %</th>
<th>Fuel utilisation ratio approx.</th>
<th>ca. 44 %</th>
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Consumption and generation balance

- Electrical energy: 2 x 800 MW
- District heat: 2 x 60 MWth
- Process steam: 2 x 480 t/h
- Lignite: 36,000 t/d
- Ash: 1,500 t/d
- Limestone: 1,000 t/d
- Gypsum: 1,600 t/d
- Water: 72,000 m³/d

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<tr>
<th>Energy conversion</th>
<th>Thermal energy</th>
<th>Rotation energy</th>
<th>Electrical energy</th>
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Energy is generated from Lignite – the most important domestic energy source which is supplied directly to the power plants over a short distance.

December 2014