http://www.energypost.eu/lignite-europe-fighting-back-renewables/

Energy Post, June 30, 2015

Lignite in Europe: fighting back renewables

By Jeffrey Michel

Bahnhof Profen (photo Daniel Baezol)

With an output of 350 million tonnes, four EU countries – Germany, Poland, the Czech Republic, and Greece – account for over a third of the world's lignite production. Renewable energies have cut into their profitability, but lignite producers are fighting back with increased deliveries and exports to third-party customers. In addition, they avoid CO_2 penalties under the EU Emission Trading Scheme by building plants below the 20 MW threshold.

For some observers, the divestment of fossil fuel investments by pension funds, foundations, and universities foreshadows the end of the Coal Age. Shale gas is unmistakably contributing to coal's declining fortunes in the United States, where gas plants were already preferred before the advent of fracking. Solar and wind generation is likewise crowding fossil fuels from the power grid.

Global coal consumption still continues to rise, but corporate equity evaluations are plummeting. Share prices on the New York Stock Exchange of the world's largest private coal company, St. Louis-based Peabody Energy Corporation (NYSE: BTU), have dropped from over $72 in 2011 to currently below $3, falling by two thirds since the beginning of the year.

The possibility of long-distance lignite deliveries was often overlooked in the past due to the low calorific value and high moisture content of crude lignite. In effect, every second lignite freight car transports only water

While comparable declines of equity in the German lignite (brown coal) industry have not been experienced, certain mining activities may be even more precarious. In the Rhineland, 17 of the existing 20 lignite power plants could become unprofitable under government climate policies according to the RWE workers' council.

Enduring loyalty to lignite

Germany is the world's leading lignite miner, excavating 178 Mt last year alone. With 879 Mt of overburden soil uncovered above the seams, total earthmoving in one year equaled 14 times the original Suez Canal completed in 1869. Any short-term abandonment of these expansive projects would lead to losses for which the producers have not made adequate provisions. The nationalization of Germany's largest lignite power producer, RWE, is already being considered, because of inadequate funding reserves for the ongoing nuclear phase-out legislated by the German Bundestag in 2011. Any added necessity for lignite plant retirements would compound this problem, reducing available financial resources both for nuclear decommissioning and for mining landscape reclamation.

The enduring loyalty of power producers to lignite is comprehensible. Mine-mouth prices for German lignite are currently about €6/MWth (thermal megawatt-hour), adjusted for calorific value and sulphur content, having risen from around €4/MWth (3.6 GJ, roughly 1/3 tonne) at the turn of the century . The resulting basic fuel cost per generated kWh of electricity at the most efficient (43 %) power plants lies below 1.5 € cents. This is considerably lower than any other available alternative. The lignite industry therefore retains a monopoly on Europe's most economical fuel for power production and for other applications requiring large quantities of thermal energy.

The average calorific value of surface-mined German lignite (*Braunkohle*) lies between 7.8 Megajoules per kilogram (1,864 kcal/kg) – the lowest grade in the Rhineland and in Lusatia southeast of Berlin – and up to 11.3 MJ/kg (2,701 kcal/kg) in Middle Germany near Leipzig. This soft brown coal exhibits a high water content along with appreciable quantities of sulphur and ash, particularly in certain eastern German deposits.

German Mined Lignite Parameters				
	Calorific Value MJ/kg	Water %	Sulphur %	Ash %
Rhineland	7.8 – 10.5	50 – 60	0.15 – 0.5	2.5 – 8
Lusatia	7.8 – 9.5	48 – 58	0.3 – 1.5	2.5 – 16
Middle Germany	9.0 – 11.3	48 – 54	1.3 – 2.1	6.5 – 10

Lignite in the border regions of Poland is similar to Lusatian grades. The calorific value of higher density Czech brown coal south of the nearby Ore Mountain range in North Bohemia, however, lies between 11.6 – 20.56 MJ/kg. As is apparent from these quality parameters, Middle German lignite is preferred for deliveries made to the Czech Republic.

Lignite's new opportunity

In contrast to the sprawling U.S. coal infrastructure, European lignite mines are invariably dedicated to local power stations. The German lignite association DEBRIV

notes that they actually form an integrated system characterized by mutually dependent fixed costs.

Under this circumstance, limiting a power plant's operation because of competition from renewable energies or CO_2 emissions penalties can effectively raise lignite costs above the price of imported hard coal. The lignite mine and plant lose their competitive advantage simultaneously. Even when a plant is relegated to a reserve capacity role, full mining employment cannot be maintained with only sporadic lignite deliveries.

An underperforming lignite mine, however, can regain profitability by supplying third-party customers. Despite delivery expenditures, the cost of generating steam from customer-specified lignite still remains 40% below that of natural gas, as one RWE customer near Frankfurt has testified.

Rheinbraun Brennstoff provides three million tonnes of LEP annually to over 600 asphalt mixing installations throughout Europe. Regular shipments are additionally made to cement plants between the Ruhr industrial region and the Alps

The possibility of long-distance lignite deliveries was often overlooked in the past due to the low calorific value and high moisture content of crude lignite. In effect, every second lignite freight car transports only water. Yet this seeming disadvantage actually provides certain unexpected benefits.

Mined lignite with a high moisture content cannot be safely stockpiled in large quantities because of the danger of spontaneous combustion. Therefore, deliveries are made several times weekly, alleviating the need for spacious bunkering. Furthermore, water losses during transport upgrade fuel quality. For instance, imported Middle German lignite has been rated at 12 MJ/kg by Carbounion Bohemia, several percent higher than mining specifications.

Pulverized lignite (*Braunkohlenstaub* BKS, alternatively LEP or LignoPlus) with double the calorific value of 21 – 22.2 MJ/kg (5.2 – 5.3 Mcal/kg), exhibits a residual water content of only 10.5 – 11% that improves combustion and reduces freight volumes. Railway container cars or silo trucks are used for transport.

German Lignite Energy Pulverized (LEP)				
	Calorific Value MJ/kg	Water %	Sulphur %	Ash %
Rhineland	22.2	11	0.35	4
Lusatia	21	10.5	0.8	6
Middle Germany	21	10.5	1.5	6 – 8

Germany's three lignite miners – RWE in the Rhineland, Vattenfall in Lusatia, and the Middle German MIBRAG – also manufacture pressed briquettes for traveling grate furnaces and heating stoves. Sifted lignite is supplied for circulating fluidized bed boilers. These products are classified at around 19 MJ/kg and 19% water content.All

grades of crude and processed lignite are considerably less expensive than natural gas, which is currently traded at over 21 €/MW ($7/MMBtu). Thermal energy therefore costs 2.1 cents per kWh, raising the fuel price of generated electricity to nearly 4 cents/kWh at a plant efficiency of 55%. Gas is too costly for industrial heating alone, compared with mined lignite at 0.6 cents. Declining grid power prices due to renewable energy penetration have also forced a number of gas generation plants into early retirement.

The expanding decentralized lignite market

There are no publicly available data on the growth of lignite deliveries to third parties, but there is plenty of evidence that this has become an important activity. Although the increasing deployment of renewable energies in Europe has strongly affected electrical power generation, this is not true for heating applications at widely distributed points of demand. In this sector, domestic lignite provides a low-cost alternative to rising energy import dependency (currently about 64% in Germany and 54% in the EU).

In 2007, Vattenfall subsidiary GMB identified 85 potential municipal power and/or heating customers in Germany suitable for LEP. An additional 250 industrial locations were compiled in the areas of energy and mining, chemical and pharmaceutical products, plastics and textiles, paper, metal and vehicles, foodstuffs, and transportation. Thermal capacities ranged between 1 and 145 MW. Vattenfall Europe Mining now supplies pulverized lignite to 10 municipal CHP power plants, some of which have been recently modernized.

Under CO_2 reduction policies, lignite power stations have become targets for priority retirement. Decentralized combined heat and power plants, however, can circumvent this restriction

The MIBRAG Mining Corporation in Middle Germany (the Leipzig/Halle/Bitterfeld “chemical triangle”) was established in 1994 to deliver lignite 40 km by rail from its Profen surface mine to the 900 MWe Schkopau CHP plant for both chemical production and 16 2/3 Hz railway power generation. The company’s second United Schleenhain mine was originally modernized for the adjacent Vattenfall Lippendorf power station dedicated in 2000 for grid electricity and Leipzig district heat. Additional lignite deliveries have more recently been made by 25 tonne truck to Profen for rail distribution.

In all, MIBRAG now supplies lignite to six power and heating plants located between 40 and 402 rail kilometers from its Profen loading depot, most recently to the Czech Republic. In addition, three sugar factories (for which lignite has been used since the 19th century) and one production facility for biofuels are served over distances of up to 120 km.

Briquette deliveries are also made from the company’s Deuben industrial power plant that was reactivated for that purpose in 2011. The briquettes are pressed from low-sulphur Rhineland lignite under contract of Rheinbraun Brennstoff, an RWE subsidiary.

Rheinbraun Brennstoff provides three million tonnes of LEP annually to over 600 asphalt mixing installations throughout Europe. Regular shipments are additionally made to cement plants between the Ruhr industrial region and the Alps. The Swiss Siggenthal cement factory north of Zürich is supplied with 1,500 tonnes of lignite per week by two trainloads from the Rhineland over a distance of 600 km. This direct route has been found preferable to loading Rotterdam coal from Rhine River barges docked at the city of Basel 60 km away.

The lignite train to the Czech Republic

The Czech parliament in 1991 adopted measures to limit lignite mining in North Bohemia. As a result, the Czech Republic imports large amounts of lignite. According to Carbounion Bohemia data, MIBRAG supplied about 1.3 Mt of crude lignite last yea mainly to a combined power and heating plant (363 MWe & 698 MWth) about 100 km east of Prague at Opatovice on the Elbe River (*nad Labem*). Briquettes were also imported for the heating market (0.14 Mt).

The crude lignite has been brought 24 km by diesel traction from Profen to the central freight yard at Leipzig / Engelsdorf. After recoupling, a Czech TRAXX MS Series 186 electric locomotive transports 32 hopper cars across the border at Bad Schandau to Děčín (179 km distant). Two train loads a day proceed to Opatovice (199 km), while lesser amounts are diverted to the Komořany CHP plant (239 MWe) near the industrial city of Most (120 km).

Regardless of reduced lignite usage in centralized power generation, lignite remains essential for an increasing number of smaller industrial and municipal applications

Since September 2014, however, MIBRAG owner EP Energy has also contracted lignite from its Polish subsidiary KWK Silesia in Czechowice-Dziedzice, with up to three deliveries made daily to Opatovice. The shorter 334 km rail route is fully electrified.

Lignite procured from nearby Turow in Poland is another possible alternative to German imports. Since Vattenfall's lignite operations are currently up for sale, however, a Czech takeover would again enhance eastern Germany's lignite export potential.

The popular 19.5 MW plants

Under CO_2 reduction policies, lignite power stations have become targets for priority retirement. Decentralized combined heat and power plants, however, can circumvent this restriction.

Electronic controls that limit rated capacity to 19.5 MW preclude the need to purchase EU Allowances (EUA) for emissions trading. Public hearings are likewise stipulated only for installations exceeding 50 MW, and environmental impact assessments per Directive 2014/52/EU above 300 MW.

Again, it is hard to find public data, but it is clear that a number of new projects are being carried out. A 19.5 MW plant operated by Allessa Chemie for pulverized lignite

recently entered service at Fechenheim east of the city of Frankfurt, realizing 40% cost savings compared with natural gas. A similar facility will be completed next year by the Weyl-Chem chemical company in Griesheim near the international airport.

This advanced CHP design will be capable of firing lignite, natural gas or White Powder, a relatively expensive biomass substitute. Besides producing herbicide ingredients, dyes, and pigments, surplus heat can be fed to adjacent industrial facilities. Three truckloads of finely pulverized lignite will be supplied daily from the Rhineland, with combustion ash returned for mining reclamation.

An application for a similar 19.5 MW design was submitted in May to the city of Darmstadt. Regardless of reduced lignite usage in centralized power generation, therefore, lignite remains essential for an increasing number of smaller industrial and municipal applications. At this level, the Lignite Age may long endure.

Freight load and transport costs

Crude lignite is generally transported in four-axle saddle-bottomed hopper cars with gravity bulk discharging chutes. Each train on the dedicated 40 km MIBRAG route from Profen to Schkopau hauls 2,200 tonnes of lignite for efficient shuttling. The specially designed cars from WBN Waggonbau Niesky include 26 kW heaters for winter operation. The empty weight of 25.5 tonnes allows about 60 t of lignite to be loaded (maximum total 22.5 t per axle).

Lower capacity gondola cars are employed for 1,500 tonne trains to the MIBRAG Buschhaus power plant near the Volkswagen factory in Lower Saxony. Middle German lignite will fully supply the 190 km distant plant after local mining is terminated in 2017.

The EcoTransIT website permits transport energy to be calculated between terminals throughout Europe. The computation accounts for freight loads, empty returns, and lines with mixed diesel and electric traction. Expenditures may be compared with truck and river transportation. Roughly 3 liters of diesel fuel are required per double rail kilometer. Electric traction is similar when power plant losses are included. Rail transport generally consumes less than 1% of the delivered lignite energy.

Total charges for fuel, rolling stock, dispatching, and personnel, however, easily make delivery more expensive than the mined value of the lignite. Railroad costs per t-km are about four times higher in Europe than in the United States, while revenues are only twice as high. Passenger trains constituting 79% (2007) of the train-kms in the European rail network may impose scheduling restrictions. Furthermore, “around seven times more trains are necessary in Europe” to move the same tonnage. Lignite deliveries to large-scale installations can nonetheless only be made by train or river barge.