Issue No. 4
November 2009

NERA
Economic Consulting

Energy Market Insights

Valuation of Generation Assets in Illiquid Markets: The Example of Poland

by Sean Gammons & Richard Druce

From the Editor

Valuation of power projects is difficult in a mature market; it is triply so in a nascent one. Forecasts must adjust for peculiarities of market structure, for political forces which drive market evolution and allow substantial scope for heightened risk. In this EMI, Sean Gammons and Richard Druce look at Poland, applying not just the standard valuation tools, but the judgment that inevitably accompanies the difficult task of valuation in developing competitive markets.

—Jonathan Falk, Editor

Introduction

The Polish electricity market is in a state of transition. Over the last 15 years, the Polish government has gradually implemented market reforms designed to comply with European Union (EU) rules on the internal market for energy. As a result, the Polish electricity market is becoming increasingly transparent and integrated with neighbouring markets.

Despite this progress, institutional and regulatory constraints in the Polish market, in particular the lack of a liquid wholesale market and regulation of end-user tariffs, continue to create risks for investors. In this EMI, we examine how these risks affect the value of generation assets in Poland.

Our analysis has implications both for policymakers and investors in the Polish power market, especially now that the Polish government has relaunched its privatisation programme. However, the issues covered in this EMI are not unique to Poland. Many emerging power markets in the EU and elsewhere exhibit similar characteristics and create similar challenges for decision-makers.

Overview of the Polish Market

At the end of 2008, the Polish electricity market had installed generation capacity of approximately 35,000 MW, compared to a peak demand of 25,000 MW. Around 84% of installed capacity is coal-fired, accounting for over 90% of electricity production.[1]

Much of Poland's coal-fired generation fleet is in need of either replacement or substantial modernisation investment. Around two-thirds of the country's coal plants have been operating for over 25 years,[2] and require costly investments in environmental mitigation equipment to comply with the EU's Large Combustion Plants Directive, or else they must close by end-2015.[3]

Largely driven by the need to attract modernisation investment in the sector, and more recently to reduce Poland's budget deficit, the government has outlined plans to privatise a number of energy sector companies.[4] However, despite some asset sales to large European utilities, particularly at the generation level, the market remains largely dominated by vertically integrated state-owned companies, the largest of which are PGE, Enea, Energa, and Tauron.

Like all EU Member States, Poland has also implemented rules to "legally unbundle" network operators from generation and supply functions, and to offer end users the opportunity to switch supplier. However, incumbents still supply the vast majority of consumers,[5] and the regulator (URE) retains control over all residential end-user tariffs.

At the wholesale level, most trade takes place through bilateral contracts. A small share of wholesale trading (approximately 2%) takes place on the Polish Power Exchange (POLPX), which provides the only transparent wholesale reference price in the market.[6]

Recent Wholesale Market Trends

A Structural Shift in Pricing

Until early 2008, POLPX prices were relatively stable and showed little or no correlation with the international CO_2 and coal prices that might be expected to determine the underlying marginal costs of generation in the coal-dominated Polish market, as Figure 1 illustrates.

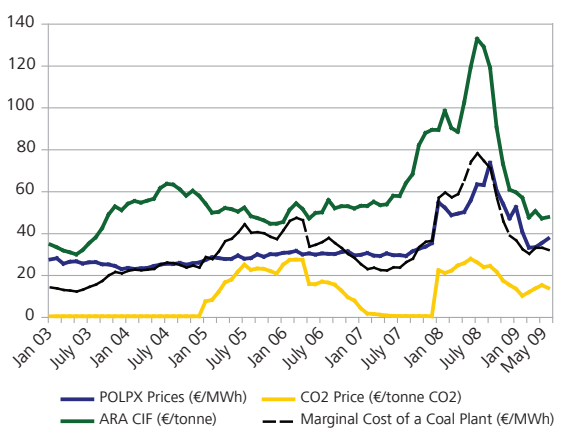
The stability of wholesale power prices, coinciding with periods of volatile CO_2 prices within the EU Emissions Trading Scheme (EU ETS), is consistent with Polish generators not passing through the full "opportunity cost" of CO_2 before 2008.

The weak correlation between POLPX prices and international coal prices also suggests that the price of coal within Poland might not have reflected the international market prices over this period, possibly due to price regulation and government control within the Polish coal industry, among other factors.[7,8]

However, a step-change in POLPX prices occurred in 2008, coinciding with the start of Phase II of the EU ETS, when the price of CO_2 emissions jumped from €0 to €20/tonne overnight. Since then, POLPX price trends show evidence of greater correlation with CO_2 prices. Figure 1 also suggests that the link between POLPX and international coal prices has strengthened.

This step-change in POLPX pricing suggests that some fundamental changes took place in the Polish electricity and/or fuel supply markets towards the end of 2008, although what exactly is not clear. We discuss some candidates below.

Figure 1 Historic POLPX vs. European Coal and CO_2 Prices

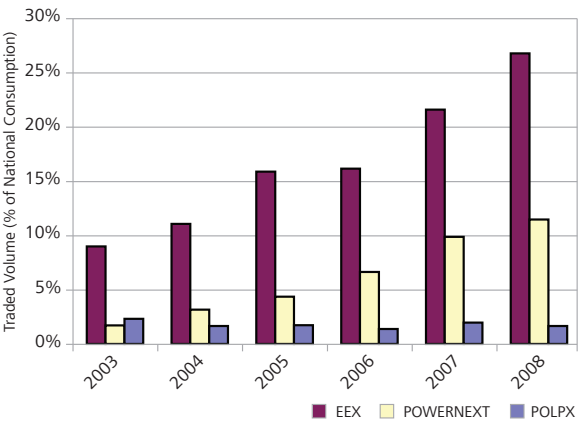


Source: NERA analysis of data from Platts Powervision, McCloskey, Point Carbon, and the European Central Bank (ECB). POLPX prices are monthly averages of day-ahead prices.

Liquidity

One possible (though tenuous) explanation for the step change in POLPX pricing is that there has been a corresponding step change in liquidity on the Polish market that has led to improved price discovery. However, as Figure 2 shows, there is no evidence of any shift in volumes traded on the POLPX at the beginning of 2008, and traded volumes remain very low compared to the EEX in Germany and the Powernext in France.

Figure 2 POLPX vs. EEX and Powernext Day-Ahead Traded Volumes



Source: NERA analysis of data from Platts Powervision (traded volumes) and the IEA (consumption). Note: IEA 2008 consumption data is not yet available, so we extrapolated 2007 demand using the growth rates observed between 2006 and 2007.

Early Termination of PPAs

After a long-running investigation by the European Commission, the Polish authorities enacted legislation in mid-2007 to phase out the long-term power purchase agreements (PPAs) that until recently covered a large share of generation in Poland.[9] The last remaining agreements were terminated in April 2008.

Well designed PPAs incorporate an energy price that reflects the underlying marginal costs of the generation asset covered by the agreement, and hence accurately signal marginal costs to the market. However, it is not clear the Polish PPAs conformed to this model. For example, some may have incorporated take-or-pay clauses. They may also not have allowed the full pass-through of the opportunity cost of CO_2 (see below). Hence, the early termination of the PPAs may help to explain the improved correlation between POLPX prices and underlying marginal costs.

CO_2 Pricing

Polish generators have been subject to the EU ETS since the start of Phase I of the scheme on 1 January 2005, and hence *in theory* have faced the market cost of their CO_2 emissions for some time now. However, for a variety of reasons, they may only have started to perceive a real cost to their emissions from the start of Phase II of the scheme on 1 January 2008.

First, it was not until mid-2006 that the Polish government implemented a registry system for Polish EUA certificates, thus allowing generators to trade their free CO_2 allowances.[10] Second, tighter allowance allocations in Phase II compared to Phase I of the EU ETS[11] may have caused a perception that Polish generators would be short of free CO_2 allowances, thus giving even state-controlled generators some incentive to recover the cost of CO_2 emissions in their prices. Third, the growing role

of private capital in the industry and the Polish government's preparations for further sell-offs may have finally instilled greater commercial discipline, thus strengthening incentives to pass through CO_2 costs.[12]

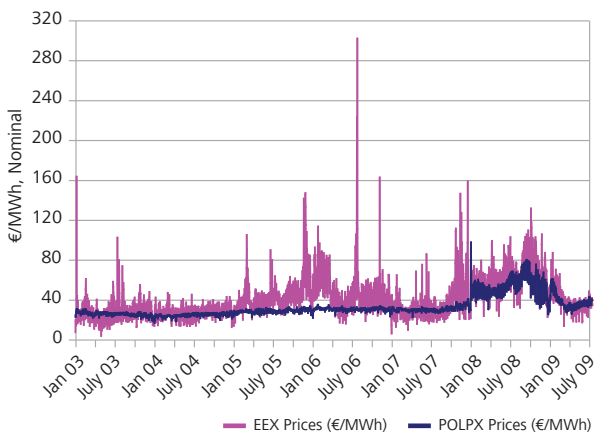
Coal Pricing

The Polish coal industry, though "notoriously opaque" and marked by government subsidy and influence,[13] has undergone gradual reforms over recent years. In particular, the government is gradually phasing out state aid to the sector, which is now monitored by the European Commission. At the same time, coal imports have grown.[14] These changes, along with the introduction of greater commercial disciplines in the electricity industry, help explain the increased correlation between international coal prices and the POLPX price.

Convergence with Neighbouring Markets

As shown in Figure 3, since the start of 2008 the POLPX price has also started to show stronger correlation with the prices seen in the neighbouring German market (EEX), a system where price setting is also dominated by coal plants. This convergence signals that the same underlying factors that drive the EEX price (international coal and CO_2 prices and the supply-demand balance) are now driving the POLPX price. It may also reflect the creation of more transparent mechanisms for cross-border interconnector access and hence more efficient arbitrage. However, EEX prices are still notably more volatile than POLPX prices, perhaps reflecting the greater role of gas-fired generation and wind farms in the generation mix in Germany, but also perhaps a lack of full commercial discipline in Poland.

Figure 3 POLPX vs. EEX Prices: Daily Average Prices



Source: NERA analysis of data from Platts Powervision, and the ECB.

Recent Retail Market Trends

The development of the retail market in Poland has lagged behind the wholesale market, due to the continued regulation of end-user tariffs and political interference in regulatory proceedings.

In the industrial segment of the retail market, where the regulator no longer fixes tariffs, the hike in wholesale prices in 2008 appears to have fed through into higher end-user prices (see Figure 4). However, the same adjustment to end-user prices has not occurred in the household segment of the market, where the regulator still sets prices and where recent events suggest the tariff-setting process is subject to political interference.

For example, on 9 November 2007, 10 days after announcing the deregulation of end-user prices as of 2008, the president of the URE, Adam Szafranski, was dismissed. His successor, Mariusz Swora, immediately reversed this deregulation, which triggered lawsuits against his office by several parties in the industry.[15] Furthermore, URE's most recent report to the European Commission notes the lack of independence of the regulator's office, and the political influence over the regulator's appointment.[16]

It therefore appears that regulated retail tariffs are currently set below the underlying costs of serving residential consumers in Poland. This hypothesis finds further support in the latest complaints from Polish retailers that regulated residential end-user prices prevent them from recovering their costs.[17]

Figure 4 POLPX vs. Polish Retail Prices

Source: NERA analysis of data from Platts Powervision, Eurostat, and the ECB.

Valuation of Thermal Generators in Poland

Valuation depends on cash flow expectations, risks and the price of risk as reflected in the cost of capital. In mature markets, a combination of forward market information and fundamentals analysis provides the best guide to these drivers. However, in illiquid markets like Poland, the framework must be expanded to account for the types of market and regulatory distortions we have identified above.

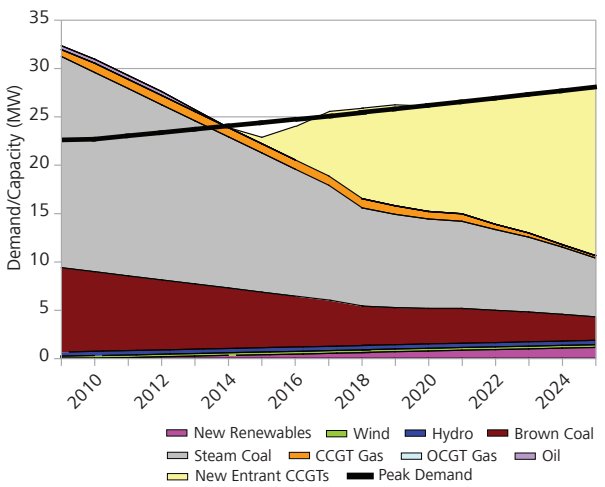
Forecasts of Polish Wholesale Market Evolution

As Figure 5 shows, based on published data, Poland appears to have a reserve margin of around 30% at present. However, much of this capacity is very old, inefficient, and dirty steam coal and lignite plants that will need to close over the coming several years. With continued demand growth—Poland has

survived the recession better than most—significant new investment will therefore be required over the next decade. Using our *EESyM*™ model of the European electricity market, we predict that incremental investment in new thermal baseload capacity will become economically viable in Poland from around 2015.[18]

EESyM™ selects new entrant technologies to minimise the overall costs of generation. In the Polish market, it selects gas-fired CCGT capacity as the cheapest baseload new entrant technology based on our forecasts of gas, coal, and CO_2 prices, as well as our assumptions on the construction costs and technical characteristics of alternative new build options.[19]

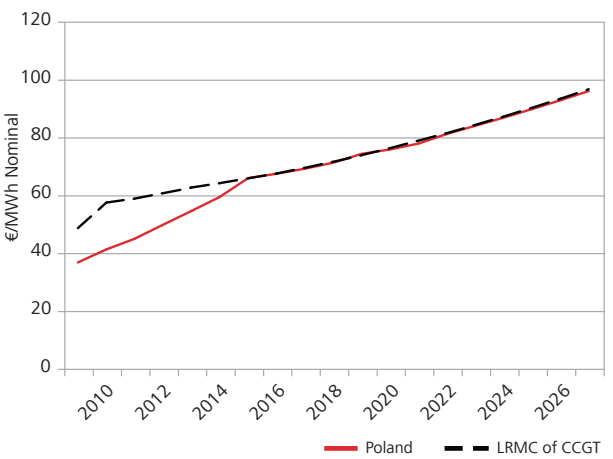
Figure 5 Forecast of the Polish Supply-Demand Balance



Source: NERA projections.[20]

Based on these forecasts of the supply-demand balance, we use *EESyM*™ to project baseload prices,[21] as shown in Figure 6. For 2009, we predict baseload prices at around €37/MWh, rising to €41/MWh in 2010.[22] Thereafter, we predict a gradual convergence to the level required to remunerate new entry from around 2015, defined by the long-run marginal cost (LRMC) of a gas-fired CCGT plant.[23]

Figure 6 Baseload Price Forecasts



Source: NERA projections.

Generation Asset Valuation: Market Paradigm

Based on this forecast of baseload prices, we have used our *EnergyMetrics*™ platform to project patterns of dispatch, captured dark spreads, and net revenues for a coal-fired generator operating in the Polish market. *EnergyMetrics*™ works at a more detailed level than *EESyM*™ and in reverse. Instead of matching generation output against demand to predict prices, it dispatches a generator against given four-hourly spot price curves (i.e., six blocks per day) to predict its output.

To generate four-hourly price curves, we "shape" our annual baseload price forecast (from *EESyM*™) using the (normalised) observed pattern of POLPX prices in 2008.[24] We also "shape" the plant's marginal cost curve using the observed pattern of coal and CO_2 daily spot market prices for 2008 in order to preserve the underlying historical correlations that drive the clean dark spread.[25] We then calculate a profit-maximising pattern of dispatch, assuming the plant runs whenever the clean dark spread exceeds the non-fuel variable O&M costs, after accounting for outages and start-up costs.

Treating the 2008 price shape as deterministic (i.e., fixing the pattern of prices observed in 2008 throughout the modelling period),[26] we find that the enterprise value of a steam coal plant varies between €215/kW and €528/kW, depending on the assumed cost of capital and thermal efficiency.[27]

Table 1 Coal Generator Valuation (2008 POLPX Pricing Method), €/kW[28]

Thermal Efficiency (%)	Nominal, Pre-Tax WACC (%) 12%	14%	16%
33%	319	261	215
35%	424	351	293
37%	528	440	371

Source: NERA Analysis.

Generation Asset Valuation: Increased Volatility

As we have seen, volatility on the POLPX increased from 2008 onwards, but still falls short of the volatility we see on the EEX in Germany. With the expected increase in investment in gas-fired capacity and renewable capacity in Poland, together with greater interconnection,[29] and enhanced commercial disciplines, we would expect to see greater convergence over time between the POLPX and EEX markets. Reflecting this scenario, if we apply the 2008 EEX price shape to our forecast baseload prices for Poland, our valuation range increases by between 7% and 22% compared to our base case, as shown in Table 2.[30]

Table 2 **Coal Generator Valuation (2008 EEX Pricing Method), €/kW**

Thermal Efficiency (%)	Nominal, Pre-Tax WACC (%) 12%	14%	16%
33%	381	315	264
35%	476	397	335
37%	569	477	405

Source: NERA Analysis.

Table 3 **Coal Generator Valuation (2008 POLPX Pricing Method, Less Retail Losses), €/kW**

Thermal Efficiency (%)	Nominal, Pre-Tax WACC (%) 12%	14%	16%
33%	155	121	95
35%	240	193	157
37%	332	272	225

Source: NERA Analysis.

Generation Asset Valuation: Regulated Scenario

The above scenarios reflect some of the risks around the development of the wholesale market in Poland, but they assume there is sufficient liquidity for generators to be able sell all their output at the POLPX price. In practice, as we have discussed, liquidity is currently very low and hence it is not clear that the POLPX price represents a reliable reference price for valuation.

In addition, most generation assets are owned by vertically integrated groups that are exposed to regulated end-user tariffs that are set below the true cost of serving residential retail customers. The resulting economic losses must show up in the form of reduced valuations for vertically integrated groups in Poland, whether the losses are allocated to the retail business, as they probably should be, or the generation business, on the basis that the POLPX does not represent a reliable reference price.

On 1 December 2008, the Polish regulator made an assessment that the "fair value" wholesale power price for calendar year 2009 was Zloty 155/MWh,[31] which compares to Platts' Polish year-ahead assessment (made two days later) of Zloty 225/MWh. The difference between these two forecasts places the regulator's view of power prices 36% below the level implied by independent assessment.

As an illustration of the impact retail losses may have on valuation, suppose that the regulator applied this discount to the wholesale purchase component of regulated residential tariffs. Assuming residential sales represent 20% of a vertically integrated company's sales,[32] this 36% loss would equate to a 7% loss on all retail power sales. Allocating this loss to a generation business throughout the period 2009-2028 would reduce valuations compared to our base case by up to 50%, as shown in Table 3.

Conclusions

The structural shift in pricing dynamics on the POLPX seen in early 2008 has increased the transparency of wholesale prices in Poland. Nevertheless, the continuing lack of wholesale market liquidity complicates the task of valuing generation assets in this market, as we have illustrated in this paper.

Unless further reforms are enacted, this situation will undoubtedly hinder the government's efforts to attract private capital into the industry and limit the price the government achieves for its assets at privatisation.

However, Poland is not the only market in Europe where illiquidity and price regulation complicate assessment. These conditions also prevail in most other EU accession countries, as well as certain western European markets. In all such environments, the application of standard valuation approaches must be adjusted to reflect specific local factors and risks, as this short description of the Polish electricity market has illustrated.

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EndNotes

1. PSE Operator S.A., Annual Report 2008, pages 18 and 21.
2. "Poland targets security of supply," Platts Energy in East Europe, 16 January 2009.
3. The LCPD places restrictions on emissions of sulphur dioxide (SO2), oxides of nitrogen (NOx), and dust (particulate matter) from combustion plants with a capacity above 50 MW (thermal). In practice, the directive requires large coal-fired generators to invest in flue gas desulphurisation, or else close by the end of 2015.
4. "Poland unveils privatisation plans," Platts Energy in East Europe, 14 August 2009.
5. National Report of the President of the Energy Regulatory Office in Poland 2008, July 2008, p. 40.
6. National Report of the President of the Energy Regulatory Office in Poland 2008, July 2008, pages 10 and 33.
7. Energy Policies of Poland 1994 Survey, International Energy Agency, 1995.
8. Ministry of Economy, Labour and Social Policy, "Restructuring of the hard coal mining sector during the period 2004-2006 and strategy for the period 2007-2010", 27 April 2004, p. 49.
9. Historically, the Polish electricity market has been covered by a large number of long-term Power Purchase Agreements (PPAs), which, according to the European Commission, covered about half of the Polish power generation market in 2005. The PPAs were signed between 1994 and 1998, when the Polish government wanted to attract capital investment to modernise its infrastructure.
10. Press Release on the 2005-2007 National Allocation Plan for Emissions Allowances and Setting Up of the National Registry of the Allowances, Ministry of the Environment, Warsaw, 5 July 2006.
11. Press sources from 2006-07 suggest market participants expected a tighter allocation of free allowances in Phase II than in Phase I: (1) "FOCUS: EU Defies Industry To Set Tougher CO_2 Targets", Dow Jones Commodities Service, 30 November 2006, and (2) "EU Carbon Price Forecast To Rise 25% In 2008 -DJ Survey", Dow Jones Commodities Service, 1 March 2007.
12. In theory, profit maximising firms have an incentive to pass through the market price of their CO_2 emissions into their sales price. In contrast, state-owned generators may not face the incentive to make a profit, and for political reasons may be reluctant to pass through CO_2 prices to their customers. However, if state-owned generators need to incur cash costs to buy allowances on the market to make good on a shortfall in their allocation, then even they would eventually need to increase the prices they charge to customers.
13. Economist Intelligence Unit: "Poland energy: Coal not dole", 29 November 2004. Polish News Bulletin, "Poland's Dependence on Coal Makes Mining Sector's Restructuring Economically and Socially Impossible", 1 December 2006.
14. Data from Eurostat shows that coal imports to Poland grew by 39% between 2003 and 2007.
15. "RWE, Vattenfall demand Polish deregulation", Platts EU Energy, 11 January 2008.
16. National Report of the President of the Energy Regulatory Office in Poland 2008, July 2008, p. 12.
17. (1) "Household rates to be liberalized", Platts Energy in East Europe, 14 August 2009; (2) RWE Expects Poland to Deregulate Domestic Power Prices, The Wall Street Journal website, 20 August 2009.
18. "Incremental" here means additional investment over and above those projects that are already under construction, which we treat as firm commitments and hence are already factored into our base line assumptions.
19. According to our assumptions, new CCGT plants are slightly cheaper than new coal plants in the Polish market in terms of the average costs for baseload generation, and for this reason our *EESyM*™ model prefers to build CCGT plants instead of coal. In reality, investors may choose to construct a diversified generation portfolio to hedge against fuel and CO_2 price fluctuations and short-term fuel supply constraints—certainly, we see a mix of coal and gas projects being developed right now in Poland.
20. Current capacity information from Platts Powervision; Peak demand projections from local Polish sources. Note: Hydro, wind and renewables capacity is adjusted for expected availability at time of system peak. The match between peak demand and installed capacity suggests that Poland will become increasingly reliant on imports to meet peak demand (mainly from the Nordic and Baltic markets where we assume the marginal costs of generation are lower in the long-run).
21. An annual "baseload" price is the arithmetic, unweighted average of power prices across all hours of the year. In Europe, "baseload contracts" for various terms are one of the most liquid instruments traded on forward markets, and hence a standard metric for reporting price forecasts.
22. We use a 22 June 2009 "information date" to define our modelling assumptions on generation capacity, fuel and CO_2 prices, exchange rates and inflation. (The "information date" is the cut-off date we use to define our assumptions, i.e., we only take account of information available at that date.) Our 2010 price forecast is close to 2010 forward power prices from around the same time as our information date: Platts' Polish Price Assessment for 2 July 2009 was €44.80/MWh for calendar year 2010.
23. We calculate the LRMC of a gas-fired CCGT plant as the sum of the fuel, CO_2, and variable O&M costs of the plant (€/MWhe), plus a margin to recover the annualised fixed costs of operation.
24. The price in each four-hour block of our modelling period is defined as follows:

    Price(i,j) = Price(i,2008) / Baseload Price (2008) * Forecast Baseload Price (j), where i denotes a four-hour block (i=1,…,2190) and j denotes a year (j=2009,…,2028).
25. We shape Polish coal prices using ARA API#2 coal prices from 2008 reported by Bloomberg, and CO_2 prices using 2008 EU ETS prices reported by Point Carbon.
26. *EnergyMetrics*™ can treat power, fuel, and CO_2 prices as deterministic variables, i.e., their "shape" over each year is predefined, or as stochastic variables, i.e., their "shape" over the year is subject to random variation. This latter functionality allows us to calculate the full option value of power plants, contracts, etc.
27. We calculate enterprise values on a discounted cash flow (DCF) basis over the period 2009-2028 (i.e., assuming a 20-year remaining life with zero terminal value). The valuations are net of fixed operating and maintenance costs, which we assumed to be US$27.53/kW/annum based on Energy Information Administration: Annual Energy Outlook 2009, and assume no incremental capex, whether for environmental compliance or life-extension. The WACCs we have used are for illustration only.
28. Thermal efficiencies in this table and elsewhere are on a high heating value (HHV) sent-out (i.e. net) basis.
29. Vattenfall-TSO and PSE Operator, the Polish grid company, recently announced plans to build a new 1,000 MW link between their two systems. Source: PSE Operator press release, 23 September 2009.
30. Using EEX price shape (volatility) results in bigger and more frequent power price spikes than with POLPX shape. Although the increase in price spikes is offset by lower prices in off-peak periods (with the same average price over the year as a whole), coal plants can avoid these lower prices by switching off in off-peak periods. Hence, using EEX price shape results in an increase in expected cash flows for coal plants in Poland, which we assume translates into higher value. This increase in value would be smaller if investors applied a higher discount rate to the more volatile cash flows under the EEX price shape scenario, but we have no evidence that investors are likely to react in this way.
31. Swora stumps Poland, Platts Energy in East Europe, 5 December 2008.
32. Based on consumption by Polish households in 2005 (22.7TWh) as a share of total final consumption (117.7TWh). Source: Statistics and prospects for the European electricity sector (1980-2000, 2004, 2005, 2010-2030), Europrog Network of Experts, December 2007, table 2.2.21.

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