INTERNET BASED ENERGY TRADING IN SOUTHERN AFRICA

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1. Introduction

With deregulated and cross-border electricity markets opening up worldwide and the imminent establishment of the Multi-Market-Model in South Africa, the mechanisms enabling the trade of electricity have become a topic of great interest. Predictably, the Internet has become the worldwide de-facto standard platform for energy trading. The reasons are compelling for both buyers and sellers. Buyers are assured that the competitive bidding process uncovers the true market value of the contracts. The seller is also assured of getting the best price for the contract, as maximum exposure is achieved. Internet-based trading positively contributes to liquidity, wide exposure for many potential contract partners, lower transactional costs, anonymous trading, real-time speed of execution and trading after-hours. The barriers to entry are low due to the relative familiarity with the Internet, the use of expensive technology seldom being required and the feasibility of back-office integration with existing systems.

In Eskom, the internal power pool has been in existence for some years and while it has not been fully opened to external participants due to the prevailing regulatory environment, there has, however, been much activity in the trading arena, some larger customers and self-generating entities having been given exposure to Real-Time Pricing, Demand Side Participation via a product called DMP (Demand Market Participation), a Reserve Market and a Forward Energy Market (based on week-ahead trades contracted via an Internet enabled financial exchange). Regionally, there has also been trade activity on the Southern African Power Pool (SAPP) for many years, with Internet-based systems being gradually introduced as well. These systems have not only resulted in substantial additional sales for the utilities concerned, but have also served to improve information flows and supply chain efficiencies.

Future participation in local multi-markets is likely to be Internet-based. This paper will cover existing case studies and demonstrate some of the functionality likely to be present in a new Multi-Market-Model.

2. Multi-Market-Model (MMM)

Most developed electricity markets cater for the trade of electricity in three basic market areas, viz. the physical market, ancillary market and financial markets, as pictured below (Figure 1.)

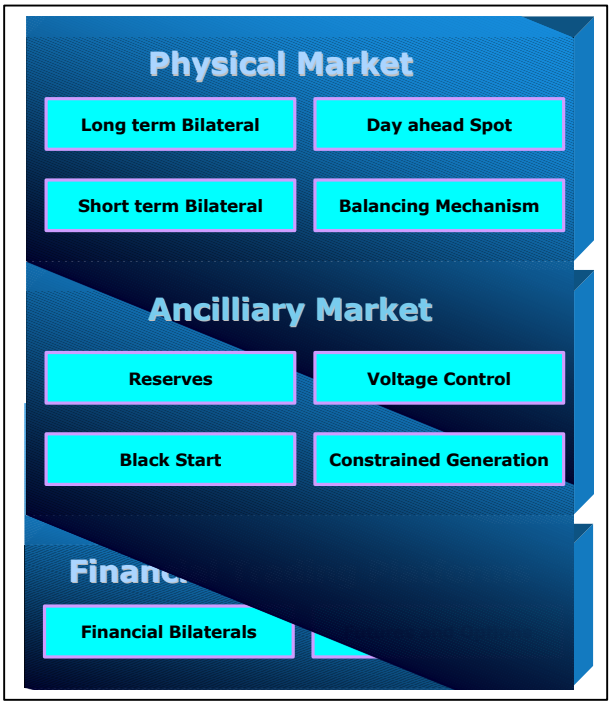

Figure 1. MMM components [1]

The Multi-Market-Model components shown above consist of:

1. A platform for **long-term (fixed) bilateral** agreements between electricity suppliers and a defined category of consumers will be specifically suited to traders who prefer consistency of volume and price.
2. The **day ahead Spot** Market (24 hour ahead) is where the actual product (electrical energy measured in kWh's) is bought and sold on a day-ahead basis. It has a fluctuating compulsory price dictated by demand and imbalances peculiar to electricity consumption characteristics.

3. The **balancing mechanism** is used to resolve the discrepancies between contracts and what is actually consumed and typically occurs within the hour.
4. The **ancillary market** will assist the systems operator to ensure security of supply, primarily from a system contingency perspective.
5. The **financial trading platform** enables the forward buying of power in much the same way as risk hedging in the commodities markets.

3. Current trading activities in Southern Africa

The Southern African Power Pool (SAPP) was created in 1995 when twelve countries within the southern half of the African continent (Figure 2.) decided to pool their electricity supply resources for their mutual benefit.

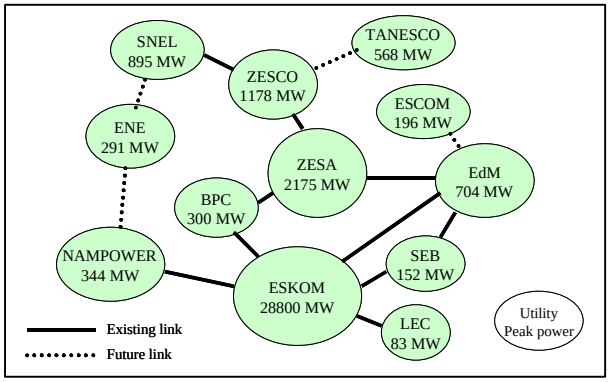

Figure 2. SAPP Participants [2]

The early years of operation in this mode provided the participants with a relatively low risk environment for trading. It also enabled them to gain enough experience (and motivation) to ultimately move to a competitive environment as and when appropriate. The advantages being increased trading opportunities, particularly in a short-term market where demand / supply shortages and surpluses can be matched to the benefit of all participants.

In terms of exchange requirements, little sophistication was initially required. Participants were able to enter into bilateral contracts with wholesale generators (Utilities) for their long-term and medium-term requirements. This ensured that most of their predictable needs could be secured at reasonable prices and also provided the generating utilities with some assurances on investment return. The short-term energy market (STEM) was subsequently established in 1999 to take advantage of gaps between day-to-day demand and contracted supply (i.e. bilaterals). While it was possible to initiate this market using faxes, emails and telephonic communication, as the volumes increased, an electronic Internet-based system became essential.

These systems require that information such as hourly energy forecasts, confirmations and schedules (often accompanied by the previous day's load measurements) are exchanged (called the daily bilateral operations). The value of the energy traded in these bilateral agreements (using Enerweb hosted platforms) is currently in excess of R1bn per annum. Due to the relative infancy of the trading environment, operational and rule changes have been frequent. The platforms are thus required to be flexible enough to be configured by the users themselves, whilst also being capable of automating and monitoring operations. Detailed reports covering bid parameters, contract data, load data, pricing and settlement data, etc. have been made available online. While the communication infrastructure may not be of the same standard as the European and American markets, all available communication networks (the Internet, SMS, e-mail and even fax machines) are utilised to ensure reliability and high-speed delivery of information. Connectivity to date has been more than adequate within the region to support electronic trading platforms.

Once the MMM is established in SA, the SAPP licensed participants may be granted access to the local market under the same rules and obligations as the local participants, subject to transmission constraints etc. In the opinion of the authors, the higher liquidity levels likely to be experienced in the MMM will result in the SAPP short-term energy market being gradually combined with the local market initiatives.

4. Trading Activities on Eskom's Power Pool

While the MMM has yet to be implemented, an internal Eskom power pool has been operational for over five years. Although its intent was to optimally schedule (on an economic basis) the various power stations, it was also useful in developing the skills and some of the technologies required in the new electricity market place.

Real Time Pricing

The first exposure to dynamic pool prices for SA Electricity Consumers was in 1998, with the introduction of the Real-Time-Pricing (RTP) tariff. Large customers who could demonstrate that their marginal consumption would increase or decrease in response to variable day-ahead energy prices

were given access to this specialised pricing regime. This has developed to the extent where now over R 1bn is transacted on this mechanism on a yearly basis. The administration is highly dependent on web-based systems to enable secure viewing and delivery of bills, settlements, reports and pricing statistics. Customer interfacing is easily facilitated via the Internet through a web browser, email, auto-fax or even a cell phone. The system architecture is specifically designed to integrate with existing systems and user interfaces and checks and balances are included to ensure that any possible erroneous data is highlighted before price posting, or final billing and settlement is produced. Account executive interaction and acceptance prior to bill processing and dispatching is facilitated.

Power Exchange Simulation

The establishment of power pools, deregulation and cross-border electricity trading make the establishment of various exchange-traded electricity trading instruments inevitable. The area of derivatives, historically the domain of commodity traders and speculators, can be complicated. Eskom's Research group therefore deemed it important to establish a real-world simulation environment in order to gain an understanding of the dynamics and risks associated with this environment, particularly in light of the harsh lessons learned elsewhere in the world (e.g. the Californian disaster, and more recently the Enron debacle).

The (Internet-based) South African Power Exchange simulation game, based on Enerweb's enerXchange platform, was customised to replicate local market conditions as closely as possible, and run over a six-month period. Participants included all prospective Eskom energy traders as well as a number of selected external participants. The market rules were modelled primarily on the Nordpool financial market (similar to the prospective SA MMM).

The interactive trading game was transparently interfaced with the financial exchange, also incorporating actual SA weather and operational constraints thus providing real-world volatility.

Over 120 participants were involved in the trading simulation, resulting in excellent liquidity. Each player was given a R1m balance to start with and had to assume the role of either a Generator (producer), Trader (speculator) or Distributor (consumer). The exercise proved highly successful, not only from a training perspective but also from a technology implementation perspective, with the lessons learned being implemented in a real Forward Energy Market as described in the next section.

In technology terms, Straight Through Processing (STP) principles using XML messaging standards were applied in the development of the platform (enerXchange). This ensured that data could be transferred in a way that is compatible (and understandable) to all interconnected systems, eliminating all human transferring of data and human interactions.

Forward Energy Market

The Forward Energy Market is an Internet-enabled electronic exchange platform where Eskom's "surplus energy" is traded with customers who have their own generating capacity but would be able to take advantage of lower cost Eskom energy in periods when demand is low. In order to hedge risks and to provide sufficient incentive for the customer and for Eskom Generation to participate, a method was required which would enable weekly surplus energy to be obtained from the Generation Energy Management Department (EMD), acting as wholesaler, and where the Eskom Distribution group customer executives would act as the retailer. The electronic trading of the contracts (volumes, prices and hedges) was required to be made available to the customer in an on-line, efficient and electronically secure environment. Furthermore, as weekly forward energy contracts were being negotiated, the customer also needed to contract electronically on a weekly basis for the following weeks', where these contracts would then also become part of the settling and billing procedures for that specific customer.

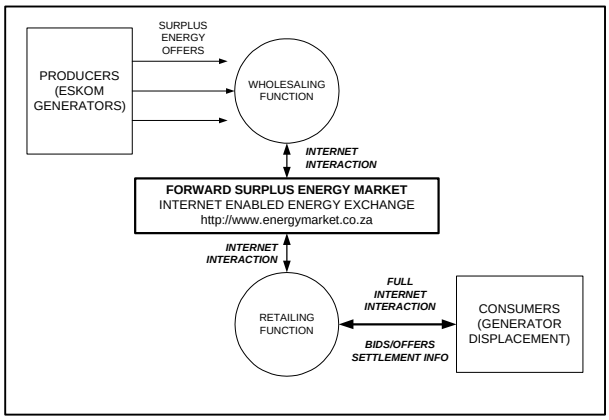

Figure 3. Forward Energy Market

An Internet browser-based energy exchange application allowing open access was implemented as illustrated in Figure 3. The web-based standardisation for user/trader interaction shortened the learning curve, reduced the set up

cost and had quick user acceptance. Eskom branded the product as Dynamic Surplus Pricing (DSP), with the self-generating municipalities and Sasol being the primary customers. More than R250 million is being transacted on the market on a yearly basis, resulting in the benefits of lower cost marginal energy sales to be derived by all parties.

Apart from the improved supply chain efficiency benefits, other positive spin-offs were improved Eskom customer information flows and real world experience through being able to demonstrate successfull participation in a wholesaling, retailing and customer trading environment, all via a secure Internet-based contracting system.

Ancilliary Services Market

Participation in the Eskom Power Pool Reserve Markets has traditionally been the preserve of the Generators. In line with international market developments however, Demand Side Participation in this area has been found to be extremely viable and the Internal Eskom Ancilliary Service Market was opened on a limited scale (albeit via Eskom Distribution as the trading entity) to customers having existing interruptible or under-frequency load shedding agreements in place.

The Eskom Reserve Energy Market is split into four categories:

- Regulating Reserve (Automated Generator Control) 4-sec response time required
- Instantaneous Reserve - 10-sec response
- 10-min Reserve
- Emergency Reserve Markets – 2 hour response

The Generator's participation in the markets was through the existing energy market mechanisms, where the system administrator interfaces are also web-based. Entirely new demand-side infrastructure however had to be established in order to cater for this new type of participant as outlined in Figure 4 below.

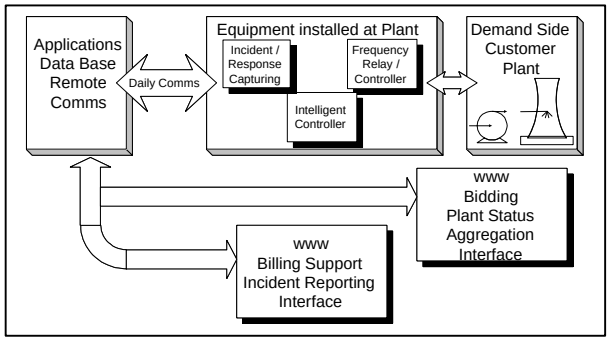

Figure 4. Generic Reserve Market Infrastructure

The Ancilliary Services or Reserve Market comprises of generating capacity (synchronised or not) or Demand Side Managed load that can respond within a pre-determined time period when required. A one day ahead bidding process for available capacity is managed through a system operations web interface. Payments are made to the lowest cost bidders for being available (capacity payments). Additional payments are made if loads are dispatched (utilised), thus providing "insurance" for the system operator in case of system contingencies. In the first year of operation, almost a third of Eskom's reserve capacity (other than regulating reserve) was supplied by the demand side using this mechanism.

5. Electronic Trading – Lessons Learned

The web platforms introduced were easily able to handle the required transaction volumes, the negotiatiation complexities of multiple bids and bid matching. Deal closure also occurred in almost real-time. The requirements of scalability to handle volumes, robustness and reliability to ensure performance were also successfully demonstrated.

The utilised platforms were able to support the full range of trading-types for assignments and allocations, making it easy to change transaction/auction types which enable the energy trading community to use the best options depending on their specific needs.

"Rules of the game" with parameters, were also easily managed and configured, including among others:

a. Who can access which markets
b. Who can bid/offer
c. What bidding information should be revealed, and to whom
d. How winning bidders are selected (not necessarily the highest bidder)
e. How bidding is structured across time
f. Any special treatments that should be extended to some bidders, and under what conditions

The following themes were considered essential (and verified by customer requirements) in the high-level system design [4,5]:

- Low transactional cost
- Ease of use
- Ease of monitoring
- Transparency of price
- Quick transactions
- Highly customisable

- Private
- Audit trails available

Utility managers were also able to use the provided platforms to collect data regarding each trading partner's bidding and buying behaviour, demand for power under various market conditions, specific price resistance points etc. This data being extremely valuable when fed into an analytics system for revenue forecasting and management.

Secondary Systems Integration

Integration with adjacent technology applications such as finance, revenue, credit and risk management systems was essential. With the prevalence of SAP and other ERP type sytems in the industry, this integration was one of the primary design requirements. [3]

6. Conclusion

There can be no doubt that the Internet (e.g. electronic exchanges) will continue to play a key role in the future of energy trading in developed, as well as developing countries. In this regard, Eskom has already, in anticipation of the new MMM, successfully deployed various platforms, systems, simulations and products. Of fundamental importance, however, remains an evaluation of the current state of cross border energy trade, the potential local and regional liquidity, as well as the state of industry liberalisation in Africa. It is expected that in Southern Africa, while the SAPP and MMM would run in parallel, they will ultimately merge as a result of the benefits of increased liquidity, lower transaction costs and the use of more efficient technologies.

7. References

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[3] Montgomery Research, Inc The Role of Web-Based Dynamic Trading in the Restructured Electric and Gas Markets Utilities Project Volume 2 (1/15/02)

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[5] Montgomery Research, Inc. CRM Project The Utilities Project Supply Chain E-Commerce