

**“ESPOT – A NEW SOLUTION FOR ENERGY MARKET”  
FOR CONFERENCE  
“THE EUROPEAN ELECTRICITY MARKET”  
SEPTEMBER 20-22, 2004, LODZ, POLAND**

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**Abstract**

One of the most important tasks for Polish energy market is consolidation. There are many obstacles in doing that so it's important to help it. We offer new kind of the solution that allows the people of different companies being consolidated to cooperate as the group even before their companies merge. The idea is to make it possible the users to trade within the group. It makes the group being balanced better as less volume needs to be balanced on the external markets. The solution may be used in different contexts as well, for example by balancing groups.

**1. INTRODUCTION**

There are lot of consolidation activities on the Polish Energy Market. The Energy Factories are being consolidated into the groups, on the other hand balancing groups come into existence. This causes more and more groups to emerge; the grups that may balance each other reducing this way the costs of buying the energy. Unfortunately, that's pretty lot of obstacles, especially organizational ones. There no market for trading electric energy till the very last minute, while the SPOT market that exists is rather local one as it is based on personal contacts (telephones, electronic mail). Because of that one may expect that providing such groups some trading platform would allow them to balance each other better as the group, without necessity of suffering excessive

costs. On the other hand, if such a platform was a competitive market, it would be possible to limit the tendencies of “escaping” to the other markets, outside of the group to be balanced. If using such a platform, the participants of the group may aim their original goals and the group as the whole gets being balanced better than it would be possible without additional trading platform.

**2. SOLUTION DESCRIPTION**

The solution being described in this article is the proposal of competitive instant energy trading platform. The most important assumption that had been made when creating this platform were as follows:

- Gaining as much fluency as possible. It is to be interpreted as being equal to gaining the maximal turnover possible.
- The trading platform is to be accessible without pauses.
- Trading must be really simple task (simple technically, for the users).

In order to trade on the eSPOT platform it is necessary to sign the contract with the platform operator. It makes any further formalities involved in trading are reduced.

*NOTE: Whenever talking of “selling offer” or “buying offer” we mean selling or buying from the perspective of the user we describe. It means that the offer that some user sets out for sale is “selling offer” for this user and “buying offer” for all the other.*

## 2.1. Crucial points of the solution

The only article of trade is energy amount for individual trading hours. One cannot set out the group of the methods (strand) as the whole. Every single hour is treated as single offer. This is the conclusion of the assumption that the trading is to be as fluent as possible and the turnover is to be maximized.

All the offers that were set out are visible for all the participants of the trading platform, all those participants may answer those offers (accomplish them). Any user may draw back his or her own offers, modify them and set forth again. Other users' offers may be only answered or accomplished, either the whole or partially.

## 2.2. eSPOT Market User's Activities

Every eSPOT user may set his buying and selling offers out. Those offers get visible for all the other users. They are accessible as long as one of the following events occurs:

- the hour that the offer is for stops being trading hour, or
- the user that has set the offer out draws it back, or
- the offer expires (the principles that stand behind expiration are explained further on).

When setting the offer forth, the user has to characterize it with:

- direction (whether it is selling offer whether buying offer),
- the amount of the energy to trade,
- the price,
- expiration time (optional); unless set, the offer does not expire at all.

Every participant of the platform may answer other users' offer. The answer is choosing the offer and using it the whole or in part. The user has some time (a few seconds) to confirm the transaction he/she offers; for this time the offer is being locked and inaccessible for all the other users. Unless user confirms the transaction, the

offer is released again without any modifications. If the user confirms the transaction, the offer is translated into the transaction and disappears from the market (or gets reduced, if the user wants only part of it). Say, for example, that there is the offer for 10MWh. Some user wants to accomplish it partially, for 6MWh. There is transaction for 6MWh registered and the difference, 4MWh, is set out as the offer left on the eSPOT market. When accomplishing the offers this way, the price for the transaction is the price of the offer that was first set out on the platform.

The offers being locked are visually marked with red colour. Only one user may lock the offer; no other user may gain the lock until the first user releases the offer.

There is one more possibility of accomplishing the transaction. When the user sets out the offer, system automatically checks whether this offer may be matched with some other offers already existent on the market. If such matching offers are found, transaction gets started at once. There are possible the following cases of matches (we take into the account the case of buying offer, when there are selling offers on the platform; to opposite situation is analogous):

1. There are matching offers on eSPOT platform and those offers cover the whole demand for the energy.
2. There are matching offers on eSPOT platform but they do not cover the demand; there are no other offers available.
3. There are matching offers on eSPOT market but they do not cover the demand; anyway, there are some more non-matching offers available.

The order of taking the offers into the account is being described further on. When saying of "matching offers" we mean the offers at least as good as we consider (if our offer is selling one, matching offers are of the same or higher price; if we want to buy energy, matching offers are cheaper

or of the same price).

ad.1. All matching offers are used in transactions, until the whole offer is accomplished. The prices of the transactions are the prices that were set for the offers that existed on the market before.

ad.2. All the matching offers are used in transactions. Next, if the weighed averaged price is still more profitable than demanded, the best non-matching offers are taken into the account. There is taken as much energy as will not cause the average price to exceed the expected price. If all the next-to-best non-matching offers get used, next bunch of the offers is taken into the account. Such iterative steps continue until one of the following events take place:

- No more offers are accessible on the eSPOT market.
- The offer we wish to accomplish is accomplished the whole.
- The amount of the energy that may be bought without exceeding the weighed average prices is below the minimal amount that may be traded (now 1MWh).

So, the condition for matching the offers is as follows:

$$price * amount \leq \sum_{i=1}^{i=N} price_i * amount_i$$

where:

price, amount — the price and amount of the energy in the offer to be accomplished.

price<sub>i</sub>, amount<sub>i</sub> — prices and amounts of the energy for all the offers taken into the account.

### The order of choosing the offers

When choosing the offers, the very first rule is choosing the best offers: the cheapest selling offers and the most expensive buying offers. If there is more than one “that good” offer, all of them are used if possible. It means that every of those offers takes part in the transaction. If the equal division is impossible, the

transactions. The part of the offer that could not have been accomplished set set out to the market. The prices of the transactions are the prices that were set for the offers that existed on the market before.

ad.3. Here the situation gets a little complicated. All the matching offers are difference is taken from the offer that was set out the first.

When two or more participants of the eSPOT market try to lock the same offer, the moment of server access matters: the first takes all.

There is no limit for the number of the offers for one user for some hour: one user may set forth as many offers as he/she likes. It allows to create some kind of ladder-like structure: selling or buying different quantities of energy depending on the price that may be obtained. Heres the example of such a ladder-like structure; all the offers are set out the the same trading hour:

buy 2MWh for 109zł  
buy 2MWh for 110zł  
buy 2MWh for 111zł.

If the price is low enough, the user may buy 6MWh total. Otherwise he/she will buy less. It makes sense if we assume that this user may buy the same energy on some other market for 101zł or so. This kind of offers may be used as the speculation tool.

### 2.2. Graphical User Interface (GUI)

Grahalical User Interface has to be in accordance with ergonomomy demands first of all. The main parts of GUI are:

- eSPOT bar,
- portfolio,
- transactions report
- some other helper elements that are described together with other elements.

All the GUI elements are ceated in accordance with Windows standards — for example, it is possible to move data to and from the MS Excel spreadsheets via Clipboard. This way the trading is more intuitive and the operator mistakes rate is

reduced to minimum.

The most of the forms had been optimized for panoramic screen or for two standard screen driven by one video card. Anyway, it is still possible to switch to single standard screen mode (with rollover of the forms).

### 2.2.1. eSPOT Bar

eSPOT Bar is the only always visible element of the whole application. In order to avoid mistaken operations, this bar is inactive by default (*passive mode*). The user may just watch the situation on the market but cannot trade. As soon as the

The Bar includes nothing but optimal offers: optimal buying offer (the cheapest) and optimal selling offer (the most expensive). As soon as the user watches the offer that he/she is interested in, he/she may pretend to accomplish it. Some additional form appear and the user has to confirm his decision in a few seconds; the offer is locked against all the other participants. Unless the user confirms, the offers is released and is accessible again for all the other. If the user confirms his/her claim, the offer if removed from the market (if claimed the whole) or reduced (if claimed partially). This way of making transactions is called *fast transaction*, or *fast buy* or *fast sell*, respectively. The user may say system tu reduce his/her own offers. Say the user set forth the offers for buying 10MWh and now buys 4MWh. If reduction is set on, the transaction is for 4MWh but the old offers are reduces from 10MWh to 10-4=6MWh.

Any time the user may move from the optimal offers to all the offers for the trading hour; additional form is used for that. When watching all the offers accessible on the market, the user sees his/her own offers. This way it is possible to correct ones own market position and it eases avoiding of changing under-estimation to over-estimation or vice versa.

eSPOT Bar shows the state of the market online: the changing of the optimal offers, locking of the offers or releasing them.

user changes the mode to active, trading becomes possible. The passive mode is useful for the users that are not empowered to trade on the eSPOT market but are to be able to see the trading situation.

The part of the eSPOT Bar is shown below.

Godzina	1	2	3	4	5	6	7	8	9
Ilość [MWh]	5	6	7	8	9	10	11	12	
Cena [zł]	120,00	121,00	122,00	123,00	124,00	125,00	126,00	127,00	128,
Ilość [MWh]	2	3	4	5	6	7	8	9	

Fig. 1. eSPOT Bar

eSPOT Bar uses rather small part of the screen in order to make it easy work with other applications and watching the eSPOT situation at the same time and taking part in trading when advisable.

eSPOT Bar always shows just one trading day. User may change this day to any other which is trading day too. On the other hand, the server may make the application change the current day because of the time passing.

The Bar as well as all the other forms use the same colour convention: some colour for all buying offers, another for selling offers. This way the user may just “gamble” on the market really fast, no need to carefully read the instructions of every single field.

### 2.2.2. Portfolio

Portfolio is the form that allows the users to control their trading position. It allows them to set forth new offers, withdraw the offers that had been set earlier, modify them and re-publish.

Portfolio form, just like eSPOT Bar, works online, showing the current state of the market. On the other hand, those two forms complement each other.

Portfolio is the place where the user may use strands. The strand is the group of the offers that are visible as the whole for the user that sets them out but for all the other users are just individual offers for individual hours. This kind of structuring makes work easier as it is simpler to

withdraw all the offers of the strand rather than withdrawing the offers one after the other (of course, if some offers of the strand had been [partially] accomplished those [parts of the] offers cannot be withdrawn).

### **2.2.3. Transactions**

Transactions form is the only offline form of the whole client application. This form includes some summing up of the market: medium prices, number of transactions, volume of trade) as well as detailed info on all the transactions that the user have accomplished. This form may be refreshed any moment, but the form is not meant to be auto-refreshed in order to reduce the net traffic.

This form includes also the button that makes possible generating the ZUSE document, or rather the part of it that includes all the transactions of the eSPOT

way it is possible to apply the platform for different environments, using different rules of trade. The differences have to do first of all with kind of the group that is served.

Important thing that has to be put into regulations is allowance for modifying the offers on the market; modifying in very strictly predetermined manner. The point is using weighted average of the prices when automatically matching the offers (as described earlier). Say for example that some user sets out the offer for 10MWh with price 105zł while there are following offers on the market: 6MWh a 100zł and 4MWh a 110zł. All three offers will be matched into two transactions: one for 6MWh a 100zł, the other for 4MWh a 110zł. Weighted-average price is lower than 105zł as demanded, but one transaction has the price higher – that's why it is necessary for the users to agree it signing eSPOT regulations.

### **2.4. eSPOT platform configuration**

eSPOT platform may be configured as the whole, at the server side. Besides, every user may set his or her own client configuration. Client configuration changes

platform.

### **2.2.4. Other GUI elements**

There are more GUI elements; the one that is worth mentioning is system log. It is activated automatically (as the pulsating icon on eSPOT Bar) whenever any transaction of the user takes place. Such a transaction may be the outcome of user's activity or activity of other users accomplishing our offer that was set forth earlier.

### **2.3. eSPOT Regulations**

If using eSPOT platform it is necessary for all the participants to agree on rules of the trade. The platform software has some configuration parameters that correspond to different regulations. Because of that all those params are to be taken into the account when preparing regulations. This

nothing but client application's behaviour and ergonomics so it won't be described in any more detail now

eSPOT server configuration decides of how the market behaves, so server's parameters have to be included into eSPOT Regulations.

Here follow some chosen configuration parameters:

- Number of seconds of delay – decide of the number of seconds that the offer is locked when chosen to accomplish. This number of seconds is the time the user has for confirmation of the transaction; otherwise the offer is released and all other users are free to use it. In practice in order to make make platform usage comfortable and to make the trading fluent the time should be 5 to 10 seconds.
- Numbers of the trading days – there are two parameters that define which day is the first trading day (usually 0 meaning today or 1 meaning next day) and the number of days that are trading days. The second parameter should not be more than about 7; greater number of days will be difficult for the users to deal with.

- Hours of closing the market – two more parameters strictly related to the previous ones. The first one, if set, allows to close the trading day; for example 17 would mean that after 17:00 one cannot trade for the first trading day. The other parameter says the number of “dead hours”. It matters only if the first trading day is today; setting 2 means that at 13:00 the first trading hour is 15:00. Not all combinations of the parameters describing trading hours and trading days are allowed, of course.

### 2.5. eSPOT and the Energy Market

eSPOT platform was planned as the product that allows to organize SPOT contracts market. Most of the SPOT transactions is accomplished based on personal contacts, via telephone or e-mail. That's why so much stress was put on making system as ergonomic as possible; otherwise it would be really hard to make the users change the way they do.

One has to take address the question of the place of eSPOT platform among the

needed. Client applications communicate the server via espot protocol; client applications don't use any databases themselves. The only data that is placed locally is client application configuration and ZUSE documents including all the transactions for the user.

### 3.2. Technology

eSPOT platform uses the following technologies:

- Java — the whole software is implemented in this language and it makes this software really platform-independent. This is the most important for client application. The requirements for client computer are very small: Java Virtual Machine 1.4 or better and any web browser (for downloading new versions of the client application).
- Java WebStart — this technology allows the users to be informed of new client software available and to download this

other markets. Two features of eSPOT should be mentioned:

- reducing the number of the products that are offered
- platform is accessible online, 24 hours per day and 7 days a week.

Reducing the number of the products (namely to one) means that the user may trade the energy only for every single hour. There is not trading with strands or blocks.

Being always accessible means that no sessions have to be closed (unless otherwise stated in the regulations and in the configuration). System monitors the clock and “shuts” hour by hour and day by day.

## 3. TECHNICAL ASPECTS OF THE SOLUTION

The platform being discussed here is implemented in Java programming language with pretty lot other supporting technologies.

### 3.1. System structure

The application being discussed is classical client/server solution. Platform server uses database for all the data that is software without the need of administrator's interference. It makes the deployment costs and service costs much lower.

- Communication is held via low-level sockets mechanism.
- Relational database – all the data needed is held here. Many optimisation techniques were introduced in order to make eSPOT server work properly even under heavy traffic.
- XML — standard used for storing helper data as well as for storing documents in accordance with Energy Market regulations (ZUSE).
- SSL — mechanism of ciphering that makes communication safe.
- Electronic signature – makes trading safer, makes the offers and then transactions undeniable.
- espot protocol – communication protocol that was designed for eSPOT platform.

It is optimized in order to lower the amount of data sent between the server and users. Users obtain only that information that is necessary for them to work. Server knows the state of every client application so doesn't send the data that isn't necessary for the moment.

#### **4. FURTHER DEVELOPMENT POSSIBILITIES**

eSPOT platform is ready-to-use solution that may organize SPOT market and make it global and more dynamic. It is worth to notice that the platform may work in two modes: distributed and central mode. In the first case all the users make transactions unbeknownst of their partner but when the transaction is accomplished they get to know each other in ZUSE document. When in central mode, eSPOT platform works much like some special market participant that makes transactions with all the other participants of the market. So instead of one transaction between A and B there are 2 transactions: eSPOT buys energy from A and sells it to B.

eSPOT platform may be used twofold:

- For organizing SPOT market between the companies that compete and
- For making balancing of the co-operating companies easier task.

In both cases there are different demands on configuration and different aspects are

- important are passing info in unbalance and putting all the information of transactions accomplished in order to correct imbalance online.

#### **4.2. eSPOT in the future**

One might think of what are perspectives for eSPOT platform. First one have to take the endangers into the account. The most important is lack of users ready to trade with eSPOT. Strong point of eSPOT platform is using pre-existing trading market (SPOT) without creating new one. SPOT market gets

of importance. Nonetheless, the basic regulations and principles don't get changed.

#### **4.1. Further development**

It is possible to sketch out some further development lines. The most important one are as follows:

- Making possible setting limits for the users and demanding guarantees. It may have different forms, like limiting the maximal currency volume for the user buying energy, stating the limits for energy volume for selling offers. The point is to make the transactions more secure.
- Limiting the maximal prices difference that is allowed. This would probably limit speculation possibilities; speculations that may fake the real market state. The example of such speculation may be putting forth very expensive energy hoping it to be included to transaction with weighted-average matching method.
- Counting the taxes for using the platform.
- Dealing with WAN offers (WAN stands for all-or-nothing). It's important to remember that platform isn't supposed to make possible trading with the whole blocks or the offers for more than one hour; WAN means all energy for one hour).
- Integration with IT systems used by eSPOT market participants. The most moved from local to global level – instead of personal contacts everybody can trade with anybody else, no matter if the eventual contractors know each other.

Another important point is possibility of trading till the very last moment – from the technical point of view eSPOT market don't have to be shut down at all.

Another advantage of eSPOT is that even balancing groups have some competitive activities. This way the energy prices aren't that far from factual market prices so the users aren't tempted so much to move to the other markets.

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### **EuroCIM company**

EuroCIM company was established in 1986. The main fields of its interest is designing, developing, deploying and servicing IT business systems that are dedicated to support economical activities. Its to main products are: ECIX@pl system for suporting company management and ECIX-Energia system for supporting turnover of electric energy. EuroCIM realizes systems for individual orders, too.

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