Supporting document of the necessary arrangements to support the functioning of wholesale electricity markets in accordance to Article 30(6) of Commission Regulation (EU) no 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation

17 November 2017

Contents

Executive summary

Pursuant to Article 30(1), 30(2) and 30(5) of the Commission Regulation (EU) no 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation (FCA Guideline), the respective Lithuanian, Latvian, Swedish and Polish National Regulatory Authorities (NRAs) bilaterally agreed as a coordinated decision on cross-zonal risk hedging opportunities of Lithuanian – Latvian (LT-LV)[1], Lithuanian – Sweden (LT-SE4)[2] and Lithuanian – Polish (LT-PL)[3] bidding zone borders. The respective NRAs requested TSOs (LITGRID AB, Affärsverket Svenska kraftnät, Augstsprieguma tīkls AS) not to issue long-term transmission rights (Art. 30.1 FCA Guideline) but to make sure that other long-term cross-zonal hedging products are made available to support the functioning of the wholesale electricity markets (Art. 30.5 (b) FCA Guideline) on above mentioned bidding zone borders.

Proposal for way forward

TSOs believe that the most efficient way forward is to focus on existing hedging options and continue with development of grid and increasing the transmission capacity of congested borders. TSOs should not interfere into the financial market. A more effective means that is in the hands of TSOs is grid development further expansion of cross-border capacities. *E.g. LitPol Link project finalization, EE-LV border expansion by building new HVAC line foreseen by 2020.*

Legal framework for TSOs participation in financial markets

As the trade of financial instruments is not specifically stated in the Market Directive as a task of the TSOs, and there are no clear direct regulation(s) regulating TSOs entering financial markets it may be concluded that the legal mandate for entering financial market by TSOs is not clear and thus, involves some legal uncertainties. Such activity would also include uncertainties regarding related TSOs financial cost coverage.

Hedging options

Today there is a financial market connecting to the Nordic- Baltic electricity wholesale market with high liquidity in the spot price, providing good possibilities to have full hedge in all Nordic - Baltic bidding zones. Existing Nordic - Baltic hedging options together with existing Polish Financial Instrument Market with Physical Delivery provides means for hedging of trades on relevant LT-LV, LT-SE4, LT-PL cross-borders.

Considering legal framework and existing hedging options within Baltic – Nordic regions and Poland, TSOs are of the opinion that hedging shall be based on the currently available

[1] 17 May 2017 Agreement between the Public Utilities Commission of Latvia and National Commission for Control and Prices of Lithuania Regarding the Hedging opportunities on Latvian – Lithuanian Bidding Zone Border Pursuant to the Commission Regulation (EU) no 2016/1719

[2] 15 May 2017 Agreement between the Lithuanian National Commission for Control and Swedish Energy Markets Inspectorate Regarding the Hedging opportunities on Lithuanian – Swedish Bidding Zone Border Pursuant to the Commission Regulation (EU) no 2016/1719

[3] 15 May 2017 Agreement between National Commission for Control and Prices and the President of Energy Regulatory Office Regarding the Hedging opportunities on Lithuanian – Polish Bidding Zone Border Pursuant to the Commission Regulation (EU) no 2016/1719

options: EPAD (Riga / Malmo (SE4) / Helsinki) and FTR/PTRs on the border Estonia – Latvia and Polish long-term forward electricity market option. Accordingly, below are details of the TSOs proposals for other long-term cross-zonal hedging products to support the functioning of wholesale electricity markets based on relevant NRAs decision according to FCA guideline Article 30(5b).

Lithuanian – Latvia

TSOs conclude that structural congestion on Lithuania and Latvia cross-border is not present neither in direction LT->LV, nor in direction LV->LT. Thus, TSOs view that there is no requirement and need for LT-LV cross border hedging products to be introduced.

Lithuanian NRA's concluded (analysis document dated May 3rd, 2017 annexed to the Lithuanian NRA's decision dated May 11th, 2017) that prices of the Lithuanian and Latvian price zones are very similar and strongly correlated and the price differences are very small. Based on this NRA also note that though there are no EPAD specifically created for the Lithuanian price zone, EPAD Riga can be used for hedging by market participants for both Lithuanian and Latvian bidding zone prices.

Lithuanian – Sweden (SE4)

For hedging LT- SE4 prices following options can be utilised:

- EPAD products as currently offered by Nasdaq OMX, i.e. EPAD Malmo (SE4) and EPAD Riga for hedging Sweden (SE4) -> Lithuania cross-border trade.
- EPAD products as currently offered by Nasdaq OMX, i.e. EPAD Malmo (SE4) and EPAD Helsinki in combination with EE-LV FTR-Option for hedging prices in Latvia, Lithuania.

Lithuania - Poland

Mainly due to Polish power system limitations the available LitPol link transmission capacity is not stable or predictable. Under normal power system conditions availability of LitPol Link for commercial trades is frequently very limited and not predictable, can't be unambiguously assessed in a form of base-load product. Thus, it can't be concluded that there is structural congestion on Lithuania – Poland cross-border (LitPol Link).

However, if Lithuania - Poland cross-border trade hedging means would be needed, following options can be utilised:

- Hedging the Polish bidding zone electricity price utilising Polish Financial Instrument Market with Physical Delivery in combination with products as currently offered by Nasdaq OMX i.e. EPAD Riga (enables hedging LT price) provides means for hedging Polish - Lithuania cross-border trade.
- Hedging the Polish bidding zone electricity price utilising Polish Financial Instrument Market with Physical Delivery in combination with products as currently offered by Nasdaq OMX i.e. EPAD Helsinki in combination with EE-LV FTR-Option (enables hedging LT price) provides means for hedging Polish - Lithuania cross-border trade.

Regional discussion may be needed and decisions taken on the coherence of existing hedging products/options.

It needs to be emphasized that the liquidity of EPAD Riga or other financial market products is a complex issue that needs to be addressed at the regional level. Possible steps and decisions for increasing the liquidity and efficiency of EPAD Riga should be considered in

conjunction with regional level decisions such as the operation of competing products (for e.g. such as in essence is the EE-LV FTR-option product). This hold true considering that EPAD Riga (or any other of considered products) liquidity would be increasing at the expense of the other. As a result actions of particular cross – border TSOs can have detrimental effect on the other border (TSOs offered products) and can have a negative socioeconomic effect on regional level at the expense of the end consumers.

Introduction

Pursuant to Article 30(1), 30(2) and 30(5) of FCA Guideline, the respective Lithuanian, Latvian, Swedish and Polish National Regulatory Authorities (NRAs) bilaterally agreed as a coordinated decision on cross-zonal risk hedging opportunities on Lithuanian – Latvian (LT-LV), Lithuanian – Sweden (LT-SE4) and Lithuanian – Polish (LT-PL) bidding zone borders. The respective NRAs requested TSOs (LITGRID AB, Affärsverket Svenska kraftnät, Augstsprieguma tīkls AS) not to issue long-term transmission rights (Art. 30.1 FCA Guideline) but to make sure that other long-term cross-zonal hedging products are made available to support the functioning of the wholesale electricity markets (Art. 30.5 (b) FCA Guideline) on above mentioned bidding zone borders.

The respective Lithuanian, Latvian, Swedish TSOs in coordination with Polish TSOs prepared this supporting document with the goal to reason and explaining relevant TSOs proposals on Lithuanian cross-borders.

1. Root-cause analyses and physical market outlook

1.1. Bidding Zones

The efficiency and functionality of wholesale electricity markets and the operational security of the network are impacted by the flows of electricity from source to sink. Congestion management methods and market design arrangements (e.g. the configuration of bidding zones) aim to handle these flows in the most efficient way respecting the necessary security criteria and providing for an appropriate framework for the optimal use and development of the EU network.

The current EU legislation envisages a zonal design, which addresses network congestions between "properly defined bidding zones" by using preventive and curative congestion management methods. The available transmission capacity may vary and congest the flow of power between the bidding zones, and thereby different bidding zone prices are established.

Lithuania together with Latvia, Estonia, Finland and Poland forms separate bidding zones that correspond with the national borders. Today there are five bidding zones in Norway, eastern Denmark and western Denmark are two separate bidding zones and Sweden is divided into four bidding zones.

In order to enable long-term cross-zonal trade between bidding zones and provide market participants with long-term cross-zonal hedging opportunities against price variations due to congestions the forward Capacity Allocation markets were established.

Based on ACER report[4], two designs of the forward market have emerged in Europe. The first design is based on the concept that for each bidding zone there is a set of hedging contracts linked to the day-ahead clearing price of the bidding zone (a single-zone hub). The second design, which is implemented in the Nordic countries and Italy, presents hedging contracts created for a group of bidding zones (a multi-zone hub) and these contracts are linked to a hub price (system price). The hub price represents average day-ahead price that would be in the hub, if no congestions existed across the bidding zones.

In a single-zone hub design, the liquidity of hedging products tends to depend, among others, on the size of the bidding zone. While large bidding zones have good liquidity due to high local competition, the liquidity of hedging products in small bidding zones is not satisfactory due to the low competition among market participants. In such case, long-term transmission rights issued by TSOs play an important role. Long-term transmission rights may serve as a bridge between the highly liquid financial electricity markets (Market A) and the adjacent poorly liquid markets (Market B). Market participants can therefore hedge the price of electricity in Market A and hedge the difference between the price in Market A and Market B. This effectively creates an alternative way to hedge the price of electricity in Market B.

In a multi-zone hub design, the liquidity of hedging products linked to a hub price is usually high. The difference between the hub price and the day-ahead price of individual bidding zones can be hedged with contracts that provide the hedge for the difference between the zonal and the hub price (e.g. Electricity Price Area Differentials known as EPADs in Nordic

[4] ACER. (March 2014). *Report on the influence of existing bidding zones on electricity markets.* Page 13.

and Baltic market). Alternatively, there might be no need to hedge the price difference between the zonal and the hub prices, when the correlation between these two is high.

1.2. Day-ahead market

i. Topography of electricity markets

In liberalised markets, electricity has one of the highest price volatility as compared to other commodities. As result, all market participants are exposed to the wholesale price variation by experiencing asymmetric consequences: when the wholesale price is high, generators make high profits, while buyers experience high costs. The situation is vice versa in case of low wholesale prices.

Naturally, to avoid exposure of wholesale price volatility, generators and buyers may contract with each other at a certain price for a specific period in forward market. In this section, we will evaluate the market structure of Lithuania, Latvia, Estonia, Sweden and Poland to understand how the market structure of each country affects the efficiency of forward markets.

Lithuanian electricity market

In 2016, the net installed capacity of the power plants operating in the Lithuanian power system was 3.4 GW[5]. The installed capacity is almost twice higher than peak demand. However, due to high power production prices in local power plants, almost 65% of energy consumed in the country was imported from neighbouring countries. As a result, power import plays the main role in Lithuanian power system.

Further, single state-owned company "Lietuvos energija group" owns 65% of installed capacity in the country. The assets of this company includes the main thermal, hydro and hydro pumped storage power plants. These power plants can compete under existing market conditions. As result, in 2016, production in power plants owned by "Lietuvos energija group" amounted to almost 40% of all electricity production in the country. Other non-renewable (industrial or small thermal power plants) producers generated 22% of energy, while the rest (42%) came from renewable sources, mostly wind power plants.

Most of renewable production receives subsidies and are not exposed to the volatility of wholesale electricity price. The production of industrial and small thermal power plants is mostly dependent on the industrial processes or heating season, and thus as electricity generation is not core business of such entities they usually do not tend to hedge. Thus, one might assume that mainly assets owned by "Lietuvos energija group" are exposed to price volatility.

However, even assets of "Lietuvos energija group" might not be seeking to hedge the price, as company's main assets are not base load producers:

- Kruonis hydro pumped power plant (900 MW), profits from day and night price difference.
- "Lietuvos energija group" thermal power plant block 7 and 8 (600 MW) are used for system security and reserves.
- Gas powered thermal power plant block 9 (445 MW has relative high production costs and operates only when there is lack of supply in the region and the wholesale price increase and is well above the average.

[5] ENTSO-E, "Statistical Factsheet 2016".

On the opposite side, there are 19 electricity suppliers in Lithuania. However, the retail market share of the six biggest suppliers is equal to 94%. The supplier that provide electricity to household consumers under regulated price are not exposed to price volatility. The others suppliers are exposed to price volatility. Their risk could be manage by buying electricity from local producers via bilateral contracts or buying electricity from power exchange and hedging via OTC or forward markets.

More than 80% of electricity bought by suppliers is bought from power exchange. Moreover, the business consumers in Lithuania are mostly interested in fixed price contracts (for the year 2017 this ratio is approx. 70% fixed to 30% spot price contracts). This would lead, that there should be high demand to buy financial product on the forward market for electricity suppliers. However, the low number of producers and competitive generation creates a skewed market conditions and the producers have little interest to offer the financial market products. Furthermore, large portion of hedging is done within incumbent market participant's generation/demand portfolio's, thus lowering overall hedging supply and demand (incl. for EPAD Riga). Additionally, due to current market set-up and regulated prices the need for hedging among electricity suppliers is limited.

Latvian electricity market

In 2016, Latvian local generation units produced 6.3 TWh of electricity energy and Latvian consumption was covered with local generation by 86%. Such market participants having large share of production and consumption are naturally hedged from price volatility, so are not interested in participation in financial market of hedging instruments. The deficit of local production was covered by imports from Estonia. In addition, Latvia has a possibility to cover its consumption on monthly bases varied from 48% to 125% in 2016.

The main domestic electricity production capacity consists of 1.6 GW of hydro and 1.2 GW of thermal power plants. The state-owned company, Latvenergo Group, controls the main portion of generation capacity and holds about 30% of Baltic electricity market share. One may assume that production of electricity in the majority of power stations in Latvia is based on short-term marginal costs. Thus, generators are not interested in price hedge.

Despite the fact that peak demand in Latvia is less than 50% of total installed generation capacity in the country, the competitive generation potential mainly consists of three hydro power plants (HPP) on the Daugava River, which means that the amount of generated power dependent on the river's water flow. Due to Daugava river's water flow, the production is seasonal – following the water flows almost two thirds of hydroelectricity is produced in the spring months (March – May). Historically in these months, Latvia has electricity surplus and exports electricity to neighbours. Major share of electricity, which is generated in Latvia, is sold in the power exchange. Similarly, all demanded energy is bought from the power exchange. During the wintertime, most of energy in Latvia is produced in Riga CHP units. However, it is expensive to run CHP unit during the summer season and the seasonal demand swings are covered with imports. Taking into account that the role of renewables in power generation increases, the role of Riga CHP becomes more important when relatively cheap imports or interconnection transmission capacity from Sweden and Finland are not enough to cover Latvian generation deficit, and other local generation becomes very expensive.

Based on Latvian NRA's update in the 21st Baltic Electricity Market Forum, in Vilnius, on May 3, 2016 the most consumers have selected fixed price contract, and only 1.25% of household have selected exchange spot price. Moreover, the business consumers in Latvia are mostly interested in fixed price contracts. This means that there is demand to buy financial product

on the forward market for electricity suppliers. Demand for financial product on the forward market now is partially covered by FTR Options on Estonia- Latvian border. In the future, this demand might decrease, because till 2022 Latvian DSO finishes installation of smart meters at all households and sites of business consumers. Existence of smart meters might make exchange spot price contract more sought and help to understand all benefits, which offer exchange spot price contracts. This in turn may decrease necessity to use financial products for hedging purposes.

Additionally, in accordance with Annual statement of Latvian TSO for the year 2016 in cooperation with the Estonian transmission system operator and the owner of Latvian transmission system, the development of the third Estonia-Latvia electricity interconnection between the 330 kV substations Riga CHP-2 in Latvia and Killingi-Nomme in Estonia is ongoing. This interconnection will increase from 2020 the available transmission capacity between Latvian and Estonian electricity systems and eliminate the congestion in the interconnection of Estonia-Latvia, which currently limits the volume of electricity trade between the Baltic and Nordic countries. The Estonian-Latvian third interconnection project is considered to be one of the most important projects for the whole Baltic Sea Region, as it will facilitate the increase of the transmission capacity of the Estonia-Latvia cross section by 500/600 MW in the normal operation modes and by 300/500 MW in isolated mode of operation.

Estonian electricity market

The production of electricity in Estonia is highly concentrated and greatly reliant on a single fuel (oil shale) and a major energy undertaking. In 2016, Estonia's net installed generating capacity was 2.7 GW, of which about 90% belonged to Eesti Energia AS, state-owned company. The peak load in Estonia in 2016 was 2,2 GW.

In 2016, the electricity production was equal to 10.4 TWh and consumption 8.2 TWh in Estonia. This is more than the half of total electricity produced in all Baltic countries. Estonia is the only Baltic country, which has electricity production surplus.

State-owned Eesti Energia AS generated in 2016 9.1 TWh, of which majority were produced using oil-shales, 82% of Estonia's electricity energy is produced from oil-shale. The rest of production mainly comes from biomass (7%) and wind power plants (6%).

As the Estonian power market is dominated by oil-shale, which makes the volumes of electricity produced sensitive to the CO_2 market prices. On the other hand, because of local oil-shale sources, marginal cost of electricity produced by this fuel is lower than the current spot price. As a result, at the current CO_2 price level, Estonia counts for more than half of Baltic electricity production, but situation can dramatically change in the future due to closures of existing power plants and lack of investments in the new ones.

In 2016, there were 17 active retail market participant and 7 wholesale market sellers in Estonia[6]. Three undertakings had less than 5% of retail market share and the biggest share of wholesale market (59%) belonged to Eesti Energia AS. The rest of the market share was divided by smaller retail market participants.

Since the Eesti Energia AS produces more electricity than the total consumption of Estonia, and is focused on electricity exports, the company is exposed to cross-border price risks. Further, new interconnections in Lithuania (NordBalt), had increased the competition on the

[6] Estonian Competition Authority. (2017). *Estonian Electricity and Gas Market Report 2016.*

Baltic market. The Group's hedge positions for electricity (including financial hedges as well as fixed price contracts with retail clients) amounted to 4.7 TWh for 2017 (at average price of 35.4 EUR/MWh) and to 0.9 TWh for 2018 (at average price of 33.6 EUR/MWh)[7].

The electricity producers and consumers have a various choice of hedging instrument in Estonia. Nasdaq OMX is offering EPAD Tallinn for Estonia bidding zone as well as Estonian and Latvian TSOs issuing FTRs-options on Estonia-Latvia cross-border. Estonia bidding zone price has strong correlation with Finnish bidding zone price (0.97 on hourly bases). As such, Estonian market participants can also hedge via EPAD Helsinki. Under such conditions, the Estonian, Latvian and Finish NRAs have decided, that there is no need to introduce additional LTTRs or other hedging products on Estonia-Latvia and Estonia-Finland borders.

Swedish electricity market

The power system of Sweden generates more electricity than is necessary to meet country's demand. In 2016, Swedish power plants totally produced 151.5 TWh of electricity, compared with country's consumption of 139.8 TWh. The Swedish power system is considered to be well-balanced, with nuclear power plants generating nearly the same amount of electricity as hydro power plants. In 2016, nuclear and hydro power plants together generate over 80% of all electricity produced in Sweden. The rest of energy is generated by renewable energy source, mostly wind, and power plants burning fossil fuel and biomass.

Nuclear and hydroelectric power is quite competitive compared with power produced from other sources. Consequently, electricity prices in Sweden are usually lower than in other countries review in this chapter, which predominantly use more expensive fuels like natural gas or coal.

Sweden is split in four bidding zones (SE1, SE2, SE3, SE4).There are EPAD contracts listed in all of the four Swedish bidding zones. The basis for the EPAD trade vary with the characteristics of the different bidding zones. There is a general allocation of generation in the northern part of Sweden while the consumption is mainly located in the southern part. This results in a need for distribution of electricity from the northern part to the southern part and a skewness in some areas. In the most southern bidding zone, SE4, there is more consumption than production and in the most northern bidding zone, SE1, the situation is opposite. SE3 is the largest bidding zone with a balanced distribution between generation and consumption. The majority of the EPAD contracts are traded in SE3. Due to good correlation between SE3 and the surrounding bidding zones, it can be assumed that market participants allocated outside of SE3 also hedge themselves through EPADs in SE3. The liquidity in SE4 is lower due to the skewness of the area, resulting in a higher risk premium and lower activity in the market.

Bidding zone	Genereation (GWh)	Consumption (GWh)
SE1	22 111	9 197
SE2	49 236	15 403
SE3	79 287	80 051
SE4	8 206	22 146

Figure 1. Generation and consumption for the Swedish bidding zones in 2015[8]

[7] Eesti Energia AS. *Eesti Energia Group results for Q1 2017.*

[8] Utvärdering av prissäkringsmöjligheter I den svenska elmarknaden – för samråd enligt FCA-förordningen, Energimarknadsinspektionen.

SYS-SE1	SYS-SE2	SYS-SE3	SYS-SE4	SYS-FI	SE1-SE2	SE1-SE3	SE1-SE4	SE1-FI	SE2-SE3	SE2-SE4	SE2-FI	SE3-SE4	SE3-FI	SE4-FI
0,96	0,96	0,96	0,95	0,86	0,99	0,99	0,97	0,89	0,99	0,98	0,89	0,98	0,90	0,85

Figure 2. Monthly correlation between the System price and day ahead price in different bidding zones from November 2011 to December 2016[9].

The Lithuanian – Swedish power interconnection Nord Balt links Lithuania with Swedish fourth bidding zones. As SE4 receives the biggest share of electricity from the SE3 where nuclear power plants are based, SE4 is not subject to major price fluctuations as long as these nuclear power plants are operational.

Polish electricity market

Poland annually produces and consumes nearly the same amount of electricity as Sweden. In 2016, Poland generated 154.1 TWh of electricity and consumed 155.3 TWh. Unlike Sweden, Poland mostly relies on thermal power plants for electricity production. In 2016, Polish thermal power plants, which burn fossil fuel (coal or lignite), covered ca. 85% of the country's electricity consumption.

Polish generation structure, which is mainly founded on thermal power plants, could be explained by historic development of the Polish generation fleet backed by abundant local coal reserves. However, it needs to be underlined that the Polish power sector is at the stage of transition where CO_2 emissions are reduced by over 30% as compared to its Kyoto Protocol obligations. Considering that emission allowance prices decreased remarkably between 2008 and 2014 feasibly due to the global economic downturn and the aim of EU to cut greenhouse gas emissions by 20 percent by 2020, it is possible that emission allowance prices will increase. Taking into account all the above and further transition of the Polish power sector including further development of RES generation, the price of electricity in Poland may be difficult to predict.

Currently there are more than 20 producers and more than 80 electricity suppliers on the Polish electricity market. Over 15% of electricity is, by law, to be sold on power exchange and the rest can be offered e.g. in bilateral OTC contracts. Long-term hedging is an integral element of the efficient development and operation of energy markets. Producers are interested in selling in long-term contracts as this – inter alia – support an efficient fuel purchasing strategy for conventional producers. On the other hand, long-term hedging is a key element of retail pricing strategy and consequently, it has influence on the ability of suppliers to offer to consumers the most competitive tariff structures. Moreover, knowledge of future prices is a basis for determining cash flows which in turn is indispensable in evaluating and financing the investments. As a result, taking into account high competition on the market, there is strong interest and sufficient conditions to hedge prices on the Polish electricity market.

ii. Price correlation

The FCA Guideline article 30.3 states that forward “products or combination of products shall be considered as an appropriate hedge against the risk of change of the day-ahead price of the concerned bidding zone where there is a sufficient correlation between the day-ahead price of the concerned bidding zone and the underlying price against which the product is settled”.

[9] Utvärdering av prissäkringsmöjligheter I den svenska elmarknaden – för samråd enligt FCA-förordningen, Energimarknadsinspektionen.

There are several opportunities available for hedging in Baltic market. If the spot prices of two (or more) different bidding zones have strong correlation, the hedging products or combination of products of other bidding zones can be used for proxy hedging.

In other words, for a bidding zones where the spot prices have high correlation (0.8 at least[10]), the same financial instrument can be used to hedge price in both bidding zones. Respectively, for a bidding zone, where the spot price has high correlation with the system price, a system price contract can be used for proxy hedging.

Therefore, if in some bidding zones the hedging products are not listed, it does not have to imply a lack of hedging opportunity. The reasons for this may be that:

- hedging in products of other bidding zones is sufficient due to high correlation with the local bidding zone price;
- market participants are hedged via bilateral contracts.

In the Nordic-Baltic market, a combination of a system price and local EPAD contract would provide a perfect hedge and correlation coefficient would be equal to one. However, if the local bidding zone's price is highly correlated with the system price, there is a relatively low demand for EPAD contracts due to the transaction costs associated with buying these products, market participants would prefer to hedge using only system price instead.[11]

As such, the correlation between the bidding zone prices and the system price is also an important measure, which indicates the degree at which the bidding zone's prices move in the same direction as the system price, and to what degree the system price contract can be used as a proxy for hedging purposes.

The correlation between bidding zone's prices in different areas, or with the system price, can be assessed with different resolution in the data. The report on evaluation of the Nordic forward market for electricity[10] suggests using long-term averages. It is claimed, that it is not decisive if the price deviations occurs on an hourly basis, as long as the average price, during e.g. a month, correlates well.

For sake of completeness, the correlations between hourly prices and monthly averages are investigated (Table 1 and Table 2 accordingly) in this report. The selected period is year 2016. The data reflect the period than NordBalt and LitPol link is in operation. Both interconnectors have a high impact on Baltic market. The investigation of price correlation before these interconnectors would be unreasonable.

Table 1: Correlation between hourly prices, year 2016

	SYS	*FI*	*SE4*	*EE*	*LV*	*LT*	*PL*
SYS	1,00						
FI	0,79	1,00					
SE4	0,88	0,88	1,00				
EE	0,76	0,97	0,85	1,00			
LV	0,56	0,73	0,62	0,74	1,00		
LT	0,54	0,72	0,61	0,73	0,97	1,00	
PL	0,37	0,56	0,52	0,58	0,64	0,65	1,00

[10] Houmoller Consulting. (2017). *Investigation of forward markets for hedging in the Danish electricity market.*
[11] NordREG. (2017). *Methodology for assessment of the Nordic forward market.*

Concerning hedging: as can be seen from Table 1 and Table 2, for Lithuanian bidding zone, the correlation between the local Latvian spot price is high enough (0.97 on hourly bases and 0.99 on average monthly bases). The market participants may use Latvian hedging products and vice versa. The same rule applies for Estonia-Finnish bidding zones.

Table 2: Correlation between average monthly prices, year 2016

	SYS	*FI*	*SE4*	*EE*	*LV*	*LT*	*PL*
SYS	1,00						
FI	0,93	1,00					
SE4	0,94	0,95	1,00				
EE	0,92	0,98	0,91	1,00			
LV	0,61	0,80	0,62	0,78	1,00		
LT	0,59	0,78	0,59	0,76	0,99	1,00	
PL	0,35	0,56	0,49	0,60	0,59	0,59	1,00

The correlation between Lithuanian/Latvian bidding zone prices and the system price (SYS) is moderate. The hedging in the system price only (proxy hedging) would not be sufficient and an additional product (e.g. EPAD contract) is needed.

However, considering the hourly data (Table 1) the hedging in the system price might be sufficient in Swedish fourth bidding zones. If it is assumed, that the monthly average is most important (Table 2), the hedging in the system price would be sufficient for Finnish, Swedish fourth and Estonian bidding zones.

1.3. The necessity for long-term cross-zonal hedging on Lithuanian cross-borders

Regulation (EC) No 714/2009 sets out in particular non-discriminatory rules on capacity allocation and congestion management for interconnections and transmission systems affecting cross-border electricity flows. In order to move towards a genuinely integrated electricity market, efficient hedging opportunities should be developed to mitigate future price risk. Therefore Regulation (EC) No 2016/1719 promotes effective long-term cross-zonal trade with long-term cross-zonal hedging opportunities for market participants by indicating the necessity of issuing long-term transmission rights or implementing other long-term cross-zonal hedging products to support the functioning of wholesale electricity markets.

Nevertheless, this is possible when the border in question is congested based on structural congestion definition, according to Article 2 of Commission Regulation (EU) no 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (CACM Guideline) as defined below. “Structural congestion” means congestion in the transmission system that can be unambiguously defined, is predictable, is geographically stable over time and is frequently reoccurring under normal power system conditions.

Structural congestion definition could be subdivided into criteria as listed in Table 3. Within this analysis data timeframe from 1st January 2016 to 31th December 2016 has been analysed to evaluate, if there is “structural congestion” on LT-LV, LT-PL and LT-SE4 cross-borders. For LT-SE4 cross border analysis timeframe starts from the commissioning of NordBalt Link on 18th of February 2016.

Table 3: Main criteria for determination of structural congestion

Criteria	Yes/No
Congestion – can it be unambiguously defined	
Congestion – is it predictable	
Congestion – is it geographically stable	
Congestion – is it frequently reoccurring under normal power system conditions	

Lithuania – Sweden (SE4) cross-border: NordBalt Link

The maximum net transmission capacity (hereinafter – NTC) through NordBalt from LT to SE4 and vice versa is 700 MW. Due to frequently lower prices in SE4 bidding zone the flow was prevailingly in direction from SE4 to LT.

During the period when NordBalt was available, 90 % of the time the maximum NTC was provided on the market in both directions. Table 4 below contains data on utilisation of NordBalt.

Table 4: Data on utilisation of NordBalt

	Direction LT → SE4	Direction SE4 → LT
% of time the Link was available (available capacity > 0 MW)	*71 %* *5411 hours out of 7632*	*71 %* *5411 hours out of 7632*
Flow direction, % of time Link was available.	*7 %* *373 hours out of 5411*	*87 %* *4687 hours out of 5411*
Average available capacity, MW (% of full capacity when Link was available)	*671 MW (96 %)*	*691 MW (99 %)*
Average commercial flow, MW (% of available capacity)	*283 MW (42 %)*	*563 MW (81 %)*
Available capacity fully utilised, % of time Link was available	*0,6 %* *34 hours out of 5411*	*53 %* *2848 hours out of 5411*

Data timeframe: 18th of February 2016 - 31th December 2016

Considering the information in the above table, and disregarding outages or unplanned maintenances, it may be concluded that LT-SE4 border (NordBalt) is congested solely in the direction SE4 -> LT, as it is geographically stable, highly predictable and frequently reoccurring under normal power system conditions, and it can be unambiguously defined.

Lithuania – Poland cross-border: LitPol Link

The maximum NTC of LitPol Link is 500 MW. However, due to power losses and technical limitation of Alytus HVDC back-to-back station, the maximum available transmission capacity

from Lithuania to Poland is 488 MW and from Poland to Lithuania is 492 MW. Table 5 below contains data on utilisation of LitPol Link.

From the time the LitPol Link capacity was available, capacity was fully utilised only by 20 % in direction LT→PL and by 24% in direction PL→LT.

Table 5: Data on utilisation of LitPol Link

	Direction LT → PL (max. ATC 488 MW)	Direction PL → LT (max. ATC 492 MW)
% of time the Link was available (available capacity > 0 MW)	*68 %* *5947 hours out of 8784*	*64 %* *5592 hours out of 8764*
Flow direction, % of time Link was available	*42 %* *3468 hours out of 8233*	*29 %* *2416 hours out of 8233*
Average available capacity, MW (% of full capacity when Link was available)	*459 MW (94 %)*	*233 MW (47 %)*
Average commercial flow, MW (% of available capacity)	*309 MW (67 %)*	*180 MW (77 %)*
Available capacity fully utilised, % of time Link was available	*20 %* *1208 hours out of 5947*	*24 %* *1363 hours out of 5592*

Data timeframe: 1st of January 2016 - 31th December 2016

It should be noted that mainly due to Polish power system technical limitations the issued LitPol link available transmission capacity is not stable or predictable, and varies from day to day and within particular days. Also, it should be noted that under normal power system conditions availability of LitPol Link for commercial trades is frequently very limited. As a result, the level of congestion of LitPol link can't be unambiguously assessed in a form of base-load product, and is not predictable. Thus, it cannot be concluded that there is structural congestion on Lithuania – Poland cross-border (LitPol Link).

Nevertheless, recently the level of export capacities in peak hours was elevated by installing new generation capacities in the north of Poland and import capacities are quite high except off peak hours. Also finalisation of Ostrołęka – Mątki 400 kV line constitutes an important milestone, which is indeed well visible in the recently offered NTCs. However, in case of less favourable wind conditions in northern Poland, the power system conditions in the east-north grid are less favourable and there might be still some limitations of the offered NTC. But it needs to be noted that the LitPol project is still not yet fully completed, i.e. Ostrołeka-Stanisławów is still under construction. It is highly probable that the LitPol link capacity will become more stable and predictable, when LitPol project will be fully completed (scheduled for 2021).

Lithuania – Latvia cross-border

The maximum NTC from Lithuania to Latvia is 684 MW, while from Latvia to Lithuania is 1234 MW. However, the available capacity for the market depends on various technical constraints: ambient temperature (yearly seasons), grid topology incl. outages in Lithuanian or Latvian transmission grids, as well as loop flows in BRELL (Belarus, Russia, Estonia, Latvia, and Lithuania) ring.

The observations of the data within Table 6 lead to the conclusion that the congestion on LT-LV cross-border cannot be unambiguously defined, normally shall not be anticipated and it is not frequently reoccurring under normal power system conditions. Thus, congestion is not present neither in direction LT→LV, nor in direction LV→LT.

Table 6: Data on utilisation of Lithuania – Latvia border

	Direction LT→LV (max NTC 684 MW)	Direction LV→LT (max NTC 1234 MW)
% of time the Link was available (available capacity > 0 MW)	*100 %* *8784 hours out of 8784*	*100 %* *8784 hours out of 8784*
Flow direction, % of time Link was available	*9 %* *817 hours out of 8784*	*86 %* *7566 hours out of 8784*
Average available capacity, MW (% of full capacity when Link was available)	*554 MW (81 %)*	*1021 MW (83 %)*
Average commercial flow, MW (% of available capacity)	*144 MW (26 %)*	*441 MW (43 %)*
Available capacity fully utilised, % of time Link was available	*0 %* *3 hours out of 8784*	*4 %* *286 hours out of 8784*

Data timeframe: 1st of January 2016 - 31th December 2016

Summary of criteria's evaluation

Table 7 contains summary of the evaluated criteria for Lithuanian cross-borders and conclusions on structural congestion presence on particular cross-borders.

Table 7: Evaluation of structural congestion on LT cross-borders

Criteria	LT→SE4	SE4→LT	LT→PL	PL→LT	LT→LV	LV→LT
Congestion – can be unambiguously defined	No	Yes	No	No	No	No
Congestion – is predictable	No	Yes	No	No	No	No

Congestion – is geographically stable	Yes	Yes	Yes	Yes	Yes	Yes
Congestion – is frequently reoccurring under normal power system conditions	No	Yes	Yes	Yes	No	No
Structural congestion	***No***	***Yes***	***No***	***No***	***No***	***No***

As the result of observations within Table 7, it might be concluded that on the LT-SE4 cross-border in the direction from Sweden to Lithuania (SE4→LT) congestion is present. Firstly, the price difference between those two bidding zones is present and substantial (5.5 EUR/MW for the considered period 18th of February 2016 - 31th December 2016). Secondly, the congestion is predictable and frequently reoccurring under normal power system conditions. Thus it may be concluded that the need for long-term cross-zonal hedging may be present for this cross-border in the direction from Sweden to Lithuania (SE4→LT).

On LT-PL cross-border despite the difference in prices (average of 1.82 EUR/MW for the considered period 1st of January 2016 - 31th December 2016), the defining if congestion is frequently reoccurring under normal power system conditions is not straightforward. It should be noted that it is hard to unambiguously define the normal power system condition definition on LitPol Link: the capacity determination on this border is heavily dependent on Polish power system's technical specification, what makes hard to predict the capacity in the long-term in both directions. As a result, the structural congestion of LitPol Link cannot be unambiguously defined (in a form of base-load product), and is not predictable.

As regards to LT-LV cross-border, it may be concluded that the congestion cannot be unambiguously defined, it is not predictable and it is not frequently reoccurring. Thus, this interconnection has no structural congestion and the necessity need for introduction of long-term hedging options introduction may be considered as non-existent on this border in both directions.

Following sections of this report contain details on options that may be used for long-term hedging within Lithuanian bidding zone and analysis of their sufficiency for the task, followed by conclusions and proposal for the way forward.

2. Financial market's outlook and description of cross-zonal risk hedging products

As of today, a number of instruments and platforms for long-term electricity trade hedging are available within the Baltic Sea region.

Hedging products / allocation platforms within the Baltic Sea Region are:

- Nasdaq OMX presents and offers its financial products in Nordic and Baltic countries;
- Polish electricity derivatives market;
- JAO – offering services for the Central European TSOs (incl. Poland) for handling auctions for cross- border;
- EE/LV FTR-Options knows as "PTR-limited" auction organized by Estonian and Latvian TSOs for the Estonia – Latvia border.

Figure 3 depicts the above-mentioned hedging products and platforms within the EU.

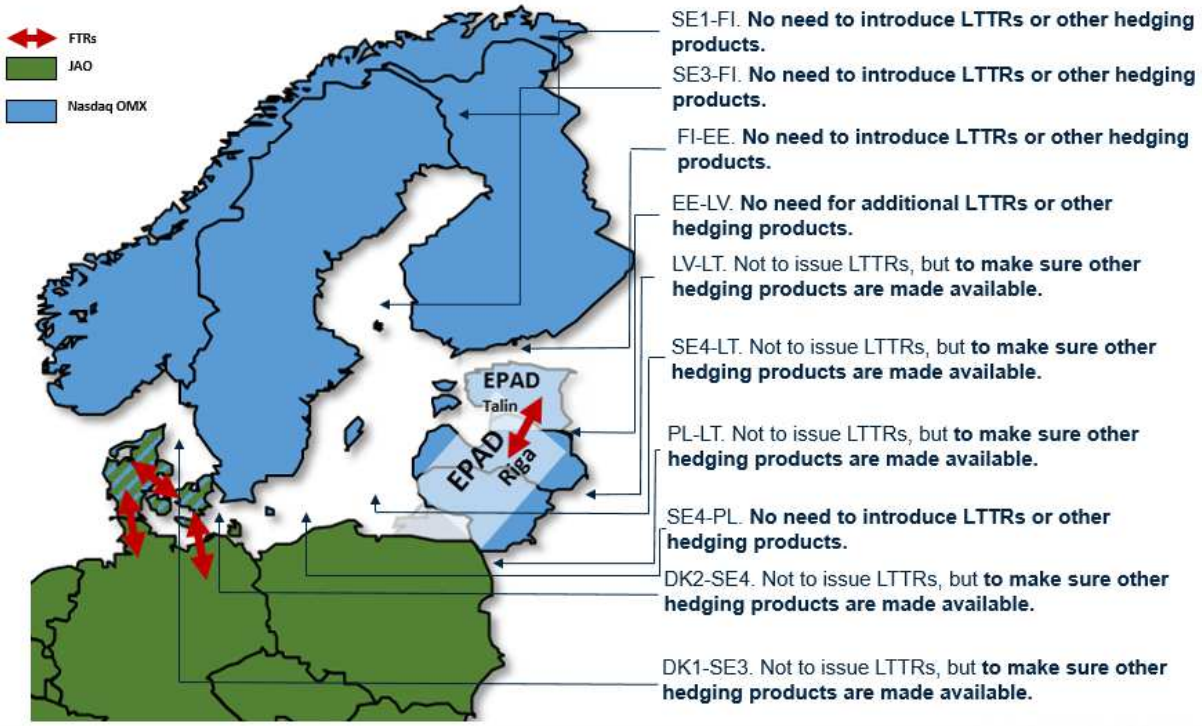

Figure 3: Hedging products and platforms in EU

The European wide vision, which is foreseen in the FCA Guideline, is that TSOs on a bidding zone border shall issue long-term transmission rights unless the competent regulatory authorities of the bidding zone border have adopted coordinated decisions not to issue long-term transmission rights on the bidding zone border. The decision on the introduction of long-term transmission rights must be based on the assessment whether the electricity forward market provides sufficient hedging opportunities in the concerned bidding zones.

As it is represented in Figure 3, the Lithuanian, Polish, Swedish and Latvian NRAs have performed the assessment, which indicated that there are insufficient hedging opportunities in the Lithuanian bidding zone. Following the FCA Guideline, the respective NRAs requested the relevant TSOs not to issue long-term transmission rights, but to make sure that other

long-term cross-zonal hedging products are made available to support the functioning of wholesale electricity markets.

As it is described in FCA Guideline, the hedging products or combination of such products offered on forward markets should represent a hedge against the volatility of the day-ahead price of the concerned bidding zone. **Such product or combination of products shall be considered as an appropriate hedge against the risk of change of the day-ahead price of the concerned bidding zone, where there is a sufficient correlation between the day-ahead price of the concerned bidding zone and the underlying price against which the product or combination of products are settled**.

In this section, the products and markets, which currently operate in Lithuania, Sweden and Poland, are assessed as viable alternative options for long-term electricity trade hedging in the bidding zones. In this section, it is analysed whether current product or combination of products could provide an appropriate hedge against the risk of change of the day-ahead price on Lithuania bidding zone borders.

2.1. Nasdaq OMX:

The Nasdaq OMX Commodities has been offering financial electricity derivatives for hedging electricity trade in Nordics (including Sweden [SE4]) for a number of years. Market participants acknowledge the existing Nordic financial market as a well-functioning system. Firstly, most of liquidity in the forward markets is linked to the system price, and specific bidding zone prices can be hedged by using a combination of a system price contracts and EPAD contracts.

A particular advantage of the Nordic market design is the combined Nordic liquidity in existing system price products. However, it may be deemed that some bidding zones may not have the right level of the liquidity in EPADs that is desired by market participants. The Nordic market stakeholders (NRAs, TSOs and market participants) favour to maintain and improve the current Nordic market design, while sustaining and improving the fundamental market participants' ability to hedge their risk.

Nasdaq OMX Commodities offers electricity derivatives products enabling full-fledged hedging of electricity prices of electricity traded at Swedish (SE4) and Lithuanian / Latvian price bidding zones. It might be concluded that combination of these hedging products provides means for Lithuania – Sweden (SE4) cross-border electricity trade hedging. In this manner, EPAD Riga product can be used in combination with Nordic System ENO(SYS) product and Sweden's 4th bidding zone (SE4) – EPAD Malmo, as an effective hedge of long-term Lithuania – Sweden electricity trade.

i. An EPAD

Product background

Electricity Price Area Differential (EPAD) is a forward contract managed by Nasdaq OMX Commodities with reference to the difference between the local bidding zone price and the system price. For instance in Nordic-Baltic region, EPADs are referred to Nord Pool system price (the unconstrained Nordic market clearing price). In contrast, for German power products the EPADs are referred to French, Dutch, Belgian and Czech system price.

The market price of an EPAD during the trading period reflects the market's prediction of the local price difference from the system price during the delivery period. This product allows members on the exchange to hedge against bidding zone's price risk. A combination

of two EPADs for different bidding zones can additionally provide market participants with the possibility to hedge cross-border trading risks.

Latvian Electricity Price Area Differential, EPAD Riga, contracts are available since November 2014. The product suite consists of two (2) monthly, three (3) quarterly and two (2) yearly EPAD Riga contracts. As the price differences between Latvia and Lithuania in practice are virtually non-existing (with very rare hourly exemptions), using these contracts, participants can hedge against deviations between the local Lithuanian-Latvian bidding zone price and the Nordic system price.

EPAD Riga

The derivatives exchange Nasdaq OMX Commodities started trading EPAD Riga derivative instruments linked to electricity prices of Latvian bidding zones (partially with an intention that combination of EPADs Tallinn and Riga might be used on for hedging frequently congested Estonia – Latvia cross-border trade). EPAD Riga was deemed to enable both Lithuanian-Latvian market participants to hedge against bidding zone prices differences with Nord Pool system prices. The combinations of these product provides perfect hedge of LT/LV bidding zone.

According to Table 2, due to adequate transmission capacity, the monthly price correlation between Lithuanian and Latvian bidding zones is very high. Lithuanian and Latvian prices being same for 99 % of the time during the last years, 2015 and 2016. As a result, it proves that EPAD Riga product referring to prices of electricity traded at Latvian bidding zone can be used for hedging needs of both Lithuanian and Latvian market participants. Thus, within this analysis EPAD Riga is considered as applicable product for Lithuanian hedging needs. Tables 8-9 contain assessment of EPAD Riga.

Table 8: Indicators of EPAD Riga product

Product	Average of bid - ask spread, EUR/MW	Trading volume, MWh	Average Daily fix[12], EUR/MW	Number of active days	Traded volume / Physical consumption %
SYRIGm+1	5,13	20555	11,36	7	0,11%
SYRIGm+2	5,06	4320	12,10	1	0,03%
SYRIGQ+1	4,86	21790	12,16	4	0,13%
SYRIGQ+2	4,59	26504	13,04	5	0,15%
SYRIGQ+3	5,22	0	13,45	0	0,00%
SYRIGY+1	4,98	78840	13,84	3	0,46%
SYRIGY+2	5,64	0	14,82	0	0,00%

Data timeframe: January 1st, - December 31st, 2016.

[12] If a contract in delivery is not traded, a theoretical daily fix is calculated to be used in the margin calculations. Read "Nasdaq SPAN® Margin methodology guide for Commodity derivatives" for more information.

Table 9: EPAD Riga Open Interest[13] data

Month (year 2016)	Total Open Interest, MW	Open Interest, MWh	Consumption, MWh (LT+LV)	Open Interest /Physical consumption %
January	9	6696	1685391	0,40%
February	7	4872	1439658	0,34%
March	20	14860	1504303	0,99%
April	32	23040	1360863	1,69%
May	21	15624	1339630	1,17%
June	21	15120	1297048	1,17%
July	11	8184	1336280	0,61%
August	9	6696	1396275	0,48%
September	9	6480	1350077	0,48%
October	15	11175	1490549	0,75%
November	15	10800	1536861	0,70%
December	13	9672	1584608	0,61%

Data timeframe: January 1st, - December 31st, 2016.

Considering the data in the Tables 8-9, the average bid-ask spread for EPAD Riga product varies between 4.59 and 5.64 euros per MWh (not seasonally adjusted). The total amount of traded volumes also varies and depends on a product category. The most popular product is one year ahead with traded volume of 78.8 GWh (SYRIGY+1). However, considering trading volumes for the various time horizon products and actual Open Interest positions in relation to combined physical consumption of Lithuania and Latvia (less than 1 percent), it can be stated that the level of activity of an EPAD Riga remains very low.

One should take into account that Estonian-Latvian TSOs offer the FTR-Options product on the Estonian – Latvian border. Further, Estonian bidding zone price closely correlates with the Finnish bidding zone price. Hence, market participants can use more liquid EPAD Helsinki product (than EPAD Riga) in combination with EE-LV FTR-Option for their hedging needs. Thus, such alternative hedging strategy can partially explain low activity in trade of EPAD Riga contracts.

EPAD Tallinn

EPAD Tallinn product is traded by Nasdaq OMX exchange and is designated for hedging the electricity price at Estonian bidding zone since 2012. Tables 10-11 contain assessment of EPAD Tallinn.

[13] https://www.nasdaqtrader.com/content/phlx/OptionsGlossary.pdf Open Interest: The net total of outstanding open contracts in a particular option series. An opening transaction increases the open interest, while any closing transaction reduces the open interest. (Correspond to volumes actually used for hedging physical deliveries).

Table 10: Indicators of EPAD Tallinn product

Product	Average of bid - ask spread, EUR/MW	Trading volume, MWh	Average Daily fix[14], EUR/MW	Number of active days	Traded volume / Physical consumption %
SYTALm+1	5,11	27528,0	8,92	1	0,034%
SYTALm+2	-	0,0	9,36	0	0,000%
SYTALQ1	0,72	17672,0	10,09	2	0,022%
SYTALQ2	-	0,0	10,50	0	0,000%
SYTALQ3	-	0,0	10,04	0	0,000%
SYTALY1	0,22	105120,0	9,79	2	0,130%
SYTALY2	-	0,0	9,84	0	0,000%

Data timeframe: January 1st, - December 31st, 2016.

Table 11: EPAD Tallinn Open Interest data

Month (year 2016)	Total Open Interest, MW	Open Interest, MWh	Consumption, MWh (EE)	Open Interest/Physical consumption, %
January	0	0	889238	0,00%
February	0	0	727455	0,00%
March	0	0	749512	0,00%
April	0	0	647947	0,00%
May	0	0	600955	0,00%
June	0	0	550617	0,00%
July	37	27528	560872	4,91%
August	0	0	600728	0,00%
September	0	0	597974	0,00%
October	8	5960	697257	0,85%
November	8	5760	773468	0,74%
December	8	5952	782166	0,76%

Data timeframe: January 1st, - December 31st, 2016.

According to the Tables 10-11, we can see that trading activity in EPAD Tallinn trading is not significant, the traded volume ratio to physical consumption is lower than 1 percent. One may state that the market participants are not interested in EPAD Tallinn contracts to hedge their price risks. The relative non-existence of trade in EPAD Tallinn should be taken into account considering that prices in Estonian bidding zone closely correlate with the Finnish bidding zone price and market participants tend to use more liquid EPAD Helsinki product for their hedging needs.

EPAD Helsinki

EPAD Helsinki product traded by Nasdaq OMX exchange and is designated for hedging the electricity price at Finnish bidding zone. Tables 12-13 contain assessment of EPAD Helsinki.

[14] If a contract in delivery is not traded, a theoretical daily fix is calculated to be used in the margin calculations. Read "Nasdaq SPAN® Margin methodology guide for Commodity derivatives" for more information.

Table 12: Indicators of EPAD Helsinki product

Product	Average of bid - ask spread, EUR/MW	Trading volume, MWh	Average Daily fix[15], EUR/MW	Number of active days	Traded volume / Physical consumption %
SYHELm+1	0,67	3814776,0	6,76	173	4,15%
SYHELm+2	1,25	1222182,0	7,45	114	0,83%
SYHELm+3	1,47	431717,0	7,92	66	0,51%
SYHELm+4	1,61	243032,0	7,93	44	0,29%
SYHELQ+1	0,61	4576686,0	7,66	200	7,74%
SYHELQ+2	0,60	2635936,0	8,49	139	3,32%
SYHELQ+3	0,81	1411109,0	8,11	87	1,61%
SYHELQ+4	0,98	1109539,0	7,90	80	1,21%
SYHELYR+1	0,37	20629800,0	7,77	201	24,57%
SYHELYR+2	0,46	9968880,0	7,53	168	11,87%
SYHELYR+3	0,68	4993200,0	5,29	113	6,05%
SYHELYR+4	0,90	2424384,0	4,09	45	2,94%

Data timeframe: January 1st, - December 31st, 2016.

Table 13: EPAD Helsinki Open Interest data

Month (year 2016)	Total Open Interest, MW	Open Interest, MWh	Consumption (FI)	Open Interest/Physical consumption
January	2467	1835448	9176586	20,00%
February	2412	1678752	7518538	22,33%
March	2499	1856757	7659418	24,24%
April	2266	1631520	6757715	24,14%
May	2315	1722360	6066854	28,39%
June	2110	1519200	5689906	26,70%
July	2135	1588440	5910532	26,87%
August	1850	1376400	6164633	22,33%
September	1976	1422720	6181815	23,01%
October	2733	2036085	7179794	28,36%
November	2796	2013120	7705643	26,13%
December	3150	2343600	7937361	29,53%

Data timeframe: January 1st, - December 31st, 2016.

According with the Tables 12-13, it is apparent that an EPAD Helsinki product was actively traded for various time horizons. EPAD Helsinki Open Interest data shows that high volume of electricity consumption being hedged using the EPAD Helsinki products: hedging volumes correspond to 20 – 30 % of Finnish consumption. The ratio of traded volume to physical consumption varies from 0.3 % to 24.6 % depending on an EPAD Helsinki product category. It should be noted that EPAD Helsinki can be used by Baltic market participants as well: due

[15] If a contract in delivery is not traded, a theoretical daily fix is calculated to be used in the margin calculations. Read "Nasdaq SPAN® Margin methodology guide for Commodity derivatives" for more information.

to high prices correlation between Finnish and Estonian bidding zones, EPAD Helsinki can be used to hedge Estonian prices or in combination with FTR-Options product (sold by TSOs on the Estonia – Latvia border) for hedging electricity prices in Lithuania and Latvia.

Considering the data above, it may be concluded that market participants had been willingly using an EPAD Helsinki product for hedging electricity price risks. An average bid-ask spread was comparatively low and didn't not exceed 2 EUR/MW. Lower bid-ask spread means that market participants are facing lower trading costs, and underlies higher product liquidity.

EPAD Malmo (SE4)

EPAD Malmo product traded by Nasdaq OMX exchange is designated for hedging the electricity price at Swedish SE4 bidding zone. Tables 14-15 contain assessment of EPAD Malmo (SE4).

Table 14: Indicators of EPAD Malmo (SE4) product

Product	Average of bid - ask spread, EUR/MW	Trading volume, MWh	Average Daily fix[16], EUR/MW	Number of active days	Traded volume / Physical consumption %
SYMALm+1	0,67	845058,00	2,92	230,29	3,19%
SYMALm+2	0,70	409220,00	3,14	120,95	1,51%
SYMALm+3	0,99	84816,00	3,02	12,26	0,32%
SYMALm+4	1,06	60279,00	2,81	9,06	0,26%
SYMALQ+1	0,73	1031430,00	3,01	250,35	4,25%
SYMALQ+2	0,75	334635,00	2,73	171,44	0,24%
SYMALQ+3	0,88	361344,00	2,59	96,36	0,39%
SYMALQ+4	0,97	235131,00	2,63	19,26	0,00%
SYMALYR+1	0,38	1874640,00	2,66	146,19	7,69%
SYMALYR+2	0,51	823440,00	2,72	82,71	3,38%
SYMALYR+3	0,48	805920,00	3,09	48,06	0,98%
SYMALYR+4	0,65	333792,00	3,29	21,84	0,40%

Data timeframe: January 1st, - December 31st, 2016.

Table 15: EPAD Malmo (SE4) Open Interest data

Month (year 2016)	Total Open Interest, MW	Open Interest, MWh	Consumption (SE4)	Open Interest/Physical consumption
January	343	255192	2734220	9,33%
February	601	418296	2399250	17,43%
March	393	291999	2340132	12,48%
April	295	212400	2047178	10,38%
May	273	203112	1754070	11,58%

[16] If a contract in delivery is not traded, a theoretical daily fix is calculated to be used in the margin calculations. Read "Nasdaq SPAN® Margin methodology guide for Commodity derivatives" for more information.

June	345	248400	1593787	15,59%
July	311	231384	1520655	15,22%
August	242	180048	1627735	11,06%
September	305	219600	1679819	13,07%
October	362	269690	2038438	13,23%
November	352	253440	2307996	10,98%
December	287	213528	2340317	9,12%

Data timeframe: January 1st, - December 31st, 2016.

According to the Tables 14-15, similarly to EPAD Helsinki, EPAD Malmo (SE4) one year ahead contract was the most popular hedging option. However, overall EPAD Malmo (SE4) were less actively traded and used, open interest volumes show that hedging with this product range from 9% to 17 % of bidding zone's consumption (as compared 20% to 30 % in case of EPAD Helsinki product). The EPAD Malmo (SE4) average bid-ask spread was comparatively low – average of 0,7 EUR/MW (not seasonally adjusted, all contract types). The above evaluation of Nasdaq OMX data shows that the EPAD market of SE4 is liquid which has also been established by the Swedish NRA, Energimarknadsinspektionen that assessed that the long-term hedging opportunities in SE4 are sufficient.

EPAD products' comparison

As EPAD Helsinki product was actively traded for various time horizons products and willingly used by Nordic market participants, EPAD Helsinki is a good reference for EPAD Riga evaluation and comparison. Nasdaq OMX offers EPAD Helsinki product for 12 different time horizons, - which is by 5 contracts more than offered for EPAD Riga. Further, during year 2016 all of the EPAD Helsinki contracts were actively traded, what is not the case for EPAD Riga, e.g. three quarters ahead EPAD Riga product (SYRIGQ+3) was not traded at all.

However, referring to the FCA Guideline, article 31(2) specifies that introduced LTTRs should at least offer yearly and monthly products. From this point of view, the trading horizons offered by Nasdaq OMX for EPAD Riga products are in line with the FCA Guideline's requirements.

The total volumes of trades of such products as EPAD Helsinki, EPAD Malmo are several times higher than one of EPAD Riga (country specific consumption taken into account). Moreover, the Nordic EPAD products have much lower bid-ask spread than EPAD Riga. In addition to this, liquidity, the number of participants who trade Nordic EPADs on a daily basis are much higher as well.

An EPAD - ex-post risk premium

An efficient market should not facilitate any significant arbitrage opportunities for strategic market participants in the long-run. In order to assess this for cross-border hedging instruments (LTTRs or EPADs), the deviation of the prices of these instruments from the reference market prices has to be checked. A measure of this deviation can be provided by the observed ex-post risk premium. Both high positive and high negative risk premium are an undesired outcome for different reasons. High positive risk premium may constitute a barrier to new suppliers while high negative risk premium may result (in the case of PTRs of FTRs) in the significantly reduced congestion rents to TSOs.

Within this analysis (as detailed above) EPAD Riga is considered as applicable product for Lithuanian\Latvian hedging needs. Due to close price correlation of Baltic (especially Estonian) and Finnish bidding zones, EPAD Helsinki has been further used as a reference

product for an assessment of EPAD Riga product's efficiency. EPAD Helsinki reference was also chosen considering the following:

- Finland and Lithuania\Latvia are net importers of electricity;
- Finnish and Lithuanian\Latvian markets are strongly dependent on trade capabilities across the interconnection links.

Table 16: Comparison of EPAD Riga and EPAD Helsinki (monthly products)

Bidding zone	Sample size	Average daily fix price (EUR/MWh)	Average difference system-BZ price	Average risk premium (EUR/MWh)	Price correlation (between BZ-system price), %	Average bid-ask spread (EUR/MWh)
EPAD Riga (LT/LV)	6	13,80	11,94	1,87	59%	5,10
EPAD Helsinki (FI)	21	7,24	5,41	1,83	93%	0,97

The provided data includes only EPADs of one month and two months ahead products.
The sample size is the number of monthly products with some volumes traded in the period 01/01/2016 – 31/12/2016.
The average Daily fix price is the arithmetic average (not seasonally adjusted) of the prices of all monthly EPADs included in the sample.
The average difference between the system price and the bidding zone price is the difference between the average DA system price and average DA bidding zone price in the sample.
The average risk premium is the arithmetic average (not seasonally adjusted) of the risk premium of all monthly products included in the sample and is equal to the difference between the average EPAD price and average difference System-BZ price).
The price correlation refers to the correlation of System price and BZ DA prices for defined time period.

Table 16 presents the risk premium for EPADs in Lithuanian-Latvian and Finnish bidding zones. The risk premium is positive in both cases and very close in its value. Comparing the risk premium to average daily fix price, LT/LV premium constitutes 14% and is smaller than EPAD Helsinki that is 25%. As stated in ACER report[17], a substantial positive risk premium reflects that there is a shortage in the supply of EPADs and that the competition for these products is more on the buyer's side, i.e. there is more competition by suppliers than sellers (e.g. generators) to cover their needs for hedging in the corresponding markets.

The price correlation of Lithuanian/Latvian biding zone compared to Finnish bidding zone towards Nord Pool SYS price is lower. Therefore, it may be expected that the need for hedging Lithuania/Latvia electricity price and subsequently risk premium to be paid should be higher for EPAD Riga than for EPAD Helsinki.

[17] ACER. *Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2014*

Table 17: Auction data differences between EPAD Riga and EPAD Helsinki

	Average BID, EUR/MWh	BID and actual BZ - SYS price difference EUR/MWh (% to BZ - SYS price difference)	Average ASK, EUR/MWh	ASK and actual BZ - SYS price difference (% to BZ - SYS price difference)	Average BZ - SYS price difference, EUR/MWh	Average Bidding Zone price, EUR	Average SYS price, EUR
EPAD Riga	9,63	-1,14 (-11 %)	14,73	3,96 (37 %)	10,77	36,99	23,72
EPAD Helsinki	6,81	1,06 (18 %)	7,78	2,03 (35 %)	5,75	31,97	

Note 1: The average data are aggregated from month and two months ahead auction on NASDAQ OMX for the year 2016.

According to Table 17, average residual of ASK and hedged underlying price is similar both for EPAD Riga and EPAD Helsinki (in percentage terms). In contrast, average residual of BID and hedged underlying price is positive for EPAD Helsinki (18%) and negative for EPAD Riga (-11%). It means that buyers of EPAD Riga in 2016 bided a price lower than the price of underlying product. The buyers for EPAD Helsinki on average were ready to pay the price higher than the underlying. The sellers of EPADs Riga asked on par with their Finnish counterparties. Difference in behaviour of market participants lead to the comparatively high 5.10 EUR/MWh EPAD Riga BID-ASK spread compared with 0,97 EUR/MWh BID-ASK spread of an EPAD Helsinki. Asymmetric behaviour of buyers and sellers might be one of the reasons for low trading volumes of EPAD Riga.

ii. An EPAD Combo

As described above, EPAD Riga price strongly differed from actual day-ahead market price and failed to have sufficient liquidity. To overcome lack of correlation, Nasdaq OMX has suggested a new product called EPAD COMBO, which could be applied for Baltic market in order to increase the availability of hedging options.

A general difference between EPAD and EPAD COMBO is how the products are structured and sold on the market. EPAD is used for one bidding zone price risk hedging, but EAPD COMBO for cross-border trade risk hedging between two bidding zones, same as FTR. Following is the description of EPAD Combo between LT and SE4 bidding zones:

EPAD LT/LV-SE4 Combo = EPAD LT/LV – EPAD SE4 = (Bidding zone LT/LV - System price) – (Bidding zone SE4 - System price) = Bidding zone price LT/LV – Bidding zone SE4

EPAD Combo products works same as by selling an EPAD in one bidding zone and buying an EPAD in another bidding zone, and same result as FTR is created

2.2. LTTR - Financial transmission rights – option

When considering cross-border trade hedging options all viable options and combination of products enabling hedging of prices on Lithuanian cross-borders should be taken into account. E.g. combination of products on Estonia – Latvia border (FTR-Options) in combination with Finnish, Estonian bidding zone hedging options available at Nasdaq OMX must be considered. FTR-Options on Estonia-Latvia bidding zone border in direction from Estonia to Latvia

Starting January 1st 2014, the Estonian TSO - Elering and Latvian TSO – AST introduced cross-border long-term electricity trade risk hedging instrument on the Estonian-Latvian cross-border FTR-Options. The TSOs organize auctions on a monthly, quarterly and yearly basis[18]. Upon purchase of FTR-Option market participants are guaranteed by TSOs for the pay-back for the price difference between Estonia and Latvia bidding zones dependent on the volume (MW) of FTR-Option purchase (defined flow direction from Estonia to Latvia) for the respective auction timeframe. Table 18 contains statistics of FTR-Option trading results.

Table 18: Indicators of FTR-Options product, year 2016

Product	Traded volume, MWh	Weighted average marginal price, Eur/MWh	Traded volume / Physical consumption, %
PTR-L m+1	1 243 200	2,27	7%
PTR-L Q+1	658 800	2,91	4%
PTR-L YR+1	2 635 200	4,55	15%
Total	4 537 200	3,69	26%

An FTR-Options - ex-post risk premium

According to the statistics, traded volumes of FTR-Option constantly increased from 2014 to 2016. In 2017 the offered volumes of FTR-Option are forecasted to be comparable to the ones in 2016. As it was mentioned before, the efficient market should not facilitate any significant arbitrage opportunities for strategic market participants in the long-run. In 2014 and 2015 weighted average price of all traded FTR-Option contracts was lower than the weighted average price difference on Estonia – Latvia border. In contrast, in 2016 the weighted average price of all FTR-Option contacts was higher than the underlying. The same tendency continues in 2017, as of the end of October. Table 19 contains statistics on FTR-Option ex-post risk premium data.

Table 19: PTR-limited ex-post risk premium data, year 2014-2017 9M

Year	Traded volume, MWh	Weighted average price, Eur/MWh	Weighted average actual price difference, Eur/MWh	Price difference, Eur/MWh	Difference, %	Financial result, TSOs congestion rent (-) loss / (+) gain, EUR.
2014	1 752 000	7,67	12,51	-4,84	-63%	-8,48
2015	3 595 920	7,36	10,54	-3,18	-43%	-11,45
2016	4 537 200	3,69	2,91	0,78	21%	3,52
2017[19]	4 423 575	1,99	1,79	0,20	10%	0,69

[18] PTR-Limited Auctions 2017

[19] As of the end of October 2017

Practice shows that all offered FTR-Option volume is sold to market participants, the demand for this hedging product is high and market participants prefer using FTR-Option auctions to trading in EPAD Riga, where the trades happen in continuous market.

2.3. TGE – Polish Power Exchange

The growing volumes on TGE's power market over the last years make it one of the fastest growing exchanges in Europe and the most dynamically developing exchange in the former CEE region. Combinations of following long-term (i, ii) and day-ahead (iii) products can be used for hedging.

i. Financial Instrument Market - FIM

In February 2015, The Polish Power Exchange (TGEP) obtained licence to operate a financial instruments exchange in Poland. The trading terms and market /product design developed by TGE upon consultation with Polish market stakeholders has been approved by the Polish Financial Supervision Authority. TGE opened their Financial Instruments Market (hereinafter – FIM) on 4 November in 2015.

Futures contract at FIM:

- Yearly: 2 series - 2 consecutive calendar years
- Quarterly: 4 series - 4 consecutive calendar quarters
- Monthly: 4 series - 4 next calendar months

ii. Commodity Forward Instruments Market with Physical Delivery - CFIM

Polish Power Exchange launched the Electricity Forward Market on 4th 20th of December in 2012. Practice shows that market participants used the new possibilities for securing prices of their electricity trading portfolios.

The instruments on the CFIM are traded for the following forward horizons:

- yearly contracts for the next 3 years;
- quarterly contracts for the next 6 quarters;
- monthly contracts for the next 9 months;
- weekly contracts for the next 6 weeks;

Figure 4 below contains the data of monthly traded volumes at CFIM

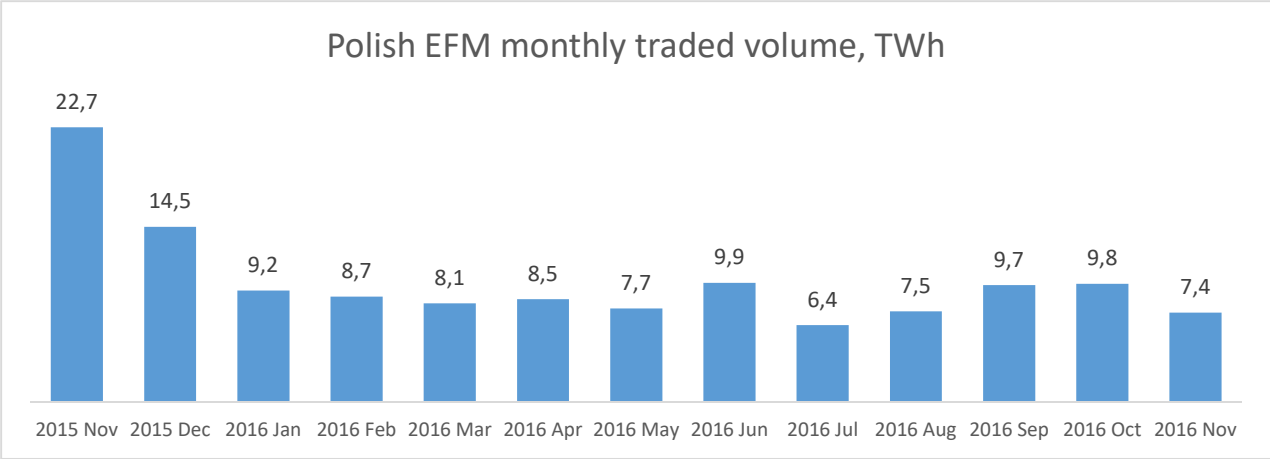

Figure 4: Monthly traded volume in CFIM. Statistics consist of base load, peak load and off-peak load data[20]

The launch of a CFIM was a great success. For example, the total traded volume in November 2015 and December 2015 were around one seventh and one tenth of the total energy consumption in 2015 (where total energy consumption in 2015 was 151.1 TWh) respectively. This amount of trades prompt that market participants were actively seizing the new trading and hedging possibilities. The total traded volume settled down in 2016, and the monthly average traded volume still accounts for around 8.4 TWh in the first 11 months of 2016. Tables 20-21 contain details of trade at CFIM.

Table 20: Hedging volumes in 2016 by traded F_TGe24_ products category

	Polish CFIM baseload product		
	Weighted average price, Eur/MWh	Trading volume, MWh	Traded volume vs Physical consumption (%)
BASEm+1	37,34	7011444	4,6%
BASEm+2	36,91	2333872	1,5%
BASEQ+1	37,01	13113947	7,9%
BASEQ+2	36,87	5259137	3,2%
BASEQ+3	35,36	3046051	1,8%
BASEY+1	36,17	45947221	27,8%
BASEY+2	35,96	6202080	3,8%

F_TGe24_ product stands for Polish baseload product

Table 21: Open interest of F_TGe24_ products

Month	Total Open Interest*, MW	Open Interest, MWh	Consumption (PL), MWh	Open Interest / Physical consumption (%).
January	5133	3818952	14956944,0	25,53%
February	5189	3611544	13695257,7	26,37%
March	4905	3649320	14197474,4	25,70%
April	4627	3331440	13140311,2	25,35%

[20] TGE Polish Power Exchange

May	4397	3271368	12848835,8	25,46%
June	4617	3324240	13004234,0	25,56%
July	4147	3085368	13153879,2	23,46%
August	4182	3111408	13179443,6	23,61%
September	4390	3160800	13275662,2	23,81%
October	3982	2962608	14240319,5	20,80%
November	4149	2987280	14354730,0	20,81%
December	4309	3205896	15024588,1	21,34%

*The Open Interest consist of delivery volumes for particular month of 2016 accumulated from traded monthly, quarterly and yearly products.

iii. Day Ahead Market with two trading sessions

On the day-ahead market there is a single quotation system with two price defining sessions:

Fixing 1 - accepting orders takes place until 10:30 on the day preceding the day of delivery for transactions exclusively on the domestic market, and

Fixing 2 - Accepting orders takes place until 11:30 on the day before the day of delivery for the transactions including Lithuanian and Swedish borders.

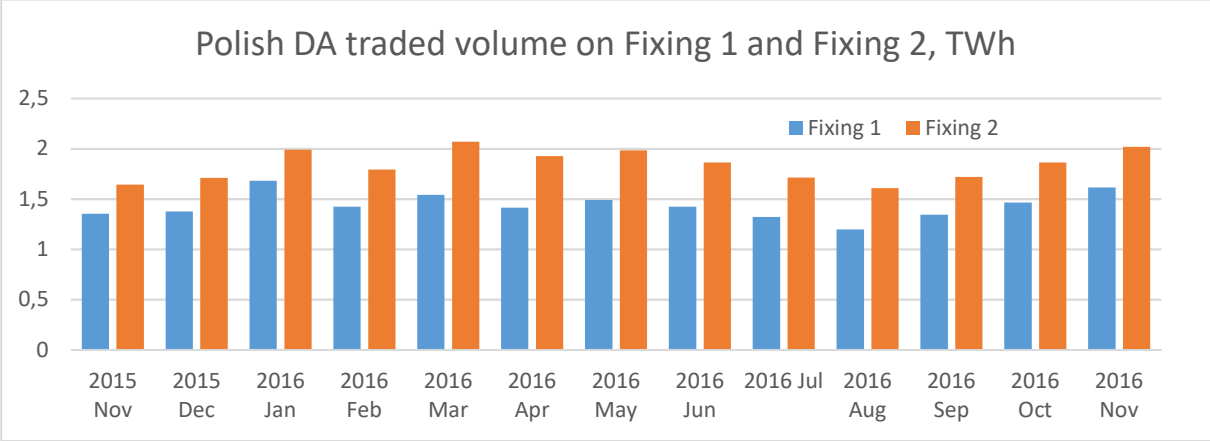

Figure 5: Monthly traded volume in Polish DA.

iv. Hedging opportunities

FCA Guideline requirements for an analysis of whether the products or combination of products offered on forward markets are efficient contains and assessment of at least Trading horizon, Bid – Ask spread, Traded volumes and Open Interest criteria. Based on analysis of the operation results it may be concluded that Polish PX provides sufficient hedging opportunities:

- Trading horizon: F_Tge24 products are traded for weekly, monthly, quarterly, yearly and up to three years ahead contracts, while the FCA GL minimum requirement is at least month- and year-ahead contracts;
- The ratio of traded volume to physical consumption for the year 2016 varies between 1,5 % up to 27,8% based on product category (volumes of each traded F_TGe24_ products category for hedging electricity prices in 2016 as detailed in Table).
- The volumes of Open Interest positions are quite large and on average for the year 2016 reaches as high as 24% of actual consumption volumes.

- As Polish CFIM is physical electricity forward market the bid-ask spread is not applicable for it.

Observing the data on performance it may be concluded that Polish power exchange provides viable and sufficient means for long-term hedging of Polish electricity prices. Especially hedging can be realised by using of following sample sequences of available power exchange products:

- purchase of one of the CFIM products with the possibility of its sale to Fixing I, and then purchase of the product available on DA Fixing II (price hedging for import of electricity);
- purchase of one CFIM product with the possibility of its sale to DA Fixing II (price hedging for export of electricity);
- purchase electricity for DA Fixing I for resale at DA Fixing II.

As result, the Polish NRA concluded, that there are sufficient conditions to hedge prices on Polish electricity market.

2.4. Financial market outlook summary

Currently, there are several products offered on forward markets in Lithuanian and neighbouring bidding zones. Each of these products or combination of these products could be used to hedge against the volatility of the day-ahead price of the concerned bidding zone, as well as to mitigate the Lithuania – Poland and Lithuania – Sweden cross-border trade risks.

Furthermore, the analysis revealed that there is no need for cross-border hedge on Lithuania – Latvia bidding zone borders. Due to high price correlation, Lithuania and Latvia bidding zone can be considered as one and hedging products available in Latvia bidding zone can be directly used in Lithuania bidding zone.

The summary of all currently available hedging products in Lithuania and neighbouring bidding zones is presented and compared in Table 22. It may be observed that all products traded in 2016 were sold at ex-post risk premium, meaning that market participants (buyers) paid premium for hedging their portfolio. This is in line with the conclusion that observed markets are consumers, who have necessity to hedge their price risks.

Table 22: Comparison of hedging products pricing in 2016

	Average hedging product price, EUR	Average corresponding market price, EUR	Difference, EUR	Difference, %
EPAD Helsinki	8,3	5,5	2,8	33%
EPAD SE4	2,9	2,6	0,3	12%
EPAD Riga	13,1	9,6	3,5	36%
FTR-Options	3,7	2,9	0,8	21%
F_TGE24	38,0	37,3	0,7	2%

*For EPADs the average financial product price reflects the average of daily price fix of monthly and quarterly EPAD products with delivery period of 2016 and traded in 2016

*For PTR limited the average financial product price reflects the weighted average marginal product price of monthly, quarterly and yearly auctions with delivery period of 2016

*For Polish Electricity Forward Market F_TGE4 the average financial product price reflects the average settlement price of monthly, quarterly and with delivery period of 2016 and traded in 2016

3. Alternative necessary arrangements

In this chapter, five possible models shall be described, which could be used by the TSOs to support the functioning of the wholesale electricity markets on above mentioned -borders. The description of the models and evaluation of their impact on the market is based on the THEMA report "Measures to support the functioning of the Nordic financial electricity market", which was commissioned by NordREG in 2015[21] and on the common work of the Lithuanian, Latvian, Polish and Swedish TSOs.

3.1. EPAD Vilnius

Likewise as EPAD Riga, listed by Nasdaq OMX, an option to introduce EPAD Vilnius might be considered. The EPAD Vilnius would provide a possibility for market participants to hedge against deviations between the Lithuanian bidding zone price and the Nordic system price.

However, as it was demonstrated in Lithuanian NRA analyses[22], the day-ahead price correlation coefficient between Lithuanian and Latvian bidding zones was equal to 0.97. In other words, there is no price difference between Latvia and Lithuania is negligible. As result, it was concluded that despite the fact that there is no hedging product directly related to Lithuanian bidding zone, the hedging product available in Latvia bidding zone (PTR-Limited auctions and EPAD Riga) are fully suitable to hedge risks of Lithuanian bidding zone.

3.2. Auction EPAD Combos

EPAD Combo could be one option to support the functioning of the wholesale electricity markets. If the EPAD Combos are traded in the continuous market, they would also result in the increase of the regular EPAD market liquidity. Further, the EPAD Combo could use two already existing EPAD products (e.g. EPAD Riga and EPAD Malmo). In such case, there would be no risk to split the liquidity between financial markets as it would be done in case of the introduction of new products (e.g. FTRs).

Impact on market

Looking from LT-PL, LT-LV and LT-SE4 borders perspective it could be investigated, if EPAD Combos could provide sufficient hedging opportunities on these borders by taking both markets on the borders into consideration:

- LT-PL border. There is no EPAD market in Poland. Since Polish bidding zone price and Nord Pool's SYS price has low correlation as well as Poland has already well-functioning financial market, there is also no demand to introduce an EPAD in Poland. As a result, it is not suitable to introduce an EPAD Combo on this border.
- LT-LV border. In this case an EPAD Vilnius should be introduced. However, as it was concluded before, there is no need for an EPAD Vilnius, since there is almost no price difference between LT and LV bidding zones. As EPAD Riga serves for both bidding zones there is consequently no need for an EPAD Combo on this border.

[21] ISBN nr. 978-82-93150-84-8

[22] VKEKK, Tyrimo ataskaita dėl tarpzoninio rizikos draudimo galimybių, 2017

- LT-SE4 border. There is an existing EPAD Malmo in SE4 as well as an EPAD Riga in LT/LV bidding zones. In such case, EPAD Combo can be created on this border.

As mentioned before, from a market participants view the EPAD Combo involves same as the sell position in EPADs in one (low price) bidding zone and a buy position in EPADs in another (high price) bidding zone.

Lithuania is highly in deficit, even in combination with Latvia, both countries are covering almost a half of consumption with import. The similar situation is in SE4. Only about 1/3 of SE4 consumption is covered by local production. Hence, LT/LV as well as SE4 has higher demand to buy than sell EPADs.

3.3. Support market maker function in EPAD contracts

A market maker is an exchange member who commits to continuously give buy and sale bids with a certain minimum volume and a certain maximum spread. The requirement matrix is based on volatility and price levels. A market maker's functioning gives mainly two benefits for the market:

- It is always possible for a market participant to buy or to sell a contract. The possible deviation between the contract price and the market price depends on the allowed bid-ask spread for the market maker(s) if nobody else than market maker(s) gives bids.
- A market participant that can exit a position if stop-loss limits are reached. The security is better, the higher the required minimum volume from market maker(s). This means that for fundamental hedgers the allowed bid-ask spreads are most important, while for speculative traders the required minimum volumes are most important.

Nasdaq OMX already has market markers for the listed bidding zones[23]. For LT/LV two market makers support the EPAD Riga product: Latvenergo AS and Energijos tiekimas UAB. Both market makers are already aiming to increase liquidity and transparency of the market allowing other traders to execute their sale and purchase orders at market prices. The historically high bid-ask spread (4-5 EUR/MW compared to bid-ask spread of 0.5-2 EUR/MW for EPAD Malmo and EPAD Helsinki) indicates that market makers of EPAD Riga are not able to provide enough liquidity.

In order to increase the effectiveness of EPAD Riga in LT/LV bidding zones, the related TSOs theoretically can finance a market maker agreement for stricter demands on maximum spread and/or minimum volumes and/or presence in the market regarding EPAD Riga contracts. In such case, the TSOs' support of the market makers may positively impact the current market setup.

Impact on market

Supporting a market maker may be an effective measure for a bidding zone where appropriate hedging cannot be achieved. Support to a market maker agreement with a stricter demand on bid-ask spreads has the potential to be effective if there is:

- a lack of liquidity because of too high bid-ask spreads;
- too small turnover or too small open interest;

[23] Nasdaq OMX

- balanced market structure within the bidding zone.

If above is true, tighter bid-ask spreads from a market maker can be an effective measure for a smoother trade in EPAD contracts, as it would reduce trading costs. This however implies that some participants who want to hedge stay out of the market due to the transaction costs.

Increasing the minimum volume of a market maker is also an option. This could facilitate trading in terms of making it less costly to exit a relatively large position in event of e.g. stop loss. This in turn could make the markets more attractive to speculative participants. However, solely increasing offered volumes may not improve the liquidity of EPAD Riga - currently provided volumes are not fully utilised due to high bid-ask spreads.

It is doubtful if such TSOs' involvement in market maker's activities would be an effective solution in bidding zone with skewed market[24] structure. A basic strategy for a market maker is to minimise its open position. If a market maker is hit on one side, it normally transfers its bid-ask spread in such a way that it is more probable that it will be hit on the other side the next time, and thus reduce its open position. This strategy is difficult to execute in a bidding zone with much higher consumption than local generation or the opposite. In such bidding zone, a market maker has an incentive to bias its bid-ask spread in such a way that minimal trades are made with the dominating side in the bidding zone or might ask a compensation for the risk of building a position.

As mentioned before, Lithuanian bidding zone is highly in deficit, even in combination with Latvia, both countries are covering almost a half of consumption with import. In such case, supporting market makers might not be an effective solution due to the lack of production (EPAD supply) in the region.

It is also doubtful, whether TSO's support to a market maker functioning can increase the liquidity in bidding zones, where demand for fundamental hedging of bidding zone price differences using local EPAD contracts is low. As it was described above, there are other options for fundamental hedging of Lithuanian/Latvian bidding zone price with combination of FTR-Option and EPAD Helsinki contracts. It should be carefully evaluated there is a need to increase liquidity in EPAD Riga contracts, while such option exists.

3.4. Auction EPADs

This option means that TSOs auction EPAD contracts for the bidding zone(s), which are assessed as having insufficient hedging opportunities. If a TSO sells EPAD contracts for a bidding zone, the consequence would be an increased supply of EPAD contracts and therefore increased hedging possibilities for retailers and consumers in the bidding zone. If a TSO buys EPAD contracts for a bidding zone, the consequence would be an increased demand of EPAD contracts and therefore increased hedging possibilities for producers in the bidding zone.

Impact on market

Auctioning of EPAD contracts may result in a direct increase in the traded volume and would be more flexible solution than auctioning of EPAD Combos. This option also has the potential to be suitable in bidding zones with a skewed market structure. Furthermore, to boost the continues trade on the exchange it would be recommended that auctioned EPAD contract is exactly the same as exchange-traded EPAD contracts and cleared at the same clearing house. In such a case, there would be no difference between an EPAD contract acquired in an

[24] A market is said to be skewed when there is an overweight of either production or consumption.

exchange and an EPAD contract acquired in an auction. Both can be included in the same continuous trade on the exchange.

However, the TSOs would be committed to sell the auctioned volume at whatever price. This means that an inelastic supply from the TSOs would meet an elastic demand from the market participants. The price in the primary auction would be the intersection point and would only be dependent on the demand from market participants. This might result that the EPAD contracts are traded at discount at auction compared to actual EPAD market values at continuous trade.

The possibility to get a contract at a lower price than the market price would, of course, also attract traders, not only market participants with a fundamental hedging need. Traders who have bought contracts in the auction have two alternatives, to keep the contracts until delivery or to resell the contracts.

The auctions would also create a risk that the liquidity will be concentrated around the time of the auctions, and then negatively affect liquidity at other times. The EPAD contracts' liquidity concentration, which was resulted by the Danish Virtual Power Plant auctions, has already been noticed.

It is also a question how the auctions would affect the behaviour of market participants with a fundamental hedging needs on regular (secondary) exchange trading. If the hedging needs are covered by the auctions then hedging interest will disappear from the regular market place, thus worsening the liquidity in the continuous market. The outcome of this would depend on how much activity the auctions would create in the secondary market, if hedging interest will primarily participate in the auctions and the parameters of the auction such as frequency and auction products.

Furthermore, it is not recommended that the TSOs should have the possibility to reduce its positions via continues trading. Continuous trading by a TSOs is questionable from a market and cost viewpoint. It can easily raise questions regarding trade based on TSOs inside information, it requires that clear criteria are established, and that such trading is announced well in advance. Under such conditions, the TSO would not be able to reduce financial risks and use the contracts trading in continues market.

Auctioning of EPAD contracts may result in a direct increase of the traded volume, but could result in the continuous market liquidity concentrating around the time of the EPAD auctions. The behaviour of market participants would be affected, which would not necessary mean the positive impact on continues market. Hence, the timing, place, volumes and products in the EPAD auctions have to be considered carefully by the TSOs to ensure the correct effect of the measure.

3.5. Buying/selling EPADs through a service provider

This option means that the TSO use a third party, a service provider, to trade EPADs in the continuous EPAD market. The service provider is chosen through a tender and given a mandate from the TSO stating what volumes to be bought/sold, in what areas and within what period of time. Then the service provider itself optimise the buying/selling within this mandate.

This option means that the TSO itself is not directly involved in the EPAD market and therefore keeps its neutral position. Another benefit is that the continuous EPAD market is

supported, making this more liquid without the risk of only gathering the liquidity around the auctions of EPADs, as in the alternatives above.

However, one downside with this option is the amount of information the service provider will be given through its mandate from the TSO. The volumes traded will probably be substantial and affect the market. This could also increase the uncertainty in the price formation, since the service provider can be in a situation where it has to buy/sell a large amount within a short period of time and therefore affect the price a lot.

3.6. Other necessary arrangements

FCA does not specify that hedging options should be "locally" based. Thus when considering cross-border trade hedging options, all viable options/combination of products enabling hedging of prices in Lithuania should be taken into account: such as for e.g. combination of FTR-Option on Estonia – Latvia border (PTR – limited) in combination with Finnish, Estonian bidding zone hedging options available at Nasdaq OMX. It may prove practical that combination of these products together with financial products available for Swedish (SE4) and Polish market enable long term hedging of Lithuania – Sweden, and Lithuania – Poland cross-border trade.

i. Increase FTRs-options volume on EE-LV border

Currently, the Estonian and Latvian TSOs offer market participants up to 550 MW of FTR-Option in the direction from Estonia to Latvia. This type of contracts are directly related to the forecasted capacity on the bidding zone border. Currently both TSOs use their own principles how to evaluate the long-term capacities and split forecasted capacity between different timeframes. Using the “lesser rule” the final offered capacity is agreed between TSOs.

According to the FCA NC article 10 and 16 TSOs within Baltic Capacity Calculation Region must develop The Capacity Calculation Methodology for long-term and the Methodology for Splitting Cross-zonal Capacity for long-term after the Baltic Capacity Calculation Region Methodology for Capacity Calculation for day-ahead and intraday markets has been approved by the NRAs.

Impact on market

According to the statistics of FTR-Option auctions[25], the demand for this hedging product substantially exceeds the supply. Increase of offered FTR-Option volumes will allow market participants (both Latvian and Lithuanian) to hedge their positions against price risks. In order to create almost perfect hedge, market participants combine FTR-Option contracts with EPAD Helsinki and System contrasts. Thus, higher volumes of FTR-Option should increase demand for EPAD Helsinki. In contrast, higher volumes of FTR-Option might reduce the demand for already illiquid EPAD Riga, as both products serve the same purpose – hedging price risks in Latvia/ Lithuania. It should be noted that above mentioned effect on demand on EPAD Riga is unambiguous and depends on market participants’ needs for hedge.

[25] PTR-Limited Auctions 2017

The following table 23 below contains the summary evaluation of analysed alternatives.

Table 23: Evaluation of possible risk hedging alternatives arrangements

Alternatives for improving risk hedging opportunities in the Baltics	Involved: Financial institutions	Involved: TSO + Financial institutions	Involved: Market participants + Financial institutions + TSO
Nasdaq introduces EPAD Vilnius	Not an effective solution because listing of EPAD Vilnius product will not improve the low liquidity of hedging instruments (similarly to EPAD Riga and EPAD Tallinn) but rather worsen the already low liquidity in EPAD Riga.		
EPAD Combo (SE4-LV) by Nasdaq/TSOs		Not an effective solution: • Legal rights of TSOs to involve in such activity is questionable, no clear regulatory framework • Not clear if the new EPAD auctions would provide better hedging opportunities than already well-established FTR auction model • No platform for such activity – not clear if Nasdaq (other) can offer such functionality and at what cost • Efficiency (costs vs benefits) of such financing activity is questionable	
TSOs support market makers' of			Not effective solution because

EPAD products with financial compensations			• Legal rights of TSOs to involve in such activity is questionable, no regulatory framework • Implementation obstacles: how to determine amount of financial compensations, how to select a receiver of financial compensations, etc. • It is unclear if such solution will effectively improve liquidity of EPAD products • Efficiency (costs vs improved liquidity) of such financing activity is unclear
TSOs auction EPADs		Not effective solution because • TSOs are not naturally hedged against such financial risks. Potential financial settlement pay-outs can exceed congestion revenues • Increases administrative costs for TSOs, investments in IT systems may be needed • Efficiency (costs vs benefits) of such activity is questionable •	
TSOs sells/buys EPADs through a service provider			Not effective solution because • TSOs are not naturally hedged against such

			financial risks. Potential financial settlement pay-outs can exceed congestion revenues • Legal rights of TSOs to involve in such activity is questionable • Implementation obstacles: how to determine price/amount of sold/bought volume, how to select a "service provider", etc. • Efficiency (costs vs improved liquidity) of such financing activity is unclear

4. Implications for TSOs

The different models for TSO intervention imply different administrative costs for the TSOs. The models may also imply different degrees of financial exposure for the TSOs, which in turn may imply extra risk costs. These administrative and risk costs are likely to be covered through grid tariffs or congestion income. These options are discussed in this chapter.

The discussion is based on the THEMA report "Measures to support the functioning of the Nordic financial electricity market", which was commissioned by NordREG in 2015 and common work of the Lithuanian, Latvian, Polish and Swedish TSOs.

4.1. Auction EPAD contracts or EPAD Combos

Administrative costs

If the TSOs decide to trade/auction off EPADs it is most likely necessary with a Chinese wall setup in order to maintain the confidence in the neutrality of the TSO. It has to be assed how strict this Chinese wall setup has to be. An example could be if the trading unit should be in another location in order to make sure that no inside information is passed from the TSO to the trading unit by accident. Another question is the separation of IT setup. In some cases the separation can be handled with access control, while in other cases separate systems may be needed. It is also an uncertainty to how high a degree the supporting functions can be shared e.g. finance and risk management. Risk management might need to be separate under any circumstances due to the fact that risk management tasks for a trading unit are different than the current tasks of the TSO.

Auctioning of EPADs would impose administrative costs for a TSO, which are related to establishing the auctioning plan, settlement with the clearinghouse, financial risk

management. Furthermore, the exchange would demand a payment for performing the auctioning process, which should be taken into account, if these options are considered. It may also be necessary to carry out a public procurement for the entity to perform the auctions.

How the Chinese wall set up will be conducted and to what costs need to be investigated.

Price risks

Auctioning of EPAD contracts and EPAD Combos implies that the TSO takes a market risk.

Thema report demonstrates that by auctioning **EPAD combos**, the TSO will earn the expected congestion rent, under the assumptions that:

- the contracted price difference for the EPADs is the expected price difference,
- the price expectations are unbiased,
- the price in B is never lower than the price in A[26],
- congestions between A and B is opposite of the expected price difference.

It was noted that the results hold because the EPAD Combo implies that the TSO sells EPADs in one bidding zone and buys EPADs in another zone. If an EPAD Combo implies that the TSO sells or buys EPADs in both bidding zones, the combination does not mitigate the TSO's financial exposure. This case is equivalent to buying or selling individual EPADs.

If the TSO offers **EPAD contracts** only in A or only in B, it is exposed to additional risks and the variability of the total TSO revenue is most often reduced compared to the full exposure to the spot congestion rent. To what extent the risk exposure is muted, depends on the relative price movements. By unilaterally buying EPADs, the TSO becomes exposed to the system price, whereas without EPADs the TSO is only exposed to the difference between the bidding zone prices. The risk exposure also depends on the correlation between the system price and relevant bidding zone price. Poor correlation increases the risk exposure.

Volume risks/firmness risks

Thema report underlines, that the volume of EPADs to be auctioned should be determined by the market need to yield sufficient hedging possibilities in the relevant bidding zones. This should not be related to the interconnector capacity between bidding zones.

If the auctioned volume of EPAD Combos is larger than the physical flow between the bidding zones, the TSO is exposed to the risk on part of the EPAD volume, since the congestion income will not cover the settlement of the EPAD Combos. The risk is equal to the difference between the expected congestion rent and the realized congestion rent. This means that the TSO incurs a net loss if the realized price difference between A and B is larger than the expected price difference. The same applies if the EPAD Combos are auctioned on a cross border interconnector where the congestion income is split between TSOs. Then the TSO auctioning the EPAD Combos are exposed to the above risk if the volume of EPAD Combos is higher than the corresponding volume that the TSO receives congestion income for. For example, if the cross border congestion income is split equally between the TSOs, i.e. 50% for each TSO, the TSO auctioning the EPAD Combos will face a risk if it auctions out a volume that is higher than 50% of the physical volume on the interconnector.

[26] Area B is deficit area where consumers lack sufficient hedging opportunity towards the area price difference and area A is a surplus area.

The TSO's financial exposure is fully related to the EPAD contracts, and not to the actual trade flows. To what extent the TSO faces such a "firmness" risk, depends on:

- how the volume of EPADs is determined,
- the interconnector capacity between the market,
- the variations in ATC values (available transmission capacity).

If the markets are liquid and the price expectations unbiased, the revenue over time, and the financial exposure should however be close to zero.

4.2. Support market maker function in EPAD contracts

Administrative costs

The main TSO cost for support to a market maker function in EPAD contracts is the fixed cost, which has to be paid to finance a market maker agreement for the concerned bidding zones with stricter demands on maximum spread and/or minimum volumes and/or presence in the market regarding EPAD contracts. It can be expected that this fixed cost will be higher if the requirements for the market maker are stricter.

This setup would not lead to any additional financial risk for the TSO. However, it is questionable if the TSO can directly negotiate with the existing exchange (Nasdaq OMX) to find a market maker, or if a public procurement is needed.

In case of procurement, it can be a procurement either for an exchange to contract a market maker or for the entity being the market maker itself. In any of the cases, there is a risk that the market maker will be active on another exchange but the existing one, Nasdaq. Therefore, there is a risk of splitting EPADs liquidity between several exchanges thereby adding to the current liquidity problems rather than solving the issue.

A procurement process for an entity being a market maker is also assumed to be more expensive for the TSO than just negotiating with one existing exchange because:

- the start-up costs of supporting the market maker would have to be covered;
- the existing exchange has the interest to increase the liquidity by itself, hence, the negotiations might result in lower costs if a combination of TSO and exchange interests are achieved.

There are two market makers for EPAD Riga contracts. However, Thema report underlines that the measure would be more cost-efficient, if the TSO supports only one market maker in a bidding zone, rather than two or more market makers. The main benefit with two market makers is that the combined minimum bid volumes makes it possible to directly exit a bigger position if stop-loss limits are reached. However, regarding the bid-ask spread it is possible for two market makers to follow the bids of each other in such a way that no essential reduction in the bid-ask spread is obtained in the market.

Hence, it is doubtful how to select a proper market maker considering not only the reasoning above, but also investigating if supporting a market maker could indirectly constitute state aid, and thus not be legal. However if there are limited or yet only single provider the problem may be that such procurement contain risk to be considered as state aid, or simply ineffective from cost perspective.

Price risks

This model does not change the TSO financial exposure. The payment to the market maker is fixed by the agreed contracts and for the period for which the market maker is contracted. The payment is not affected by realized spot prices.

Volume risks/firmness risks

There are no volume risks or firmness risks associated with this alternative.

Auction risks

There are no auction risks, since TSO would not be involved in the auction of EPAD contracts.
Impact on tariffs and TSO incentives

i. Tariffs

The Article 58 of FCA Regulation states, that costs incurred by TSOs arising from obligations in FCA Regulation shall be assessed by all regulatory authorities. Costs assessed as reasonable, efficient and proportionate shall be recovered in a timely manner through network tariffs or other appropriate mechanisms as determined by the competent regulatory authorities.

In other words, the TSOs obligation to support the functioning of financial markets will come at a cost for the TSOs that ultimately will be funded by tariff customers. It is important to consider if such cost provides a positive socioeconomic benefit for the consumers or the new measures is mostly benefiting speculative agents, which is not the aim of TSOs.

Furthermore, current financial market setup provides regional hedging opportunities (e.g. EPAD Riga covers both Lithuania and Latvia bidding zones). Moreover, proper tariff design complexity increase since not all EPAD market participants are TSOs customers (almost any entity can trade EPADs).

The inclusion of the costs in the tariff base is subject to regulatory approval, at the latest at the start of the next regulatory period. The financial market support action plan should take into account the regulatory period in order to ensure, that TSOs' costs will be covered and NRAs' decisions are provided on time.

The question is not really TSO financial exposure and their possible risk costs, but rather how the costs and risks of the end-users are affected by a TSO intervention, compared to the current situation. It should be kept in mind, that TSOs do not have relevant expertise in financial markets. Shifting the risk from a market participant to a TSO means socializing the market risk to the TSO's and finally to the end consumers via tariff.

ii. TSO incentives

TSOs' intervention in financial markets are not a natural activity, which can negatively impact the market participant's trust in the market and also trust and neutrality for the TSO. NRAs should be responsible to monitor and review the effectiveness of measures, while market participants should have full picture of TSOs actions in the market.

As result, the TSOs cost recovery mechanism should be transparent and designed in the way, that TSOs would have no incentive to set ATC values in order to minimise risk exposure and mitigate the costs.

5. Market impact

All market support models described above could mean a procurement procedure. In such case, the requested services could be provided by any exchange with different clearing houses. Formally, an open position with one clearing house can only be traded with a member of that clearing house. A market participant wishing to trade on several exchanges have therefore to be a member of these exchanges and their connected clearing houses. This results in extra fees, extra IT costs and extra collateral costs. To avoid those costs, the market participants could choose to be an under-customer to another big market participant and ceases to be a direct participant in the market.

To some extent, this change has already started. Nordic system price contracts are traded on EEX, and German financial contracts are traded on Nasdaq OMX. However, only a small part of the trading in these contracts have moved to the competing exchange. We conclude that liquidity is a very important factor when exchanges compete. Most of the trading on the competing exchange seems to be performed by members who also want to be able to trade contracts in another region on the same exchange. There are of course also big traders who are members of both exchanges and try to profit from arbitrage.

6. Legal assessment

Almost all of the options mentioned above require the TSOs to trade in financial instruments. From that perspective it is relevant to exam whether the EU Market Directive[27] allows the TSOs to carry out such activities. When discussing EPAD trading it is also important to have the MIFID II (Markets in Financial Instruments Directive) regulation in mind. Further, it should be looked upon whether the TSOs are allowed to use congestion rents as a tool to cost recover potential losses and costs from EPAD/EPAD COMBO trading/Market maker. When considering the recommendations regarding hedging opportunities on cross-borders we have looked also in the currently discussed Clean Energy Package proposed by European Commission and considering to be voted in the end 2017 or early 2018.

6.1. Economic conditions (coverage of costs)

There are in general two ways for TSOs to cover the costs which may arise due to the measures for supporting liquidity of the financial market under article 30 of the FCA Regulation; through either congestion income or through network tariffs.

The TSOs' use of congestion income is regulated in the Regulation (EC) no 714/2009. Pursuant to this provision, the TSOs can only cover costs related to measures under FCA Regulation Article 30 from the congestion income, if the cost recovery is for the purpose of i) guaranteeing the actual availability of the allocated capacity; ii) maintaining or increasing interconnection capacities through network investments, or iii) if approved by the NRAs up to a maximum amount.

Regarding the first measure, i), it is assessed that it is most likely not possible for TSOs to use congestion income to cover the costs of measures for supporting financial markets, unless directly connected to the capacity of interconnectors, which is not the case for the contemplated measures.

Concerning ii) it is assessed that the different arrangements also fall outside the scope of this part of the provision, as the measures and the costs incurred are not taken for the purpose of "*maintaining or increasing interconnection capacities*".

Under iii), the NRAs may allow congestion income to be included in the calculation of network tariffs to the extent it cannot be efficiently used for the purposes mentioned under i) and ii). Consequently, the use of congestion income is in any case subject to NRA's indirect approval.

It is finally noted that there does not seem to be a clear or consistent practice in the EU NRAs' handling of costs in relation to the use of congestion income.

The legal framework for the use of network tariffs is less specific. The Directive 2009/72/EC sets out general principles of the NRAs approval of costs to be included in the calculation. Additionally, FCA article 58 states that costs arising from the FCA regulation should be assessed by all NRAs and recovered through network tariffs or other appropriate mechanisms as determined by the competent NRA.

In the first instance it will therefore be up to the NRAs to decide if the measures are acceptable, and afterwards to form an opinion of whether the associated costs comply with the general principles set out by the Directive 2009/72/EC and FCA Regulation.

[27] Directive 2009/72/EC concerning common rules for the internal market in electricity, (the "Market Directive")

The new Energy Regulation proposal is covering also the use of congestion rents issues and the currently prevailing opinion of the legislator proposal is to use these revenues only for maintaining or increasing interconnection capacities through network investments, in particular in new interconnectors and internal lines with cross-border relevance, but not anymore to be used also as income to be taken into account by the regulatory authorities when approving the methodology for calculating network tariffs and/or fixing network tariffs. This leads the issue of the TSOs participation in the implementation of financial risk hedging instruments under serious doubt.

6.2. Regulation of the TSO activities

The tasks of the TSOs are generally described in the Market Directive, but are not exhaustive. Under the Market Directive, TSOs play an important role in achieving the directive's goal of moving towards a fully liberalised internal market in electricity.

From the wording of the Market Directive it is clear that issuing or trading financial instruments in support of the financial electricity markets is not a core task of the TSOs. However, this does not necessarily mean that TSOs are prevented from carrying out such activities either.

6.3. Financial regulation

MIFID II regulates trading with financial instruments including energy derivatives, and comes into force January 1st 2018.

TSOs are not currently governed by MIFID, which is why trading financial instruments would add a whole new section of regulation that the TSOs would have to comply with.

If a TSO will support the liquidity of existing EPADs market by entering into EPAD contracts directly with counterparties on its own account. This kind of trading activity is considered an investment service or investment activity according to MiFID II, provided that the activity is carried out with financial instruments comprised by MiFID II. As EPADs constitute commodity derivatives contracts it may be assessed that they are comprised by MiFID II. As a result, TSOs will, *prima facie*, become subject to MiFID II. However, it is assessed that TSOs will most likely be able to rely on the TSO exemption in article 2(1)(n) of MiFID II.[28]

According to our legal assessment TSO's may be exempted from MIFID II regulation under article 2(1)(n). This however requires that the task is carried out in the Market Directive, that the services only involve commodity derivatives and that the TSO is not operating a secondary platform. It is assessed that the TSO's can fall under these requirements, however as there is no official definition of what it is to operate a secondary platform, the biggest uncertainty is around this question. It would have to be cleared with the financial regulators in the countries of the TSO's that would want to trade EPADs due to article 30 under GL FCA, that the TSO does not fall under MIFID II.

According to current legislation it is not obvious that TSOs are allowed to use congestion rents as a tool to cost recover potential losses and costs from EPAD/EPAD Combo trading.

6.4. Conclusion

As the trade of financial instruments is not specifically stated in the Market Directive as a task of the TSOs, and there are no clear direct regulation(s) regulating TSOs entering financial markets it may be concluded that the legal mandate for entering financial market

by TSOs is not clear and involves some legal uncertainties. Such activity would also include uncertainties regarding related TSOs financial cost coverage.

7. Conclusion

The TSOs (AST, Litgrid, Svenska kraftnät with involvement of PSE) in response to relevant specific LT-LV, LT-SE4, LT-PL cross-border bilateral NRAs decisions regarding hedging opportunities on cross-borders pursuant FCA Guideline has made an analysis on the hedging options within Baltics, Sweden (SE4), Poland. The conclusions are presented below.

7.1. Currently available hedging options

Today there is a financial market connecting to the Nordic- Baltic electricity whole sale market with high liquidity in the spot price, providing good possibilities to have full hedge in all Nordic - Baltic bidding zones. Existing Nordic - Baltic hedging options together with existing Polish Financial Instrument Market with Physical Delivery provides means for hedging of trades on relevant LT-LV, LT-SE4, LT-PL cross-borders.

TSOs conclude that structural congestion on Lithuania and Latvia cross-border is not present neither in direction LT->LV, nor in direction LV->LT. TSOs view that there is no requirement and need for any additional LT-LV cross border hedging products to be introduced.

Lithuanian NRA's concluded (analysis document dated May 3rd, 2017 annexed to the Lithuanian NRA's decision dated May 11th, 2017) that prices of the Lithuanian and Latvian price zones are very similar and strongly correlated and the price differences are very small. Based on this NRA also note that though there are no EPAD specifically created for the Lithuanian price zone, EPAD Riga can be used for hedging by market participants for both Lithuanian and Latvian bidding zone prices.

For Lithuanian cross-borders where structural congestion is present and thus there may be a need for long term electricity trade hedging, there are available financial markets products (system price ENO in combination with EPADs by Nasdaq OMX and Polish Electricity Forward Market) that directly can be utilised for hedging on LT-SE4 and LT-PL cross-borders.

- System price product ENO in combination with Riga and EPAD Malmo (SE4) products offered by Nasdaq OMX EPAD as option for hedging Sweden (SE4) -> Lithuania cross-border trade.
- System price product ENO and EPAD Riga in combination with a suitable Polish Financial Instrument with Physical Delivery provides an option for hedging Lithuanian – Polish cross border electricity trade hedging.

It should be noted that FCA guidelines does not require that the effective hedging options/products should be enabled through locally based products/platforms. The practicality of this approach is well proved by current hedging practices, for e.g. Nasdaq's EPAD Helsinki is actively being used by Baltic market participant for hedging Estonian area prices, or EPAD Helsinki in combination with EE-LV FTR-Option for hedging prices in Latvia, Lithuania. Thus when considering cross-border trade hedging options all viable options/combination of products enabling hedging of prices for particular area should be taken into account.

7.2. Assessment

Evaluating the above products performance (based on year 2016 data) it may be observed that EPAD Malmo (SE4) open interest volumes show that hedging with this product range from 9% to 17 % of bidding zone's consumption. The EPAD Malmo (SE4) average bid-ask spread was comparatively low – on average 0,7 EUR/MW. Considering the EPAD Malmo (SE4) trading results, the Swedish NRA, Energimarknadsinspektionen, has assessed that the long-term hedging opportunities in SE4 are sufficient.

It may be concluded that Polish power exchange provides viable and sufficient means for long-term hedging of Polish electricity prices. On average volume of Open Interest vs. Physical consumption (%) hedged in Polish Financial Instrument Market with Physical Delivery varies between 20 – 26 %. As a result, the Polish NRA concluded, that there are sufficient conditions to hedge prices on Polish electricity market.

Considering EPAD Riga, trading volumes for the various time horizons and actual Open Interest positions in relation to combined physical consumption of Lithuania and Latvia, it can be stated that the level of activity of an EPAD Riga remains very low (less than 1 percent).

Evaluating the products performance (based on year 2016 data) it may be concluded that also EPAD Tallinn trading activity is low, the traded volume ratio to physical consumption is lower than 1 percent. As such it can be stated that the market participants are not interested in EPAD Tallinn contracts to hedge their assets. The relative non-existence of trade in EPAD Tallinn and low activity of the EPAD Riga shall be viewed considering that NordPool's Estonian area prices closely correlate with the Finnish price area and market participants tend to use the more liquid EPAD Helsinki product for their hedging needs. In addition it should be noted that Estonian-Latvian TSOs also offer the FTR-Option product on the Estonian – Latvian border, which among other reasons in comparison to EPAD Riga is cost-wise beneficial and therefore a preferred option for market participants to purchase/sell. Hence market participants tend to use the EPAD Helsinki product in combination with EE-LV FTR-Option for their hedging needs for Latvian – Lithuanian bidding zone prices. Thus this factor diminishing demand for EPAD Riga products should be taken into account.

In Table 24 it may be observed that EPAD Riga BID – ASK spread ratio to the actual Bidding Zone (Riga) – SYS price difference is in line with EPAD Helsinki. However, it should be noted that buyers for EPAD Helsinki on average are willing to Bid and pay the risk premium for hedging, whilst buyers of EPAD Riga on average are not interested to pay this hedging risk premium. The sellers of EPADs Riga ASK bids are in par with their Finnish counterparties, however buyers of EPADs in Lithuania/Latvia's bidding zone are aiming for the discount, this leads to the comparatively high 5.10 EUR/MWh EPAD Riga BID-ASK spread compared with 0,97 EUR/MWh BID-ASK spread of an EPAD Helsinki product.

Table 24: Auction data differences between EPAD Riga and EPAD Helsinki:

	Average BID, EUR/MWh	BID and actual BZ - SYS price difference EUR/MWh (% to BZ - SYS price difference)	Average ASK, EUR/MWh	ASK and actual BZ - SYS price difference (% to BZ - SYS price difference)	Average BZ - SYS price difference, EUR/MWh	Average Bidding Zone price, EUR	Average SYS price, EUR
EPAD Riga	9,63	-1,14 (-11 %)	14,73	3,96 (37 %)	10,77	36,99	23,72
EPAD Helsinki	6,81	1,06 (18 %)	7,78	2,03 (35 %)	5,75	31,97	

Note 1: The average data are aggregated from month and two months ahead auction on NASDAQ OMX for the year 2016.

Based on the EPAD Riga and EPAD Helsinki data comparison, it should be noted that that EPAD Riga as product is an ineffective solution (this is proved by EPAD Helsinki success), however market participants do not use EPAD Riga extensively. This is to great extent because market participants choose to use other available option(s) such as EPAD Helsinki + EE/LV FTR option for hedging trading within LT/LV. Also it should not be disregarded that high volume of hedging may take place within generation / consumption portfolios of few incumbent Baltic market "champions".

In order to make hedging utilising EPAD Riga product more effective substantial improvements in its performance would need to be attained. Following suggestions on improving the efficiency of EPAD Riga may be needed:

- **Market makers role for EPAD Riga may need to be improved**, however this role should be attributed to market participants. Participation in Financial Forward Markets is not a "natural" part of TSOs business, and TSO should not be counted as liquidity provider or market maker within financial markets, due to high risks and costs of such activity to TSOs and subsequently end consumers.

- **Market participants may need to adjust their market behaviour for make trading EPAD Riga product more effective**: it may be observed that EPAD Riga BID – ASK spread ratio to actual Bidding Zone (Riga) – SYS price difference is in line with EPAD Helsinki. However, it should be noted that buyers for EPAD Helsinki on average are willing to Bid and pay the risk premium for hedging, whilst buyers of EPAD Riga on average are not interested to pay hedging risk premium, and act seeking to gain by hedging at a discount in financial market. Ungrounded aiming of the buyers for hedging at a discount may be one of the core reasons for low trading volumes for EPAD Riga, as normally hedging should come with some risk premium payments.

7.3. Possible solutions

Considering the currently available hedging products and taking into account that EPAD Riga is not actively traded, TSOs looked into various possible solutions to make sure that other long-term cross-zonal hedging products are made available to support the functioning of wholesale electricity markets.

It should be noted that as **the trade of financial instruments is not specifically stated in the Market Directive as a task of the TSOs, and there is no clear direct regulation regulating TSOs entering financial markets** (for e.g. Nasdaq/EPAD trading or market maker supporting activities) legal mandate for entering financial market by TSOs is not clear and involves some legal uncertainties. **Such activity would also include uncertainties regarding related TSOs financial cost coverage**. Considering the lack of legal regulation and interpretation of the current regulatory legal framework TSOs should not be engaged in deeper in any form in facilitation of the currently functioning financial risk hedging market.

As a general note it should also be taken into account the fundamental Baltic market problem that TSOs are not in power to solve. Baltic electricity market is highly concentrated, meaning that few incumbent market participants make up large share of the generation and demand within Baltics. Consequently, large portion of hedging is done within incumbent market participant's generation/demand portfolio's, thus lowering overall hedging supply and demand (incl. for EPAD Riga). Additionally, due to current market conditions and regulated prices the need for hedging among electricity suppliers is limited.

7.4. Proposal for way forward

Considering evaluations of legal framework and analysis on existing hedging options within Baltic - Nordic regions and Poland, TSOs believe that the most efficient way forward is to focus on existing hedging options and continue with development of grid and increasing the transmission capacity of congested borders.

Focus on existing hedging options set up

As already available Baltic – Nordic – Polish long term products provide hedging options for wholesale market participants, TSOs propose to focus on utilisation and optimisation of existing hedging options set up by wholesale market participants. Shifting the risk from a market participant to a TSOs means socializing the market risk to the TSO's and finally to the end consumers via tariff.

Expansion of congested border's capacities

TSOs should not interfere into the financial market. A more effective means that is in the hands of TSOs is grid development further expansion of cross-border capacities.
E.g. LitPol Link project finalization, EE-LV border expansion by building new HVAC line foreseen by 2020.

- The expansion of EE – LV border capacities may reduce differences between EE and LV/LT (and bring wider Baltic- Nordic price convergence). It should also facilitate better access and promote access to a well-functioning hedging in Finnish/Estonian EPAD.

- Building interconnectors is a core business of TSOs. It does not threat trust in TSOs, neither does bring added costs in terms of administration or risks. It also improves the functioning of the physical as well the financial market and gives market participant measures to be active to solve the lack of liquidity.

It would not be worth to take any other measures on board they could be in place at the earliest at the end of 2018 together with added cost and uncertainty this would bring the market.

Regional discussion may be needed and decisions taken on the coherence of existing hedging products/options.

It needs to be emphasized that the liquidity of EPAD Riga or other financial market products is a complex issue that needs to be addressed at the regional level. Possible steps and decisions for increasing the liquidity and efficiency of EPAD Riga should be considered in conjunction with regional level decisions such as the operation of competing products (for e.g. such as in essence is the EE-LV FTR-option product). This hold true considering that EPAD Riga (or any other of considered products) liquidity would be increasing at the expense of the other. As a result actions of particular cross – border TSOs can have detrimental effect on the other border (TSOs offered products) and can have a negative socioeconomic effect on regional level at the expense of the end consumers.

8. Recommendations

8.1. Lithuania - Latvia (LV-LT) border

As structural congestion is not present neither in direction LT->LV, nor in direction LV->LT, in TSOs view and conclusion based on data analyses is that there is no requirement and need for LT-LV cross border hedging products to be introduced in either direction.

EPAD Riga can be used for hedging by market participants for both Lithuanian and Latvian bidding zone prices.

Considering the lack of legal regulation and interpretation of the current regulatory legal framework TSOs can't be engaged in deeper in any form in facilitation of the currently functioning financial risk hedging market.

Latvian TSO and Estonian TSO are executing currently investment project planning and later its implementation for the Estonian – Latvian border. The investment will be implemented in 2020 and from then it shall alleviate the currently existing structural congestion on this border and ultimately will also lead to the integration of the Latvian and Lithuanian bidding zones in deeper price convergence between Estonian bidding zone and Latvian and Lithuanian bidding zones combined.

8.2. Lithuania- Sweden (LT-SE4) border

Analysis of the market data show that structural congestion is present (direction from SE4 to LT).

FCA guidelines do not require that hedging should be enabled through locally based products/platforms. Thus, when considering cross-border trade hedging options all viable options/combination of products enabling hedging of prices for particular area should be taken into account.

As of today a number of hedging product options designated for Nordic - Baltic hedging needs **are available**: Nasdaq OMX traded EPADs (for NordPool's EE, LV/LT, FI, SE4 etc. price areas), TSOs' traded FTR-Option on EE-LV border. These various combinations of ENO(SYS) and EPAD Riga with available Nordic EPADs (Malmo, Helsinki + EE/LV border FTR option) provide means for hedging of LT-SE4 border.

For hedging LT- SE4 prices following options can be utilised:

- ENO(SYS) product with EPAD products as currently offered by Nasdaq OMX, i.e. **EPAD Malmo (SE4) and EPAD Riga** for hedging Sweden (SE4) -> Lithuania cross-border trade.

- ENO(SYS) product with EPAD products as currently offered by Nasdaq OMX, i.e. **EPAD Malmo (SE4) and EPAD Helsinki in combination with EE-LV FTR-Option** for hedging prices in Latvia, Lithuania.

8.3. Lithuania – Poland (LT-PL) border

It can't be concluded that there is structural congestion on Lithuania – Poland cross-border (LitPol Link). **It needs to be noted that the LitPol project is not yet fully completed**, i.e. Ostrołeka-Stanisławów is still under construction. It is highly probable that the LitPol link's capacity will become more stable and predictable, when LitPol project will be fully completed (scheduled for 2021).

If Lithuania - Poland cross-border trade hedging means would be needed, following options can be utilised:

- Hedging the Polish bidding zone electricity price utilising **Polish Financial Instrument Market** with Physical Delivery in combination with products as currently offered by Nasdaq OMX i.e. **ENO(SYS) + EPAD Riga** (enables hedging LT price).
- Hedging the Polish bidding zone electricity price utilising **Polish Financial Instrument Market** with Physical Delivery in combination with products as currently offered by Nasdaq OMX i.e. **ENO(SYS) + EPAD Helsinki in combination with EE-LV FTR-Option** (enables hedging LT price).

8.4. Expansion of cross-borders capacities

TSOs should not interfere into the financial market. A more effective means that is in the hands of TSOs is grid development further expansion of cross-border capacities.
E.g. LitPol Link project finalization, EE-LV border expansion by building a new HVAC line foreseen by 2020.