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A financial electricity market in the Baltic States
Report from Houmoller Consulting

1. Executive summary
1.1 The task
Elering has charged Houmoller Consulting with the task of carrying out a feasibility study analysing the potential for financial instruments in the Baltic electricity markets.

The feasibility study investigates, weather financial instruments are needed.

If "yes":
* Which kind of instruments will be relevant on the Estonia-Latvia border and what is their theoretical background?
* What are the different options?
* Who would be the party establishing the financial instruments? If it is (partly) TSOs, what will be the obligations and risks for the involved TSOs?
* How can trading with Baltic, financial contracts in practice be launched?
* How can financial instruments and the spot market mutually support each other?
* What are the preconditions for implementing FTRs (financial transmission rights), when should this be implemented?

1.2 The study's conclusions
The study recommends having financial instruments in the Baltic electricity markets. Please refer to chapter 4: here it's discussed how the financial and physical markets support each other and how they mutually can enhance each others' liquidity. Note that this is a general observation – it's not a speciality for the Baltic electricity markets.

For the Estonian-Latvian border – as well as for other Baltic borders – **the study recommends the establishment of financial transmission rights** (FTRs).

The Baltic and the Nordic TSOs are the parties responsible for establishing FTRs on the Baltic interconnectors. The TSOs' risks and obligations are described in detail in chapter 9.

The risk is selling the FTR capacity too cheaply.

At the outset, the TSOs' obligations are very modest: it sums up to establishing and operating the FTR auctions and the associated settlement system. However, as described in chapter 9, MiFID II is a sort of "dark horse": as MiFID II is currently being drafted, it's impossible to say whether MiFID II will saddle TSOs operating FTR auctions with extra obligations.

As for the other FTR practicalities: they are described in chapter 10. If the MiFID II requirements turn out to be manageable, the main practical challenge is to establish and carry out the multinational project required for launching FTRs.

An alternative to FTRs would be launching Baltic CfDs – similar to the existing Estonian-Nordic CfDs. However, the CfDs have very low liquidity and are not much used by the market players, as table 1 illustrates. Hence this option is considered unviable.

Another alternative to FTRs would be launching Baltic financial contracts having the average Baltic spot price as the underlying reference.[1]

However, with a total consumption of about 26 TWh, it's estimated the Baltic electricity market do not have a size, which can support such a stand-alone financial market. The Danish experiences described in chapter 6.4 do not encourage this approach.

When Estlink 2 becomes operational in 2014, the total capacity between Estonia and Finland will be 1000 MW. With this capacity, we may have a situation, where there will be a high correlation between the Estonian and the Finnish spot prices. In this case, Estonian market players may use the current Finnish price hedging system (System Contract plus Finnish CfD). For Estonia, the border Estonia-Latvia will in this case become the interesting border for FTR.

2. Introduction

The chapters 3 and 4 describe the electricity market's price volatility and the connection between the physical and the financial market. Chapter 5 explains why liquidity is crucial for both the physical and the financial market.

The chapters 6 and 7 describe the current Baltic-Nordic financial market and the TSOs' role in this market. Note that table 1 is the vital element in the description of the current financial market.

Chapter 8 presents the study's conclusion: the Baltic TSOs must offer FTRs in order to provide the market players with viable hedging options.

[1] The volume-weighted average of the Estonian, Latvian and Lithuanian spot prices could be the underlying reference for such financial contracts.

For FTRs, the chapters 9 and 10 discuss the TSOs' obligations and risks, and the practicalities of launching Baltic FTRs.

Appendix A describes how the current financial contracts work. It is strongly recommended you start with reading appendix A, if you are not familiar with the functioning of financial electricity contracts.

Appendix B explains how FTRs work and how they can be used for hedging. Before reading the chapters 8-10, it's recommended you read appendix B, if you're not familiar with FTRs.

Appendix C contains a list of the terms and acronyms used in this document.

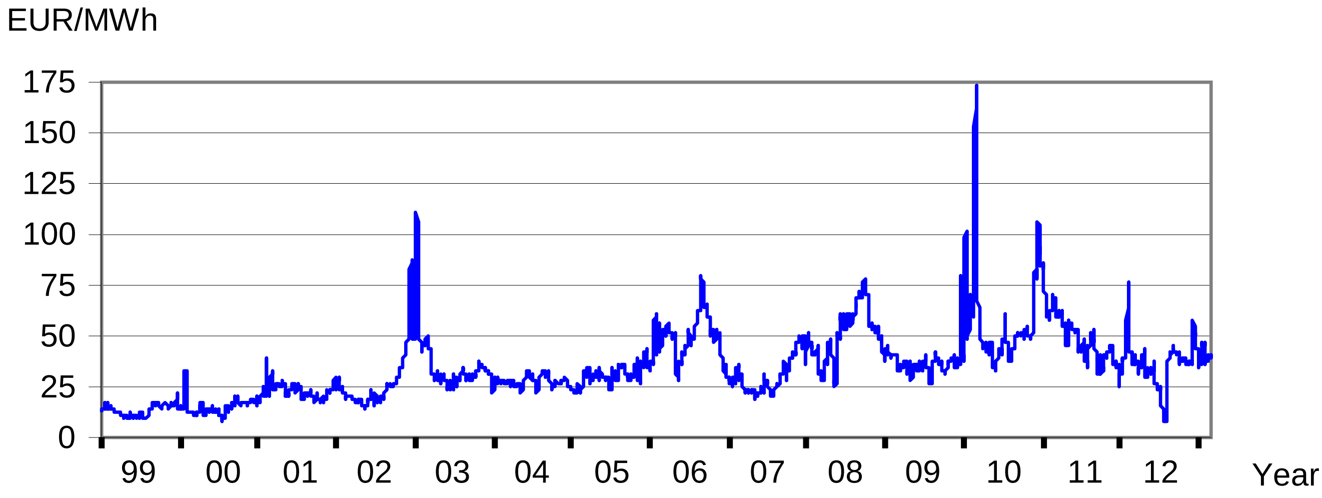

Fig. 1 Finnish spot prices 1 Jan. 1999 – 28 Feb. 2013. Moving 7-days average.

3. The electricity market's price volatility

The electricity market has extreme price volatility. For a case, please refer to fig. 1: here you have the moving 7-days average of the Finnish spot prices from January 1999 to February 2013. During this period, the moving average fluctuates between 8 EUR/MWh and 173 EUR/MWh.

The extreme volatility is due to two factors:

* On the supply side, fluctuations in the prices of fossil fuels and in the content of the hydro reservoirs create huge variations in the sellers' offer prices.

* The demand is very inelastic (ie, insensitive to the price).
  For the consumers, in the short term, it's very hard to reduce electricity consumption: it's difficult to do without the services provided by electricity. Further, in the short term, substituting electricity with another commodity is not easy.

4. The connection between the physical and the financial market

In order to investigate this connection, let's consider a case: a retailer who has just signed a contract with a big, industrial end user. The retailer will sell the end user electricity for the year 2014 at a fixed price of 42 EUR/MWh. The retailer assumes his customer will consume about 100 MWh during 2014.

Having sold energy, the retailer must buy the 100 MWh at the whole-sale market. However, the retailer need not buy the energy yet. All the retailer needs for now, is a financial contract.

For example, the retailer's profit is fixed at 2 EUR/MWh, if the retailer enters into a financial contract with a hedging price of 40 EUR/MWh.

When we actually arrive at 2014, for this customer, the retailer can daily from the spot exchange buy an amount of energy corresponding to the customer's consumption. Even though the retailer is buying the customer's energy from the spot exchange, the spot price is of no concern for the retailer: by means of the financial contract, the retailer has fixed his profit.

Without a financial contract, it would be very risky for the retailer to plan buying the 100 MWh by means of daily purchases from the spot market during 2014. This is because the whole-sale price of electricity is very volatile, as described above.

As can be seen, the financial market supports the spot market by making it possible for a retailer to plan buying from the spot market, even if the retailer has promised his customer a fixed, future price.

Thereby the combination of a spot market and a financial market makes it possible for players without electricity production facilities to operate as retailers. This improves the competition at the retail market, as the entrance barrier to the retail market is lowered: without the physical and the financial market, a retailer must either own power stations – or the retailer must go through tortuous bilateral whole-sale negations each time he has a new, big end user in his sights as the next customer.

Due to the extreme price volatility, it would be very hard to have liquid spot markets without the financial markets' hedging opportunities.

Naturally, for a producer, the financial market provides a corresponding hedging opportunity: by entering into a financial contract, the producer can hedge against low prices.

On the other hand, the spot market provides the reference price, which is used when the financial contracts are settled.

In this way, the financial market and the spot market mutually support each other.

5. The importance of liquidity

5.1 Liquidity at the spot market

It is imperative the spot price is reliable. Otherwise the market players will not trade at the spot exchange. With an unreliable spot price, producers will asses they can probably sell at better prices at the bilateral market. Correspondingly, retailers will make a similar judgement.

Naturally, both parties cannot trade at netter prices at the bilateral market. However, the sellers and the buyers will prefer the safety of bilateral negotiated prices, if the spot market's prices are seen as casino prices without a firm anchoring to the actual market situation.

Reliable spot prices mean prices faithfully reflecting the market situation.

A necessary condition for reliable spot prices is high liquidity. Among other things, high liquidity implies individual players' decision to buy or sell will not affect the spot prices.

As noted in chapter A4 in appendix A: reliable spot prices are also a necessary condition for a well functioning financial electricity market. In turn, a well functioning financial market will support the spot market's liquidity. Hence, high spot liquidity will normally lead to a virtuous circle where liquidity promotes liquidity.

5.2 Liquidity at the financial market

Also at the financial market, liquidity is a necessary condition for a well functioning market.

Without high liquidity, a few players' decision to enter into contracts can change the hedging prices a lot – thereby creating volatility unrelated to the actual market situation. In turn, this brings about a feeling the market is a casino best avoided by sane players. This is the vicious circle, where lack of liquidity creates lack of liquidity.

In the Nordic area, the physical market is simply used for trading reflecting production and consumption of electricity. Speculation takes place at the financial market. Speculation feeds liquidity to the financial market and thereby makes it difficult for individual players to change the hedging prices: if the speculators regard a change of the hedging prices as being against the true market situation, they'll move in and start trading – thereby restoring the hedging prices to values accepted by the market as a whole.

Again, we may have the vicious circle where lack of liquidity creates lack of liquidity: with low liquidity, it's exceptionally risky to be a speculator. If you take a speculative position in a financial contract, the lack of liquidity may make it very expensive to get out of this position. Hence, stop-loss strategies are difficult to employ effectively. This will deter competent speculators from operating in low-liquidity markets.

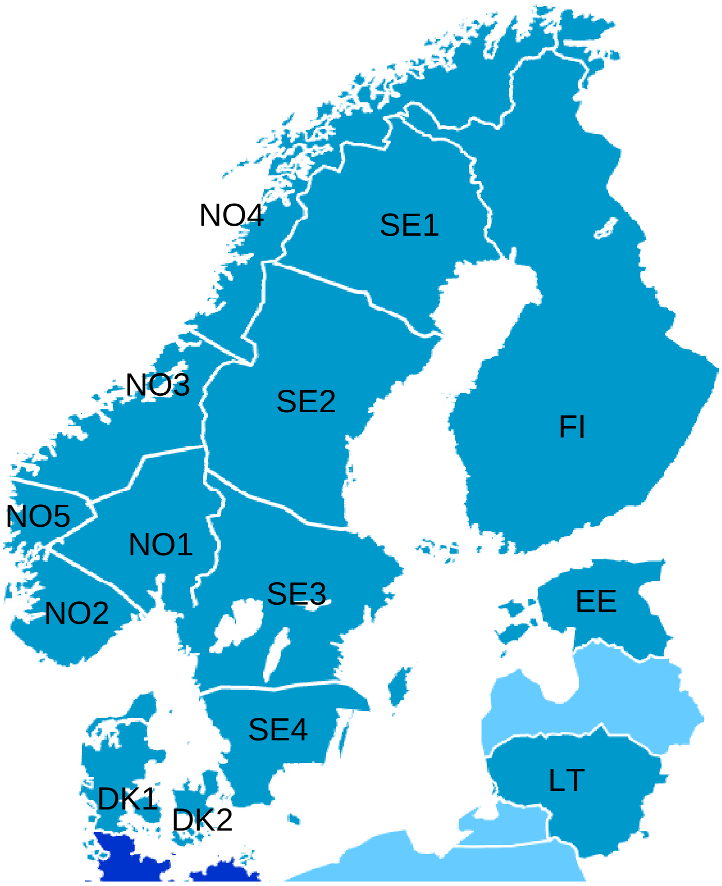

Fig. 2 The current Baltic-Nordic price zones

6. The Baltic-Nordic financial electricity market

6.1 The Nordic System Price

Figure 2 illustrates the Baltic-Nordic price zones. As can be seen, we have currently 14 prize zones. We'll have 15 zones from the summer 2013 where a spot quotation will formally be established in Latvia.

In 2012, the consumption in the Baltic-Nordic area was about 413 TWh[2].

[2] Sources: ENTSO-E and www.nordpoolspot.com.

As for price hedging: naturally, the market players prefer a hedging as perfect as possible. For a market player operating in the Swedish price zone SE4, the perfect hedge is a hedge against precisely the spot price of SE4, for example.

Unfortunately, there's an inherent contradiction between the liquidity requirement and the desire for a perfect hedge.

With SE4 as the case: the annual consumption is about 25 TWh. With a consumption of this size as the base, it's impossible to create a liquid, financial market.

Nasdaq OMX therefore uses a virtual price as the starting point for the company's Nordic financial contracts: the Nordic System Price is the theoretical price there would be in the Nordic countries, if there were no grid bottlenecks in the area covered by the four countries.

At the outset, a SE4 market player looking for a hedge must enter into a System Price contract. This gives the player a hedge against the virtual System Price.

6.2 Contracts for Difference (CfDs)

However, as can be seen from table 1: last year, the correlation between the SE4 spot price and the System Price was only 0.88. Hence, in order to get a better hedge, the player may also enter into a SE4 CfD contract. The CfD hedges against the risk there is a difference between the SE4 spot price and the System Price.

Figure 3 illustrates the settlement for a producer having both a CfD and a System Price contract. In the example, the spot price in the producer's area turns out to be 44 EUR/MWh. This is 8 EUR/MWh lower than the total hedging made by the producer.

As can be seen – the producer receives the 8 EUR/MWh in two separate settlements:

* A settlement yielding 5 EUR/MWh, because the System Price turned out to be 5 EUR/MWh lower than the System Price contract's hedging price.
* A settlement yielding 3 EUR/MWh, because the difference between the area price and the System Price turned out to be 3 EUR/MWh lower than the CfD's hedging price.

Therefore, it's a system similar to LEGO bricks: a player wanting a hedge against an area price needs two financial contracts – a System Price contract and a CfD.

6.3 The experiences from the Baltic-Nordic financial market

Referring to table 1: players in SE1, SE2, SE3, NO1, NO3 and NO4 do not necessarily need a CfD contract in order to get a reasonable hedge. This is because the correlation between their area prices and the System Price is high.

Therefore **players in these Scandinavian price zones are well served by the System Price contracts**.

Naturally, for the Swedish price zones, it's hard to say, whether the correlation will stay high in the future. We do not have much experience with this, as Sweden was split into four price zones 1 November 2011. Presumably, this is why the SE3 Open Interest is not negligible.

Probably, the very low Open Interest for the NO1 CfD reflects confidence that the NO1 area price will stay well correlated with the System Price (ie, the NO1 players estimate System Price contracts will continue to give a reasonable hedge).

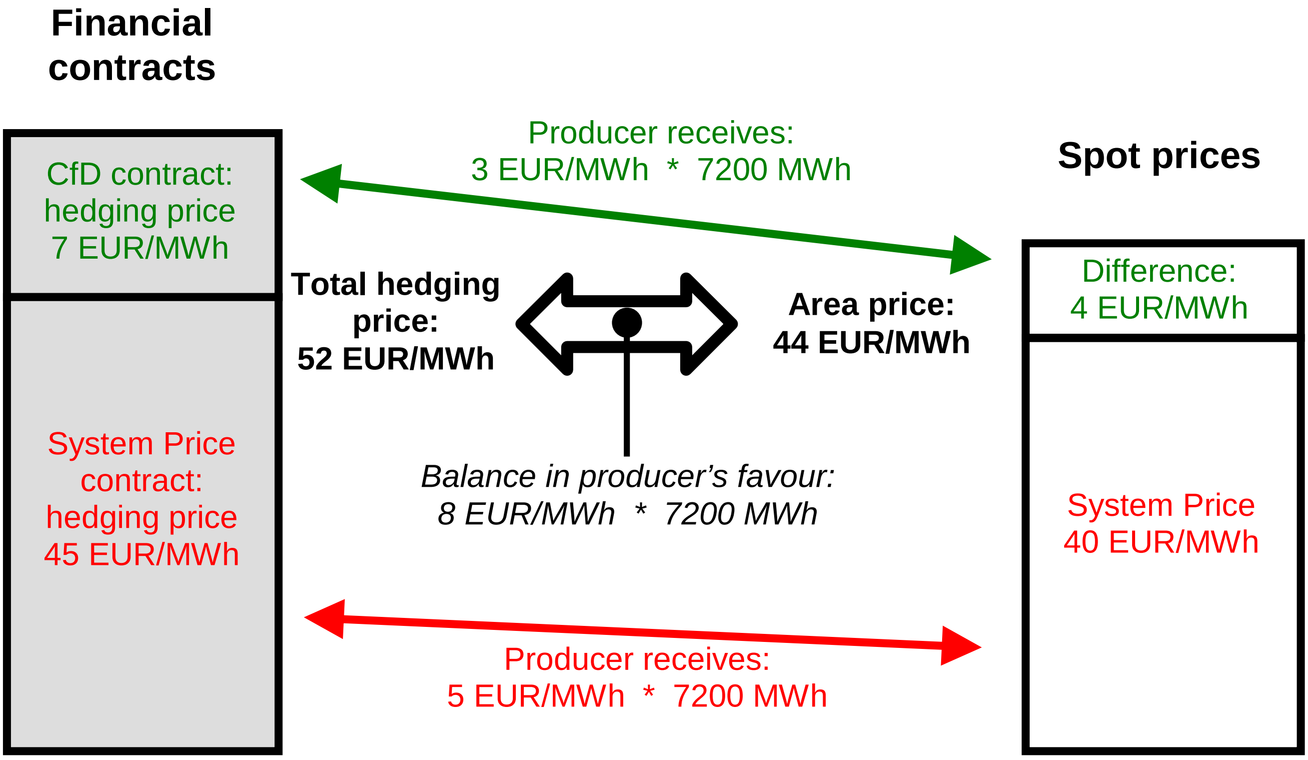

Fig. 3 Settlement of a CfD and a System Price contract. In the example, both financial contracts have a volume of 7200 MWh.

For Finland and SE3, the Open Interests for their CfDs are not insignificant.

For all the other price zones, the Open Interests are close to zero. However, due to low correlation, the System Price provides a poor hedge in the price zones EE, SE4, DK1 and DK2.

Hence you can conclude **the CfD plus System Price hedging mechanism is of limited value for Estonia and Southern Scandinavia**: the System Price contacts do not provide adequate hedging and the CfD liquidity is virtually non-existing.

Probably, this will remain true for the Baltic States. In this respect, the Baltic States are very similar to SE4, DK1 and DK2: they have strong electrical connections to Continental Europe. Therefore, we must expect the correlation between their area prices and the System Price will stay low. As the consumption in both the Baltic States, in SE4 and in Denmark is too low to sustain liquid financial markets, there’s a basic problem.

<table>
<tr><th>Area</th><th>Consumption[3] 2012
TWh</th><th>Production[4] 2012
TWh</th><th>CfD max. Open Interest[5, 6, 7]
TWh</th><th>Correlation with System Price during 2012[8]</th></tr>
<tr><td>System Price</td><td>387</td><td>402</td><td>103.7</td><td>1</td></tr>
<tr><td>EE</td><td>8</td><td>10</td><td>0.1</td><td>0.58</td></tr>
<tr><td>LV</td><td>8</td><td>6</td><td>na</td><td>Na</td></tr>
<tr><td>LT</td><td>11</td><td>5</td><td>na</td><td>Na</td></tr>
<tr><td>FIN</td><td>83</td><td>66</td><td>38.7</td><td>0.80</td></tr>
<tr><td>SE1</td><td>12</td><td>23</td><td>2.0</td><td>0.95</td></tr>
<tr><td>SE2</td><td>14</td><td>46</td><td>7.3</td><td>0.95</td></tr>
<tr><td>SE3</td><td>89</td><td>86</td><td>41.9</td><td>0.95</td></tr>
<tr><td>SE4</td><td>25</td><td>7</td><td>1.3</td><td>0.88</td></tr>
<tr><td>DK1</td><td>20</td><td>20</td><td>4.4</td><td>0.61</td></tr>
<tr><td>DK2</td><td>14</td><td>9</td><td>2.9</td><td>0.68</td></tr>
<tr><td>NO1</td><td rowspan="5">128</td><td rowspan="5">146</td><td>1.6</td><td>0.94</td></tr>
<tr><td>NO2</td><td>na</td><td>0.89</td></tr>
<tr><td>NO3</td><td>na</td><td>0.96</td></tr>
<tr><td>NO4</td><td>0.6</td><td>0.96</td></tr>
<tr><td>NO5</td><td>na</td><td>0.90</td></tr>
</table>

Table 1 Not applicable (*na*) indicates data do not exist.

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[3] Source for EE, FIN, SE, DK and NO: www.nordpoolspot.com.
Consumption data for individual Norwegian price zones were not available. In 2012, the Norwegian consumption was 128 TWh. The Nordic consumption was 387 TWh.
Source for LV and LT: ENTSO-E. For LV it's the consumption during 12 months from Nov. 2011 to Oct. 2012. For LT it's the consumption during 12 months from Dec. 2011 to Nov. 2012.

[4] Source for FIN, SE, DK and NO: www.nordpoolspot.com.
Source for EE, LV and LT: ENTSO-E. For EE and LT it's the production during the 12 months from Dec. 2011 to Nov. 2012. For LV it's the production during the 12 months from Nov. 2011 to Oct. 2012.
Production data for individual Norwegian price zones were not available. In 2012, the Norwegian production was 146 TWh. The Nordic production was 402 TWh.

[5] Source: picture of Nasdaq OMX home page for 28 Dec. 2013 (downloaded 2 March 2013 from www.nasdaqomx.com/commodities/markets/marketprices/history).

[6] Nasdaq OMX introduced the Estonian CfD 26 November 2012. Currently there is no CfD for LV, LT, NO2, NO3, NO5.

[7] In the first row, it's the Open Interest for the System Price contracts (**not** for CfDs). The concept "max. Open Interest" is explained in appendix B.

[8] Source: Houmoller Consulting.

6.4 An attempt to establish a price-transparent long-term market in DK1 and DK2

In 2003, a group of Danish (and a few non-Danish) market players decided to try to remedy the Danish situation. In an attempt to create liquid Danish long-term markets, they established Trading Group Denmark.

The participants traded electrical energy in DK1 and DK2: they traded long-term physical contracts on a platform provided by an electricity broker.

As the traded prices and volumes were public, this provided DK1 and DK2 with price-transparent long-term markets.

Note that this physical trading was **not** similar to trading with the financial CfD contracts. Compared with financial trading, this physical trading was comparable to financial contracts having as underlying reference the spot prices in DK1 and DK2, respectively. This is because the players directly were setting long-tem prices for electricity in DK1 and DK2 via their trading.

Actually, the players considered initially to use financial trading with the spot prices in DK1 and DK2 as underlying reference for the financial contracts. This was abandoned in favour of physical trading, as some of the German participants at the time had internal legal reservations toward non-German financial contracts.

However, the attempt was not successful. Mergers and acquisitions reduced the number of participants, and Trading Group Denmark was closed after a few years of operation.

In principle, after the closing of Trading Group Denmark, a financial exchange could have launched contracts using the average Danish spot price as the underlying reference.[9] The German reservation towards non-German financial contracts does not exist anymore; and the hedging system consisting of CfDs plus the System Price does not work for DK1 and DK2, as noted above. However, neither EEX nor Nasdaq OMX has shown any appetite for launching such contracts. Apparently, with DK1 and DK2 consumption of 20 TWh and 14 TWh, its estimated there's no basis for such contracts. Naturally, the fate of Trading Group Denmark does not encourage launching such financial contracts, either.

[9] The volume-weighted average of the DK1 and DK2 spot prices could be used as the underlying reference for such financial contracts.

7. The current financial market: the TSOs' role

For the financial market described so far, the TSOs do **not** have any role. The operation of a financial exchange and a corresponding clearing house is a purely commercial activity.

So far, Nasdaq OMX has been the only company offering clearing and exchange trading for Nordic contracts. However, other players – for example EEX – may launch trading & clearing of Nordic financial contracts.

Indeed, for German financial contracts, there is a little competition: both EEX and Nasdaq OMX offers clearing and trading of German contracts. However, for Nasdaq OMX the turnover of German contracts is very small – in practice it's EEX, which handles the clearing and exchange trading of German contracts.

Interconnector	Capacity MW	Max. transfer capacity TWh/year[10]
Estonia-Finland: Estlink 1, Estlink 2	1000	8.8
Estonia-Latvia[11]	800/750	6.1
Latvia-Lithuania[12]	850/1450	7.4
NordBalt Lithuania-Sweden	700	6.1
LitPol Link	500	4.4

Table 2 Baltic-Nordic cross-border trading capacities[13]

8. How to establish viable hedging options for players in the Baltic States?

8.1 FTR auctions

As described above: for Southern Scandinavia, the current financial contracts do not work well – and there's reason to believe this will be the case for the Baltic States as well.

Therefore, innovation is needed.

[10] The max. transfer capacity per year is calculated this way: (capacity) * 24 h * 365.
For example, for Estonia-Finland this gives 1000 MW * 24 h * 365 = 8.76 TWh.
[11] Summer capacity 650/750 MW. 700 MW capacity is used in the calculation of max. transfer capacity.
[12] 850 MW capacity is used in the calculation of max. transfer capacity.
[13] Sources: Elering, www.litpol-link.com and www.litgrid.eu

As for innovation: we can turn our attention to ACER's "*Framework Guidelines on Capacity Allocation and Congestion Management for Electricity*" from 29 July 2011. Here it reads in chapter 4.1:
"*The CACM Network Code(s) shall foresee that the options for enabling risk hedging for cross-border trading are Financial Transmission Rights (FTR) or Physical Transmission Rights (PTR) with Use-It-Or-Sell-It (UIOSI), unless appropriate cross-border financial hedging is offered in liquid financial markets on both sides of an interconnector.*"[14]

By establishing FTRs on the interconnectors, the Baltic TSOs can provide the market players with hedging options. The FTRs can be established on the internal Baltic links, on the interconnectors to Finland and on the planned interconnectors to Sweden and Poland.

As there'll always be players at the FTR auctions, these auctions will enhance the price finding for the Baltic States.

Also, you may compare the numbers in column three of table 2 with the Baltic consumption and production (listed in table 1). As can be seen, FTR will provide the Baltic players with very good hedging options.

It's important the players are allowed to trade FTRs after having bought initially at the FTR auctions. This will enhance the price discovery, as a secondary market for FTRs can adjust the FTR pricing to new market situations. Hence, the FTRs must be transferable.

8.2 Financial contracts using the FTRs as liquidity feeders?

In the next step, financial exchanges may launch CCfDs (Cross-Border Contracts for Difference)[15]. No financial exchange is yet quoting CCfDs. However, a CCfD will hedge against the risk there is a price difference between two price zones.

For example, an Estonian-Finnish CCfD will hedge against the risk there is a price difference between Estonia and Finland.

The FTR auctions will automatically provide a reference for the hedging prices of CCfDs. For example, if the Estonian-Finnish FTR auction yields a price of 2 EUR/MWh, this indicates the expected price difference between the two zones. Hence, this will be a reference for the hedging price of an Estonian-Finnish CCfD.

Thereby, FTR auctions will automatic feed liquidity to CCfDs.

Only time will show if financial exchanges will launch CCfDs, and whether liquidity from FTR auctions can ensure the CCfDs will not suffer the liquidity problems plaguing the CfDs. Nasdaq OMX and EEX are two examples of financial

[14] Appendix B explains how FTRs work and how FTRs can be used for hedging.
[15] CCfD is defined in appendix C.

exchanges, which may introduce CCfDs after the TSOs have launched FTR auctions.

9. FTR auctions – the TSOs' obligation and risk

For FTR auctions, the TSOs have a clear role: they must set up and operate the auctions (or select an organisation for the task). Also, the TSOs must establish settlement systems for the auctions and for the payment of the congestion rents belonging to players having bought FTR capacity. These are the TSOs' obligations.

Question: what is the risk for the TSOs?

Answer: if there's too few buyers at the FTR auctions, the TSOs risk under-selling the future congestion rent. With too few bidders at the auctions, the auctions may on the average give the TSOs revenue lower than the actual congestion rent. Naturally, this will give the TSOs a loss.

Only practical experience can show if the FTR auctions will make the TSOs under-sell the future congestion rent. It's impossible to figure out this theoretically. Either way, ACER's Framework Guidelines require the TSOs set up such auctions. Due to the low CfD liquidity, the CfDs cannot be used to employ the opt-out mentioned in the phrase: "*liquid financial markets on both sides of an interconnector*".

For the German-Danish interconnectors, it's planned to launch a FTR pilot project by the start of 2014.

Originally, the plan was to launch the pilot project by the start of 2013. However, the project was delayed by EU's amendment of the MiFID directive. The amendment is the so-called MiFID II, which is currently being worked out. The question is, whether MiFID II will apply to the TSOs' FTR auctions – and if "yes" what this will entail.

As the MiFID II is not completed yet, you cannot say whether MiFID II will saddle TSOs operating FTR auctions with extra obligations. As an extreme outcome, MiFID II could require TSOs with FTR operations to subject themselves to the regulations applied to financial institutions (banks etc.). However, this is currently not clear.

10. Launching FTR auctions – the practicalities

As soon as all the Baltic States have a spot quotation, FTR auctions can be launched. Hence, in principle FTR auctions can be launched from the summer 2013.

In practice, it may take longer to launch Baltic FTR auctions. However, as the financial and the physical market mutually support each other, launching hedging options is important for the Baltic electricity market. Therefore, the project of establishing FTR auctions on the Baltic interconnectors should be started immediately. A Baltic TSO project group must start looking at the following issues:

* How to establish the FTR auctions and the associated settlement system. For example: should the Baltic TSOs themselves set up the appropriate organisation, or can CASC be used?
  If the Baltic TSOs themselves set up the FTR auctions: how to choose the suppliers of the auction system and the settlement system? How will the organisation operating the auctions and the settlement system be established?

* Establish a dialogue with market players in order to ensure, the products offered by the FTR auction system fit the players' needs.
  For example: how should capacity be apportioned to daily, monthly and annual auctions?

* Establish a dialogue with the Baltic regulators (and perhaps politicians).

* At which interconnectors should FTR auctions first be launched?

* Follow the development of MiFID II in order to clarify, if MiFID II will burden the FTR project with extra obligations.

Note that establishing FTR auctions is inherently a multinational project. For each link, two TSOs will normally be involved. In order to make the project manageable, it may be wise to start with a purely Baltic TSO project group, although the group naturally must later be expanded to include Nordic TSOs and the Polish TSO.

Probably, it's advisable to start the project group right away, in order to have Baltic FTRs within the foreseeable future. Experience shows multinational projects take time.

11. The Estonian case

Referring to table 1: for Finland, the Open Interest for the CfDs was not insignificant last year. Hence, you may ask if Estonian players can simply use the Finnish CfDs for hedging?

Currently the answer is "no". In 2012 the correlation between the Estonian and the Finnish spot prices was only 0.73. In practice this means a System Price contract plus a Finnish CfD would not provide an Estonian market player with much of a hedge.

However, when Estlink 2 comes into operation in 2014, the total capacity between Estonia and Finland will be 1000 MW (the capacity of the current Estlink 1 is 350 MW). Hence, you may ask if Estonian players by then can use System Price contracts plus Finnish CfDs as a hedge?

Actually, only time will show. For now, we can analyze the current capacity and the historically flows between Estonia and the neighbouring countries in order to get a clearer picture.

First, we can have a look at the average difference between production and consumption in Estonia in 2012 (please refer to the last column of table 3). As for the monthly averages: as can be seen, they are never bigger than 500 MW.

Therefore, at the outset, you'd expect an Estonian-Finnish capacity of 1000 MW to create a situation, where the Estonian and the Finnish spot prices would have a very high correlation.

However, in the next step we must consider the trading capacities Estonia-Latvia and Estonia-Russia. As a case, we can consider the trading capacities during February 2013 (please refer to table 4).

With the numbers in the tables 3 and 4 as the starting point: consider a dry year, where the spot prices in the Nordic countries are very high. In this case, there will be a production surplus in Estonia, as Estonian producers will take advantage of the high spot prices. Simultaneously, we must expect energy will flow from Russia and Latvia via Estonia to Finland. This will create congestion between Estonia and Finland.

In a wet year, we may have the opposite situation – especially if Russia in this case will also take advantage of the low Nordic spot prices.

Hence, the correlation between the Estonian and the Finnish spot prices will to a high degree be determined by the flows on the interconnectors Estonia-Latvia and Estonia-Russia.

	Estonian production TWh	Estonian consumption TWh	(production - consumption) TWh	Average difference betw. production and consumption MW[16]
Jan. 2012	942	821	121	163
Feb. 2012	950	844	107	153
March 2012	808	753	56	75
April 2012	767	659	108	150
May 2012	793	598	195	262
June 2012	768	553	215	298
July 2012	682	541	141	190
Aug. 2012	927	565	363	488
Sept. 2012	852	586	266	370
Oct. 2012	928	676	252	339
Nov. 2012	964	715	249	346
Dec. 2012	1084	847	237	318

Table 3 Estonian production and consumption 2012[17]

Nevertheless, with a capacity of 1000 MW between Estonia and Finland, we may have a situation, where congestion between the two countries is very rare. In this case, the border Estonia-Latvia, which currently is virtually never congested[18], will become the interesting border for FTRs, as the primary congestion may move to this border.

[16] For example, for January 2012 the number is calculated this way:
(production - consumption) / (the number of hours in Jan.) = 121 TWh / 744 h = 163 MW.
[17] Source: www.nordpoolspot.com
[18] During 2012, the Estonian-Latvian border was congested during less that 6% of the hours (source: Elering).

Interconnector	NTC in MW
Estonia → Latvia	650 – 900
Latvia → Estonia	350 – 800
Estonia → Russia	750 – 800
Russia → Estonia	650 – 950

Table 4 NTC Net Transfer Capacity during February 2013 (capacity usable for trading)[19].

[19] Source: Elering's data archive http://elering.ee/data

Appendix A – The functioning of a financial electricity contract

A1. The financial electricity market

At the financial electricity market you cannot trade a single kWh. The financial market is **not** used for energy trading – it is solely used for **price hedging and risk management**.

The contracts used at the financial electricity market are examples of the so-called *derivatives*.

In general, a commodity derivative is a contract whose value is dependent upon the price of the commodity in question. There are many types of derivatives – for example futures, forwards and options. In this chapter, we'll discuss forwards and futures only. The description is adapted to the Nordic forwards and futures, which can be cleared at Nasdaq OMX' clearing house. However, actually the description fits also the German and French financial electricity contracts, which can be cleared at European Clearing Company ECC.

Figure A1 illustrates how a financial contract works. In the example, a retailer and a producer have entered into a bilateral contract with a volume of 3,600 MWh and a hedging price of 40 EUR/kWh. In the example, the contract's so-called "delivery period" is a given, future month.

The parties have a **mutual insurance and a mutual obligation**. Suppose the average spot price for the month in question turns out to be 44 EUR/MWh (ie, 4 EUR/MWh higher than the hedging price). A high price at the wholesale market is obviously disadvantageous for the retailer. However, in this situation the producer will compensate the retailer. The producer pays the retailer

4 EUR/MWh * 3,600 MWh = EUR 14,400.

Hence, the retailer has an insurance against high spot prices: the producer will compensate the retailer, if the average spot price turns out to be higher than the contract's hedging price.

Suppose instead the average spot price for the month in question turns out to be 38 EUR/MWh (ie, 2 EUR/MWh lower than the hedging price). A low price at the wholesale market is obviously disadvantageous for the producer. However, in this situation, the retailer will compensate the producer. The retailer pays the producer

2 EUR/MWh * 3,600 MWh = EUR 7,200.

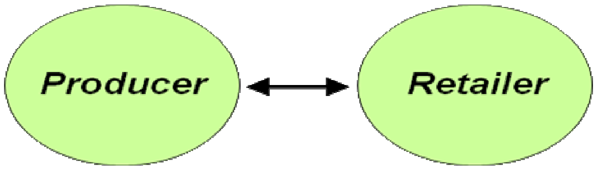


Fig. A1 Producer and retailer sign a financial contract with hedging price 40 EUR/MWh and volume 3,600 MWh: if, for instance, the average spot price in the month concerned turns out to be 44 EUR/MWh:

The producer pays the retailer 4 EUR/MWh * 3,600 MWh.

If, for instance, the average spot price in the month concerned turns out to be 38 EUR/MWh:

The retailer pays the producer 2 EUR/MWh * 3,600 MWh.

Hence, the producer has insurance also: the retailer will compensate the producer, if the spot price turns out to be lower than the contract's hedging price.

As can be seen: the contract is settled by comparing the hedging price of the contract with the average spot price for the period in question. The price difference is multiplied by the contract's volume. This sum of money is exchanged between the parties.

It is important to note that the parties of a financial contract are not trading energy with each other. They **only** exchange money (therefore the name "**financial** electricity market").

However, in addition, the retailer may submit a purchase bid with an unspecified price to the spot exchange (a so-called "price taking" purchase bid). The retailer can notify the spot exchange that he will buy 5 MWh each hour during the month irrespective of the exchange price. With a purchase of 5 MWh each hour during the whole month, the retailer will in total have bought 3,600 MWh by the end of a 30-days month:

5 MWh/h * 30 * 24 h = 3,600 MWh.

The spot price is irrelevant for the retailer. If it is higher than 40 EUR/MWh, he will be compensated. On the other hand, if the price is lower than 40 EUR/MWh, he must compensate the other party of the financial contract.

Hence, the retailer has two trade arrangements – please refer to fig. A2: a purchase at the spot market and a financial contract. In total, the two trade arrangements guarantee his net cost for the 3,600 MWh will be 40 EUR/MWh.[20]

[20] Because the Nordic market has many price zones, the Nordic financial contracts are actually more complicated than this description indicates
(For the technically interested: for the Nordic market, this description fits a case, where the two parties have both a so-called System Price contract and a so-called CfD with each other).

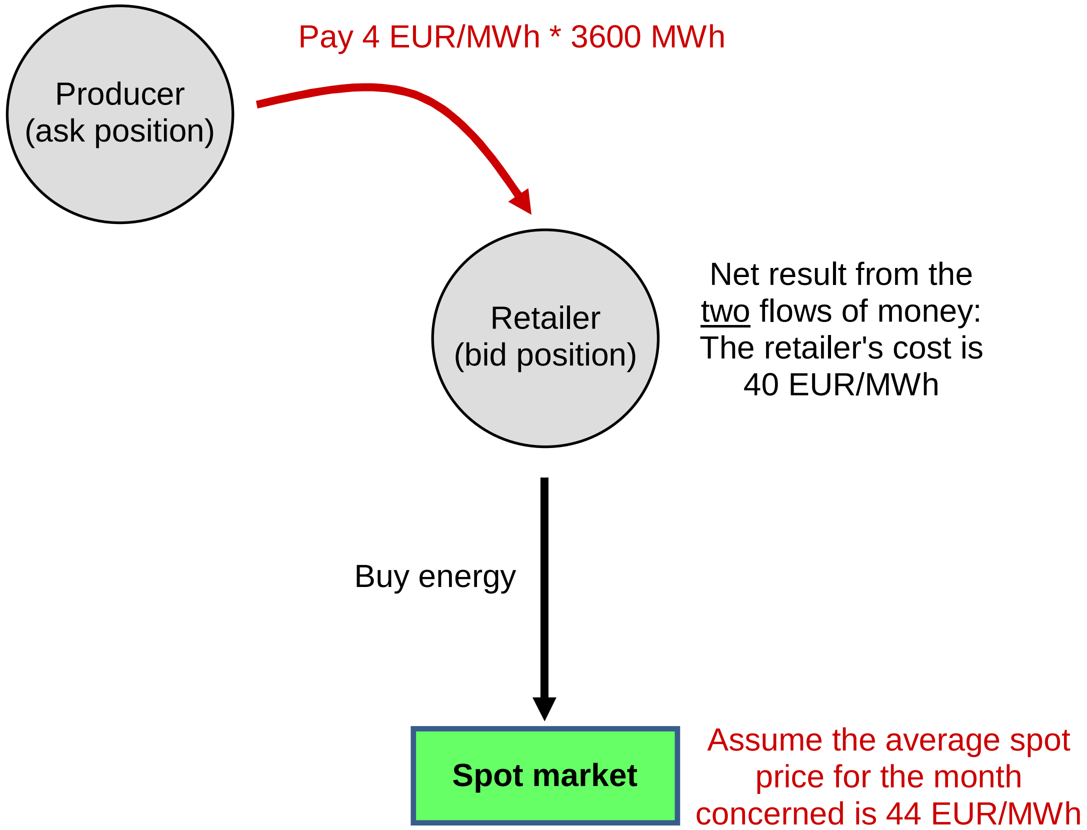


Fig. A2 An example of settlement of a financial contract

A2. Clearing of financial contracts

The two parties having a bilateral financial contract can choose to clear the contract – using a clearing house. In this case, the clearing house takes care of the settlement of the contract (fig. A3). Furthermore, the clearing house guarantees the settlement: the clearing house will ensure the settlement is carried out, even if one of the parties cannot fulfil his obligations.

If the parties have entered into the contract via a financial exchange, clearing is mandatory. This is because the trading at the financial exchange is anonymous: the parties do not know each other's identity. Hence, the contract must be cleared, so the clearing house sits between the parties[21, 22].

[21] Nasdaq OMX operates the clearing house, where Nordic financial electricity contracts can be cleared. In addition, Nasdaq OMX operates an exchange, where Nordic financial contracts can be traded.
[22] Virtually all those German and French financial electricity contracts, which are cleared, are cleared at European Clearing Company ECC. ECC is 98.5% owned by EEX AG.
In addition, EEX AG owns 80% of the exchange EEX Power Derivatives, where financial electricity contracts can be traded.

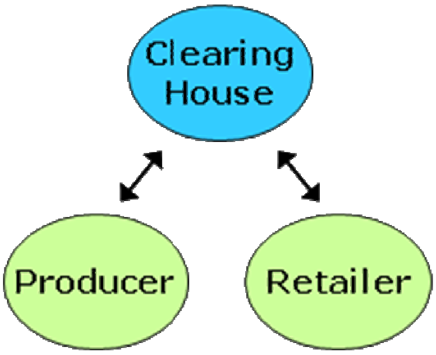


Fig. A3 Clearing

A3. Long-term contracts

At the spot market, the commercial players can trade electricity day-ahead. Now, let us take a look at the market for long-term contracts.

For example, let us consider a retailer who has sold 5 MWh/h to a big customer at a price of 42 EUR/MWh for a future month (ie, a total sale of 3,600 MWh). The retailer now has to make a corresponding purchase on the wholesale market.

However, the retailer does not need to buy the energy yet. In order to hedge his position, all the retailer needs now is a financial contract. For example, the retailer has earned 2 EUR/MWh if he enters into a financial contract with a hedging price of 40 EUR/MWh.

When we arrive at the month in question, the retailer can simply buy the energy from the spot market or from a local producer.

Therefore, the financial market is also the market for long-term contracts.

A4. The spot price must be reliable

As can be seen: the spot price is used when the financial contracts are settled. We say the spot price is the underlying reference for the financial contracts.

A reliable spot price is an absolutely essential basis for a financial market. It is imperative all the players regard the spot price as the true market price. For obvious reasons, only in this case the players will be interested in entering into financial contracts, which have the spot price as the underlying reference.

As a case illustrating this point – assume a retailer and a producer enters into a bilateral, physical contract: during April 2014, the producer will sell the retailer 5 MWh/h at a price of 40 EUR/MWh.

Assume the average market price during April 2014 turns out to be 44 EUR/MWh. With our without a spot exchange, this means the producer could have sold his energy at a price of 44 EUR/MWh, as this is the price, the buyers are willing to pay.

In this case, due to the bilateral contract's price of 40 EUR/MWh, the producer has a loss of 4 EUR/MWh, and the retailer has a corresponding gain.

If the spot price is reliable, it will faithfully reflect the market's equilibrium price: the price at which buyers and sellers will trade. Hence, in this case, with a reliable spot price, the average spot price during April 2014 will be 44 EUR/MWh.

Therefore, a **reliable** spot price plus a financial contract using the spot price as the underlying reference create the same losses and gains as bilateral, physical contracts.

Hence, a reliable spot price and a financial market can replace bilateral, physical contracts.

A5. Why electricity exchanges?

The service exchanges provide to society is **price transparency at the whole-sale market**. Below this is elaborated for spot exchanges and financial exchanges, respectively.

A5.1 Spot exchanges

The spot market provides price transparency for tomorrow's whole-sale market. For example at the internet, everybody can learn today's and tomorrow's whole-sale prices.

A5.2 Financial exchanges

The financial exchanges provide price transparency for the more distant future: the coming months, quarters and years, for example.

This is because the financial contracts' hedging prices are in effect the market players' estimate of the future prices.

As the financial exchanges publishes the hedging prices, everybody can learn the market's estimate of the future electricity prices, if we have a liquid, well functioning financial electricity market.

This price transparency is enhanced by the standardisation of the long-term contracts provided by the financial exchanges. By quoting a limited number of standard contracts, the liquidity is drawn to these contracts. Thereby the price discovery is greatly simplified.

In contrast: the price discovery is impeded – or perhaps even blocked – if the trading is done by means of bilateral, tailor-made contracts between producers and retailers. In this case, for a given area, you may have a situation, where only the local incumbent has a (relatively) clear picture of the fair market price.

A6 Why trade at electricity exchanges?

Chapter A5 describes the socio-economic value of exchanges. However, for the individual player, you may ask why the player should trade energy at the spot exchange and why the player should enter into a financial contract via a financial exchange?

After all, for both the physical and the financial market, the players can save the trading & clearing fees by trading bilaterally.

The exchanges charge trading & clearing fees. This is how the exchanges finance their operations. Compared with bilateral trading, in return for charging the trading & clearing fees, exchanges having liquidity and reliable prices can offer three advantages:

* When trading with an exchange, you always trade at the market price. Hence, there's no haggling over the price.

* Exchange trading is simple – you need not spend time and money finding someone, with whom you can trade.
  For the spot exchanges, simply send your bids and offers during the morning. Early in the afternoon, you receive a message informing you on your trading for the next day.
  For the financial exchanges, simply use the exchanges' electronic trading system to execute trades.

* You do not have counterparty risk.
  This last exchange competitive advantage has limitations, however:
  For the spot exchanges, this only applies to the seller: when you sell energy to a spot exchange, you will get paid (For the buyer spot trading does not offer a similar advantage: note that a spot exchange does not supply energy – a spot exchange merely sets the price for electrical energy. It's the TSO's responsibility to ensure, there's always electricity for the end users).
  For the financial exchanges, this applies to both parties in the financial contract. Depending on the hedging price and how the spot price later turns out, one of the parties must pay a sum of money – and the other party will receive a similar sum of money.
  However, for the financial market, you can enter into a bilaterally negotiated contract and in the next step clear the contract. This will also eliminate the counterparty risk.

Appendix B – Financial transmission rights

B1. Introduction

This appendix explains how financial transmission rights (FTRs) work and how FTRs can be used for hedging.

B2. How does FTRs work?

You can have FTRs at a border, where there's implicit auction (market coupling or market splitting). By considering a case for a north-south border, this chapter will illustrate how FTRs work.

As a case – referring to fig. B1: the TSOs operate an FTR auction system at the border. At the FTR auction, a player buys 50 MW FTR capacity in direction south.

As this is a FTR auction, the player is obliged to give the capacity to the implicit auction. In return, the player gets the congestion rent for the 50 MW (if any).

Therefore, at the auction, the player did not actually buy cross-border capacity. Instead, the player bought the unknown, future congestion rent for the 50 MW. Hence the name financial transmission right.

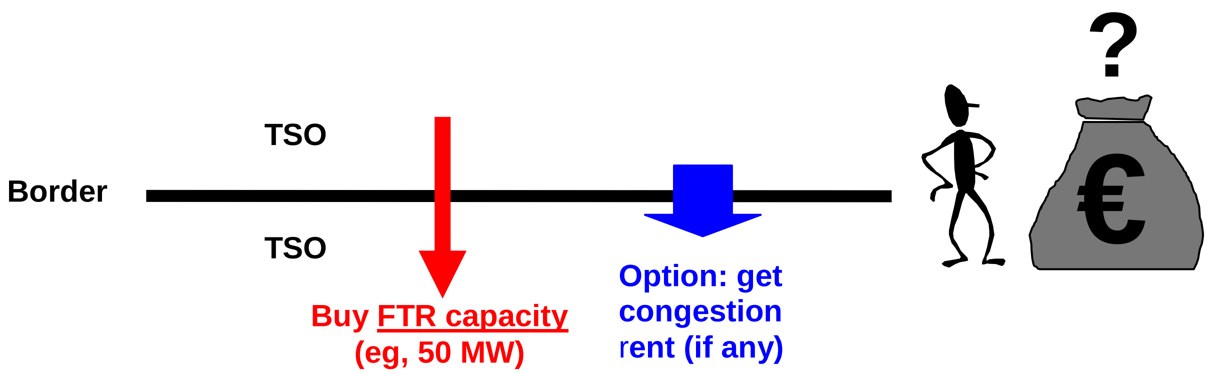


Fig. B1

Figure B2 illustrates how a FTR can be used as a hedging tool. Again, we consider a case, where a player has bought 50 MW FTR capacity in direction south. We are considering one, given hour of operation.

The player in the case is a retailer. For this hour, the retailer needs to buy 50 MWh for his customers on the southern side of the border. The retailer buys the energy at the spot exchange.

Assume the spot price on the southern side of the border spikes and turns out to be 2000 EUR/MWh during the hour in question. Further, assume the spot price on the northern side of the border turns out to be 40 EUR/MWh.

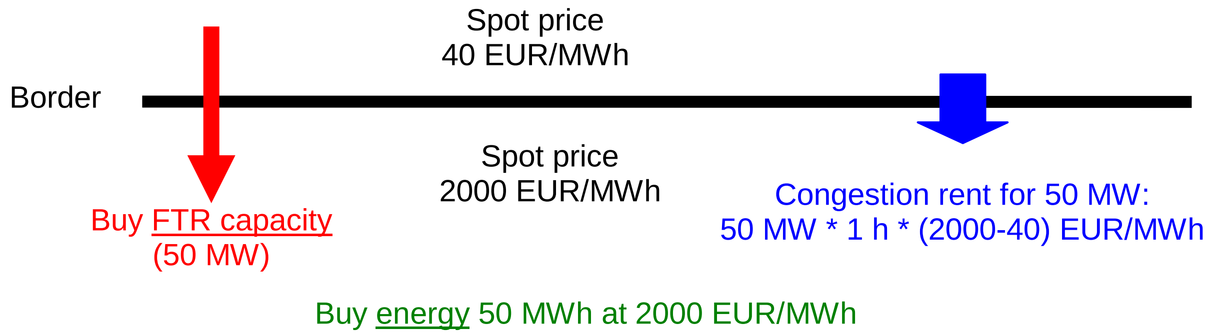


Fig. B2 FTR as a hedging tool

On the southern side of the border, the retailer will buy 50 MWh at 2000 EUR/MWh.

The congestion rent for the 50 MW is   50 MWh * (2000 - 40) EUR/MWh.

Hence, for the retailer the mathematics looks like this:

Expenditure – purchase on the southern side	50 MWh * 2000 EUR/MWh
Receipts – congestion rent	50 MWh * (2000 - 40) EUR/MWh
Net expenditure	50 MWh * 40 EUR/MWh

Hence, **financially the FTR makes it look as if the retailer has bought the 50 MWh on the northern side of the border**.

Note that a FTR is an option. The retailer has an outlay buying the FTR. However, after having bought the FTR, the retailer has no further expenses due to the FTR. For example, if the spot price turns out to be high on the northern side of the border, this does not give the retailer extra expenses.

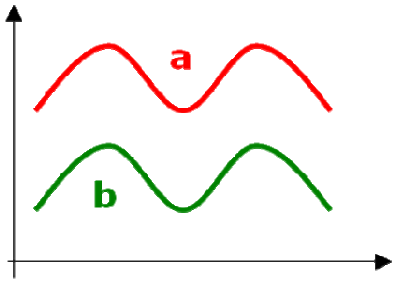
In this way, FTR can be used to hedge against the prices in a given price zone. For the retailer in the example above, the anchor for the FTR option is the spot price on the northern side of the border.

Appendix C – Terminology and acronyms

ACER	Agency for the Cooperation of Energy Regulators. An EU body established in 2010.
Bilateral contract	A contract made by means of bilateral trading.
Bilateral trading	This is off-exchange trading done directly between two parties, without any supervision of an exchange. Bilateral trading is also called OTC trading (over-the-counter trading).
Bilateral trading (financial market)	At the financial electricity market, bilateral trading is trading where two market players A and B enter into a financial contract with each other without any supervision of an exchange. A will pay B directly, if the contract creates a cash flow from A to B (however, if the parties subsequently clear the contract, a clearing house handles the settlement). Bilateral trading is in contrast to exchange trading, where A and B enters into a contract via a financial exchange. As the trading is anonymous, they do not know the identity of each other. Hence, clearing is mandatory. A clearing house takes care of the settlement. A will pay the clearing house, and the clearing house will pay B, if the contract creates a cash flow from A to B. Actually, for exchange trading, A and B do not even have a contract with each other. Instead, they each have a contact with the clearing house (where A's position toward the clearing house mirrors B's position). This is also the end result, if A and B enters into a bilateral contract, which they subsequently clear.

Bilateral trading (physical market)	At the physical electricity market, bilateral trading is trading where two market players agree to trade electrical energy with each other. The buyer will pay the seller directly. This is in contrast to exchange trading, where the seller sells energy to the exchange and the buyer buys energy from the exchange. The trading is anonymous. The buyer pays the exchange and the exchange pays the seller. The fact that the exchange takes care of the settlement is called clearing.
Border	Means a border between two price zones. Hence, it need not be a border between two countries. It may be a border between two price zones inside a country.
CACM	Capacity Allocation and Congestion Management.
CASC	The central auction office for cross-border transmission capacity for Central Western Europe, the borders of Italy, Northern Switzerland and parts of Scandinavia. Plese refer to www.casc.eu.
CCfD	Cross-border Contract for Difference. A financial contract, which hedges against the risk there is a difference between the spot prices of two price zones. No financial exchange is yet quoting such contracts.
CfD	Contract for Difference. A financial contract, which hedges against the risk there is a difference between the System Price and the spot price of a given Nordic price zone. Example: the underlying reference for the CfD for Finland is this difference (Finnish spot price) - (System Price).

Clearing	See the explanations under “bilateral trading (financial market)” and “bilateral trading (physical market)”. For clearing of financial contracts, you may also refer to chapter A2 in appendix A.
Congestion rent	The arbitrage revenue earned by implicit auction. In implicit auction, for each interconnector, somebody must buy energy from the spot exchange on the interconnector’s low-price side and sell the energy to the spot exchange on the high-price side. Normally, this body is appointed by the interconnector’s capacity owners; and the arbitrage revenue is collected by the capacity owners. The amount of energy traded cross-border is calculated by means of market splitting or market coupling. The phrase “congestion rent” is synonymous with “congestion revenue”.
Correlation	Given two data sets, the correlation function measures the degree to which the two data sets move in lockstep. The value of the correlation function is 1, if the two data sets move in perfect lockstep. A value of 0 indicates no correlation at all. In the example below correlation(a,b) = 1 as a and b move in perfect lockstep.



Double auction	A calculation method whereby an exchange’s price is set by calculating the intersection between the exchange’s supply curve and the exchange’s demand curve

EEX	European Energy Exchange. Please refer to www.eex.de.
ENTSO-E	European Network of Transmission System Operators for Electricity. ENTSO-E is an association of Europe's TSOs for electricity. It is a successor of ETSO, the association of European transmission system operators founded in 1999 in response to the emergence of the internal electricity market within the European Union.
EU	European Union.
Estlink 1	The 350 MW DC link between Estonia and Finland.
Estlink 2	The future 650 MW DC link between Estonia and Finland. Estlink 2 is expected to come into operation in early 2014.
Exchange trading	See the explanations under "bilateral trading".
Financial market	In this document, this term refers to the market, where you trade financial electricity contracts. In contrast, electrical energy is traded at the physical electricity market.
FTR	Financial Transmission Right. Please refer to appendix B.
Implicit auction	The common term for market coupling and market splitting.
LitPol Link	The future interconnector between Lithuania and Poland. By the end of 2015, LitPol Link will begin operating with a capacity of 500 MW, while by 2020

	the capacity will be 1000 MW. Please refer to www.litpol-link.com.
Market coupling	A day-ahead congestion management system, you can have on a border, where two spot exchanges meet. The day-ahead plans for the cross-border energy flows are calculated using the two exchanges' bids and information on the day-ahead cross-border trading capacity.
Market splitting	A day-ahead congestion management system, you can have on a border, where you have the same spot exchange on both sides of the border. The day-ahead plans for the cross-border energy flows are calculated using the exchange's bids and information on the day-ahead cross-border trading capacity.
Max. Open Interest	For a given financial contract, this is max. Open Interest for the year 2013 as registered 28 December 2012. This can be illustrated using the Finnish CfD as a case: by 28 December 2012, the Open Interest for the Finnish 2013 CfD contracts were (in GWh)[23] January-2013 725 February-2013 34 March-2013 158 April-2013 0 Q1-2013 2352 Q2-2013 1464 Q3-2013 16942 Q4-2013 17056 By adding up the eight numbers, we get an upper limit for the hedging for 2013 done at the end of last year by means of cleared Finnish CfD contracts. The number is 38.7 TWh.
MiFID	Markets in Financial Instruments Directive. An EU law that provides harmonized regulation for investment services across the 30 member states of the European Economic Area (the 27 Member States

[23] Source: picture of Nasdaq OMX home page for 28 Dec. 2013 (downloaded 2 March 2013 from www.nasdaqomx.com/commodities/markets/marketprices/history).

	of EU plus Iceland, Norway and Liechtenstein). The main objectives of the directive are to increase competition and consumer protection in investment services. A major amendment – known as MiFID II – is currently being worked out.
na	Not applicable (ie, data do not exist).
Nasdaq OMX	In this document, this is used as a short-term for Nasdaq OMX Commodities Europe.
Nasdaq OMX Commodities Europe	Please refer to www.nasdaqomx.com/commodities
NordBalt	The future 700 MW DC interconnector between Lithuania and Sweden (SE4). The cable is expected to be commissioned in 2016. The interconnector is also known under the name SwedLit.
Nordic	In this document, "Nordic" and "Nordic area" is a short term for the four countries Denmark, Finland, Norway and Sweden.
Nordic System Price	See System Price.
NTC	Net Transfer Capacity (transfer capacity usable for trading).

Open Interest	For a given financial product, this is the net hedging done by means of the product. A financial product's turn-over will normally be bigger than the product's Open Interest, as traders may move in and out of positions in financial contracts. Note: For a given financial product, the Open Interest only measures the product's cleared volume (i.e. the volume of contracts where the contracts' settlements are done by a clearing house). In addition to this volume, there may be bilateral contracts made between parties who have chosen to do without clearing. For each such contract, the contract's two parties will themselves take care of the settlement. However, these contracts do not contribute to the market's transparency: the contracts' prices and volumes are not public known.
OTC trading	Over The Counter trading. Off-exchange trading. See "bilateral trading".
Physical market	In this document, this term is used for the market where you trade electrical energy. In contrast, energy is **not** traded at the financial electricity market.
Price discovery	This is the process of determining the price of an asset in the marketplace through the interactions of buyers and sellers.
Price zone	A geographical area, within which the players can trade electrical energy day-ahead without considering grid bottlenecks

Scandinavia	Denmark, Norway and Sweden.
Spot exchange	In this document, a spot exchange is an exchange where * Electrical energy is traded day-ahead. * The day-ahead prices are calculated by means of double auction.
System Price	A virtual price. It’s the theoretical, common spot price there would be in the Nordic area, if there were no grid bottlenecks in the area covered by the four countries.
TSO	Transmission System Operator.