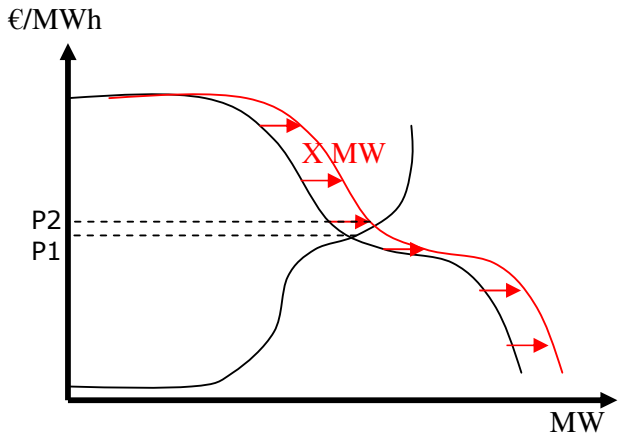
Market resilience analysis

Market resilience, or market depth, indicates the price sensitivity due to an increase in offer or demand on the market. Because of the importance of this indicator, Belpex has performed an analysis, based on historical order book data starting from 1/01/2007, excluding the decoupled days (28 and 29 April 2007 and 28 March 2011).

In the past, Belpex has noticed several similar analyses made by third parties which were based on the aggregated curves data. In general economics, a shift of one of the two curves, either offer or demand, would influence the price, and exactly this price influence is monitored as a market resilience indicator. The picture below visualizes this method for a X MW increase in demand at a certain hour. When X MW increase in demand is put on the market, prices will go up from P1 to P2. The difference between P2 and P1 is a clear indicator for the resilience of the market.



However, Belpex would like to point out that in the Belpex day-ahead market, two specific circumstances are to be taken into account when performing this analysis. The first one is the market coupling, and the second one is the effect of block orders on the market. Both increase the resilience on the market, because they create a link between the offer and the demand curve, as explained below.

The effect of market coupling (MC)

Market coupling optimizes the utilisation of the day-ahead cross-border capacity by combining the price information captured in the order book of the day-ahead exchanges with the day-ahead available transfer capacity (ATC) from the transmission system operator. Simply said, if the price in a local market is higher than the price in another local market, there is a transfer of energy realized from the latter market to the first one. By importing the energy in the first market, the price on this market drops down, and vice versa for the exporting market. The increase in transfer between the two markets is stopped when both markets reach a single price, or when all available transfer capacity is utilized.
This being said, one can understand that a local increase in demand or offer will not only influence the local price on this market, but also the prices on the other markets, via the market coupling. An increase in demand will result in an increased price, and thus an increased import, as long as the ATC is sufficient. This increased import will result in an increased export on the other coupled markets, on which the price will rise as well. Clearly, the resilience in the market becomes linked to the import and export resulting from the market coupling, and the resilience of the other markets.
Looking at the aggregated curves information, one might pose the question why this links the offer and demand curve. It is therefore important to understand that the import/export volumes, resulting from the

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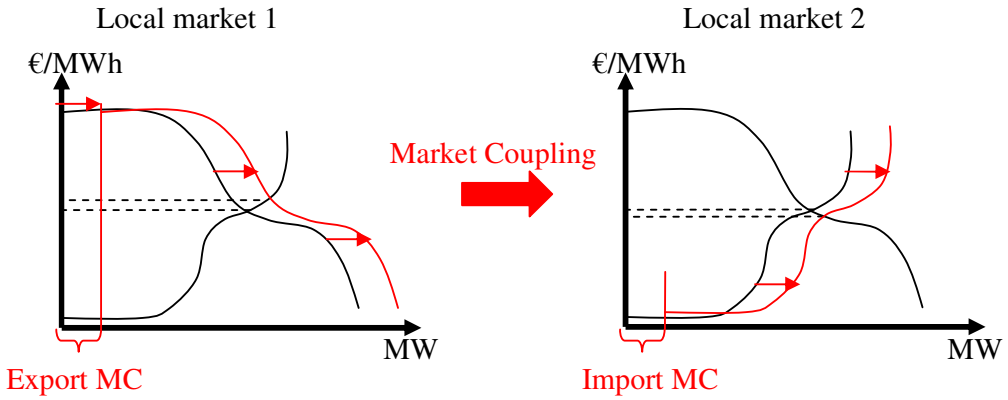
market coupling, are offered/demanded on each local market at the minimum/maximum price, as is shown in the picture below. These volumes can thus be found at the beginning of the offer and demand curve.



Market coupling thus shifts the local curves on each market, as long as there is a price difference between the markets and there is still some unused transfer capacity available. If one would shift a curve on a local market, to simulate resilience, there are two possibilities:

1) one would compensate the market coupling effect
2) one would anticipate the market coupling effect

Let's give an example in case of local market 1 in the picture above, respectively for an increased demand or an increased offer situation.

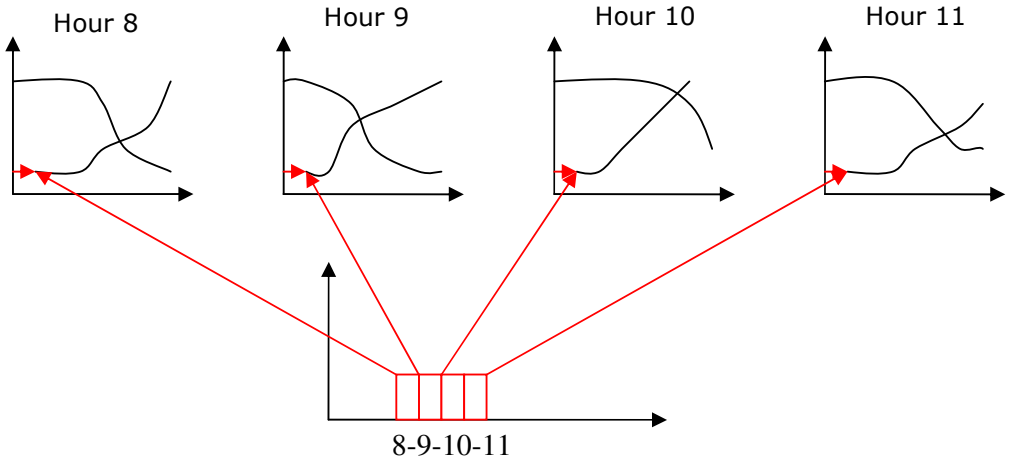
1) Increased demand: the local price on market 1 would increase. Thus, market coupling would not export the same amount to local market 2, since prices would converge sooner. The effect of the market coupling is thus reduced, since it was anticipated. The final shift of the curve (after introducing the additional order and the market coupling) remains the same, only the **final** prices increased **on both markets**.
2) Increased offer: the local price on market 1 would decrease. Thus, market coupling would increase the export to market 2 (if the ATC's are sufficient). The market coupling compensates the effect of the increased offer. **Final** prices would drop **on both markets**.

Market coupling thus increases resilience in the market, since it stabilizes the effect of an increased/decreased offer/demand over all the coupled markets, as long as there is sufficient transfer capacity.

The effect of block orders

The most common order on the Belpex day-ahead market is the limit order. It is characterized by a price threshold and a volume for a specific hour. Solely these orders construct the price dependent part of the aggregated curves (being the part without the orders at minimum and maximum price).
However, one can introduce block orders on the Belpex day-ahead market. This order is characterized by an average price threshold and a volume for a consecutive period of (several) hours. One could introduce for example a sale block order of 20MW for an average price of 50 €/MWh from hour 8 till hour 11. The order can only be accepted if the average price of hour 8 till hour 11 is equal to or above 50€/MWh. This might mean that the price on hour 8 could be 40€/MWh, but on average the price over the 4 hours is equal to or above 50€/MWh.
When looking at the aggregated curves, an **accepted** block order will be introduced into the curve at minimum or respectively maximum price, for respectively a sale or a purchase block order. This is purely

for visual reasons, to avoid having accepted block orders at the right hand side of the crossing of the curve, or non accepted block orders at the left hand side of the curve, which might occur strange at a first glance. Non accepted block orders are not visualized at all.



When simulating resilience in the market by shifting the aggregated curves, one does not take into account that block orders are price dependent orders, although visualized in the aggregated curves data as price independent. When demand increases (shift of the demand curve to the right), prices will increase. At the increased price, less demand block orders will be accepted (shift of the demand curve to the left) and more sale block orders will be accepted (shift of the offer curve to the right).
Via the market coupling, the effect of shifting one curve at a local market, influences also the amount of block orders accepted on the other markets.

The Belpex resilience analysis

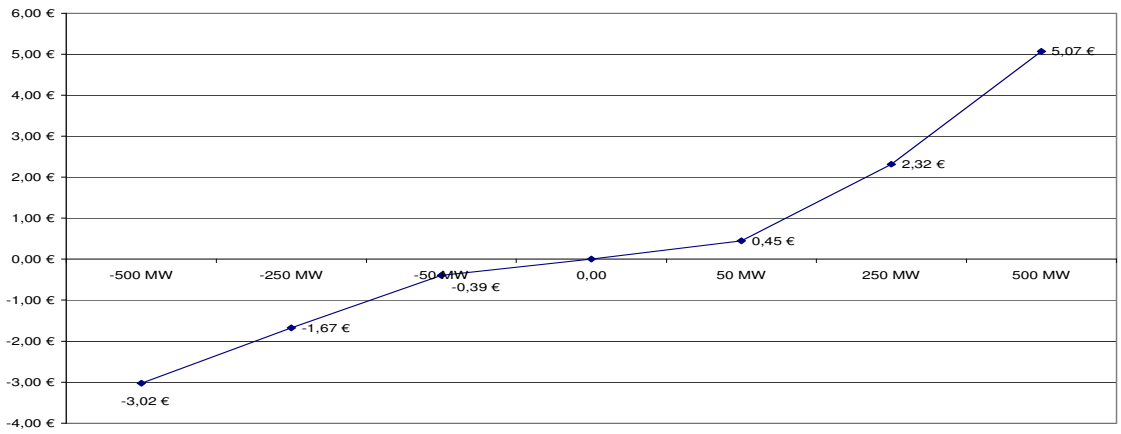
Both previous paragraphs explained the linkage between the offer and demand curves on the Belpex day-ahead market. This clearly shows that one cannot perform a resilience analysis by looking at the aggregated curve data alone, since both the effect of the market coupling, as well as the effect of block orders will be neglected in such an analysis.
Belpex understands the importance of a resilience indicator for its market, and has therefore performed the analysis itself, taking into account both the above mentioned effects. The analysis reruns the fixing on the 3 markets based on historical order books of Belpex, APX Power NL and EPEX Spot France and Germany from 1/01/2007 (Germany since 10/11/2010) for 6 different scenarios:

1. An increased offer of 50, 250 or 500 MW at any price for each hour.
2. An increased demand of 50, 250 or 500 MW at any price for each hour.

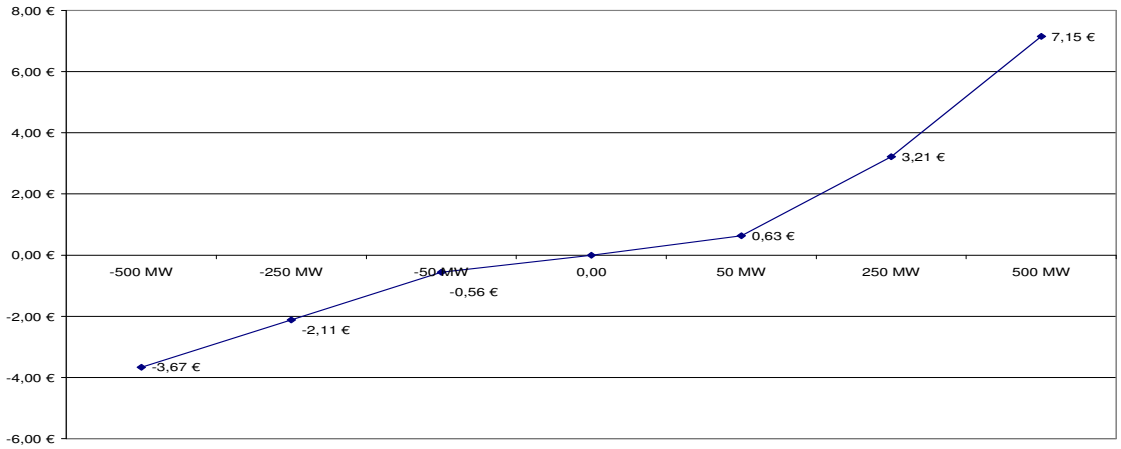
The decoupled days of 28 April and 29 April 2007 and 28 March 2011 were left out of the analysis. The graphs below show the resulting price difference for each scenario on the average baseload, peakload and off-peak price, compared to the historical prices on Belpex, per year. The analysis is performed every month.

2007:

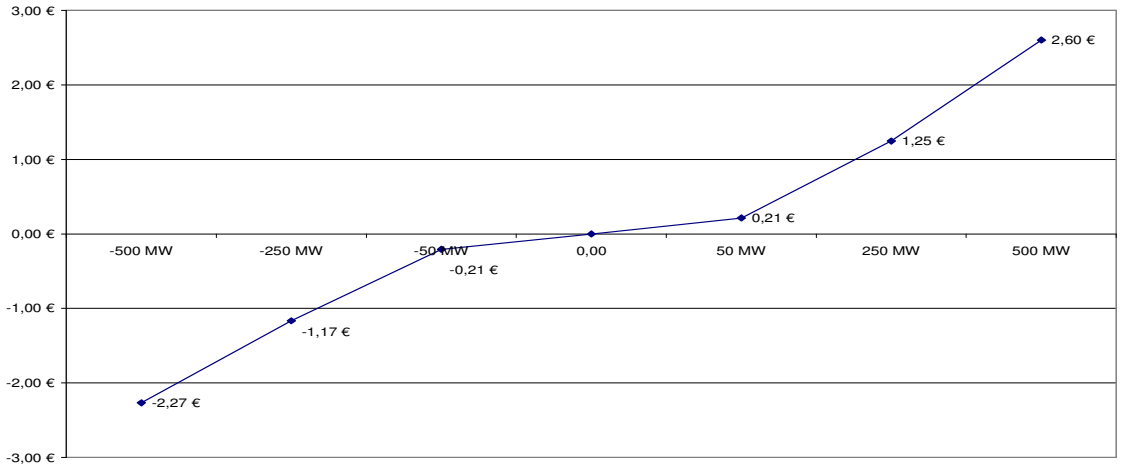
Belpex baseload resilience



Belpex peak resilience



Belpex off-peak resilience



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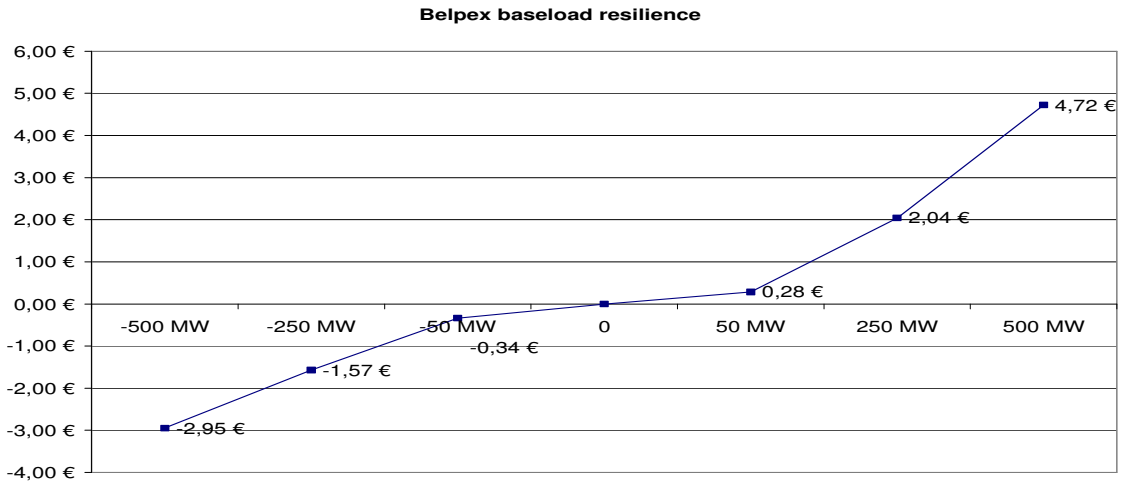
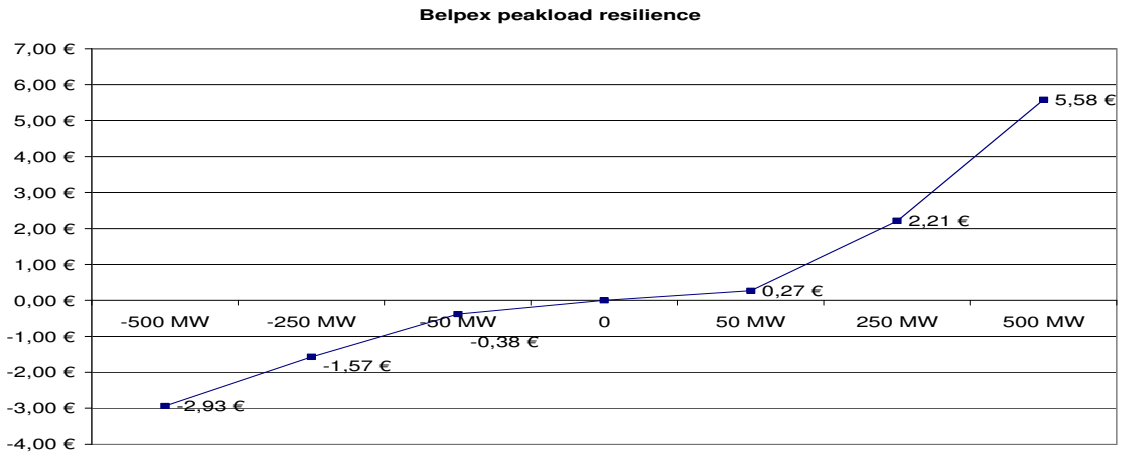
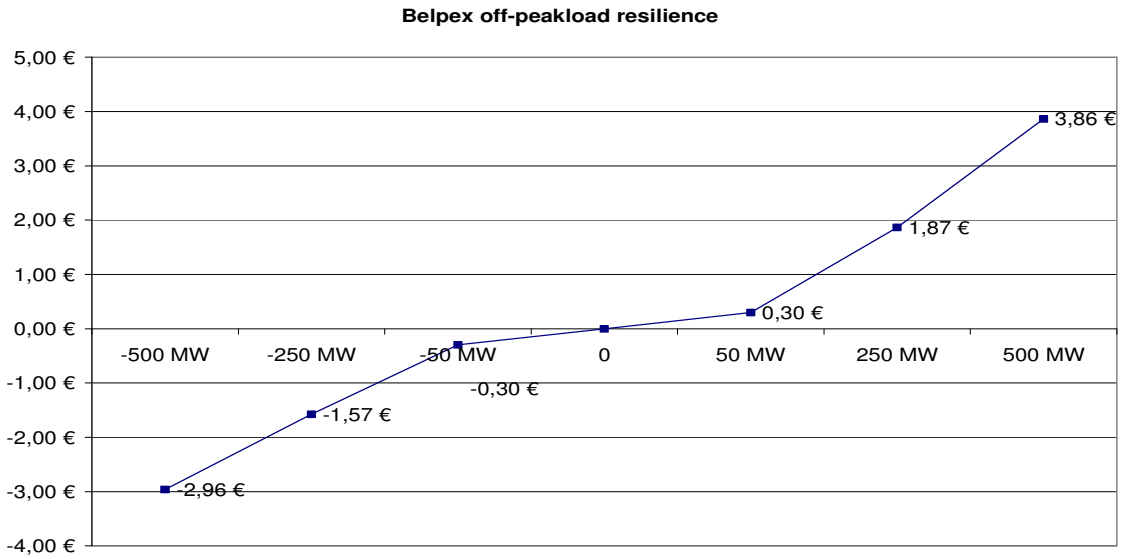
2008:







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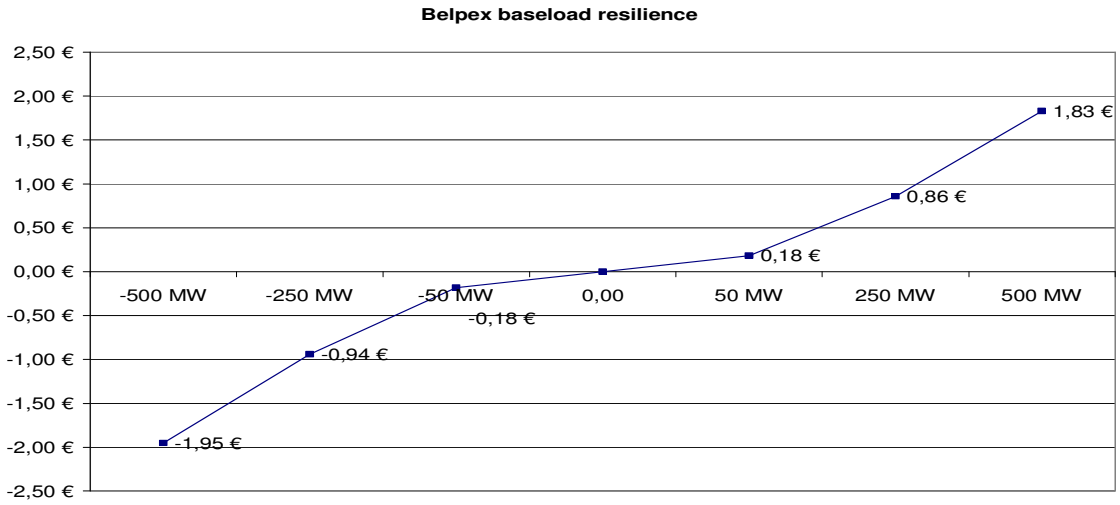
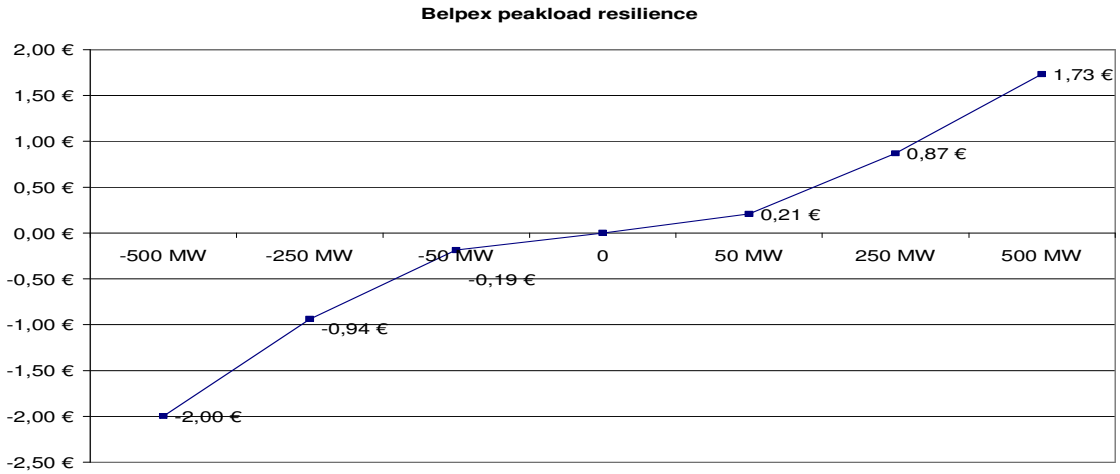
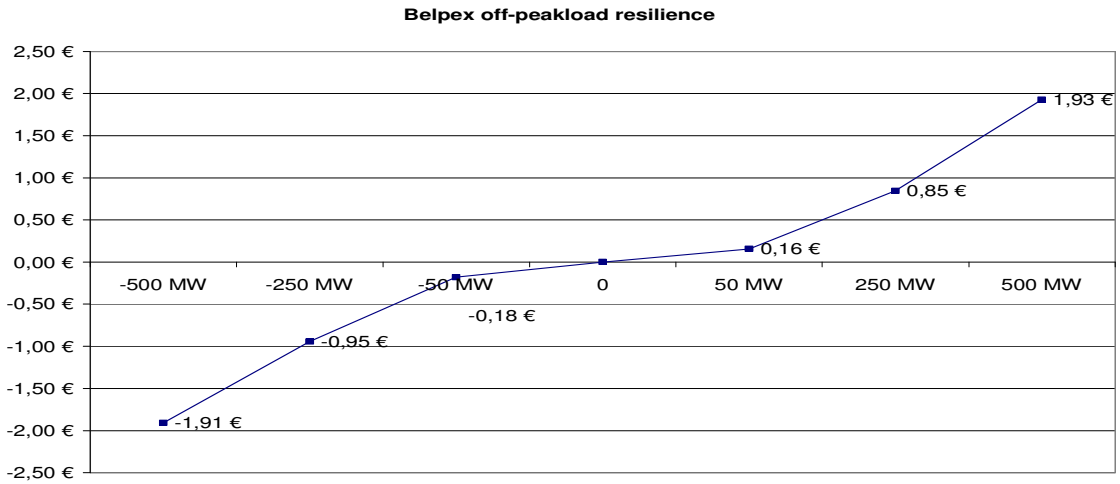
2009 :







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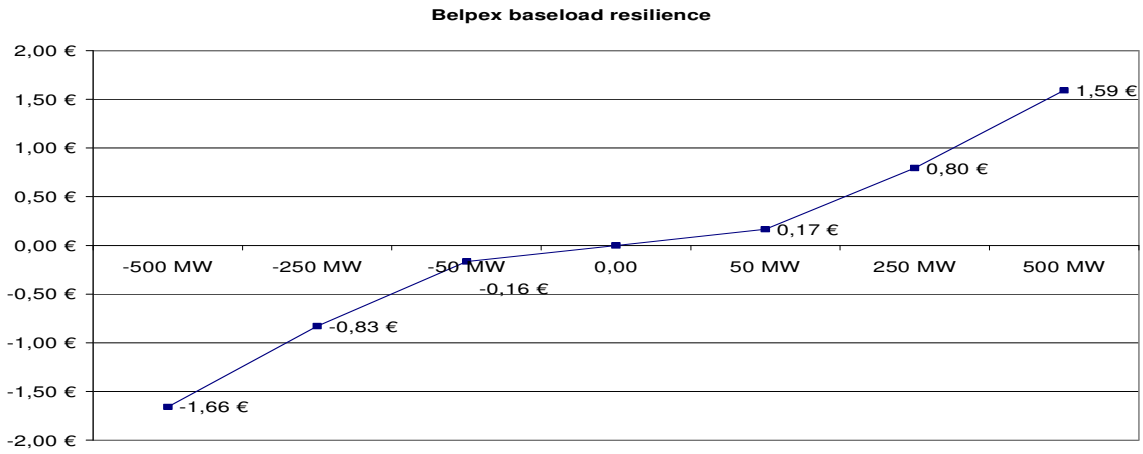
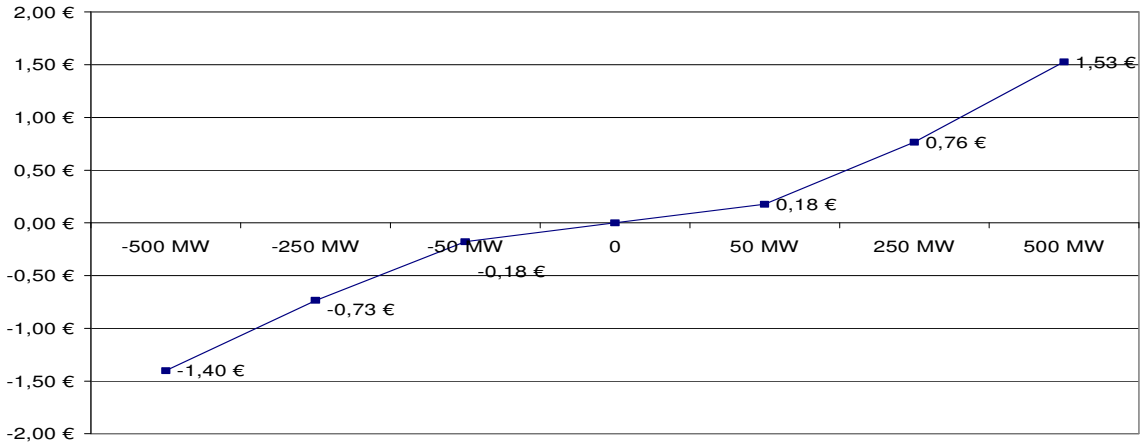
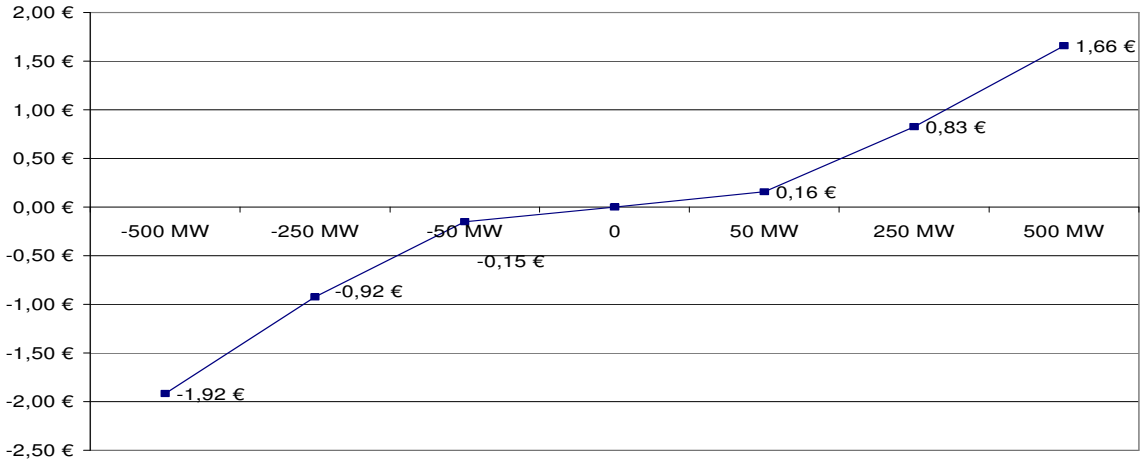
2010:







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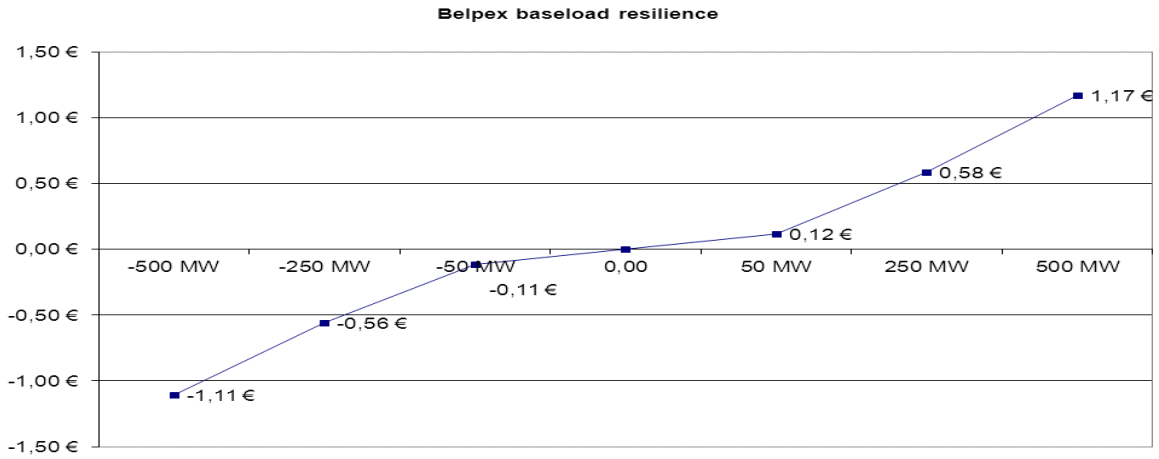
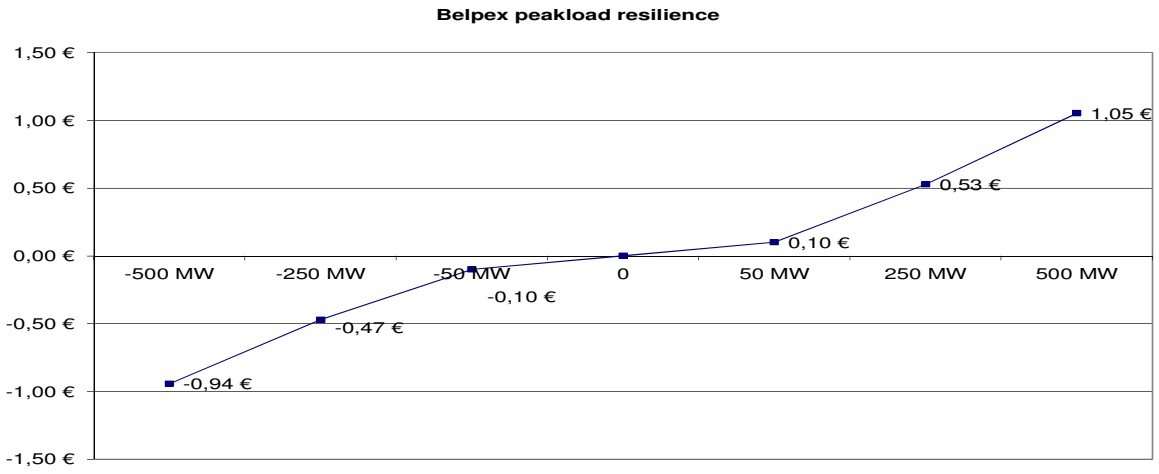
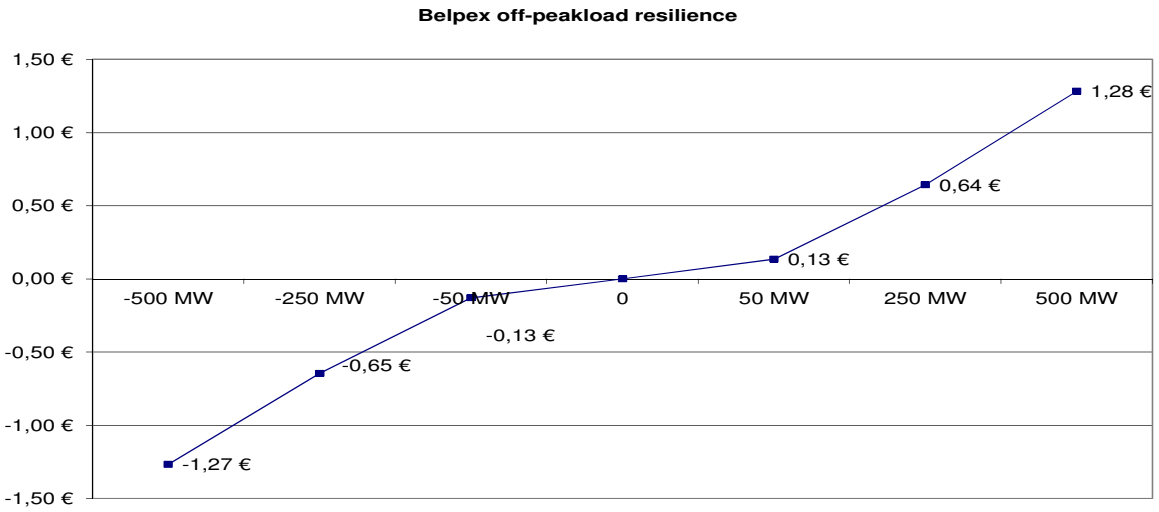
2011 :







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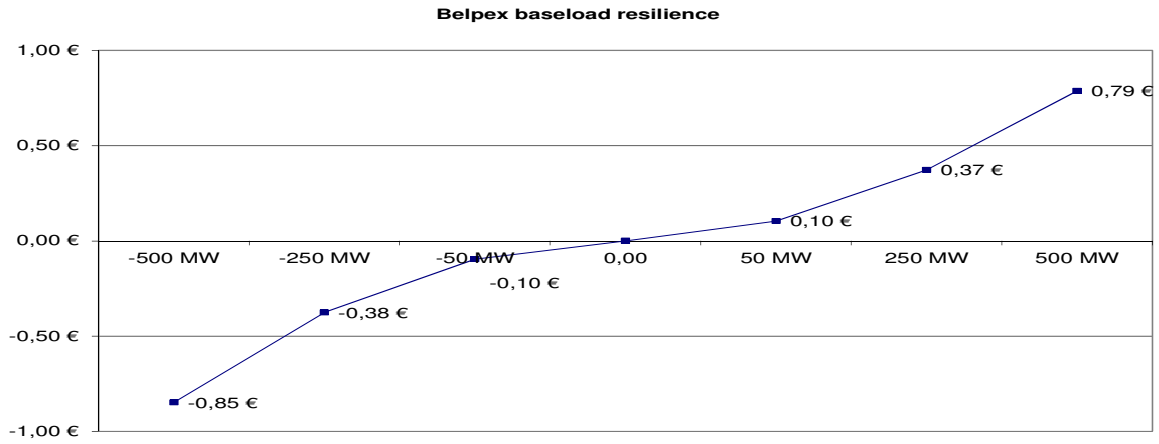
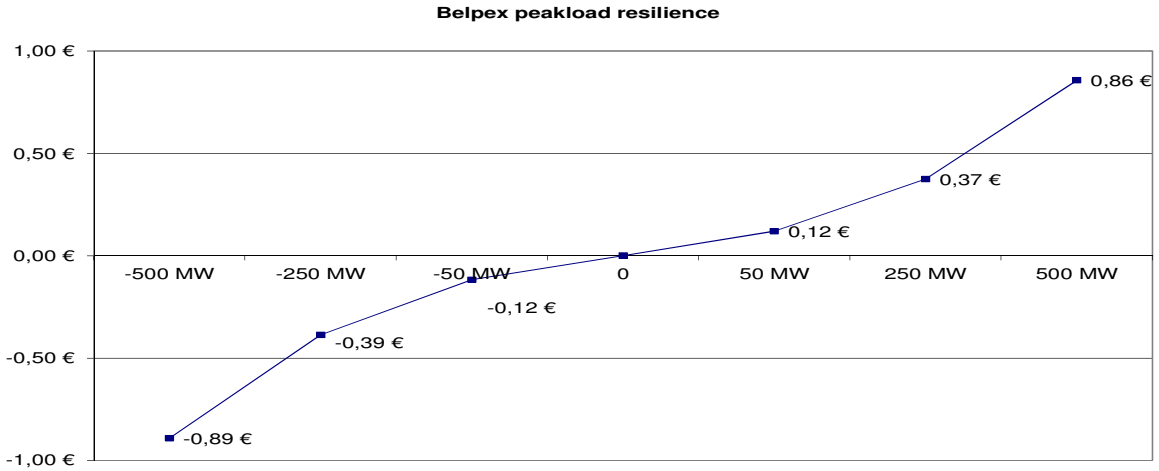
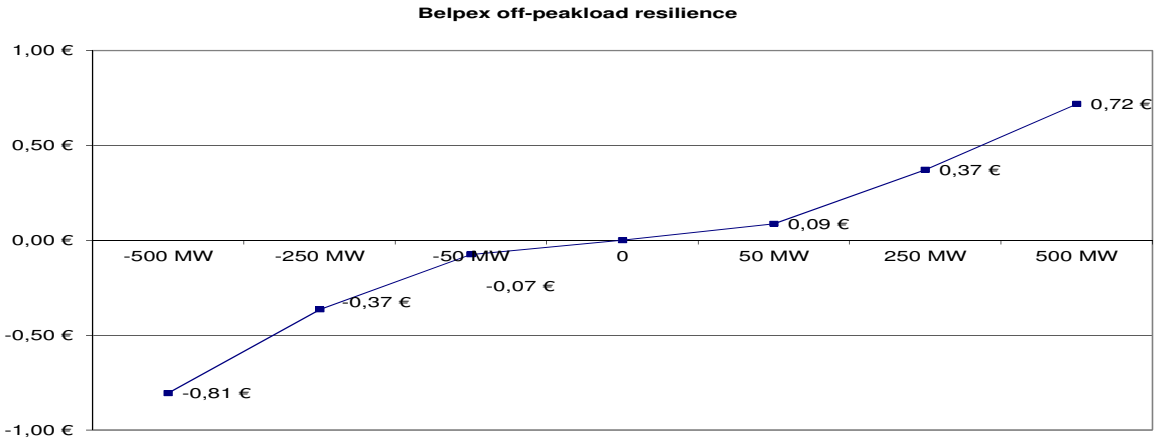
2012 :







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