Joint study by ČEPS, MAVIR, PSE and SEPS regarding the issue of

# Unplanned flows in the CEE region

## In relation to the common market area Germany - Austria

January 2013

## Table of contents

Executive summary

| | |
|---|---|
| *Structure of the report* | This is the second joint analysis of transmission system operators (TSOs) of the Czech Republic (ČEPS), Hungary (MAVIR), Poland (PSE) and Slovakia (SEPS) focused on the issue of unplanned power flows in the context of zonal market design and primarily the existing common German-Austrian (DE-AT) market area.<br>The study presents a follow-up to the March 2012 common position on bidding zones' definition which provided several recommendations for further steps to be taken in order to efficiently tackle the issue of unplanned flows. One of these steps included an analysis of the bidding zones' configuration and its impact on the efficiency of the Target Model for the Central and Eastern Europe (CEE) region - FBA Market Coupling (FB MC). Elaboration of this particular analysis was repeatedly proposed by four TSOs within the CEE TSOs High-Level Meetings, yet was never carried out due to a lack of consensus among all CEE TSOs. This study is thus an attempt to answer the question asked by four CEE TSOs concerning the adequacy and sustainability of the current bidding zone structure in the CEE region in connection with unplanned power flows and the impact of the FB MC implementation on such flows.<br>The study covers three main areas: a simple analysis of cross-border flows using the Vulcanus database, a more elaborated analysis of the impact of simulated transactions within the common DE-AT market area on selected critical branches in the CEE regional grid, and a discussion on the implications of the findings for the CEE FB MC. Further investigation reflecting the actual evolution may follow. |
| *Transparent data* | The study uses transparent and verifiable data available to all TSOs from: the Vulcanus database, the transparency platform of ENTSO-E, transparency web sites of local TSOs and the ENTSO-E reference model. The analysis covers different periods between January 2010 and December 2012. |
| *Approach of the Study* | The approach of the study was twofold. Firstly, a high level statistical analysis of unplanned power flows was carried out using data time series available in the Vulcanus database. Then, the findings were analyzed in detail using power flow analysis software and the ENTSO-E reference model to simulate the impact of transactions within the common DE-AT market area on the CEE grids. |
| *Unplanned flows* | For the purpose of the study, unplanned power flows are defined as any difference between physical and commercial flows on a given cross-border profile in any given hour. Though the authors do recognize the limitation of such approach, this simple analysis is enough to indicate problems that should be further studied in more detail. This is exactly why the simple Vulcanus study was followed by a power flows-based study. |
| *Role of DE-AT market area* | The Vulcanus analysis confirms the significance of the common DE-AT market area, where scheduled internal transactions may in certain cases significantly influence neighbouring power systems. Transactions between Germany and Austria, unlike any other transactions between EU Member States, are considered internal transactions concluded within the market areas and hence are not subject to the coordinated capacity allocation mechanism. Hence, while |

| | |
|---|---|
| | having no risk of being constrained by TSOs due to a lack of capacity, they have preferential treatment over all other cross-border transactions in the region. |
| *Impact on neighbouring countries* | At the same time, the analysis shows that a significant part of these transactions does not flow directly via the DE-AT border but rather flows through the neighbouring systems. Taking into account data covering the period between January 2011 and December 2012, it can be estimated that up to about 50% of commercially scheduled transactions may physically flow through interconnections with other countries, usually in the direction DE → PL → CZ → SK → HU → AT, while further transiting to south European countries. Due to their geographical position, Poland and the Czech Republic are the countries mostly affected by internal DE-AT north-south transactions. Countries west of Germany are also affected, yet due to the PST devices installed on the DE-NL border, this impact is better manageable. |
| *High volume of DE-AT commercial flows leads to high volume of unplanned flows through cross-border interconnections with neighbours* | The analysis shows that the volume of commercial flows between DE and AT significantly influences the volume of unplanned flows passing through the neighbouring grids. When DE-AT commercial exchange schedules exceed 3 000 MW, which was experienced in some 17% of hours in the studied periods, unplanned power flows between DE-PL are on average about 1 300 MW. With low exchanges DE-AT, these unplanned power flows are at the level of about 450 MW, which could be considered as a level of natural flows due to synchronous operation. A similar effect is visible on the interconnection CEPS-50Hertz and ČEPS-APG, where with increased DE-AT scheduled exchanges unplanned power flows rise by about 1 000 – 1 200 MW above the level experienced with low DE-AT exchanges. For particular hours, these values of unplanned power flows can be even higher, the highest recorded value on the DE-PL border exceeding 2 700 MW. |
| *Considerable number of transactions outside allocation procedure* | Regarding the share of commercial transactions within the DE-AT market area and at other CEE cross-border interconnections, the assessment shows that scheduled commercial flows between DE and AT represent about 28% of all commercial exchanges within the whole CEE region. This is by far the largest volume identified for all CEE borders. It is not subject to coordinated capacity allocation and, which is even more important, will not be subject to the future FB MC allocation procedure if the current bidding zone delimitation is not changed. Hence, it will continuously be considered as an external effect and thus prioritized as compared to other cross-border transactions within the CEE region. |
| *Situation on 22 August* | The situation on 22 August 2012, and in particular the activation of a set of remedial actions, confirmed the significant impact of transactions within the common DE-AT area on the flows over selected borders of Poland and the Czech Republic, and the security of their transmission systems. The impact of redispatching between DE and AT ranged on the 50Hertz/PSE, 50Hertz/ČEPS, and common 50Hertz/(ČEPS+PSE) profile respectively between 18% and more than 40% (in total). |
| *Impact on the FB MC efficiency* | The study confirms that the increasing level of unplanned flows over CEE grids observed since 2011 is a direct consequence of an improperly functioning cross-border market in the CEE region, namely a lack of sufficient coordination during |

| | |
|---|---|
| | cross-border capacity calculation and allocation as well as an incorrect bidding zone structure. This fact shall be adequately taken into account when decisions regarding the FB MC implementation in the CEE region and in Europe are made. If not, not only market functioning but also the security of transmission systems in Europe (especially in the CEE region) might be seriously endangered. |
| *Proper market design needed* | Based on the outcomes of this analysis, the TSOs from the Czech Republic, Hungary, Poland and Slovakia are of the shared opinion that the future cross-border capacity calculation and allocation mechanism must be able to correctly reflect interdependencies between exchanged trade volumes and the resulting impact on power flows in the interconnected European power system. In the view of ČEPS, PSE, MAVIR and SEPS, only a correctly applied Flow-Based methodology is able to meet this requirement.<br><br>V4 countries recognize the challenges related to meeting the above-mentioned requirements. However, the challenges are to be tackled, especially when all involved TSOs and national regulatory authorities are committed and willing to address the issues that have been undermining this process to date. |

# 1. Introduction

**In March 2012**, four transmission system operators (TSOs) from the Central and Eastern Europe (CEE) region (Czech Republic - ČEPS, Poland - PSE, Hungary - MAVIR and Slovakia - SEPS) presented their shared **position on the issue of bidding zones**[1]. The position responded to the increasing level of unplanned power flows and specifically the October 2011 Frontier/Consentec study[2] which focused on one aspect significantly affecting physical and commercial flows within the CEE region, namely the issue of bidding zones and the joint German-Austrian (DE-AT) bidding zone respectively. Whereas the Frontier/Consentec study dealt with the economic merits and downsides of breaking up the joint DE-AT bidding area into smaller zones and came to the conclusion that no changes to the bidding zone delimitation are needed, the four CEE TSOs analysed the issue from a different perspective and focused on a broader context of market design and its role in managing unplanned flows.

The intention of the four CEE TSOs was to attract attention to the increased risks related to the growing level of unplanned flows in the CEE region and to initiate discussions aimed at achieving a well-designed and efficient solution that is balanced and convenient to all stakeholders affected by the developments on the European energy market. Therefore, the shared position **also identified four steps to be taken**:

- split the DE-AT common market area into separate bidding zones as the first and easiest way to improve market design,
- analyse the impact of the German north-south flows for the different power system condition scenarios,
- perform an analysis of the configuration of bidding zones and its impact on the efficiency of the target model – FBA Market Coupling and
- investigate the relation between smaller bidding zones and trade liquidity, price signals, etc.

According to the March 2012 shared position of the V4 TSOs, achieving the final goal of a common EU-wide integrated electricity market required resolving the above-mentioned issues. **Without changing the configuration of bidding zones, and more specifically, without treating Germany and Austria as separate bidding zones, the introduction of the Target Model – Flow-Based Market Coupling (FB MC), will only have a moderate or minor influence on unplanned power flows, as flows would - due to intra-zonal transactions - stay outside the coordinated cross-zonal capacity allocation mechanism.**

**Since the publication of the position, many activities** have been carried out at both the regional as well as European level that have contributed to the current situation when **unplanned flows are broadly acknowledged as a phenomenon which inter alia affects the TSOs ability to manage the security of supply**[3] **and undermines the efficiency of the internal electricity market**[4]. A number of possible ideas for tackling the issue have been presented and continue to be sought.

---

[1] *Position of ČEPS, MAVIR, PSE and SEPS regarding the issue of Bidding zones Definition*, released on 26 March 2012

[2] *Relevance of established national bidding areas for European power market integration – an approach to a welfare-oriented evaluation* – commissioned by Bundesnetzagentur and released in October 2011

[3] *Letter from ENTSO-E president D. Dobbeni to Commissioner Oettinger " Risks to interconnected system operations – follow-up to Spring 2011 letters",* 17 April 2012

At the European level, two main projects dealing with the issue of bidding zones delimitation are currently under way:

- Study on loop flows commissioned by the European Commission and carried out by an external consultant, results are expected to be delivered by mid-2013;
- Pilot study on early implementation of the draft NC CACM bidding zones' provisions carried out by ENTSO-E(TSOs) and ACER (NRAs), preparations are currently on-going, the study has not yet been launched;

Although fully supported by CEE TSOs, neither of these studies seems to focus on the relation of unplanned flows, market design and the implementation of the FB MC, a key concern of the four TSOs.

**At the level of the CEE region**, the four TSOs have repeatedly proposed and called for the need to analyse the impact of the current bidding zone structure on the efficiency of the Flow-Based Market Coupling (FB MC). The divergent opinions of CEE TSOs on the issue of the current bidding zone structure in the CEE region resulted in July 2012 in the drawing up of a letter[5] addressing national regulatory authorities (NRAs) and ACER with the key question of whether the FB MC should be implemented under the current bidding zones structure in the CEE region or whether the implementation of the FB MC should also include an assessment and possible modification of the bidding zones structure in the CEE region regarding the FB MC efficiency before its implementation. At the time being, a reply from the NRAs is still pending and the CEE region thus continues to experience a deadlock as the lack of a clear reply and guidance from the regulatory authorities prevents TSOs from further activities in preparing the FB MC implementation.

**In the view of the four CEE TSOs, the issue of the bidding zone structure continues to play a key role in the preparation for achieving the EU goal – completion of the internal energy market by 2014.**

Due to the CEE TSOs discussions throughout the year 2012, the apparent lack of consensus on the efficiency and effectiveness of FBA to facilitate liquid cross-border trade and to tackle unplanned power flows, **TSOs from the Czech Republic, Hungary, Poland and Slovakia have decided to investigate and assess on their own the impact of the current bidding zone structure within the CEE region with the focus on the joint market area of DE-AT, and especially on the energy exchanged between the two countries outside the coordinated capacity allocation scheme and without coordination with the neighbouring countries.** The four CEE TSOs are convinced that such investigation is essential for taking a qualified decision on the future cross-border capacity calculation allocation mechanism poss. before the Target Model implementation.

The result of their joint work is **this study. Its aim** is to:

- follow up on the March 2012 shared position on bidding zones delimitation,
- provide - based on transparent data available to all (CEE) TSOs (Vulcanus + ENTSO-E transparency platform) and the ENTSO-E reference grid model - a detailed numerical assessment of:
    - the overall level of cross-border physical, commercial and finally unplanned flows over selected CEE borders and

[4] *ACER/CEER Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2011,* 29. November 2012

[5] Letter of 18 July 2012

- possible correlations of commercial transactions realised within the common DE-AT market area and cross-border flows over selected CEE borders,

- assess the impact of intra-zonal transactions within the DE-AT market area based on a detailed power flows model with nodal resolution (ENTSO-E reference model) on particular grid elements within the transmission grids of ČEPS, PSE, SEPS and MAVIR, and
- present the shared position of the four CEE TSOs on further development in the CEE region with regard to implementation of the Target Model.

**Structure of the report and methodology**

The report covers two main areas of data analyses: analysis of cross-border flows and analysis of the impact of simulated transactions within the common DE-AT market area on CEE grids.

The first part provides an assessment of physical, commercial as well as unplanned power flows based on the Vulcanus database[6] and also information from local TSOs transparency web sites, e.g. www.ceps.cz[7] and the ENTSO-E transparency platform[8]. In principle, the analysis contains aggregated hourly values per border. However, in order to provide a complex overview for a period of a few years, the analysis had to be simplified by introducing data aggregations (e.g. monthly averages) so as to allow the investigating of correlations between commercial exchanges within the DE-AT market area and unplanned flows in the CEE region. On that basis, preliminary findings have been drawn up and are presented.

The second part complements the findings of the simplified analysis through a sensitivity assessment of intra-zonal transactions within the DE-AT market area vis-à-vis the grid elements of the four TSOs. The assessment uses a detailed power flows model with nodal resolution, i.e. the ENTSO-E reference model. This grid model, available to all TSOs, is considered a realistic starting base case scenario for the power-flow driven technical approach of this study. The assessment consists of a set of load flow simulations representing the additional exchange of 100 MW between the DE and AT bidding zones: a zone-to-zone exchange(s) simulation followed by simulations of additional exchanges comprising all particular pairs of generators in DE and AT (more than 2 100 combinations in total). As a result, the most affected critical branches in the high and extra-high voltage networks of ČEPS, SEPS, PSE and MAVIR have been identified.

The focus of the analysis is the DE-AT market area. This is the largest market area in the CEE region consisting of more than one EU Member State. Moreover, there are transparent data available on DE-AT exchanges. Though the effects of internal transactions within Germany or within other large market areas in Europe might also be visible in the CEE region, these were not investigated in detail due to the unavailability of credible data.

The third part of the report focuses on the implications of the previously carried out analyses on the situation in the CEE region in both practical operational matters (situation on 22 August 2012) and with regard to the Target Model implementation (FB MC).

Finally, the report ends with conclusions and recommendations for future shared work on the fulfilment of the common EU goal to complete the internal energy market by 2014 while ensuring fair and equal treatment.

---

[6] www.vulcanus.org

[7] http://www.ceps.cz/ENG/Data/Vsechna-data/Pages/default.aspx

[8] www.entsoe.net

## 2. List of Abbreviations

| | |
|---|---|
| **ACER** | Agency for the Cooperation of Energy Regulators |
| **AT** | Austria |
| **CEE** | Central and Eastern Europe |
| **CWE** | Central West Europe |
| **CZ** | the Czech Republic |
| **DACF** | Day Ahead Congestion Forecast |
| **D-2CF** | Two-day ahead congestion forecasts |
| **DE** | Germany |
| **ENTSO-E** | European Network of Transmission System Operators for Electricity |
| **FBA** | Flow-Based Allocation |
| **FB MC** | Flow-Based Market Coupling |
| **G-G** | generator to generator |
| **GSK** | Generation Shift Key |
| **HU** | Hungary |
| **NRA** | National regulatory authority |
| **PL** | Poland |
| **PSSE** | Power System Simulator |
| **PST** | Phase Shifting Transformer |
| **PTDF** | Power Transfer Distribution Factor |
| **RA** | Remedial actions |
| **SK** | Slovakia |
| **TSO** | Transmission System Operator |
| **TTG** | TenneT TSO GmbH |
| **UA** | Ukraine |
| **UCTE** | Union for the Co-ordination of Transmission of Electricity |
| **VAR** | Volt ampere reactive |

### 3. Analysis of cross-border flows based on VULCANUS data

The aim of this chapter is to conduct an overall assessment of cross-border flows (both the nominated commercial schedules and the measured physical flows). For the purpose of the analysis, the following terms are defined and shall be understood as follows:

- ***realised schedules*** – commercial flows through a given cross-border profile comprising long-term nominations, day ahead nominations and intraday nominations,
- ***measured load flows*** – measured physical cross-border power flows,
- ***unplanned power flows*** – the difference between measured load flows and realised schedules (see the figure below).

The term *"unplanned"* refers to the fact that the difference between commercial and physical flows are due transactions conducted-/realized outside the cross-border capacity allocation mechanism related to the concerned border. Hence, these power flows are not "planned" or "scheduled" to be realized via the interconnection. Though the authors of the report do recognize the limitation of such approach, unplanned power flows obtained using this simple exercise are a good indication of the inefficiencies of the cross-border capacity allocation scheme.

The analysis was carried out using data collected in the Vulcanus database for the period from January 2010 to December 2012. These data are available with hourly resolution and consist of aggregated values per border. Where available, Vulcanus data were complemented with more detailed information. This is the case for the DE-CZ border. In Vulcanus, the interconnections ČEPS-50Hertz and ČEPS-TTG (TenneT Germany) are aggregated as one common profile. However, in the case of this border, the loading of both interconnections is structurally different, as one conducts power flows in the direction usually from 50Hertz to ČEPS (DE→CZ) and the other one from ČEPS to TTG (CZ→DE). When aggregated, this introduces a strong netting effect. In order to eliminate it and reveal the actual difference, the standard Vulcanus data analysis is complemented by an additional one which assumes the separate treatment of the interconnections ČEPS-50Hertz and ČEPS-TTG. The data used for this purpose are publicly available in the market transparency section on the ČEPS website[9].

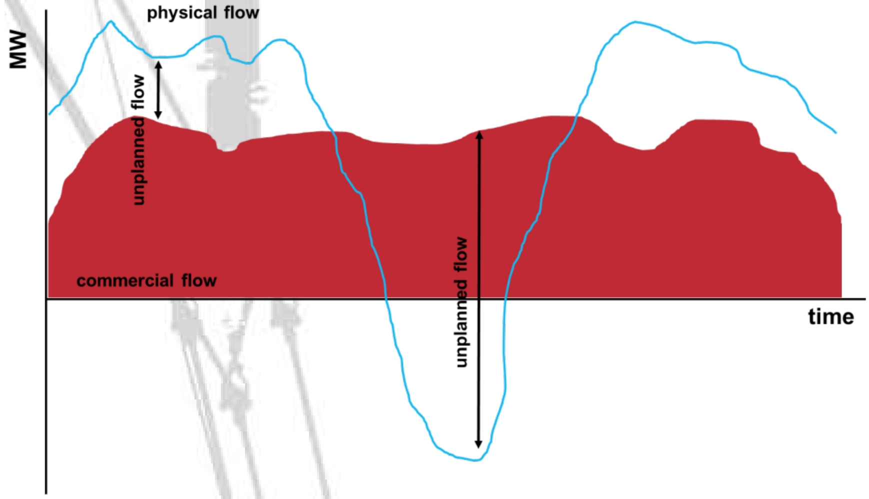


**Figure 1. Definition of unplanned flows**

[9] http://www.ceps.cz/ENG/Data/Vsechna-data/Pages/default.aspx

### 3.1. General analysis of Realised Schedules, Measured Load Flows and Unplanned Flows

The following figures show Average Realised Schedules, Measured Load Flows and Unplanned Flows for the time period January 2011 – December 2012. What is particularly noticeable is that the two-year average of unplanned power flows on some borders ranges as high as 1 000 MW.

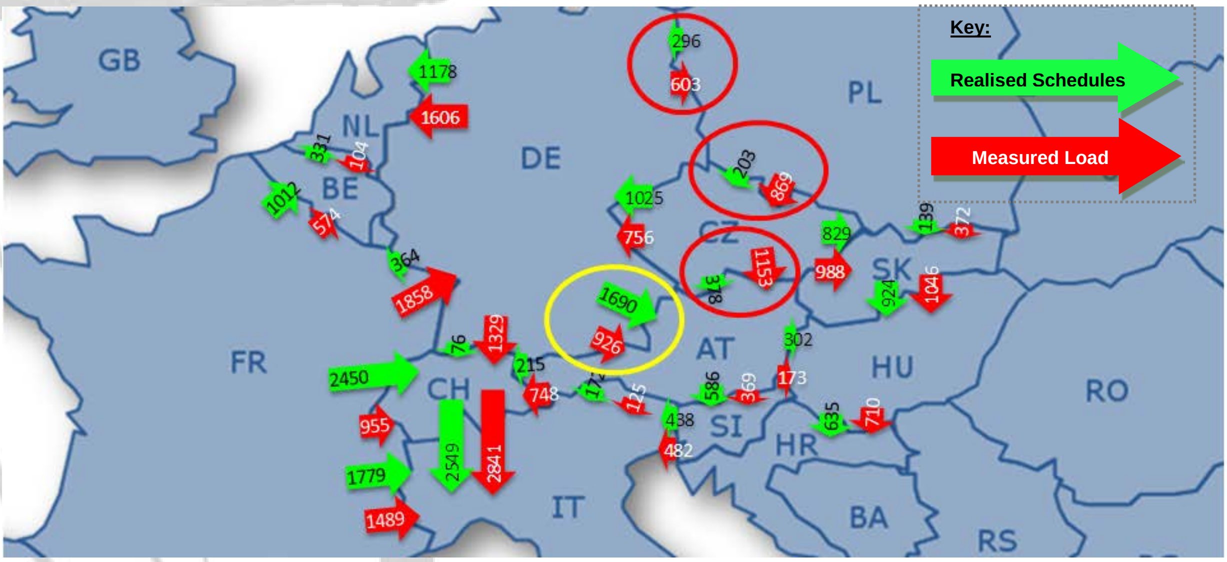


Figure 2. Average Realised Schedules and Measured Load Flow in Europe [MW], 01.2011–12.2012

Figure 3 shows the same information as Figure 2, but this time with the DE-CZ border split into two separate profiles, ČEPS-50Hertz and ČEPS-TTG. This is to reveal the actual impact of unplanned power flows on this border and uncover the netting effect.

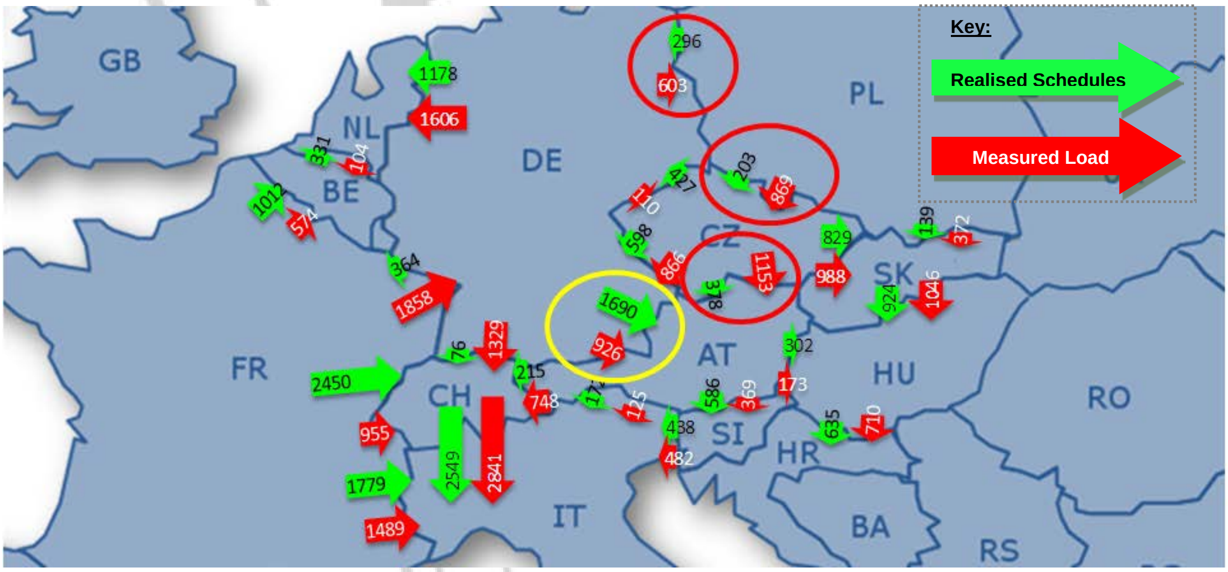


Figure 3. Average Realised Schedules and Measured Load Flow in Europe [MW], 01.2011–12.2012. ČEPS-50Hertz and ČEPS-TTG are shown separately

Additionally, Figure 4 shows information about the location of PSTs in the Benelux area, as well as main loops for power flows in continental Europe:

- **CEE Region**: DE→PL→CZ→AT→DE and DE→CZ→DE
- **CWE Region**: DE→NL→BE→FR→DE

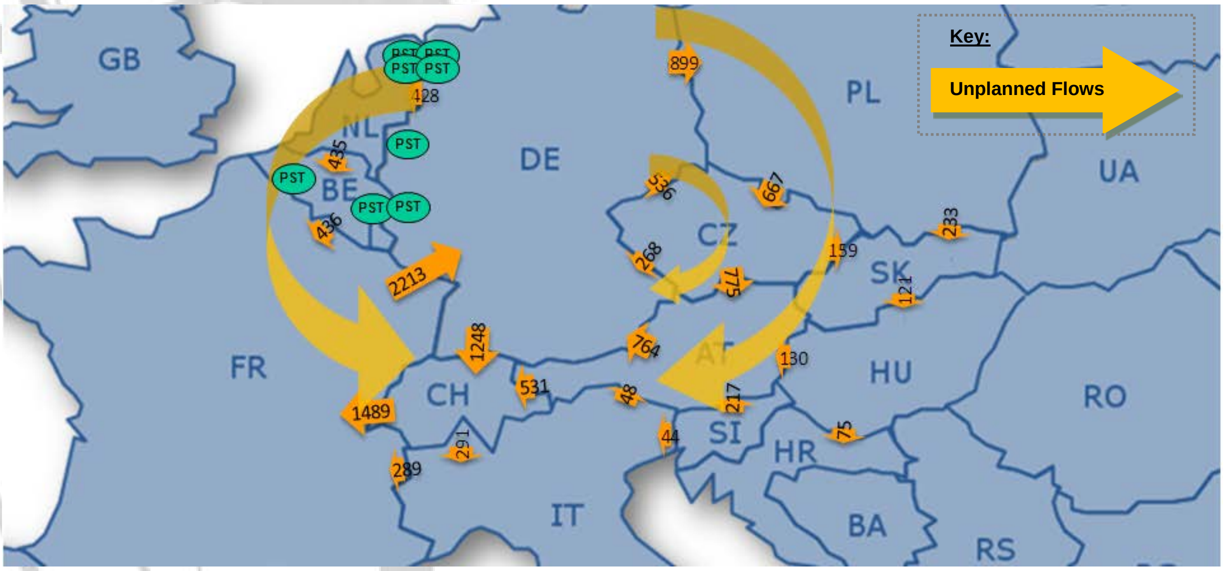


Figure 4. Average Unplanned Flows in Europe [MW], 01.2011–12.2012

### 3.2. Analysis of selected borders

After making a general overview of unplanned power flows in continental Europe, this chapter aims to show the situation on a border-per-border basis using a time series of monthly averages with Realised Schedules, Measured Load Flows and Unplanned Flows for the selected CEE borders.

Note that the figures in this section are monthly average ones, which means that the hourly or even momentary values can be quite volatile and can significantly exceed the average values.

#### 3.2.1. Germany-Austria

Figure 5 shows the evolution of monthly average values of Realised Schedules, Measured Load Flows and Unplanned Flows for the border between DE and AT. This border is the one that exchanges by far the highest volume of energy. Scheduled exchanges exceeding 4 000 – 5 000 MW are not rare. One can clearly see that commercial transactions DE→AT (Realised Schedules) are in most time stamps higher than the Physical Power Flows on this border, indicating that a significant part of these transactions does not flow via the DE-AT border but rather flows through the neighbouring CEE and CWE systems.

The difference between realised schedules and physical flows on the DE-AT border since July 2011 ranges on average between about 500 – 2 000 MW. This is the level of magnitude for power that is on average transmitted through the neighbouring power systems. However, market participants that are concluding transactions on this border do not need to compete for access to the cross-border capacity of the neighbouring systems. This can be considered as free riding, where one power system (or rather market participants from that power system) uses the transmission networks of other systems without the need to participate in any allocation mechanism and without any coordination or compensation for these systems.

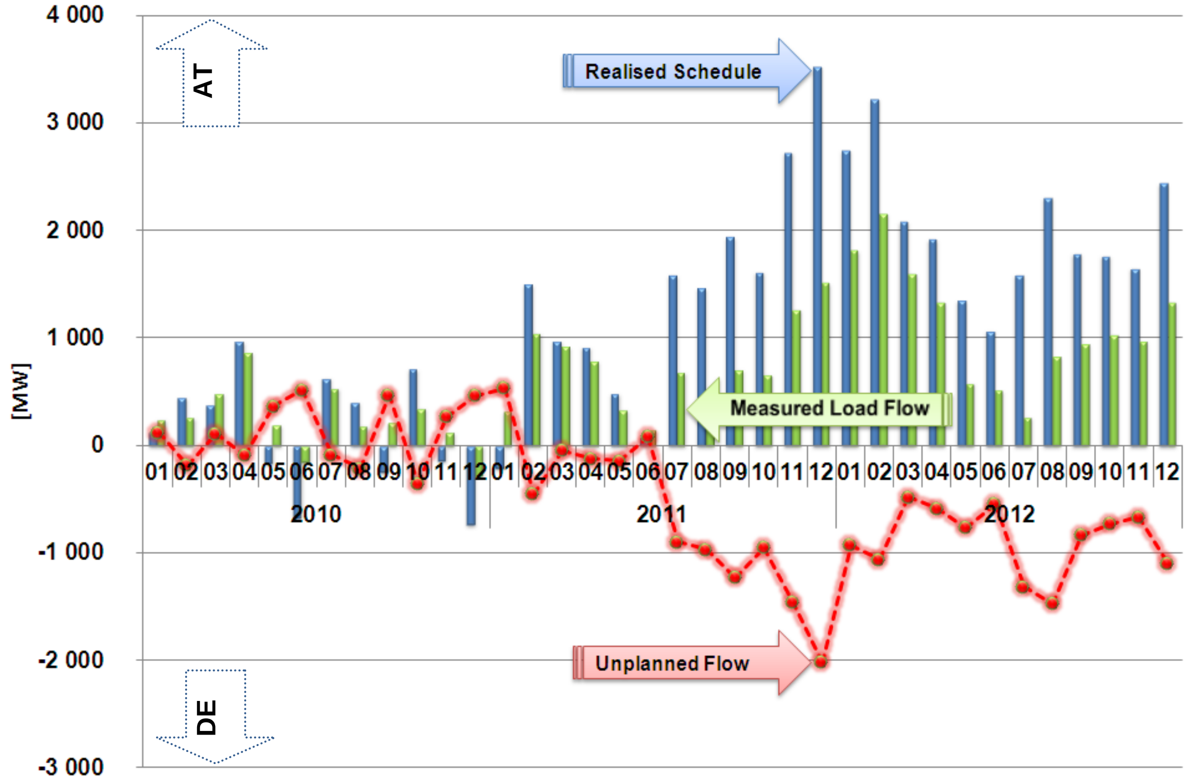


**Figure 5. Realised Schedules, Measured Load Flows and Unplanned Flows (average monthly values) on the DE–AT border**

On other borders of the region, TSOs have to take into account the effect of anticipated unplanned power flows and are forced to correspondently reduce tradable capacities in order to maintain the reliable operation of the interconnected system, thus removing the trading possibilities of other market players in this part of the region.

It is particularly interesting to note that the level of DE-AT commercial exchanges exceeded 5 500 MW already in 2011, though such exchange levels were expected not earlier than in 2015 (assumptions of the EWIS study – Figure 6)[10].

[10] http://www.wind-integration.eu/downloads/library/EWIS_Final_Report.pdf

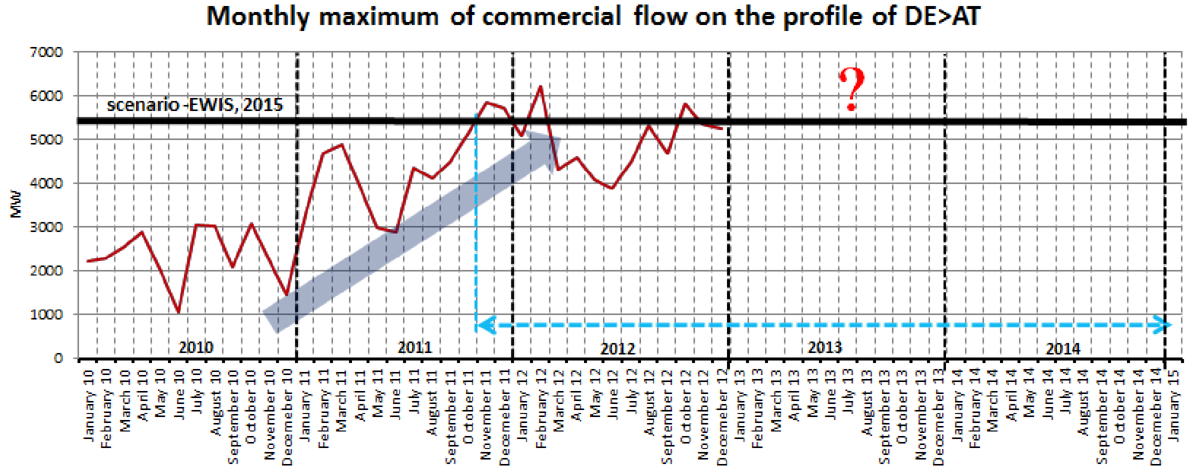


Figure 6. Evolution of maximum hourly values of Realized Schedules seen in a given month on the DE-AT border. The thick black line indicates 5500 MW - the level of exchanges assumed by the EWIS study

### 3.2.2. Germany-Poland

Figure 7 shows the evolution of monthly averages values of Realised Schedules, Measured Load Flows and Unplanned Flows for the border between Germany and Poland. One can clearly see that the direction of the physical flow is usually in the opposite direction to the commercial schedules (schedules: PL→DE, flow: DE→PL).

During the whole analysed period (January 2010 – December 2012) the measured physical flows on the DE-PL border were much higher and had the opposite direction than the realised commercial schedules between these countries. There was a permanent and high level of unplanned flows: 500 – 1 500 MW.

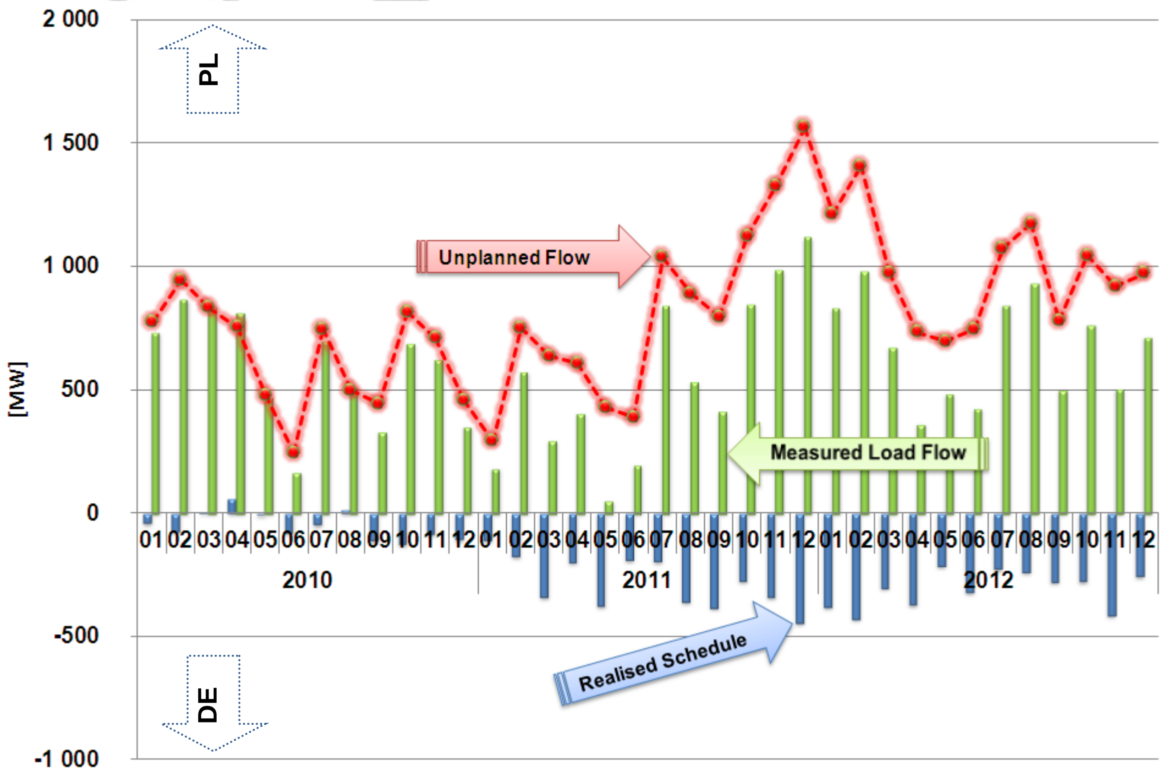


Figure 7. Realised Schedules, Measured Load Flows and Unplanned Flows on the DE–PL border

3.2.3. Poland-Czech Republic

Figure 8 shows the evolution of monthly averages values of Realised Schedules, Measured Load Flows and Unplanned Flows for the border between Poland and the Czech Republic. The level of Unplanned Flows on the PL-CZ border is only slightly lower than on the DE-PL border and ranges between 200 – 1 200 MW.

During the whole analysed period (January 2010 – December 2012) the measured physical flows on the PL-CZ border were much higher than the realised commercial schedules between these countries. This was quite similar to the situation on the DE-PL border, except that on the PL-CZ border the direction of scheduling was usually the same as the direction of flow.

The pattern of Unplanned Flows is similar to that on the DE-PL border.

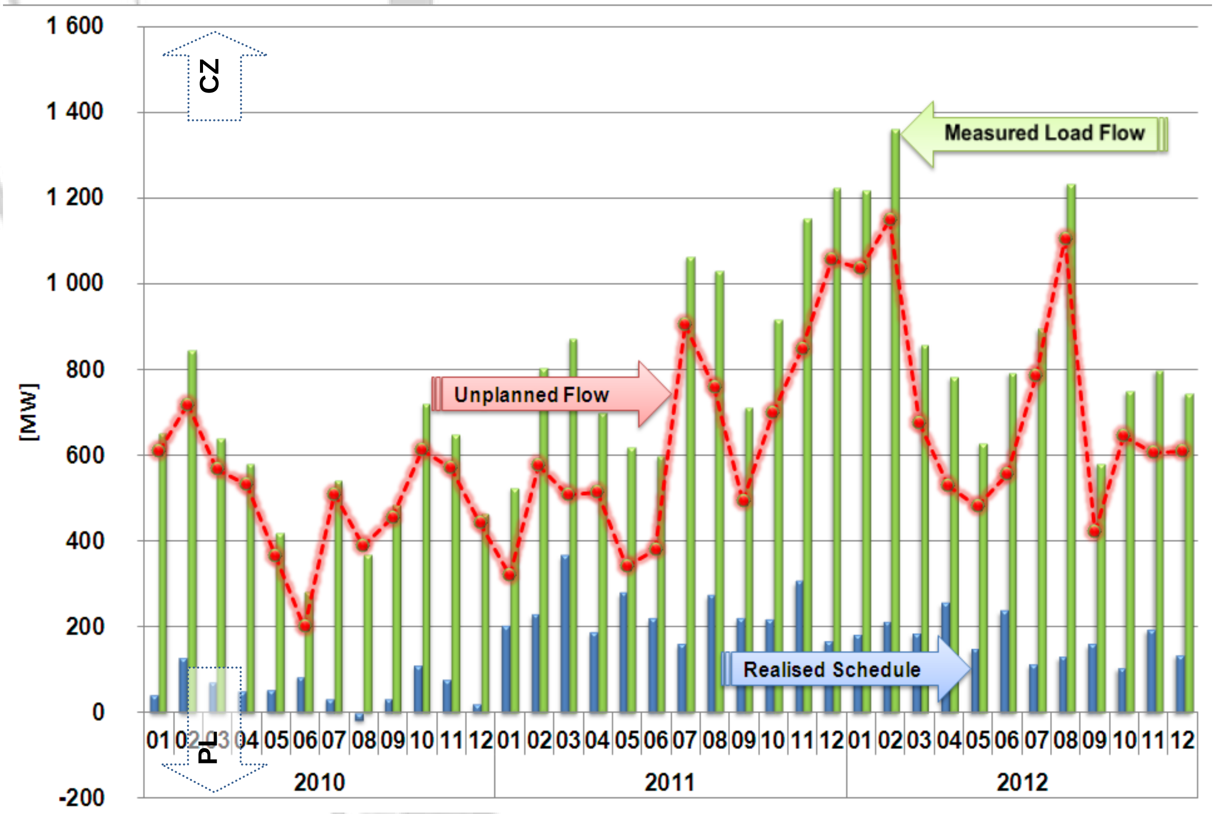


Figure 8. Realised Schedules, Measured Load Flows and Unplanned Flows on the PL–CZ border

3.2.4. Czech Republic-Germany

In Figure 9, the evolution of monthly averages values of Realised Schedules, Measured Load Flows and Unplanned Flows for the whole border between the Czech Republic and Germany is shown.

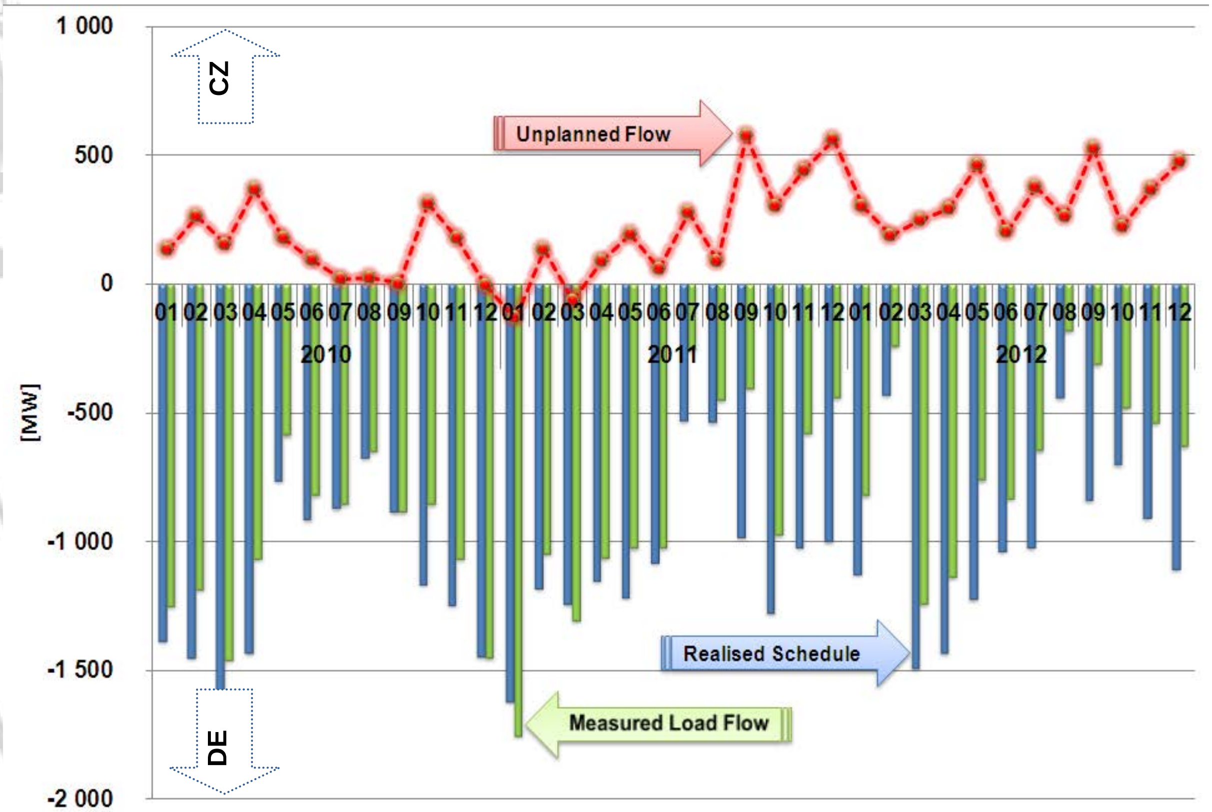


**Figure 9. Realised Schedules, Measured Load Flows and Unplanned Flows on the DE–CZ border**

At first sight, unplanned flows do not seem too high for this border. However, this is due to the reasons mentioned briefly at the beginning of Chapter 3, in particular the structurally different loading of interconnections between ČEPS-50Hertz and ČEPS-TTG, the aggregated nature of the Vulcanus database introducing a strong netting effect. On one set of interconnecting lines the power flows usually in the direction from 50Hertz to ČEPS (from DE to the CZ) and the other one from ČEPS to TTG (from the CZ to DE). Hence, a separate assessment for the cross-border profile between ČEPS and 50Hertz had to be done. Figures 10 – 11 show the evolution of monthly averages values of Realised Schedules, Measured Load Flows and Unplanned Flows for the border between the CZ and DE for each set of interconnection lines separately. For a better understanding of the phenomenon of DE→CZ→DE unplanned power flows, it was split into two parts: (i) DE (50 HzT)→CZ and (ii) DE (TTG)→CZ.

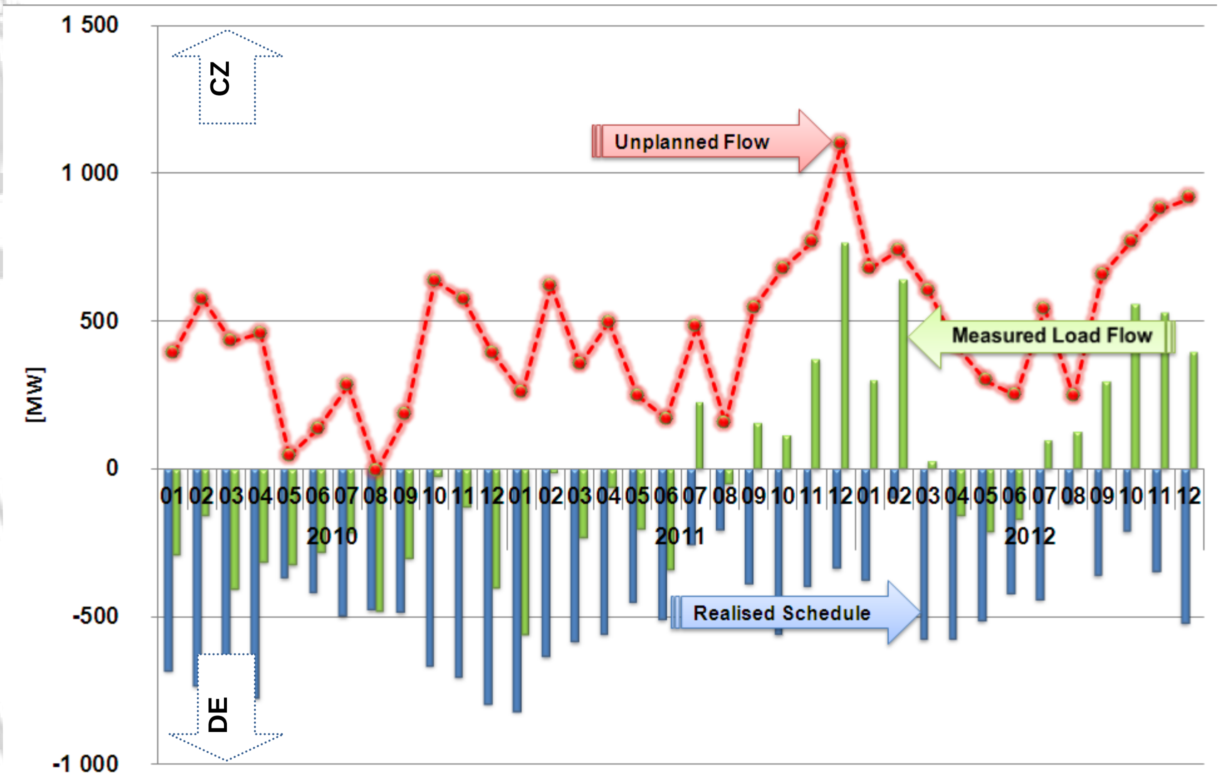


Figure 10. Realised Schedules, Measured Load Flows and Unplanned Flows on the DE (50Hertz)–CZ border

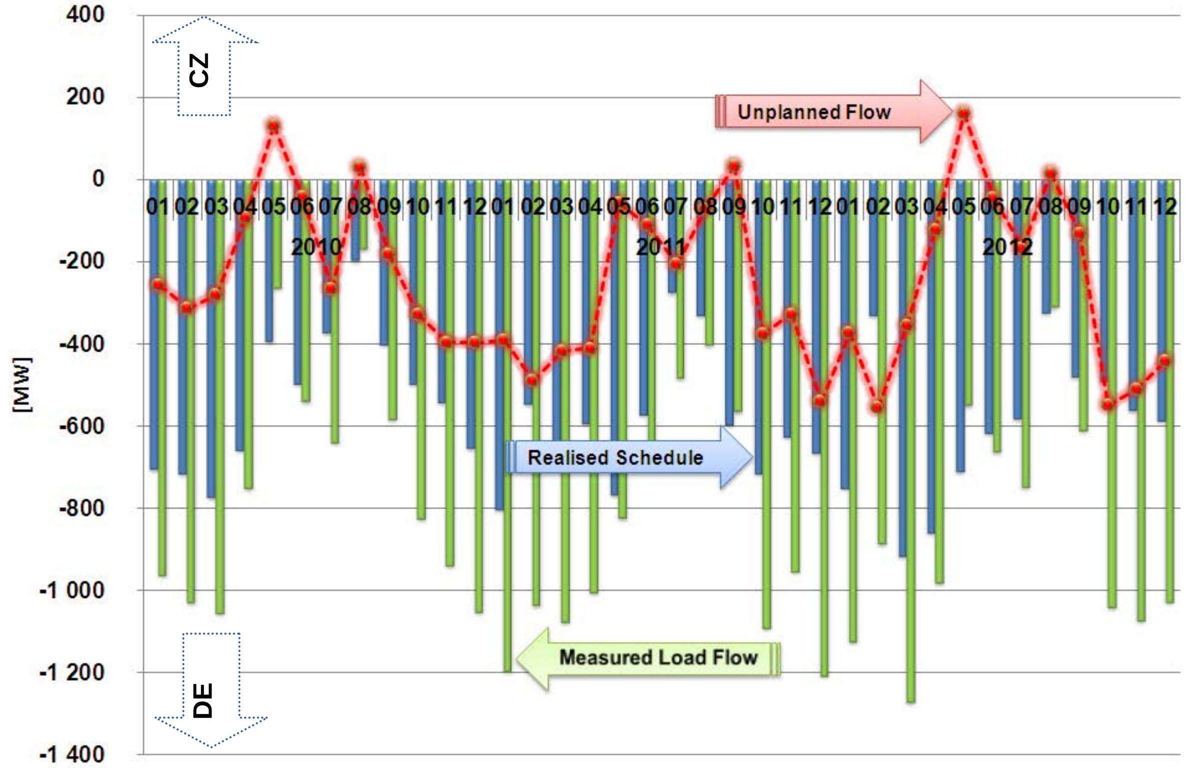


Figure 11. Realised Schedules, Measured Load Flows and Unplanned Flows on the DE (TTG)–CZ border

### 3.2.5. Slovakia – Hungary

Figure 12 shows the evolution of monthly average values of Realised Schedules, Measured Load Flows and Unplanned Flows for the border between Slovakia and Hungary. Even if this profile is not the most affected border, one can see a dominant unplanned flow – with minor exceptions – in the direction SK→HU. The average values of unplanned power flows reach 400 - 500 MW, which is less compared to levels reached on the most affected borders. However, the SK-HU profile is the major import direction for Hungary and as such is very important for ensuring a reliable power supply for this structurally importing country. Considerable unplanned flows (as transit flows) reduce these trading possibilities and increase the risk of overloading.

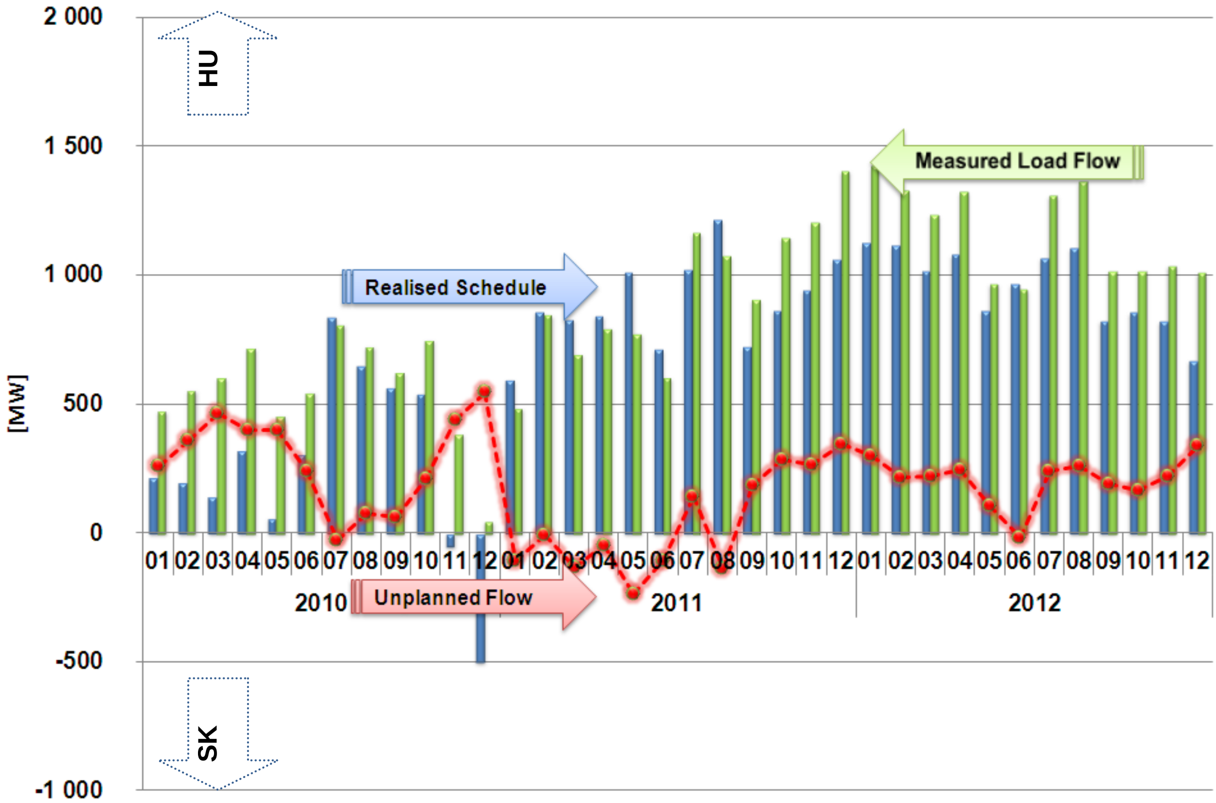


Figure 12. Realised Schedules, Measured Load Flows and Unplanned Flows on the SK–HU border

A worse situation than on this profile was experienced by Slovakia on its profile with Ukraine as this profile, though at first sight quite remote from the DE-AT market area, is affected by development at DE-AT and SK-HU profiles. Previous figures show differences between average values of measured and commercial flows. But the congestion is caused by the actual values of the power flow. Figure 12.1 shows the loading of the SK-UA profile on 29 December 2011. Loading of this profile was more than 90% and for some time periods the profile was overloaded. If in these periods the transmission line Levice - God (tie line between SK and HU) was shut down, there would be a very high probability of cascading switching-off of the following lines:

1. Levice – God - tie line between SK-HU
2. V.Kapusany - Mukachevo - tie line between SK-UA
3. Gabcikovo – Gyor - tie line between SK-HU
4. 220kV profile between CZ-AT (two tie lines)
5. 400kV profile between CZ-AT (two tie lines)

**In these periods, the total sum of loading profiles between SK-UA, SK-HU and CZ-AT was on the level 4700 MW.** As a result, differences between scheduled and measured flows on the CZ-SK and PL-SK profiles are in fact moved to the SK-HU profile and SK-UA profile. **Cascading switching-off of these profiles would probably have fatal consequences for the whole continental Europe.**

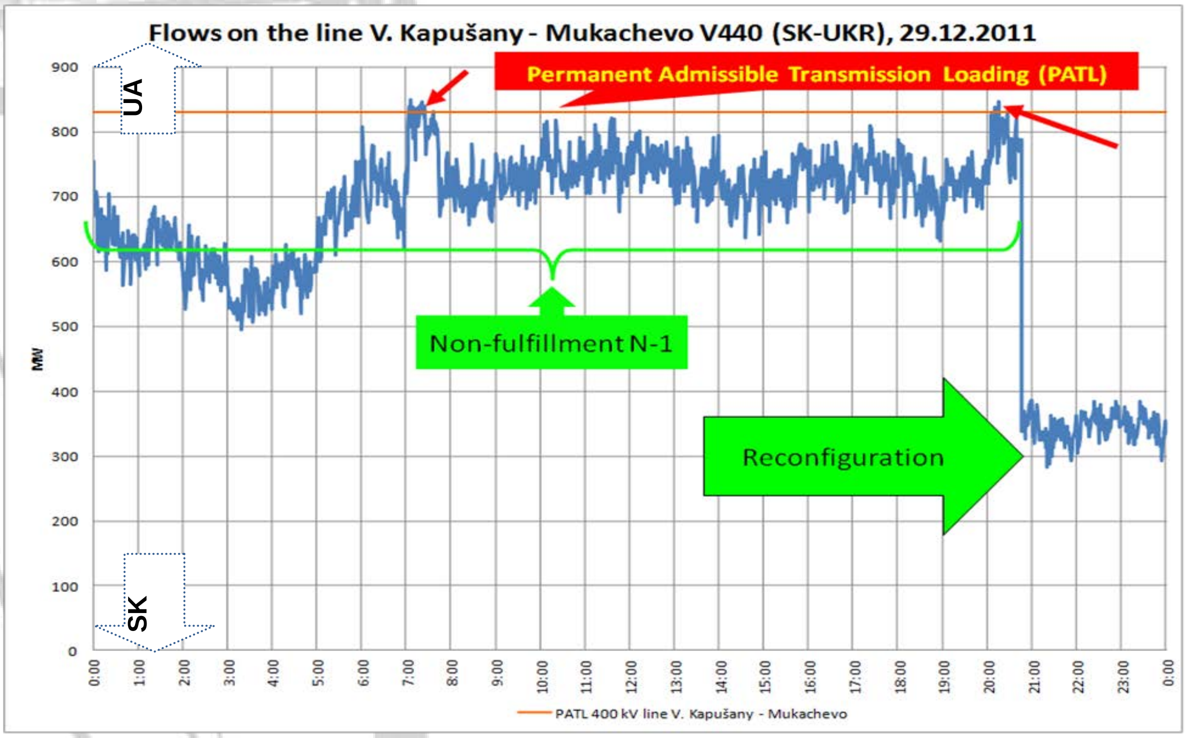


Figure 12.1. Flows on the profile between SK and UA – 29.12.2011

### 3.2.6. Austria – Hungary

Figure 13 shows the evolution of monthly average values of Realised Schedules, Measured Load Flows and Unplanned Flows for the border between Austria and Hungary. One can see that until autumn 2011 the range of Unplanned Flows remained between <-200, 200 MW> which can be regarded as an acceptable deviation. From that time the level of unplanned flows has been growing in one direction, HU→AT, sometimes reaching almost 400 MW, meaning they are also part of the unplanned flows (SK→HU→AT) described in this study.

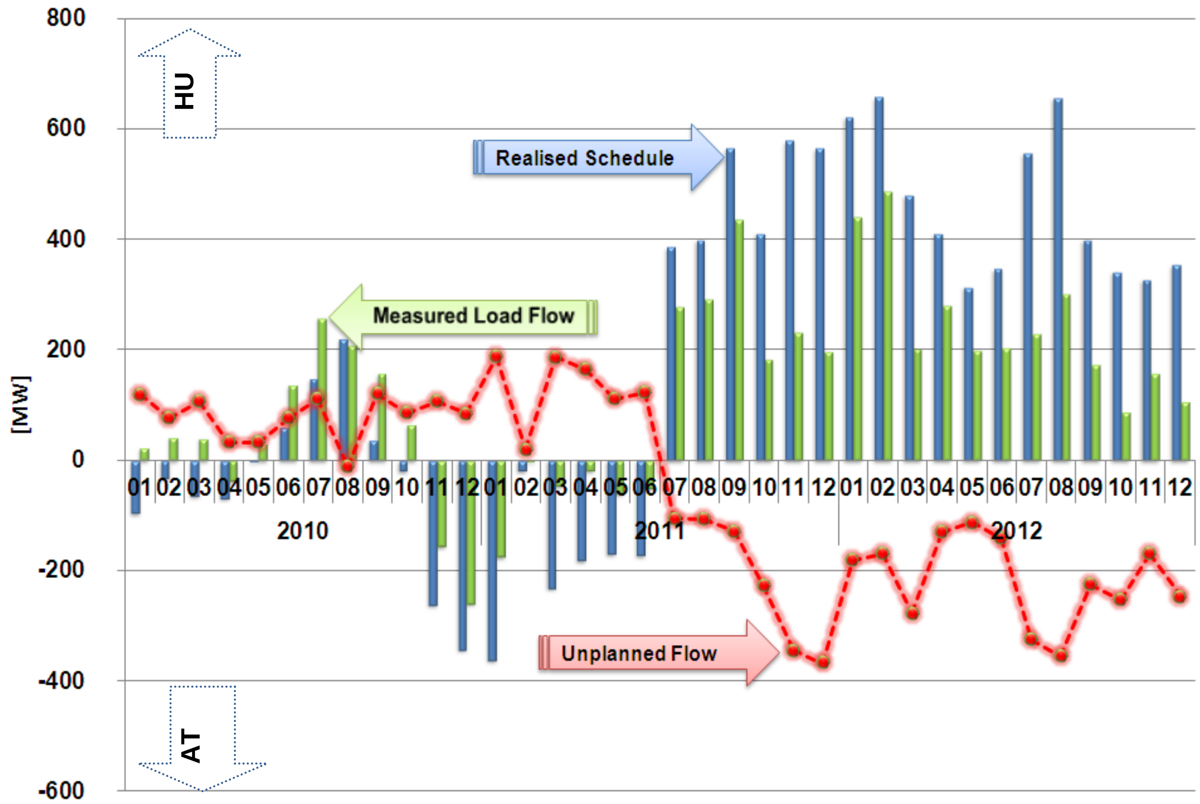


Figure 13. Realised Schedules, Measured Load Flows and Unplanned Flows on the AT–HU border

### 3.3. Impact of DE-AT power flows on other borders

After assessing the situation at different borders in the CEE region, this chapter aims to answer the question about the impact of DE-AT exchanges on the level of unplanned power flows in the CEE region. In order to investigate this impact, from the whole population of 2011-2012 hourly data, the time samples with low DE→AT exchanges (low exchanges are those exchanges in the range <-500 to 500> MW) were selected and are shown in Figures 14 and 15.

The situation with low exchanges was then compared with the situation where exchanges DE→AT were high, meaning i.e. above 3 000 MW (this threshold is a matter of choice). High exchanges constituted about 17% of the 2011-2012 hourly data population (see Figure 18). Figures 16 and 17 present these data samples. A comparison of these two figures seems to suggest that the level of DE→AT exchanges has a significant impact on unplanned power flows in the CEE region. With low exchanges DE-AT, the levels of unplanned power flows in the whole CEE were very low compared to the average values for 2011-2012. With high values of DE-AT commercial exchanges, the level of unplanned power flows in the CEE were also very high.

One must note that all figures in this section are average values over a long period, which show a mean effect, but wrap the extreme cases which occurred e.g. on 22 August 2012, causing security problems in the synchronous system.

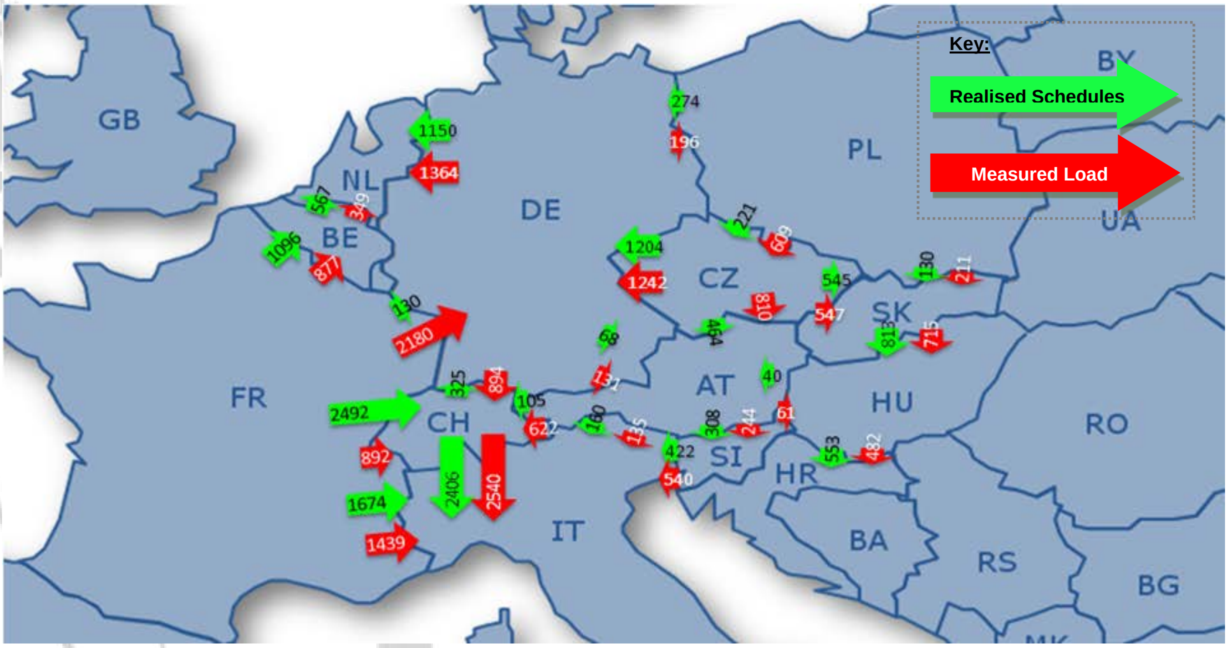


Figure 14. Average Realised Schedules and Measured Load Flow in Europe in cases when Realised Schedules DE→AT are within the range <-500,500> MW. Range of data: 01.2011–12.2012


Figure 15. Average Unplanned Flows in Europe in cases when Realised Schedules DE→AT are within the range <-500,500> MW. Range of data: 01.2011–12.2012

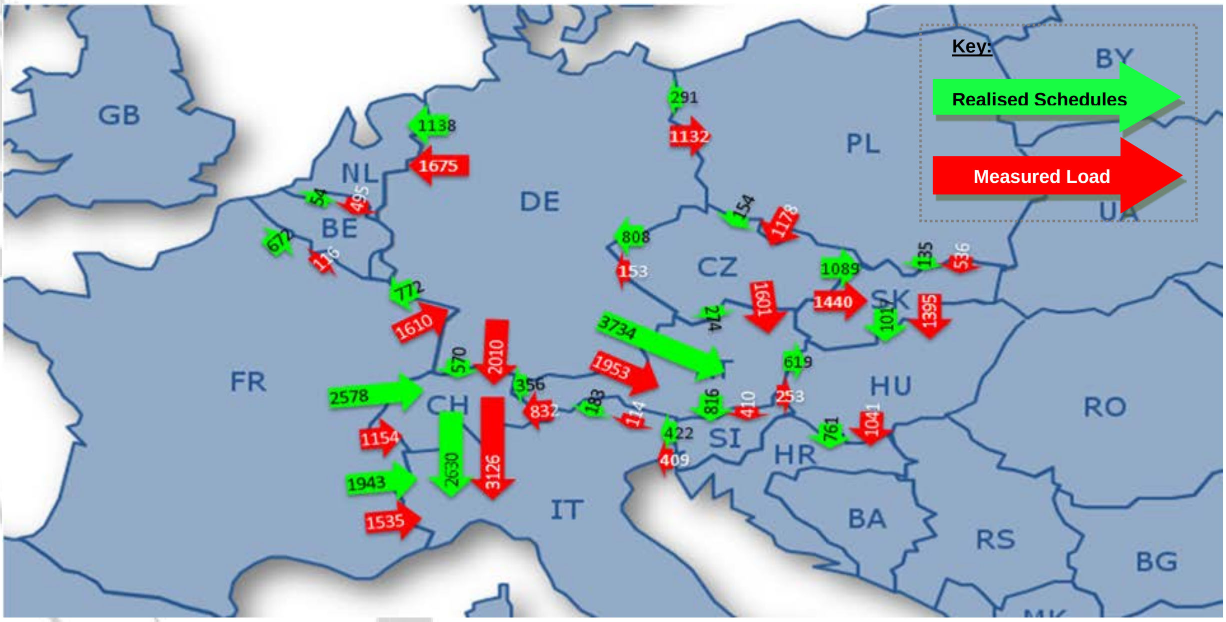


Figure 16. Average Realised Schedules and Measured Load Flow in Europe in cases when Realised Schedules DE→AT are greater than 3000 MW. Range of data: 01.2011–12.2012

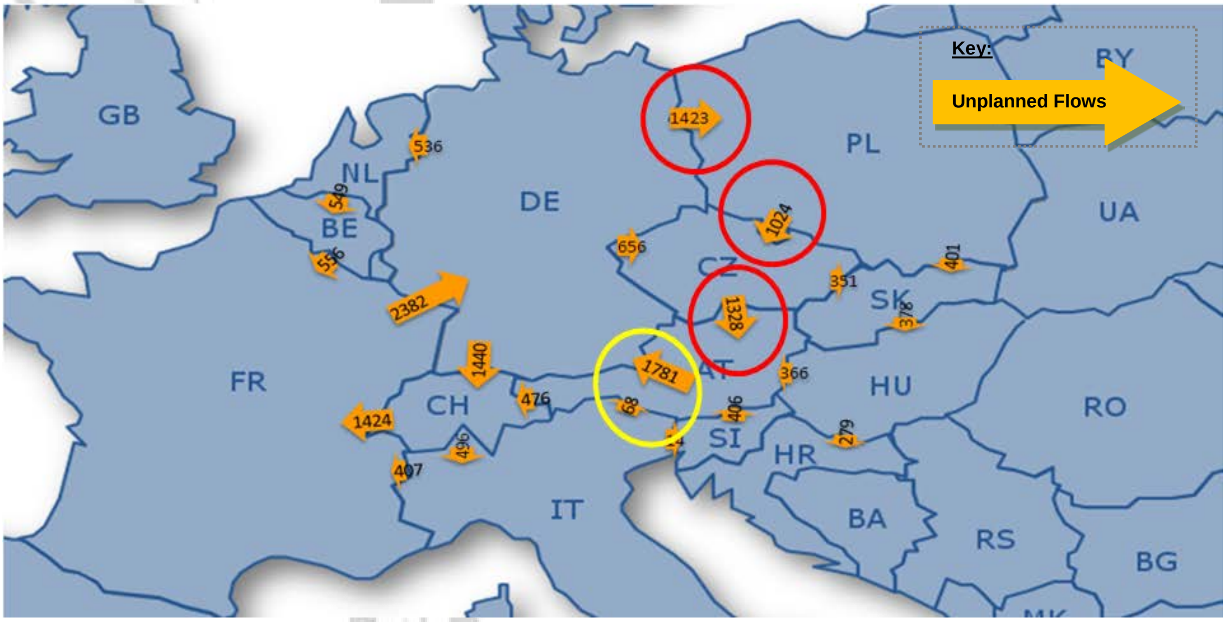


Figure 17. Average Unplanned Flows in Europe in cases when Realised Schedules DE→AT are greater than 3000 MW. Range of data: 01.2011–12.2012

In order to understand how important this observation is, one needs to understand how often the level of DE-AT exchanges is so high as to trigger significant unplanned power flows in the CEE region. For this purpose, Figure 18 presents a histogram of DE-AT exchanges. What is clearly seen from this figure is that for **69%** of all hourly samples from January 2011 to December 2012, realised schedules are greater than **1 000 MW**. Moreover, for **17%** of hours, realised schedules are greater than **3 000 MW**. This clearly shows the scale of the problem.

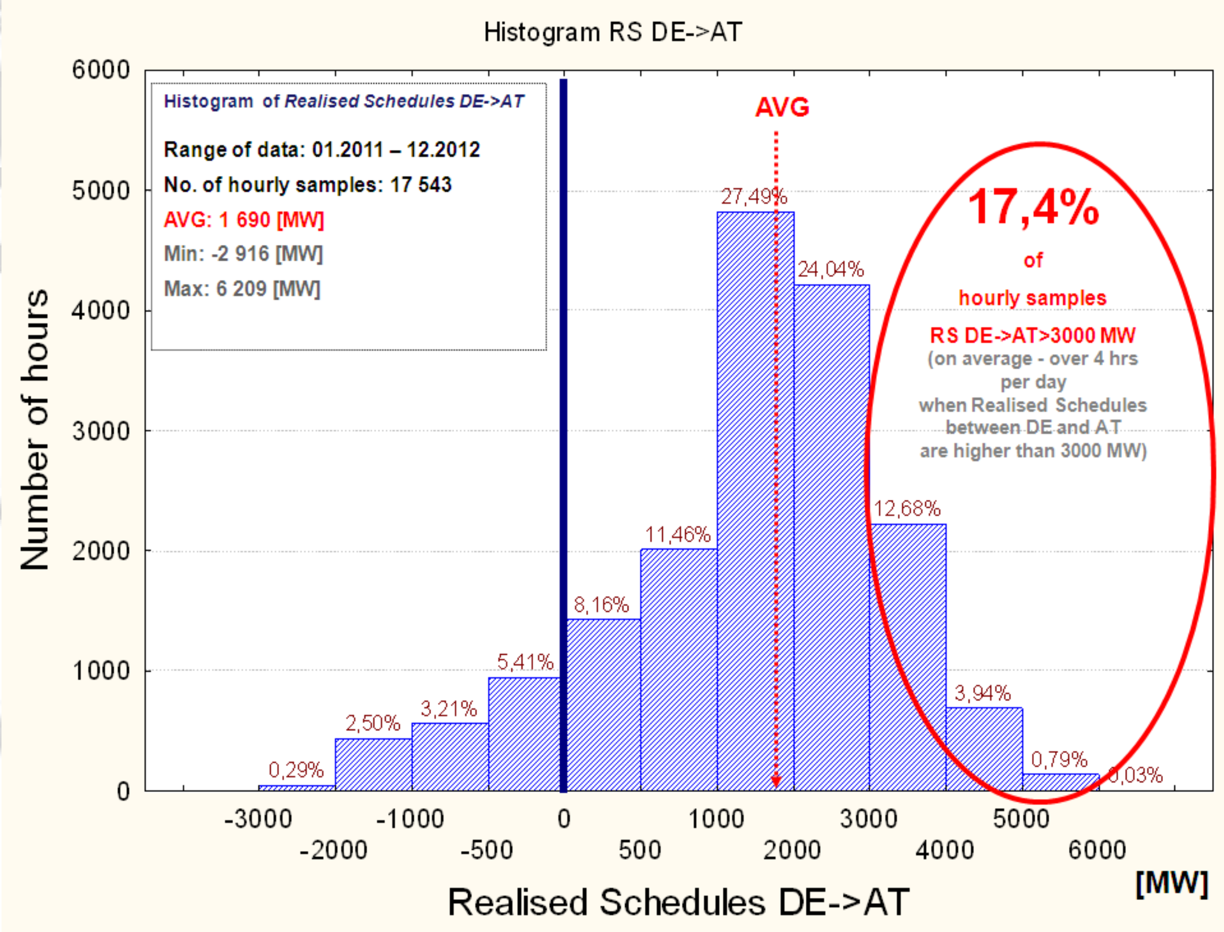


**Figure 18. Histogram of Realised Schedules DE→AT. Range of data: 01.2011–12.2012**

The previous analysis suggests that there is a correlation between the level of DE-AT exchanges and unplanned power flows in the CEE region. In order to investigate whether there is any direct correlation between DE-AT exchanges and unplanned power flows on the border between Germany and Poland, Figure 19 shows the value of the unplanned power flows DE-PL for the different levels of DE-AT exchanges. As seen in the figure, such correlation can clearly be found. For low DE-AT exchanges indicated by Figure 18 in the range <-500, 500> MW, unplanned power flows visible on DE-PL are mostly natural loop flows resulting from grid topology and generation configuration, approaching in its median value some 450 MW. It can be said that this is a “safe level" for unplanned flows. What is even more important, all CEE borders experience these low values of unplanned power flows. With increasing values of DE-AT exchanges, unplanned power flows DE-PL are on the increase. Moreover, the correlation seems to be quite strong. The scale of the problem is determined by fact that in about **80%** of the 2011-2012 hourly data population (see – Figure 18) the above-mentioned **safe level is exceeded**. When Realised Schedules between DE and AT are in the range 3000 - 4000 MW (over 17% of hourly samples in the period January 2011 – December 2012), the median of unplanned flows on the DE-PL border is at the level of **1 320 MW**, i.e. about 900 MW higher than it is in the case of the above-mentioned “safe level” of natural loop flows. Exchanges above 4000 MW trigger about 1200 MW of unplanned power flows on top of natural loop flows of 450 MW, adding up to some **1 650 MW** of unplanned power flow expressed in terms of median value. Finally, in cases when Realised Schedules between DE and AT are lower than - 2000 MW (schedules in the direction AT→DE), very low unplanned power flows in the opposite direction (from PL to DE) appear on the border between Germany and Poland. This confirms how strong the relation is between schedules on the DE-AT border and unplanned power flows on the PL-DE border.

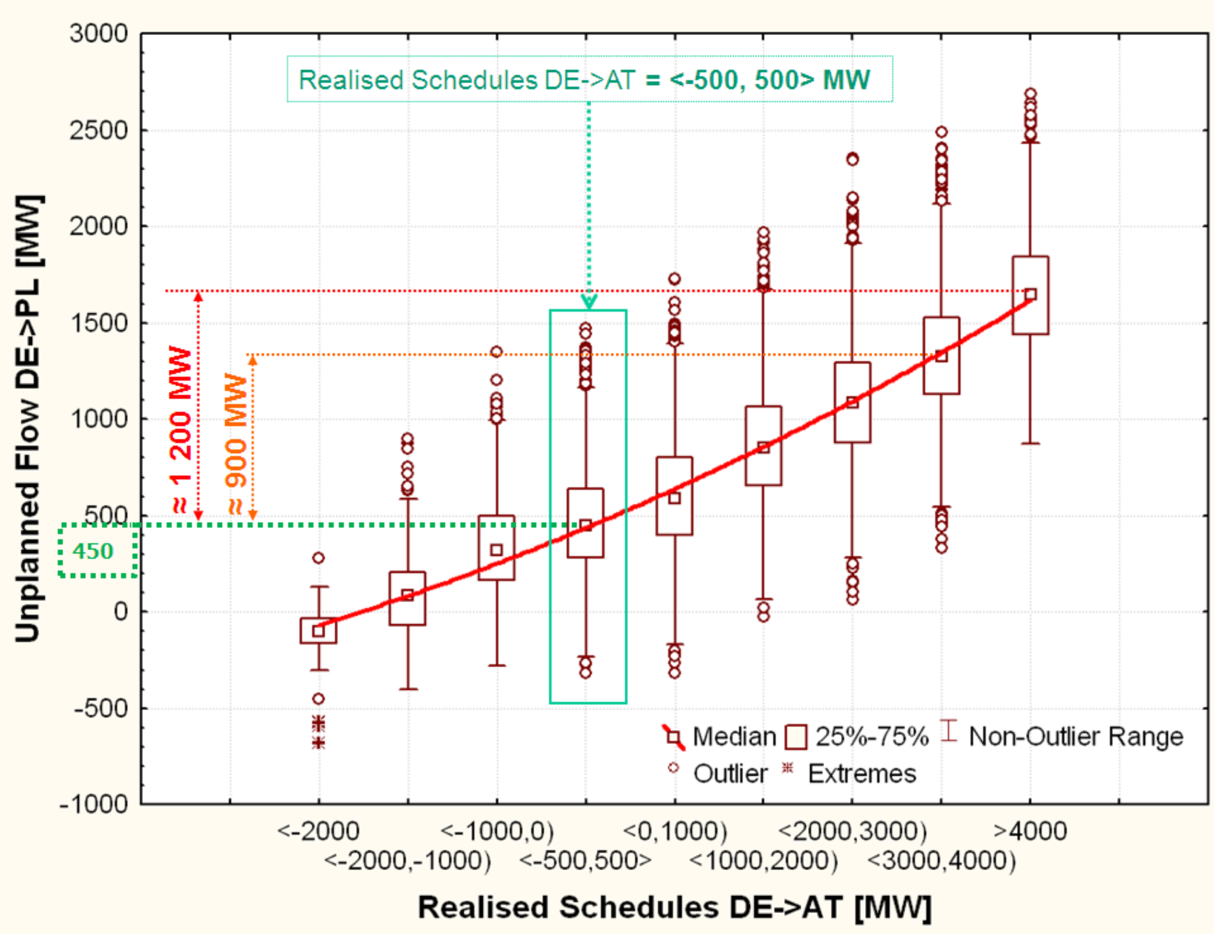


**Figure 19. Statistical analysis of Unplanned flows DE→PL in relation to Realised Schedules on the DE→AT border. Range of data: 01.2011–12.2012**

Concerning the border between Germany and the Czech Republic, the statistical analysis of the 2011-2012 hourly data population (see Figure 22) shows that about 19% of the DE→AT scheduled exchange flows through the DE→CZ border. However, as discussed earlier in Chapter 3.2.4, the aggregated nature of the Vulcanus database introduces a false image here and the actual effect of DE→AT transactions on the loading of the interconnection lines between 50Hertz and ČEPS is much higher than merely 19%. The following Figures 20 and 21 depict the correlation between the increasing level of DE→AT exchanges and the unplanned power flows on the interconnection lines between: (i) 50Hertz and ČEPS and (ii) ČEPS and AT. The border ČEPS-TTG is not presented here as it is usually loaded in the direction of Germany and its loading is within a safe range (as opposed to the loading of lines 50Hertz – ČEPS).

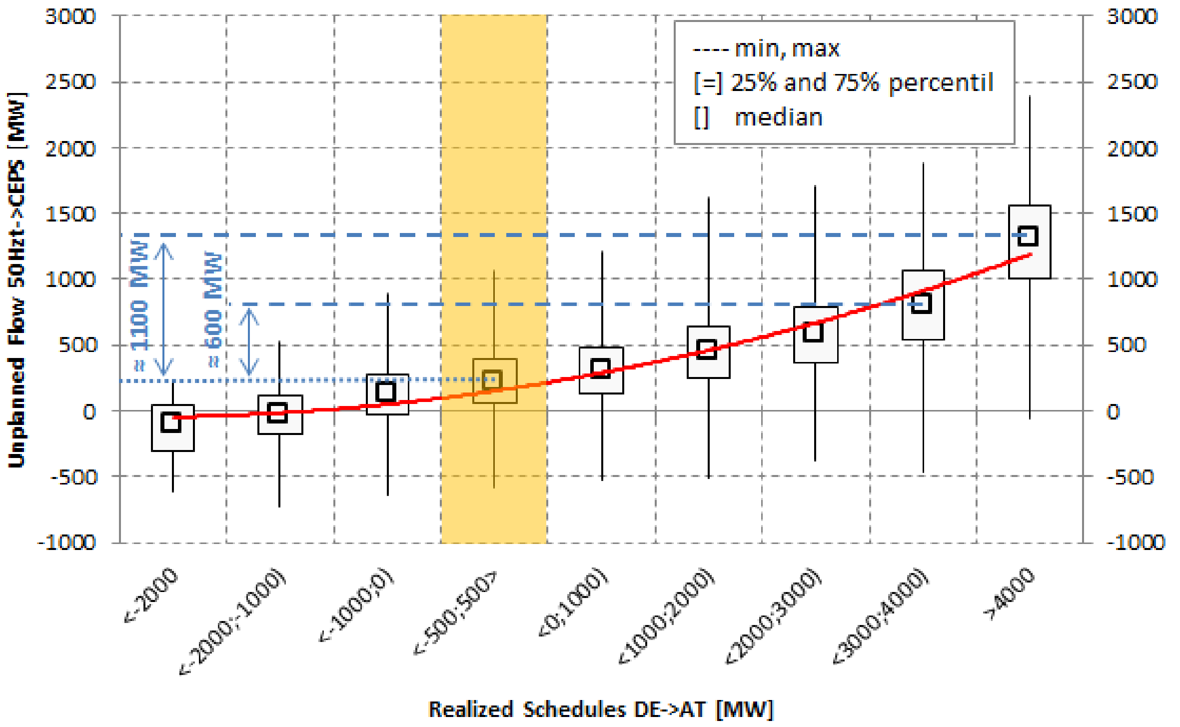


Figure 20. Correlation of DE→AT scheduled exchange and unplanned flow over ČEPS-50Hertz border

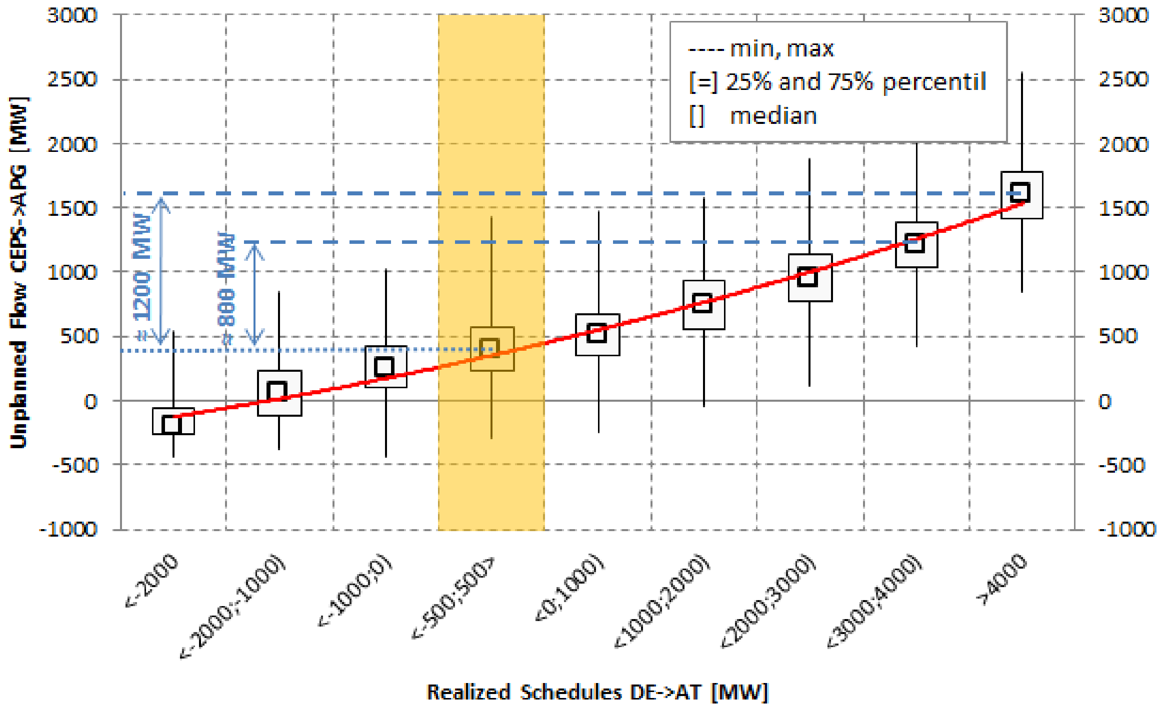


Figure 21. Correlation of DE→AT scheduled exchange and unplanned flow over ČEPS-APG/AT border

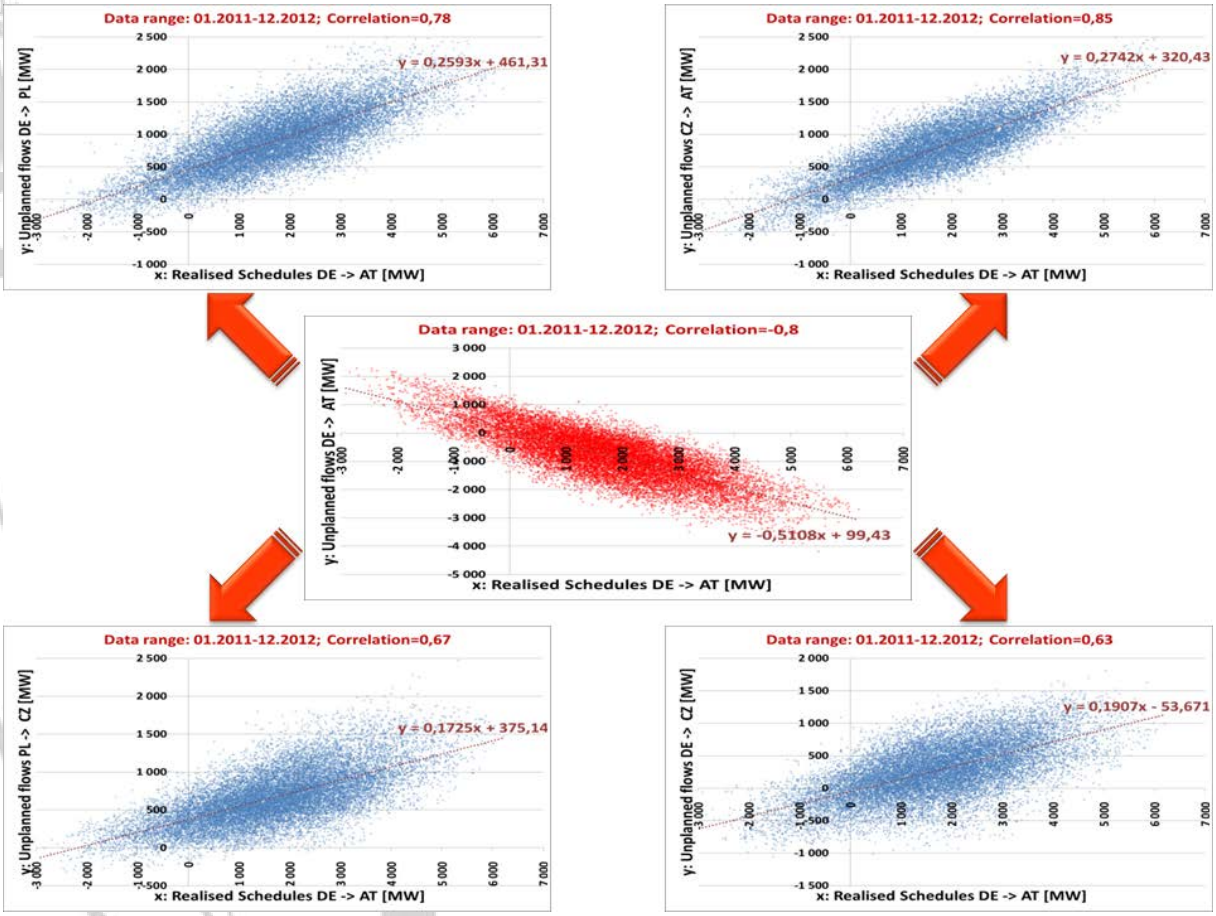


**Figure 22. Correlations of unplanned flows at selected CEE borders vs. Realised Schedules DE-AT**

Figure 22 presents the relation between Realized Schedules DE-AT and the level of unplanned power flows for selected CEE borders. It is worth noticing that the **DE-AT border is the only case where this correlation is <u>negative</u>**, i.e. the higher the Realized Schedule, the higher are the *"negative unplanned power"* flows. Negative power flows imply that the border benefits from unplanned power flows, as there are more commercial power schedules than the power flow on that border.

Moreover, over 50% of DE→AT scheduled exchanges flow via the neighbouring systems, as is suggested by the mathematical function considered as a representative approximation for the sample data from Figure 22. As said earlier, the higher the schedules, the higher the negative unplanned power flows.

### 3.4. Share of commercial flows

This chapter gives an evaluation of the ratio of the total commercial exchange between DE-AT and other cross-border exchanges in the CEE region based on the 2012 data set. The results show that the volume of commercial transactions between DE and AT in 2012 represented about 28% of all commercial transactions within the CEE region. <u>This means that if not considered under the future FBMC target model, more than one-fourth of the overall cross-border trade in the whole CEE region would not be subject to common coordinated capacity calculation and allocation mechanisms. This value represents about 60% of all commercially scheduled transactions from Germany towards the CEE region.</u>

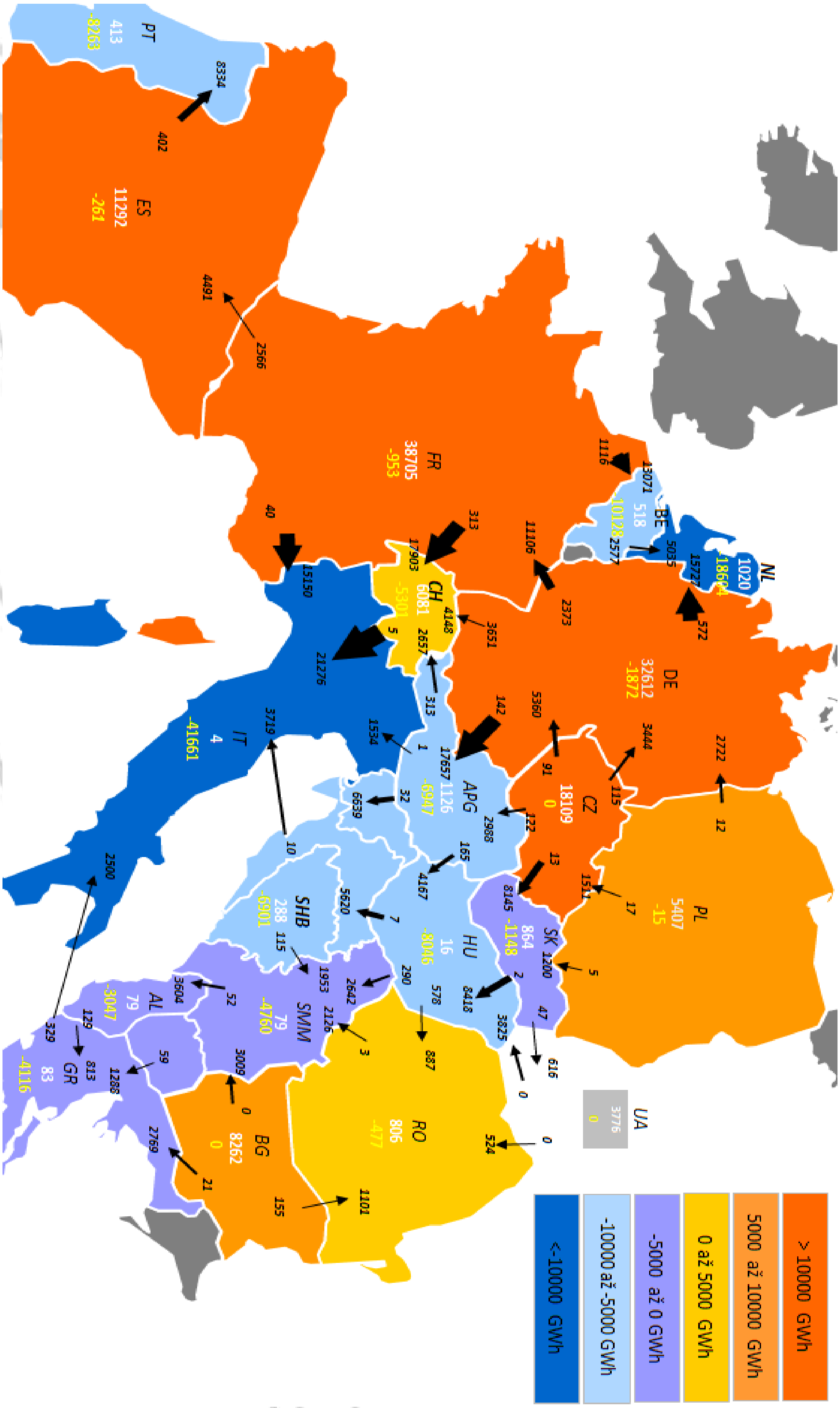


Figure 23. Volumes of commercial flows – 2012 (source: Vulcanus)

### 3.5. Conclusions from the Vulcanus analysis

- When Realised Schedules between DE and AT are in the range of 3 000 – 4 000 MW (about 17% of hourly samples in the period January 2011 – December 2012), the median of unplanned flows on the DE-PL border is at the level of 1 320 MW, i.e. about 900 MW higher than in the case of the “safe level” (450MW) of natural loop flows. Exchanges above 4 000 MW cause about 1 200 MW of unplanned power flows on top of natural loop flows of 450 MW, adding up to some 1 650 MW of unplanned power flows expressed in terms of a median value.
- Regarding the ČEPS and APG border, the situation may be described in a similar way. When commercial exchanges within the DE-AT zone reach up to 500 MW, a level of unplanned flows around 400 MW may be observed. However, in the case of commercial exchanges between 3 000 and 4 000 MW, unplanned flows would on average represent an additional 800 MW, for exchanges over 4 000 MW add flows at an average level of 1 200 MW.
- Regarding the ČEPS and 50Hertz border, the situation is also similar. When the level of commercial exchanges within the DE-AT market reaches up to 500 MW, a level of unplanned flows around 250 MW can be observed. However, in the case of commercial exchanges between 3 000 and 4 000 MW, unplanned flows would on average represent an additional 600 MW. Exchanges over 4 000 MW bring additional flows of about 1 100 MW on average.
- The results show that the volume of commercial transactions between DE and AT in 2012 represented about 28% of all commercial transactions within the CEE region. This amounts to more than one-fourth of all CEE trade transactions which would not be subject to common coordinated capacity calculation and allocation mechanisms if the current zone structure remained unchanged when implementing the Target Model of FB MC. A similar outcome can be derived also for the previous year.
- A level of commercial exchanges through the DE>AT profile exceeding 5 500 MW, forecasted by the 2010 EWIS study for 2015, was reached already in 2011.
- The high level of unplanned power flows in the CEE region is related to the high level of schedules DE→AT. It is important to notice particularly the following loops:
  - Region CEE: DE→PL→CZ→AT→DE and DE→CZ→DE;
  - Region CWE: DE→NL→BE→FR→DE.
- On the DE-AT border, commercial volume transactions DE→AT are consistently higher than physical power flows on this border, indicating that a significant part of these transactions does not flow via the DE-AT border but rather flows through the neighbouring CEE and CWE systems.
- On the DE-PL border, the measured physical flows are much higher and have the opposite direction than the realised commercial schedules between these countries. This is the result of transferring a significant part of the commercial exchange scheduled on the DE-AT border via Poland and other countries from the CEE region. There is a permanent high level of unplanned flows: 500 – 1 500 MW in the monthly average and **over 2 500 MW** in hourly values.
- The 50Hertz→ČEPS interconnection is usually loaded in the direction DE→CZ. Interconnection TenneT-ČEPS is usually loaded in the direction CZ→DE. This is the result of transferring the commercial exchange between different regions of Germany using another country's network.

- For over 80% of the time, realised schedules on the DE-AT border are greater than 500 MW, a level which as indicated in chapter 3.3 seems not to cause any excess unplanned power flows in the region. Moreover, for 17% of hours, the realised schedules are greater than 3 000 MW.

## 4. Analysis of flows with the use of the ENTSO-E reference model

In the previous chapters the level of cross-border commercial, physical exchanges and unplanned flows at selected CEE borders was presented. The conducted analysis was carried out using the aggregated Vulcanus dataset that is available to all (CEE) TSOs. The analysis enabled us to identify potential issue(s), evaluate and show the level of discrepancies between the commercial and physical world within the CEE region and also between different borders and interconnections. The impact of the common DE-AT market area was indirectly visible as reflected in the unplanned flow values.

In order to investigate in more detail the impact of internal transactions within the DE-AT common market area on specific transmission grid elements within the CEE region (at least in PL, CZ, SK and HU), the analysis had to rely on a detailed grid model containing a significantly higher level of details, including transmission network topology and generation and load pattern.

### 4.1. Base case

In general, there are different types of grid models available. All TSOs have in principle access to forecast models like DACF (Day Ahead Congestion Forecast), D-2CF (two-day ahead congestion forecasts), network snapshots, etc. Each of these models has its own specifics, i.e. limited representativeness of DACF/D2CF, limited availability of merged grid snapshots. As the objective of this analysis was to provide a kind of sensitivity assessment, the ENTSO-E Winter 2012/2013 Reference model was taken as an input, providing for a widely acceptable detailed information source. This model should be able to reflect the network situation within the interconnected European power system (topology, generation and load pattern). The intention of this study was not to use extreme cases, but rather a “normal state” representing a timestamp with a sensitivity analysis carried out on top of that model. The intention was not to be exact in terms of predicting the power flows for a particular day, but rather to demonstrate the impact of transactions between selected areas on power flows in critical network elements in the CEE region. For the sake of such analysis, the chosen **ENTSO-E Reference Model** may be considered as representative, both from the net balance perspective and also the given network availabilities as during winter time, scheduled outages for maintenance are at a minimum (and hence topology impact).

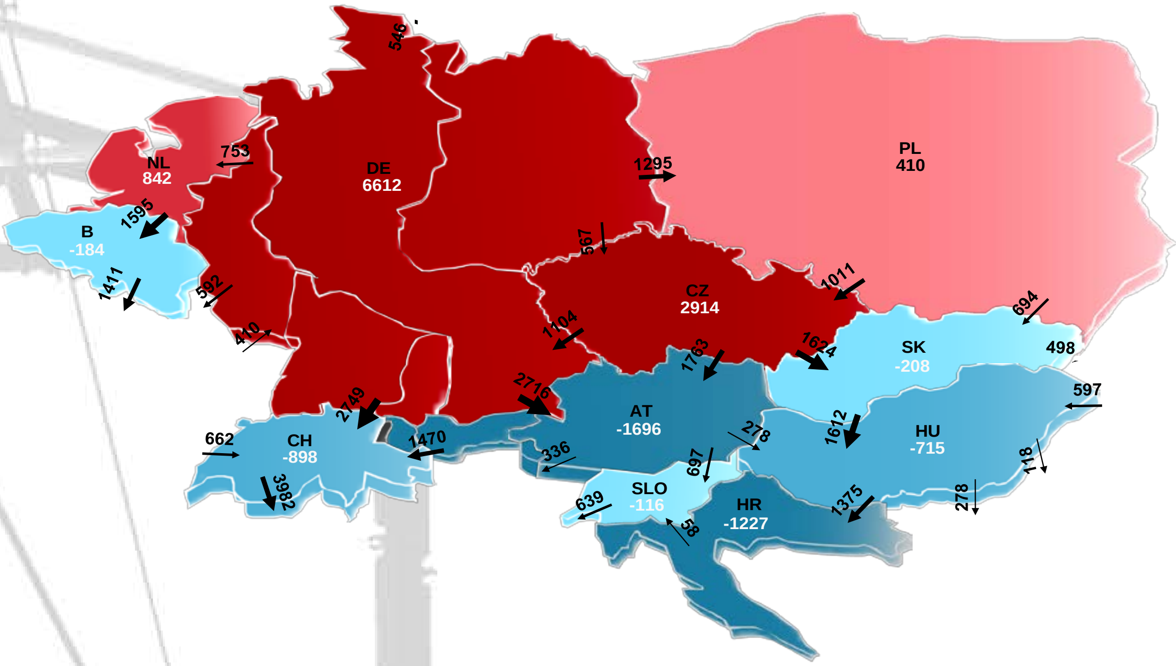


Figure 24. ENTSOE reference model - Winter 2012/13, base case zonal balances and cross-border flows

Zonal balances and cross-border flows in the base case are shown in Figure 24. The surplus areas (marked in red) are: Germany, Poland and the Czech Republic. The deficit areas (marked in blue) are: Austria, Slovakia and Hungary.

In order to conduct the analysis, the ENTSO-E Reference model in the UCTE format was converted into the PSSE raw format and data consistency was checked. For the assessment of the impact of DE-AT additional intra-zonal transaction of 100 MW using the load flow computation(s), the Siemens PTI PSS-E v.31 software was used. Settings of the load flow calculation were as follows: Full Newton Raphson methods, Lock Taps, switched shunt adjustment – enable all, Area interchange control – disabled, flat start, adjust DC taps, ignore VAR limits.

## 4.2. Scope of the study

A reference scenario (see Figure 24) was taken as a base case, on which basis various transaction simulations were carried out comprising the following options: proportional generation shift – Figure 25 (all generators used) exchange between DE-AT, proportional generation shift between 50Hertz and APG zone (Figure 26) and of generator to generator (G-G) based transactions (for each generating node with generation of at least 100 MW, including so-called negative load, within the DE-AT area – Figure 27).

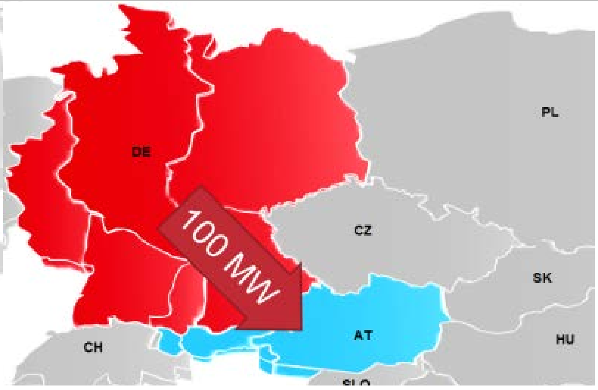


Figure 25. Generation shift Germany-Austria


Figure 26. Generation shift 50Hertz zone to Austria

While in zone-to-zone simulations the change naturally “originates” from the “centre of electrical gravity” and “ends up” at the “centre of gravity”, in the G-G based simulations high variability of the impacts occurs in line with the geographical/electrical location of the generators within the grid. From the ČEPS point of view, naturally the most significant effect appeared for transactions between generators geographically located in the eastern part of the 50Hertz zone and the eastern part of Austria (e.g. the Vienna location). For PSE the impact is the greatest if the generators are located in the north-eastern part of the 50Hertz control area.

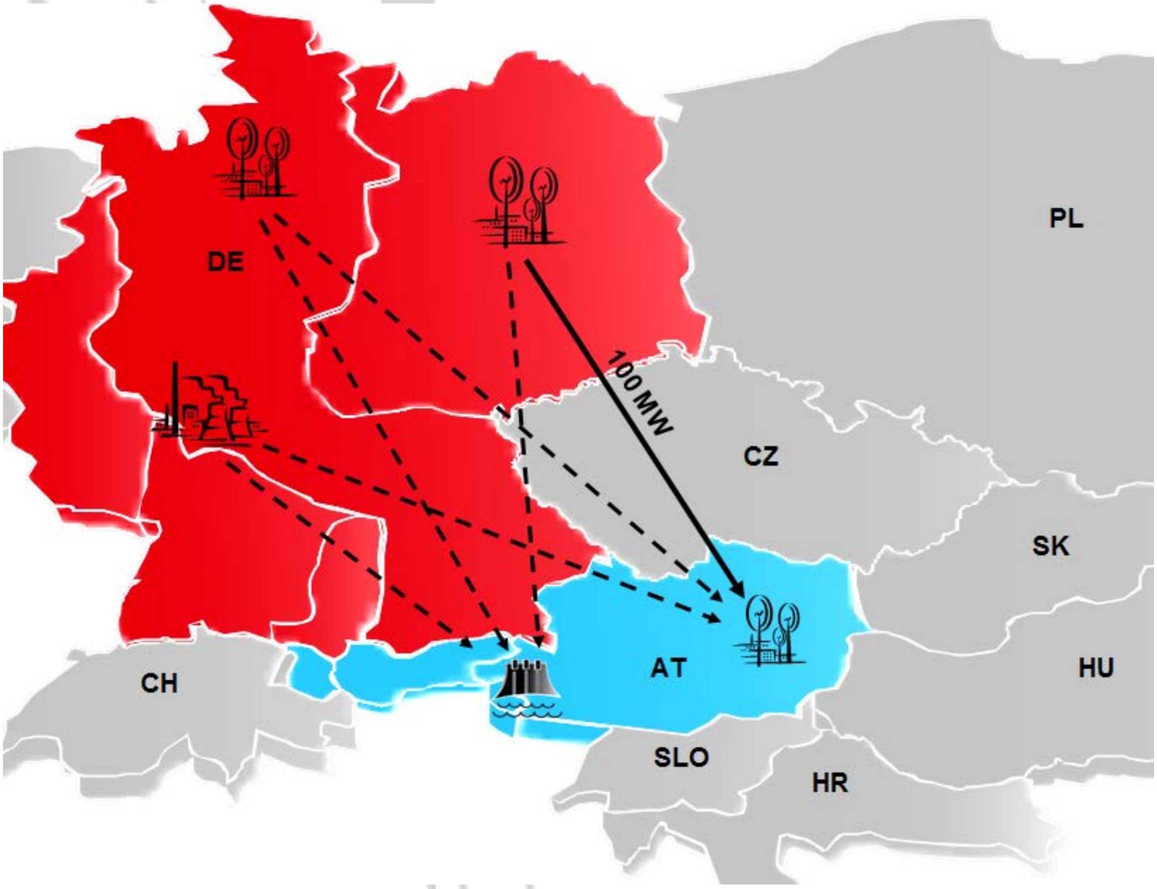


Figure 27. G-G shift between Germany and Austria

### 4.3. General assessment

Loading for all monitored branches at a voltage level of 220 kV and higher in the base case scenario was received. With subsequent additional shifts of 100 MW (which finally may be interpreted also as percentage changes) additional commercial transactions between DE and AT were simulated. Besides two kinds of generation shift (entire DE→AT, 50Hertz→AT), several hundred (2 189) Generation to Generation simulations were carried out.

After each shift change, the new loading on all monitored branches was recorded and compared with the reference base case scenario. So, for each monitored branch a set of values was obtained which was consequently evaluated both quantitatively and qualitatively. In principle, all branches with sensitivity above 10 MW (10%) were given further attention.

The following Figure 28 shows for all relevant zones (CZ, PL, SK, HU) the deployment of branches with this loading sensitivity represented. **This is a non-simultaneous overview of the results**. That means that the maximum loading recorded did not necessarily have to occur on the branches at the same time. All these lines were affected by the 100 MW shift by at least 10 MW (this means dependence on the shift of 10%).

The highest impact (over 23%) was observed at the DE – PL border (branches Vierraden – Krajnik, dependence of 23%) and at the CZ – AT border (branches Slavetice – Duernrohr, dependence of 24%). **We consider that in some particular cases the impact of DE-AT internal transactions is at the level of more than 23% for Czech and Polish transmission network branches, which constitutes a justification for the need to coordinate the commercial exchanges within the common DE-AT market area with other cross-zonal capacity calculation allocation.** The outcome of this analysis may be further verified in other models (like DACF) where the impact of topology change and seasonal effect may be further investigated. This is nevertheless outside the scope of this study.

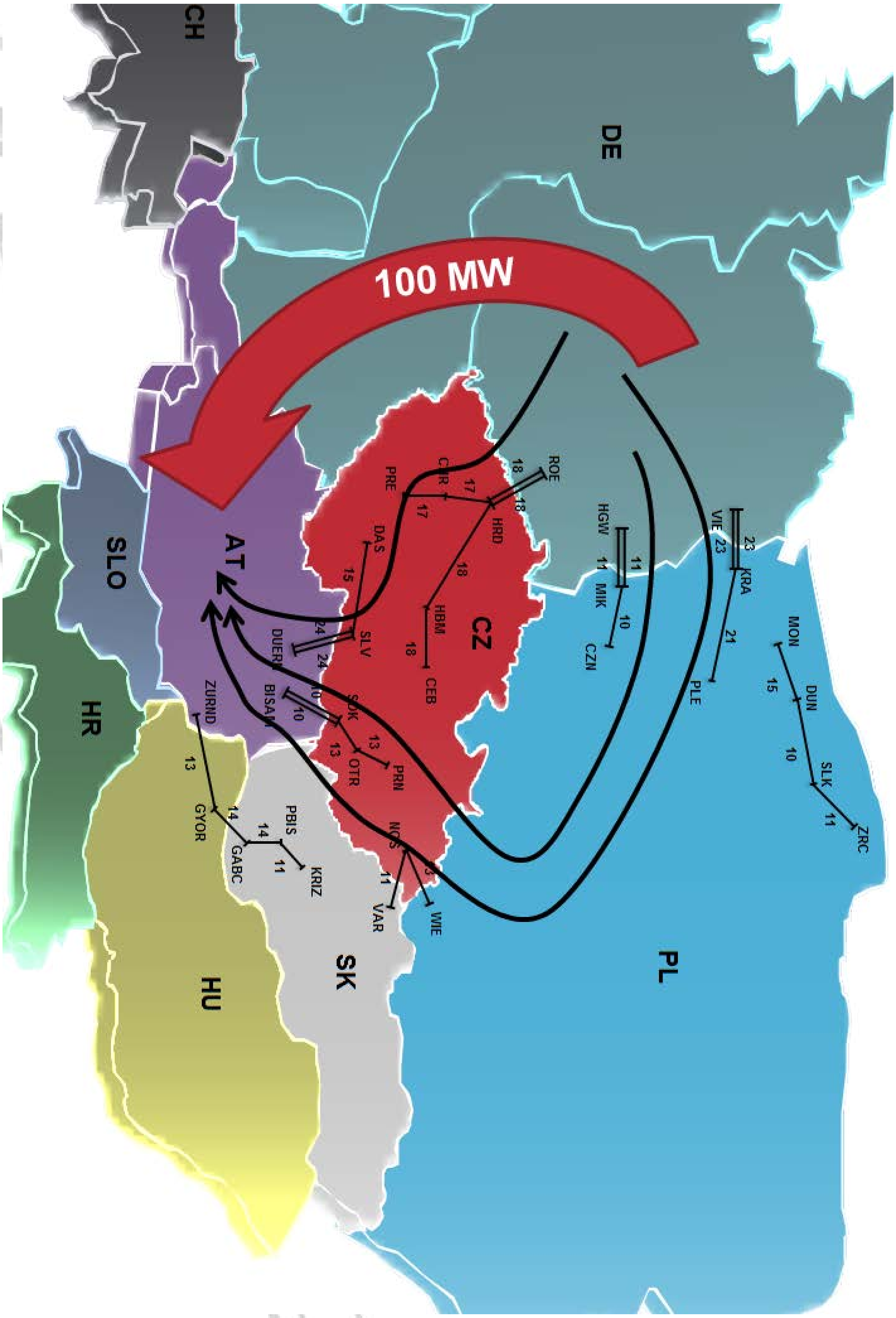


**Figure 28. Overview of the most impacted branches – non-simultaneous values**

The analysis also identified the most significant (affecting) nodes (i.e. nodes which caused flow change over the defined level of 10%). For the shift up cases, the results are shown in Figure 29 (zone 50Hertz) and Figure 30 for shift down nodes (Austria). These figures represent a list of nodes where the shift caused a change of over 10% sorted in descending order and the number of steps (shifts) when this occurred.

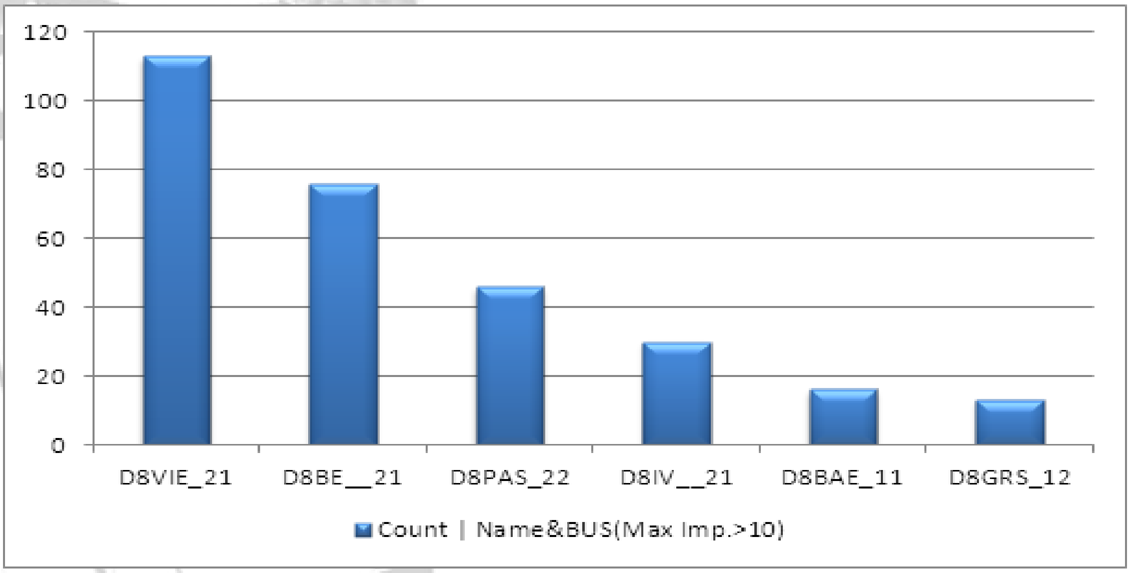


**Figure 29. Most affecting shift up nodes**

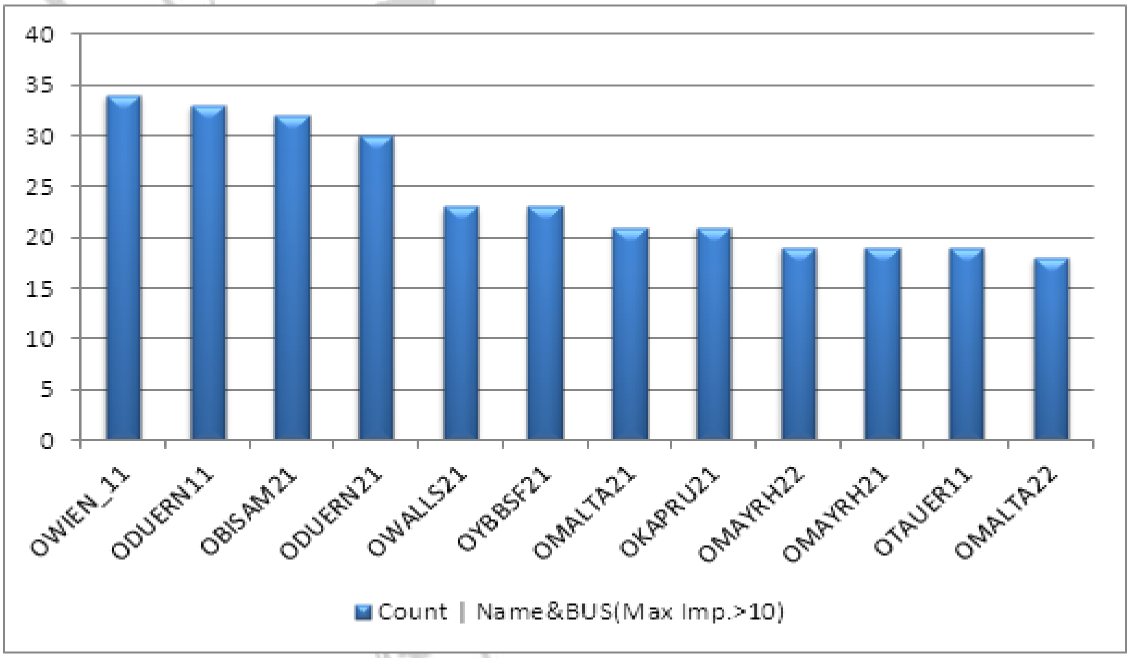


**Figure 30. Most affecting shift down nodes**

Figure 28 shows a non-simultaneous overview of the most affected branches within the four TSOs zones within the whole set of simulations. To complement this information, the situation for specific generation shift combination and relevant most affected branch (here cross border line between ČEPS and APG) is shown on in the following Figure 31, which also presents the impact on other selected branches. The pair of most affecting generation nodes is marked (black points). One can observe that for this "worst case" scenario, the impact on the ČEPS border amounts to 35% (50Hertz - ČEPS) and 45% (ČEPS - APG). For this combination, the impact on the DE-PSE border is almost 20%.

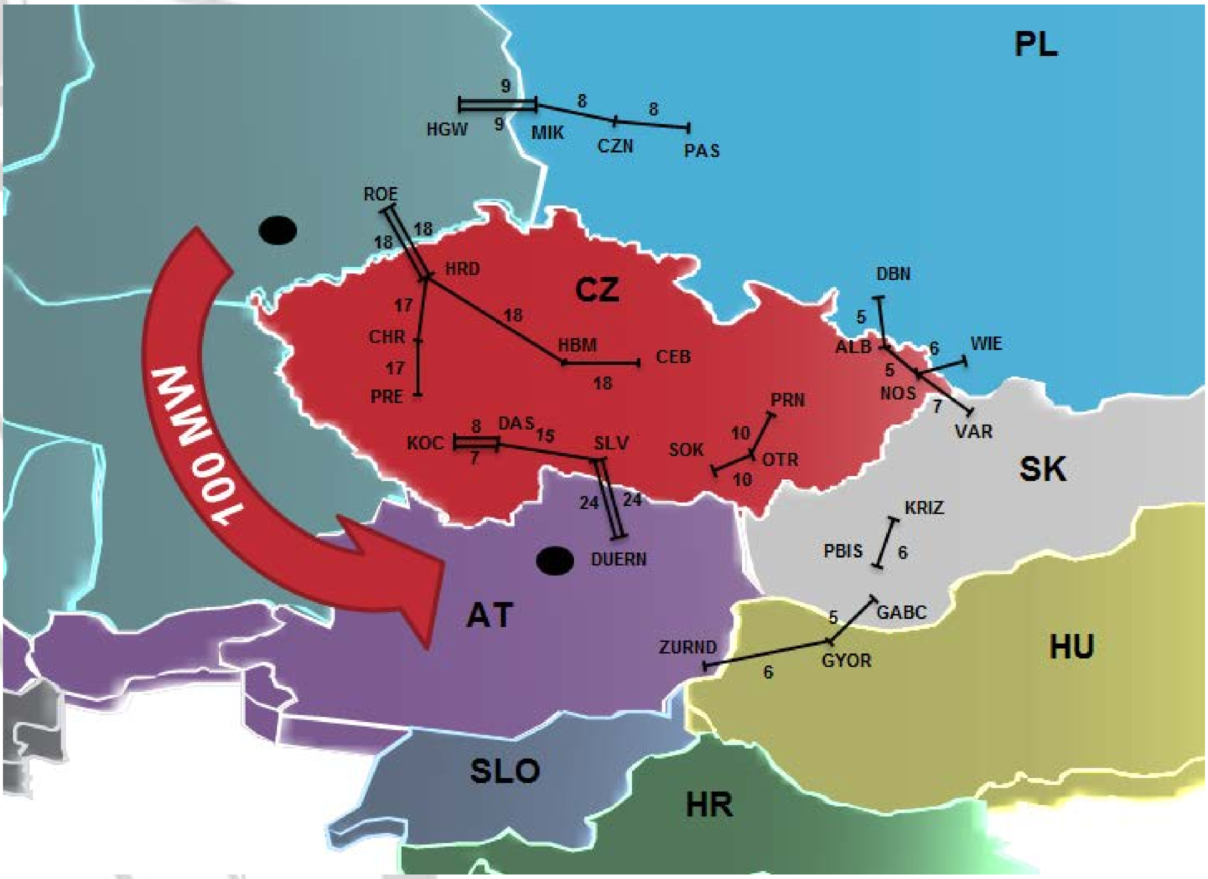


Figure 31. Impact of most affecting shift up, simultaneous values – example for line between ČEPS and APG

### 4.4. Conclusions from the analysis based on the ENTSO-E reference model

The simulation's outcomes have shown the considerable impact of some intra-zonal exchanges within the common DE-AT market area on the transmission grids of Poland and the Czech Republic. This may represent an impact of up to 24% per given critical branch. The greatest impact was naturally observed within the grids of PSE and ČEPS, as they are geographically directly surrounded by the common DE-AT area.

For example, the Czech Republic is affected the most (for given generation shift combination) when the impact on cross-border flows amounts to the level of 35% (between 50Hertz and ČEPS) and more than 45% (between ČEPS and APG). This corresponds with the north-west to south-east transiting path. The most affected line is the 400 kV cross-border line(s) between ČEPS and APG. For this particular case, the impact on the PSE-50Hertz cross-border profile is at the level of 18%, which in total represents a 55% impact on the 50Hertz-ČEPS and 50Hertz-PSE interconnection.

With the increasing electrical (in principle also geographical) distance, the impact naturally decreases. This means that the highest values can be observed in the case of the PSE and ČEPS networks rather than in the grids of SEPS and MAVIR.

# 5. Implications on actual operation and CEE Target Model

## 5.1. Situation on 22 August 2012

In winter 2011/2012 some CEE TSOs faced serious operational N-1 violations *(e.g. see March 2012 shared position of four CEE TSOs).* At that time, massive transiting flows from the northern part of continental Europe to the southern part were recorded. This chapter shows that also in the summer period a similar situation may occur and some TSOs from the CEE region again faced difficulties (N-1 violations) in connection with transit flows. Worsened operational conditions on 22 August 2012 finally led to the activation of a set of RA ( Remedial Actions).

To understand the operational and market situation, Figures 33 - 34 provide an overview of scheduled and physical cross-border flows before the activation of redispatching between APG and 50Hertz.

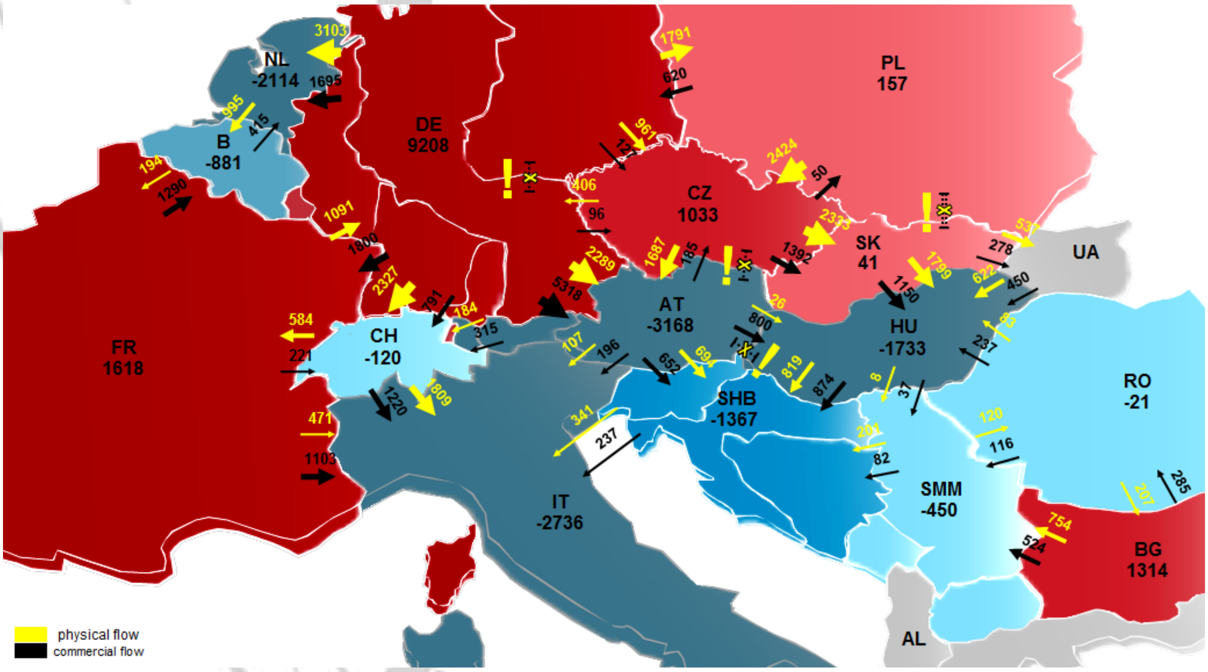


**Figure 32. Commercial and physical flows 22.8.2012 13-14hr (*source Vulcanus data*)**

On the given day and hours, the following specific operational and market conditions were observed (when compared with other days from the appointed week): export balance of Germany > 9 000 MW, import balance of Austria > 3 000 MW, scheduled commercial exchange > 5 000 MW between DE and AT (but the physical flow was only half of it), scheduled exchange between PL>DE 600 MW from PL to DE, but a physical flow of more than 1 700 MW from DE to PL, relative low export balance of the Czech Republic (like 1 000 MW, usually it is a level of 2 000 – 3 500 MW). For this day also maintenance (including several cross-border lines - switching off of the whole cross-border profile between PL and SK, switching off of the cross-border line between APG and ČEPS, etc.) within the region was scheduled (see Figure 34). Regarding the DE-AT profile, of ca. 5 300 MW of scheduled DE-AT commercial transactions only half physically flew through this border. The other half transited through neighbouring states on both the western and eastern neighbouring systems. Subsequently, in the case of the PSE-ČEPS border the physical flow was at the level of 2 400 MW, although almost no commercial exchange was scheduled from ČEPS to PSE.

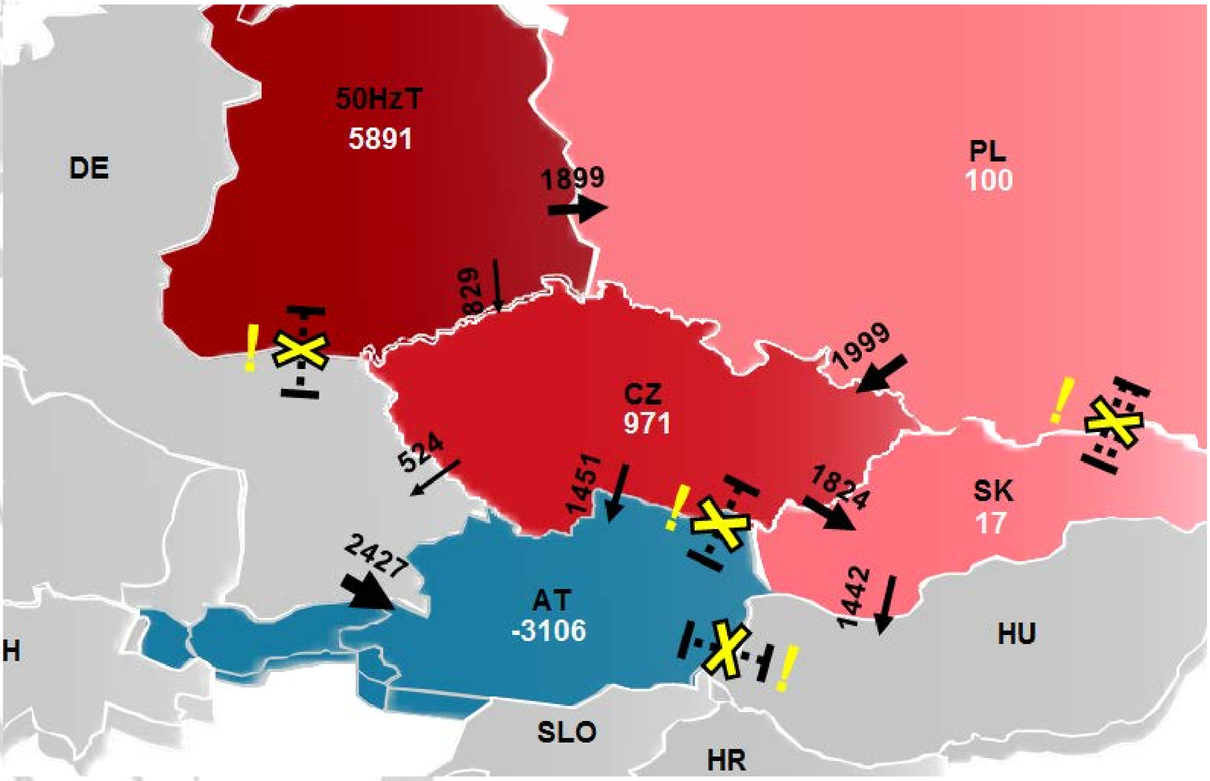


Figure 32. Cross-border flows before RA activation (source DACF 22.8. 15:30)

Operational conditions requiring the activation of remedial actions (at first on the national level) finally led to the activation of a remedial action in the framework of the TSC initiative - the re-dispatch of 800 MW between DE and AT (in the opposite direction of the transiting flow) which contributed to relieving the congested grid elements.

For the purpose of this study, the effect of the applied redispatching was ex-post simulated by a reduction and increase in generation in the relevant grid nodes. The impacted change of flows on congested branches and cross-border profiles was then evaluated. The impact of redispatch can be seen as the difference between Figures 32 (situation before application of redispatching between APG and 50Hertz) and Figure 33 (situation after application of redispatching – redispatched units marked as black points). The following can be observed: about 20% impact on the grid of PSE and about 20% impact on the grid of ČEPS - in total 40% impact of the re-dispatch measure described above.

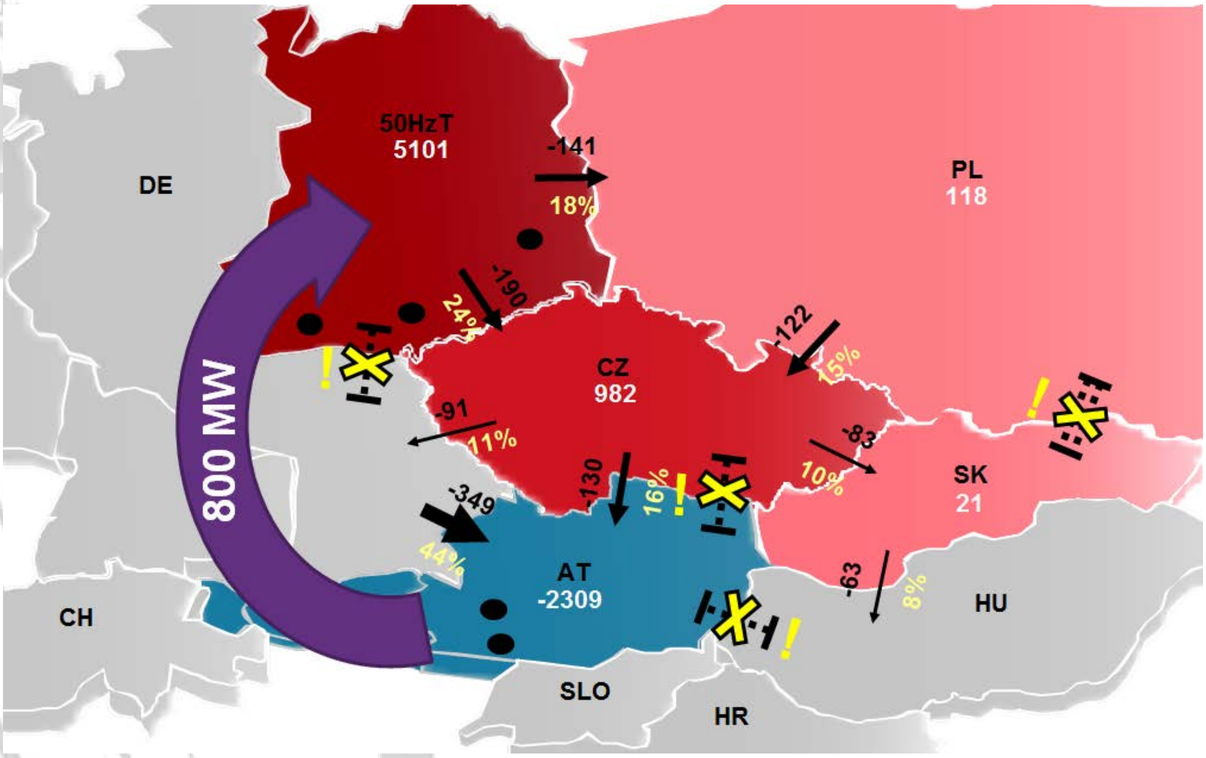


Figure 33. Impact of the redispatching of 800MW between APG and 50Hertz zones (source: DACF 22.8. 15:30)

To sum up, the situation on 22 August 2012 showed that difficult operational and market conditions may occur not only during the winter period. On that specific day scheduled maintenance occurred (outages of several cross-border lines and the whole cross-border profile between PL and SK). High transiting flows simultaneously affected some CEE TSOs grids (PSE, ČEPS, SEPS) so remedial actions had to finally be activated (800 MW between APG and 50Hertz zones). Effected redispatching is considered effective as the impact on the Czech and Polish transmission networks in total represents about 40%.

## 5.2. CEE day-ahead Target Model

The Czech Republic, Hungary, Poland and Slovakia are committed to implementing the European target model for the day ahead market and cross-border capacity allocation. According to the Joint Declaration of CEE Regulators from March 2012 and the ACER Framework Guidelines on Congestion Management and Capacity Allocation, transposed by ENTSO-E into a Network Code that is to become a legally binding, community-wide Regulation, cross-border energy trade for the day ahead market in Europe is to be organized based according to the Flow-Based Market Coupling principle.

In the opinion of Czech, Hungarian, Polish and Slovak TSOs, successful implementation of the European integrated electricity market depends on the way the rules for the cross-border electricity market are aligned with the technical capabilities of the interconnected power systems. It is of utmost importance that cross-border trading arrangements are based on coordinated capacity calculation and allocation. The Flow-Based Allocation methodology is therefore regarded as the correct answer to the future challenges. However, it is of utmost importance that this FBA method, very sound in theory, is also correctly applied to be able to prove itself in practice. In that respect, future cross-border market rules must ensure that at least all cross-border transactions are coordinated so as to ensure that interdependencies between cross-border transactions and the resulting power flows are correctly managed and constraints in the whole interconnected power system are taken into account. This need is the main driver for continuously expressing the requirement to coordinate all commercial cross-border exchanges in the CEE region in the future FBA Market Coupling mechanism.

The TSOs from the Czech Republic, Hungary, Poland and Slovakia agree that the present bidding zone configuration does not create a level playing field among CEE countries. The key issues are internal transactions within large bidding zones that cause significant power flows in other bidding zones, strongly and negatively influencing the distribution of cross-border capacities and trading opportunities. Therefore, the introduction of FBA must either entail fair reconfiguration of bidding zones (as a minimum, bidding zones equal to EU Member States), or there is a need to amend the FBA mechanism to correctly account for all the negative impacts and consequences of incorrectly defined bidding zones so that their internal transactions are not overly prioritized over other transactions.

Should FB MC still be implemented under the current bidding zone delimitation (i.e. including the common DE-AT market area), a solution will have to be found that would mitigate the negative consequences of that situation in the short term (prior to FB MC implementation), would properly reflect unplanned flows and guarantee that all power flows within the CEE region are controlled by the market mechanism, resulting in social welfare maximization and secure system operation.

## 6. Conclusions

Successful implementation of the European integrated electricity market depends on the way the rules for the cross-border electricity market are aligned with the technical capabilities of the interconnected power systems. It is of utmost importance that cross-border trading arrangements are based on coordinated capacity calculation and allocation. The TSOs from the Czech Republic, Hungary, Poland and Slovakia view the Flow-Based Allocation methodology as the correct answer to the future challenges. However, it is crucial that this FBA method, very sound in theory, is also correctly applied to be able to prove itself in practice. In that respect, future cross-border market rules must ensure that all cross-border transactions are coordinated so as to ensure that interdependencies between cross-border transactions and the resulting power flows are correctly managed and constraints in the whole interconnected power system are taken into account.

This need is the main driver for continuously expressing the requirement from Poland, the Czech Republic, Slovakia and Hungary to coordinate cross-border trade between Germany and Austria in the future FBA Market Coupling mechanism. We view as unacceptable the situation where the greatest volume of cross-border transactions in the region is not considered to be subject to coordination under regional or European cross-border market rules. As announced in the previous communication from the V4 countries (e.g. joint communication of V4 TSOs “Position of ČEPS, MAVIR, PSE Operator and SEPS regarding the issue of Bidding Zones Definition” from March 2012), the above-mentioned lack of coordination results in the continuous occurrence of security threats in our power systems and limits cross-border capacities available to market participants for trading between V4 countries and other parts of Europe, esp. Western Europe.

The presented second study of the V4 TSOs has confirmed the justification for our requirements. The volume of commercial transactions between Germany and Austria, which amount to nearly one-third of all commercial exchanges within the whole CEE region, has a direct link to the level of unplanned flows and may increase the risk of endangering the transmission systems of neighbouring countries.

The TSOs from the Czech Republic, Hungary, Poland and Slovakia remain committed to working on the implementation of a cross-regional Market Coupling solution based on a correctly applied Flow-Based methodology. V4 countries recognize the challenges related to meeting the above-mentioned requirements. However, these challenges are to be tackled, especially when all the involved TSOs and national regulatory authorities are committed and willing to address the issues that have been undermining this integration process to date. The TSOs from the Czech Republic, Hungary, Poland and Slovakia underline the fact that they are ready to investigate all possible solutions to enable the creation of the future European Market.

## 7. List of Figures