2015

WINTER OUTLOOK 2015/2016 & SUMMER REVIEW

1 December 2015

entsoe

Content

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

1. Introduction

ENTSO-E adopts and publishes annually the '**Winter Outlook and Summer review**' as required by Article 8 of EC Regulation n. 714/2009.

These short-term adequacy reports explore the main risks identified within a seasonal period and highlight the possibilities for neighbouring countries to contribute to the generation/demand balance in critical situations. They provide a platform for information exchange amongst TSOs, promote discussion on transparency, and inform stakeholders on the potential system risks, so appropriate decisions can be made on topics such as maintenance schedules, postponement in decommissioning, and stakeholder awareness about levels of adequacy.

The present Winter Outlook Report addresses power balances with a national resolution between forecast generation and demand on a weekly basis for the Winter period **from 1 December 2015 (week 49) to 3 April 2016 (week 14).**

This report considers uncertainties such as climatic conditions and outages, as well as other risk characteristics of the system including the evolution of load, load-management, generation capacities, and stability issues.

The Summer review covers the period from **1 June 2015 (week 23) to 20 September 2015 (week 38).** It outlines the main events that occurred during the previous summer, according to TSOs, with reference to the security of the electricity supply (i.e. weather conditions, power system conditions, as well as availability of interconnections).

The purpose of this report is to present the TSOs' views on any matters concerning the security of supply for the forthcoming winter period. It also seeks to identify the risks and the countermeasures proposed by the TSOs in cooperation with neighbouring countries, whilst also assessing the possibility for neighbouring countries to contribute to the generation/demand balance if required.

In addition, throughout this period, an assessment of 'downward regulation' issues is performed in order to provide a level of confidence regarding the effects of variable generation such as wind and solar on system operation. For this assessment, two reference points in time are used, which aim to identify situations where excess inflexible generator output exceeds minimum demands (typically windy off-peak nights and sunny Sundays).

Compared to the last seasonal Outlook report, further improvements have been implemented regarding consistency and simplification of the data collection process.

In order to harmonise the Pan European assumptions for regional assessments, the load factors of solar and wind infeed generation were calculated using a probabilistic approach based on the Pan European Climate Database[1] (PECD).

The Pan European regional analysis has been improved compared to the last seasonal Outlook report by including a simplified 'merit-order' market simulation approach.

Furthermore, the forced outage rate by generation type was proposed by default as calculated for the System Outlook and Adequacy Forecast 2015 report.

The geographical perimeter for adequacy assessment has been extended to include Turkey. It comprises the countries enclosed by ENTSO-E members, as well as Albania, Malta, Ukraine West and Turkey.

The assessment is performed at three levels:

- Assessment by individual country;
- Pan European regional analysis, assessing the possibility for neighbouring countries to contribute to the generation/demand balance if required;
- Additional probabilistic approach for the countries/regions that may have adequacy issues.

[1]Data from Technical University of Denmark

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

2. Executive summary

The Winter Outlook Analysis by ENTSO-E shows that, in general, Europe has sufficient generation for both normal and severe demand conditions. While various countries may require imports to cover expected demand, cross-border capacity is expected to be mostly sufficient to accommodate them.

The trend of a decreasing dispatchable generation capacity in Europe, as already mentioned in previous seasonal outlook reports, is still confirmed for the coming winter. On the one hand, renewable installed capacities—mainly wind and photovoltaic—continue to grow strongly. On the other hand, besides the fact that many conventional generation units are decommissioned each year (mostly coal or oil), only a few are newly commissioned (mostly gas).

Thanks to the highly interconnected European electricity network, the regions that need to rely on imports will be able to import from neighbouring countries. The grid allows a necessary flexibility to shift the energy from variable generation (e.g. depending on regional weather conditions such as wind and photovoltaic) to demand areas.

Using the interconnection flexibility and the installed demand side management and strategic reserve measures, the adequacy for the coming winter should be met for most of the European countries. However, adequacy in Poland was identified as potentially at risk.

During severe conditions, there is a risk that Polish import needs may exceed its available import capacity, which, especially on the synchronous profile (with DE+CZ+SK), is significantly limited due to high unscheduled flows through Poland, from its Western border towards the South. No import capacity is predicted on this profile for the coming winter, because import to Poland increases physical flows on the PL-DE border, which is often congested by unscheduled flows. Urgent actions are required so that not less than 1000 MW of import capacity is available on the synchronous profile, at least in emergency situations, and to ensure enough remedial actions to keep N-1 security state on DE-PL border. Ongoing work within the TSO Security Coordination (TSC) is investigating the actions needed to find a solution to the above-mentioned issues, otherwise secure operation of all of Continental Europe is endangered due to a risk of cascading tripping leading to Continental-wide splitting, similar to 4 November 2006.

Moreover, the situation in Belgium, France and Great Britain could be potentially stressed in severe climate conditions. Due to safety issues, two Belgian nuclear units (2000 MW) are currently shut down. But the decision to re-open these units recently approved by the Belgian nuclear safety authority reduces the risks to security of supply[2]. In France and Great Britain, several thermal units have been decommissioned this year. Nevertheless, compared to last winter, additional volumes of contracted load reduction and strategic reserves have been put in place in France and Belgium this winter to mitigate potential adequacy risks. In Great Britain, additional 'balancing reserve' services have been contracted to support the balance when capacity margins are tight.

In addition, throughout the winter period a 'downward regulation' assessment was done to assess the constraints generated by an excess of renewable generation and classical inflexible generation when load is at a low level. This could occur on weekend nights (characterised by low load, high wind and inflexible thermal generation) or on weekend days, especially in cases of high photovoltaic generation. The present report highlights that during certain weeks over the winter it may be necessary to export excess inflexible generation in various countries. Furthermore, in some countries it might even be required to reduce excess generation as a result of insufficient cross-border export capability. For example, the combination of high renewables in-feed and inflexible generation in Germany, Poland, Denmark, Romania and Spain could lead to high exports to all surrounding countries at the overnight reference points. Curtailment may become necessary under certain conditions in Germany and Poland due to limited interconnection capacity. Around the daytime reference point, Germany, Spain and Romania may have to export some of its generated power to neighbouring systems during low-load periods. Based on the minimum Net Transfer Capacities (NTC) provided, not all excess energy can be exported from Germany and Romania, and thus measures could be required to limit the generation surplus.

[2] "On November 17, the Belgian nuclear safety authority announced that the two nuclear units (2000MW) are safe to re-open. They will probably go into operation on December, 15. It has not been possible to rework the Winter Outlook based on this new information. Moreover, it is not clear at this moment what impact this will have on the lifetime extension of 2 older nuclear units (2*433MW). The global adequacy situation of Belgium for the coming winter will, however, improve drastically due to this event."

3. Methodology

3.1. Towards a new ENTSO-E Adequacy Methodology

The integration of large amounts of Renewable Energy Sources (RES), the completion of the internal electricity market, as well as new storage technologies, demand side response and evolving policies require revised adequacy assessment methodologies.

ENTSO-E is therefore continuously improving its existing adequacy methodology with a special emphasis on harmonised inputs, system flexibility and interconnection assessments.

ENTSO-E published its *Target Methodology*[3] after a consultation period with the stakeholders, who acknowledged the proposed target methodology. The comments received mainly focused on adequacy assessments methodology, assumptions made, models to be implemented for the assessments and the need for increased transparency. The stakeholders feedback on seasonal reports are always welcome and can further contribute to developing the present methodology. There is an increased focus on the economic feasibility of generation assets related to adequacy assessments.

3.2. Source of information for Winter Outlook and Summer Review report

The coordination team that developed the Seasonal Outlook reports is comprised of experienced experts from various TSOs across Europe. The analysis is based on data submitted by each TSO. A synchronous point in time was requested for all data to allow for comparisons between regions. This enables European adequacy calculations to ensure there is enough generation to meet demand under normal and severe scenarios.

The present ENTSO-E Winter Outlook 2015/2016 is based on information provided by each involved TSO in mid-September 2015. Both qualitative and quantitative data were submitted through a questionnaire that is updated each season. The questions mainly focused on practices as well as qualitative data sent by TSOs in order to present country forecasts on a common basis. The report presents the TSOs' views on national and regional matters regarding the security of supply and/or inflexible generation surplus for the coming winter,

[3] https://www.entsoe.eu/news-events/announcements/announcements-archive/Pages/News/ENTSO-E-Assessment-of-the-Adequacy-Methodology-Consultation-is-Released-.aspx

including the possibility of neighbouring countries contributing to the generation/demand balance of each country in critical situations.

The Summer Review 2015 report is based on information provided by each involved TSO through a questionnaire in order to present the most important events that occurred during the summer period and compare them to the forecasts and risks reported in the previous Seasonal Outlook. The TSOs mainly answered whether their respective power system experienced any important or unusual events or conditions during the summer period as well as identified the causes and the remedial actions taken.

3.3. Data used for the regional analysis

An extensive regional analysis is performed to complete the per-country analysis. The aim of this investigation is to assess whether the country-based adequacy is still fulfilled or even improved when a Pan European scale is taken into account. In other words, it assesses whether the combination of countries with an electrical surplus and interconnection capacities between countries will be adequate at certain points in time to allow the countries with a generation deficit to import the electric power needed.

A synchronous peak point in time was used for all countries to allow for a meaningful analysis when determining the feasibility of cross-border flows. Before starting the data collection, a study was conducted using European historical load data to identify the most representative synchronous time to cover the global European peak load in winter. It was concluded that Wednesdays at 19:00 CET (Central Europe Time) most closely represent this situation, so data was requested from TSOs for this time[4]. Regarding the regional analysis, the following data from the data collection spreadsheet was used as input:

- Remaining capacity for **normal** and **severe** conditions;
- Simultaneous importing and exporting capacity;
- A best estimate of the minimum Net Transfer Capacity (NTC) values to and from individual neighbouring countries.

[4] ENTSO-E internal report '*Pan European peak and off-peak load study*' Peter Olofsson, Svenska Kraftnät (2013)

In addition, during the assessment period, off-peak 'downward regulation' issues (when excess inflexible generator output could exceed demand) are investigated at Pan European level. Similar to the peak demand analysis, the 'downward regulation' provides an indication of which countries require exports to manage inflexible generation. This involves an analysis of their ability to export this energy to neighbouring regions that may need to import. This analysis becomes more and more essential as a number of TSOs experience growing system operation constraints due to an increase of variable generation on the system (wind and solar) and the lack of flexible generation.

To carry out a regional downward analysis, a synchronous off-peak point in time was used for all countries to allow for meaningful analyses when determining cross-border flows. The same European load study mentioned earlier concluded that minimal demand conditions generally take place around 05:00 CET on Sunday mornings.

In addition to these minimal demand conditions, it was concluded that the issues with inflexible generation are not only prone to happen during the night, but also during the weekend daytime when the energy generation of solar panels nears its maximum. To consider this as well, an additional synchronous time point was added for Sundays at 11:00 CET, when a combination of potentially high photo-voltaic in-feed and reduced demand levels exists. Quantitative data for this off-peak point in time was therefore also requested from all TSOs to allow for a meaningful regional analysis.

For the regional downward analysis, the following data from the data collection spreadsheet was used as input:

- The expected inflexible generation surplus on Sundays at 05:00 and 11:00 CET;
- Sum of the inflexible and must-run generation;
- Simultaneous importing and exporting capacity;
- A best estimate of the minimum NTC values to and from individual neighbouring countries.

3.4. Renewables in-feed data

For the off-peak downward analysis, each country was asked to provide an estimate of the highest expected proportion of solar, onshore wind and offshore wind generation. Default values of 65% for wind and 95% for solar were proposed, and countries could also enter an alternative best estimate.

For the peak generation adequacy analysis, the renewables in-feed is handled through an estimate of non-usable capacity in normal and severe conditions by country. For wind (onshore, offshore) and photovoltaic, the non-usable capacities by default were calculated using a Pan-European Climate Database. This Pan-European Climate Database[5] contains per country and per hour, load factors for solar, onshore wind and offshore wind in a fourteen-year period (2000 to 2013). It also includes geographically-averaged hourly temperatures.

To create a consistent scenario throughout Europe, the following approach was adopted for a given time:

1) All 'records' are retained that lie within the interval of one hour before the reference time and one hour after the reference time, on a date (day/month) from six days before the reference date and six days after the reference date. This yields a collection of 546 (14 years x 13 days x 3 hours) records per reference time point;

2) To achieve per country representative load factors for the generation adequacy analysis, the 50^{th} and 10^{th} percentile of the 546 record collections are respectively calculated for normal and severe conditions of the capacity factors per country and for solar, onshore wind and offshore wind separately.

As such, consistent Pan-European renewable in-feed scenarios are created. For example, the 10^{th} percentile scenario represents a consistent worst-case scenario for the different countries and for the different primary energy sources. It should be highlighted that this approach guarantees a worst-case scenario as it considers a perfect correlation between the different capacity factors, i.e. renewable in-feed in all countries is simultaneously assumed to be equal to the 10^{th} percentile. This scenario can then be used to detect regional adequacy issues that can consequently be investigated in more detail and with a more realistic (and therefore less worst-case) renewable in-feed scenario if necessary.

[5] Data from the Technical University of Denmark.

The methodology for the downward analysis is very similar to the one above, with the difference that the 90th percentile is used.

3.5. Load scaling

For each simulation, the per-country load needs to be scaled to a target temperature as given by the Pan-European Climate Database. To this end, ENTSO-E calculated load-temperature sensitivity coefficients. A detailed description on how these coefficients were determined can be found in Appendix 3. During data collection, the TSOs were able to modify the ENTSO-E proposed load sensitivity factors with their best estimate.

The graph below shows how these coefficients, combined with the normal load conditions and temperature reference as a starting point, are used to scale the load to the target temperature of the concerned record.

To this end, when temperatures are concerned, the population-weighted average daily temperatures are used. Population-weighted daily average temperatures are considered since they are better suited to assess temperature dependence of demand (see Appendix 3 for details).

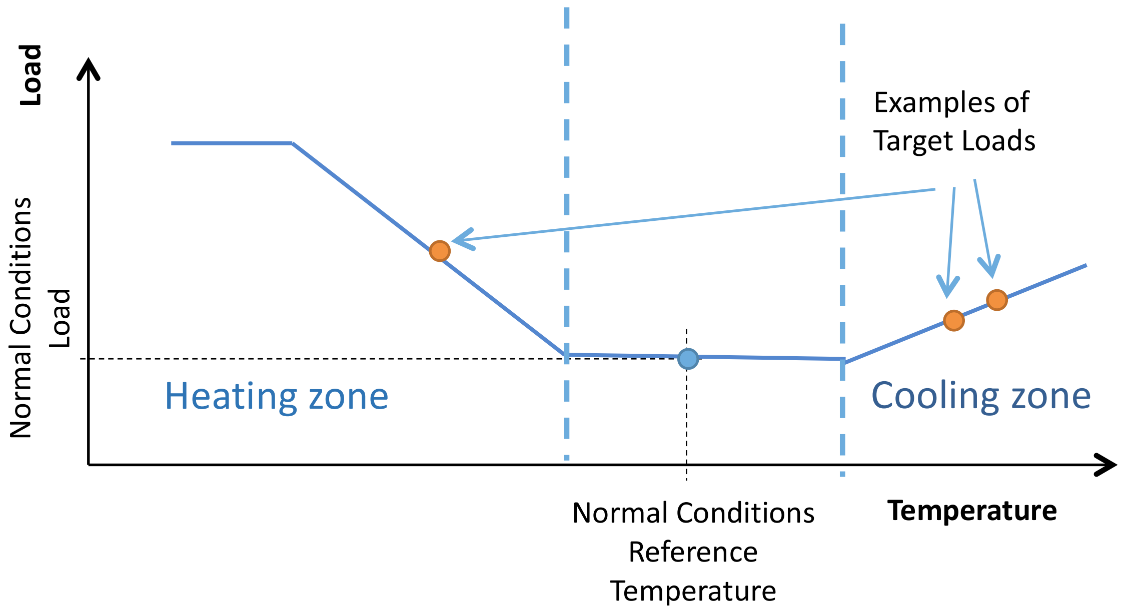


Figure 1: Load temperature sensitivity

In case no reference temperature at normal conditions is given by the TSO, the average of the collection of selected records is used instead.

3.6. Upward and downward adequacy methodology

Upward adequacy

Upward adequacy methodology consists of identifying the ability of generation to meet the demand by calculating the 'remaining capacity' under two scenarios: normal and severe weather conditions.

The methodology is schematically depicted in the below figure:

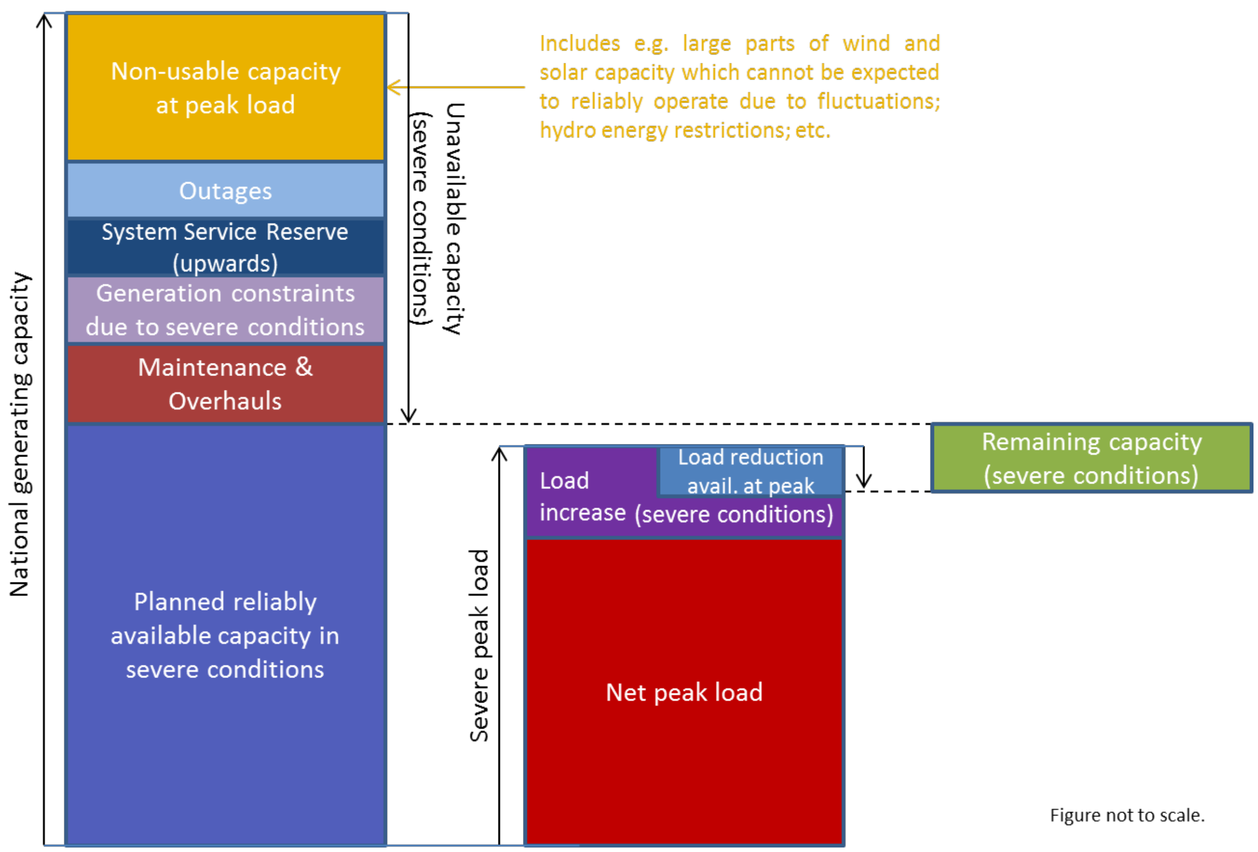


Figure 2: Upward adequacy methodology

The basis of the analysis is the situation called '**normal conditions'**. Normal conditions correspond to normal demand on the system (i.e. normal weather conditions resulting in normal wind production or hydro output and an average outage level). A '**severe conditions**' scenario was also created showing the sensitivity of the generation-load balance to low temperatures and extreme weather conditions. The severe conditions are related to what each TSO would expect in terms of demand (higher than in normal conditions) and in terms of reduced generation output (i.e. severe conditions resulting in lower wind or restrictions on classical generation power plants due to, e.g., extreme cold).

The figures representing the individual country responses show the 'National Generating Capacity', the 'Reliably Available Capacity' and the 'Load at Reference Point' under normal and severe conditions. The remaining capacity is then calculated for normal and severe conditions.

Net Transfer Capacity (NTC) values are used to limit commercial exchanges between neighbouring countries. All contributors were asked to provide a best estimate of minimum NTC values to be able to conduct a worst-case analysis. When two neighbouring countries provided different NTC values on the same border, the minimum value was used. Additionally, for the regional analysis, simultaneous importing and exporting limits can be considered to limit the global imports or exports of a country. These simultaneous limits were also reported by the contributors if applicable.

Downward adequacy

Under minimum demand conditions, countries could potentially have an excess of inflexible generation running. Every TSO is likely to have varying levels of 'must-run' generation. This may be Combined Heat and Power (CHP) units or generators that are required to run to maintain dynamic voltage support, etc. In addition, there will be renewable generation such as run-of-river hydro generation, solar and wind power, whose output is inflexible and variable. At times of high renewable output, the combination can result in generation exceeding demand plus the pumped storage capacity of the country. In that case, the 'excess' generation is either exported to a neighbouring region or curtailed.

The regional analysis takes the data submitted by TSOs and alters the renewables in-feed to a representative European scenario, as was described in the section above. For countries that have a generation excess, the optimisation tries to export the excess power to neighbouring regions in deficit, by use of the best estimate of the minimum NTC values submitted, and via a constrained linear optimisation.

The analysis will highlight periods in which groups of countries cannot export all of their excess generation. It should be again stressed that this analysis is not a market simulation. Rather, it is a feasibility analysis to indicate countries that may be required to curtail excess generation due to limited cross-border export capacity.

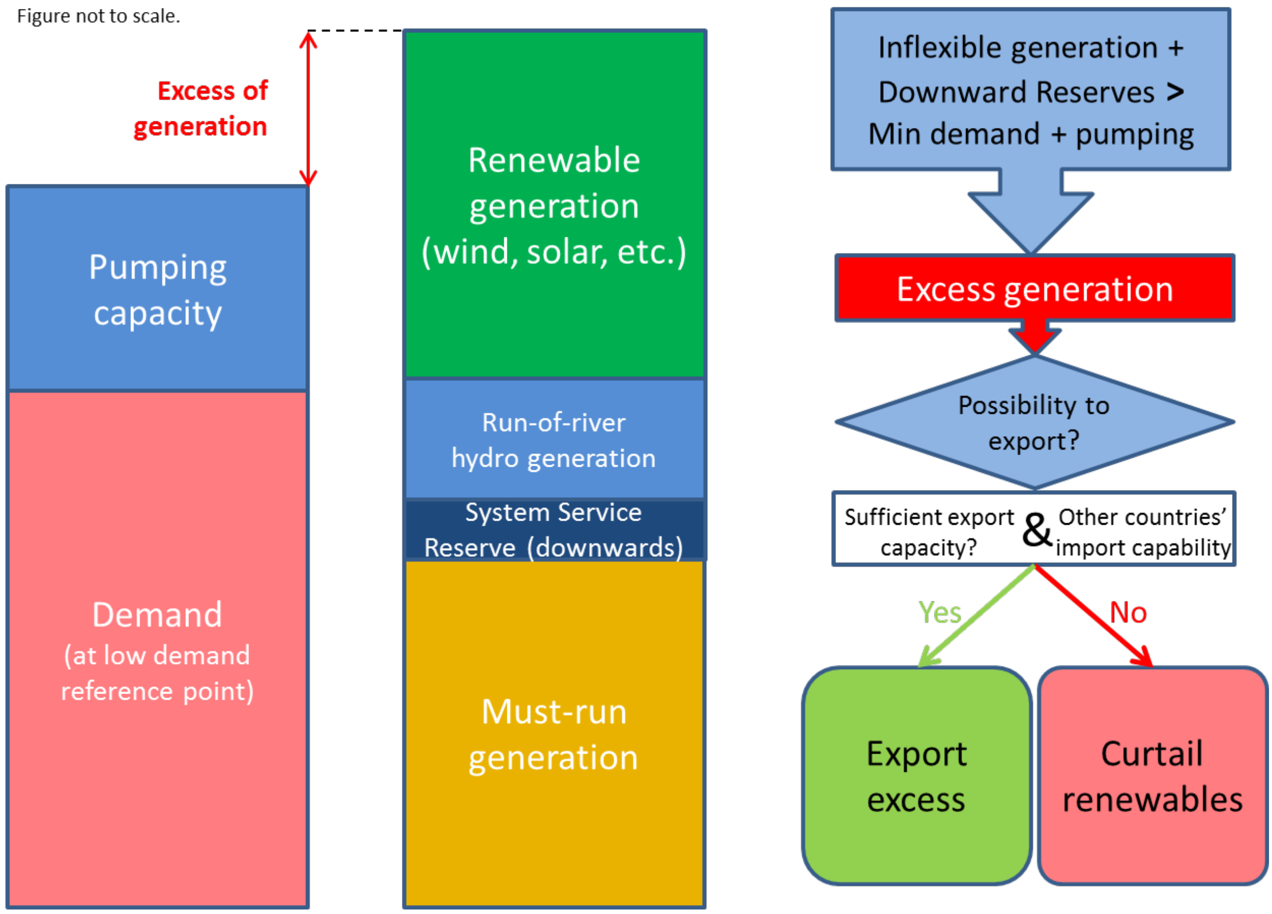


Figure 3: Summary of downward adequacy methodology

3.7. Regional analysis approach

The basis of the regional analysis is a constrained linear optimisation problem. The goal is to detect if problems could arise on a pan-European scale due to a lack of available capacity. A simplified merit order simulation approach has been implemented in this report compared to the last Seasonal Outlook following the implementation roadmaps of the consulted Target Methodology[6]. The current improvements provide an indication of whether countries requiring imports will be able to obtain these across neighbouring regions under normal and severe conditions, as well as which from countries the needed energy might originate from. In case a potential shortage is detected in one or more countries, the potential curtailment *will be equally shared*. In other words, the curtailed energy to initial remaining capacity ratio will be equal among those countries. At present, the distribution of curtailed energy follows much more complex rules, which can lead to significantly different distributions of curtailed energy.

The first element that is checked is whether in a 'copperplate' scenario there is enough power capacity to cover the demand. Here, all remaining capacity is simply added, and when the result is greater than zero, theoretically enough capacity is available in Europe to cover all countries' needs. No problems are expected using this approach, either for normal or severe conditions. As this method does not take into account the limited exchange capacity between countries, it is too optimistic to draw final conclusions based on it.

As a consequence of this, a second, more precise approach is taken. The problem is modelled as a linear optimisation with the following constraints:

- Bilateral exchanges between countries should be lower than or equal to the given NTC values;
- Total simultaneous imports and exports should be lower than or equal to the given limits.

Based on this methodology, it was calculated which groups of countries would have a generation deficit for a certain week due to saturated cross-border exchanges.

[6] Future improvements of the existing methodology for regional assessments foresee a gradual inclusion of market and/or grid modelling features.

For not modelised neighbouring systems, like Morocco, Russia, Belarus, the Ukraine (except the Burshtyn Island, which is part of the Ukrainian system that operates synchronously with Continental Europe), the following values were assumed for these systems for the regional analysis:

- The balance (remaining capacity) of these systems was set at **0 MW**.
- A best estimate of the minimum NTC comes from neighbouring systems belonging to ENTSO-E.

This approach will result in the possibility to 'wheel' energy through these bordering countries, without them adding to or subtracting from the total generation level of the region.

Regarding the linear optimisation problem, two variants can be distinguished: a feasibility simulation and a simplified merit-order simulation. For most simulations in this outlook report, by default, the feasibility simulation is used. For this simulation, the input used is the calculated remaining capacity of all countries when using the available generating capacity of all generation types. For the simplified merit-order simulation the approach is slightly different. In this case, an iterative approach is used by gradually adding available generating capacity of different generation types. The simplified merit-order that is used is the following:

1) Solar
2) Onshore Wind
3) Offshore Wind
4) Other Renewable Sources
5) Nuclear
6) Coal
7) Gas
8) Other non-renewable sources
9) Hydro pumped storage
10) Demand side management and strategic reserves

3.8. Probabilistic analysis for regions or countries at risk

In case the aforementioned regional analysis shows that a country or region (combination of adjacent countries) could experience adequacy issues for a specific time point, this country or region is investigated in more detail in the next step.

The goal of this detailed analysis is to detect what the main drivers are of a certain adequacy issue (e.g. temperature in country X, wind or photovoltaic infeed in country Y, etc), and to be able to give an indication of probability of occurrence to a situation.

For every reference time point, the collection of 546 records is used to run 546 different simulations. The following high-level methodology is applied to build each one of those simulations:

1) As a starting point, the qualitative data provided by the TSOs for severe conditions is used;

2) Next, the severe conditions load is replaced by normal conditions, average load as given by the TSOs. For the related reference temperature, the average temperature over all 546 records is used;

3) The capacity factors for onshore wind, offshore wind and solar are replaced by those of the concerned record;

4) The normal conditions load is scaled by use of load-temperature sensitivity relations. The difference between reference temperature and the temperature of the concerned record is translated into 'increase/decrease' of load, using the methodology described in section 3.5.

After performing these manipulations on the base data, the simulation is run (including the simulation of cross-border exchanges with other countries), and the results are calculated. In this manner, for every simulation it is determined whether or not the considered region suffers adequacy issues or not.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

4. Winter 2015/16 Outlook

4.1. A context of decreasing flexible generation capacity

The trend of a decreasing programmable capacity, already mentioned in the previous seasonal outlook reports, is still confirmed for the coming winter. For this reason, adequacy tension may appear more often in the future.

An illustration of the evolution of generation capacity throughout Europe is depicted in the figure below. The capacity from dispatchable units strongly decreased compared to last winter (-22.4 GW), while the Renewable Energy Sources (RES) capacity increased (+18.6 GW), causing the total Net Generation Capacity to slightly decrease (-3.8 GW).

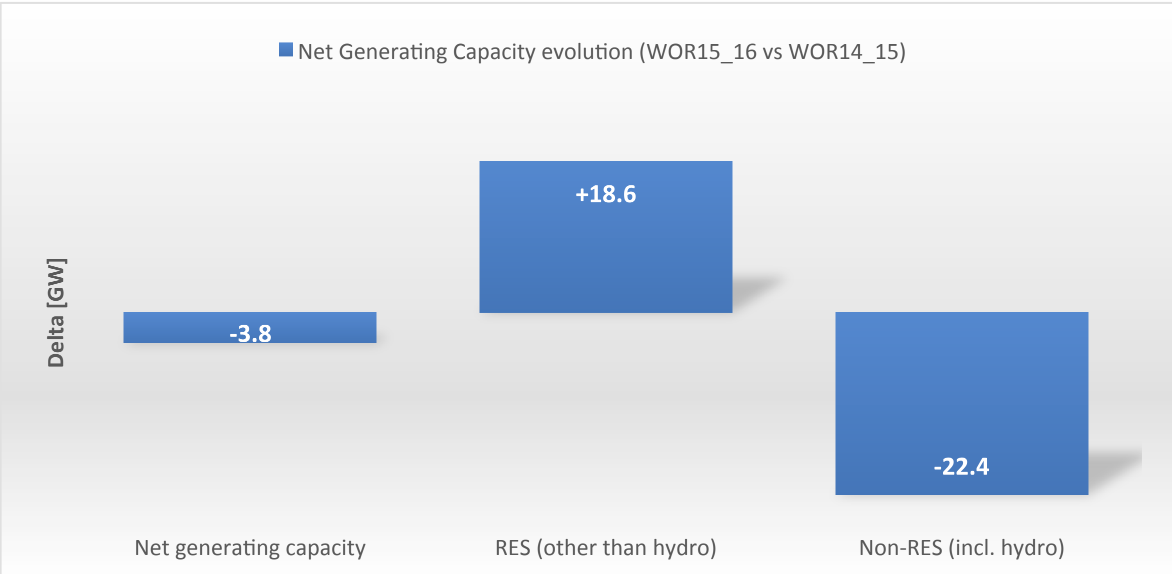


Figure 4: Evolution of net installed generation (compared to previous Winter Outlook report, data in GW)

It needs to be noted that the quoted quantities are net generating capacities; outages or the availability (of renewables) are not taken into account in the above graph. This comparison has been performed on the same perimeter as in the previous report: Malta and Turkey, which have been included starting from WOR 15/16, are not included in this comparison.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

4.2. Main regional adequacy risks identified for the coming winter

The Winter Outlook Analysis, done by ENTSO-E, shows that most countries in Europe would have sufficient generation in both normal and severe conditions. Several of them, however, may have to rely on imports, load reduction measures or the use of strategic reserves to cover their demand.

However, the Polish TSO (PSE) may have a problem balancing the system during the winter if severe conditions occur. An extremely dry summer and its continuation into autumn (resulting in low water levels in rivers used for cooling some thermal power plants) means that during severe winter conditions, the risk of a full freeze of rivers will be real. Possible import on the synchronous profile (with DE+CZ+SK) strongly depends on the level of unscheduled flows through Poland, which are the result of market transactions concluded outside of Poland. Therefore, PSE is not able to offer any import capacity for the coming winter on a yearly, monthly or day ahead horizons. Consequently, PSE has asked TSOs in the TSO Security Coordination (TSC) area to take actions, which will allow PSE to rely on not less than 1000 MW of imports on the synchronous profile, at least in emergency situations, and to ensure enough remedial actions to keep an N-1 security state on the DE-PL border.

4.3. Regional adequacy assessment

A regional assessment of the upward regulation (generation adequacy) and downward regulation margin was performed. For the generation adequacy analysis, in-feed from wind and solar was calculated from the Pan European Climate Database (Cf. section 3.4) to achieve a consistent scenario of renewable in-feed over Europe.

It is important to emphasise that the scenarios evaluated in the regional assessment (for both upward and downward analysis) represent conditions that are significant and realistic for the European system as a whole. Therefore they may differ from the scenarios evaluated in each individual country perspective analysis, which correspond to conditions significant and realistic for each country. For example, the severe conditions of the entire European System do not correspond to the 'simple envelope' of each individual severe condition.

4.3.1. Upward regulation under normal conditions

Based on normal conditions for generation and demand, the majority of countries do not require imports at the synchronous reference time points, as shown pictorially in the table below. **It should be noted that for these simulations, the demand reduction measures and available strategic reserves are taken into account as reported by the TSOs.** Where a country is coloured green, it has excess capacity to meet demand and reserves. The countries that are fully coloured in purple can cover their deficit with imports, whereas the regional analysis revealed that for the countries that show partial orange results, their deficit cannot be fully covered with imports due to insufficient reported cross-border exchange capacities or a lack of energy. The portion of the cell that is coloured in orange reflects the portion of the deficit that cannot be covered with imports.

For example:

(green)	excess capacity
(purple)	deficit can be fully covered with imports
(25% orange)	25% of deficit cannot be covered with imports
(50% orange)	50% of deficit cannot be covered with imports
(75% orange)	75% of deficit cannot be covered with imports
(100% orange)	100% of deficit cannot be covered with imports

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Table 1: Import needs under normal conditions

Week	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14
AL																		
AT																		
BA																		
BE																		
BG																		
CH																		
CZ																		
DE																		
DK																		
EE																		
ES																		
FI																		
FR																		
GB																		
GR																		
HR																		
HU																		
IE																		
IT																		
LT																		
LU																		
LV																		
ME																		
MK																		
NI																		
NL																		
NO																		
PL																		
PT																		
RO																		
RS																		
SE																		
SI																		
SK																		
CY																		
TR																		
MT																		
UA_W																		

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Simplified merit order approach

While the majority of regions do not require imports for adequacy reasons, the markets will determine the economic energy transfers based on the respective price differentials between regions, so various borders may be transmitting power at their maximum capacity.

As indicated in the description of the methodology, a simplified merit order analysis was also conducted to provide an indication of which countries will probably import energy from a market point of view. Different from the table above, which shows the import needs from an adequacy perspective (using a 'feasibility simulation'), Table 2 shows which countries are prone to import from a market point of view for next winter and under normal conditions. Those countries and weeks that do not require imports from an adequacy perspective, but are prone to import due to market conditions, are coloured in light purple.

Figure 5 shows which countries are prone to such a market-based importing position for some or all weeks of the coming winter and under normal conditions.

	Country prone to export from a market perspective
	Country prone to import from a market perspective
	Country requires imports from an adequacy perspective

Table 2: Countries prone to market-based imports in normal conditions

Week	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14
AL																		
AT																		
BA																		
BE																		
BG																		
CH																		
CZ																		
DE																		
DK																		
EE																		
ES																		
FI																		
FR																		
GB																		
GR																		
HR																		
HU																		
IE																		
IT																		
LT																		
LU																		
LV																		
ME																		
MK																		
NI																		
NL																		
NO																		
PL																		
PT																		
RO																		
RS																		
SE																		
SI																		
SK																		
CY																		
TR																		
MT																		
UA_W																		

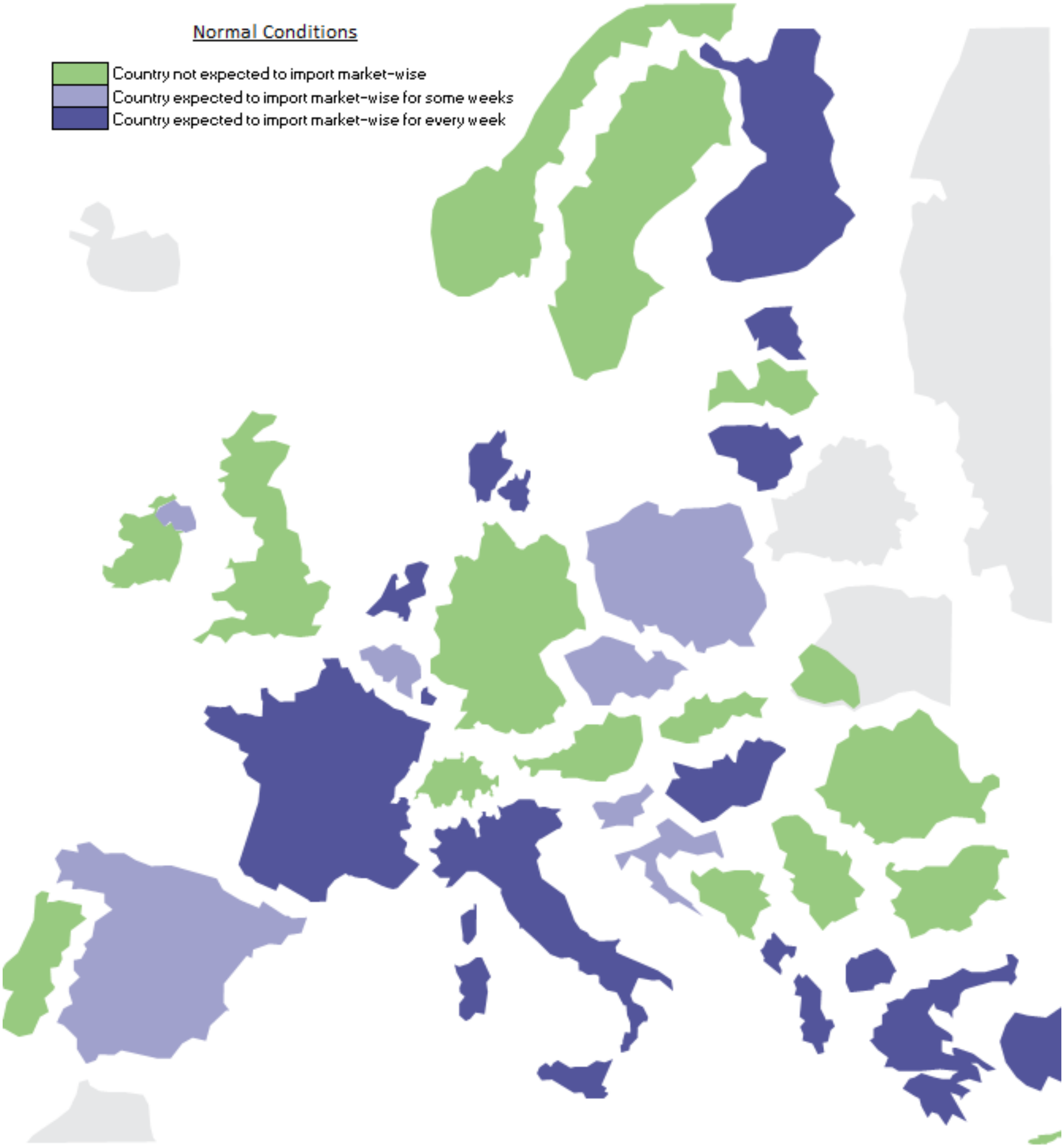


Figure 5: Estimated market-based imports under normal conditions

4.3.2. Upward regulation under severe conditions

Under severe conditions (cf. methodology: this is a worst-case envelope, representing an extreme scenario to detect regions potentially at risk), the picture is somewhat different: the demand of several individual countries increases, whilst generation availability might be lower due to unfavourable meteorological conditions. **It should be noted that for these**

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

simulations, the demand reduction measures and available strategic reserves are taken into account as reported by the TSOs.

The analysis indicated that even under severe conditions, demand can be met and reserves can be maintained across nearly all of Europe, thanks to energy surpluses in most regions and available interconnector capacity to supply the regions depending on imports.

However, a potential risk is identified for Poland as can be seen in the following table. **Figure 6** shows a detail of the simulated Polish situation for **Week 5** when using the simplified merit order approach. As depicted, all available cross-border capacities into Poland are saturated (all import arrows entering Poland are red), and no import capacity is available on the common synchronous profile (with DE+CZ+SK shown as coupled black arrows). The unavailability of import capacity on this profile is because it is often congested by unscheduled flows through Poland from its western border to its southern border. The numbers shown in the countries represent the simulated exporting (positive) or importing (negative) position of every country. For a more detailed appreciation of the expected situation in Poland, please refer to the Polish section in Appendix 1.

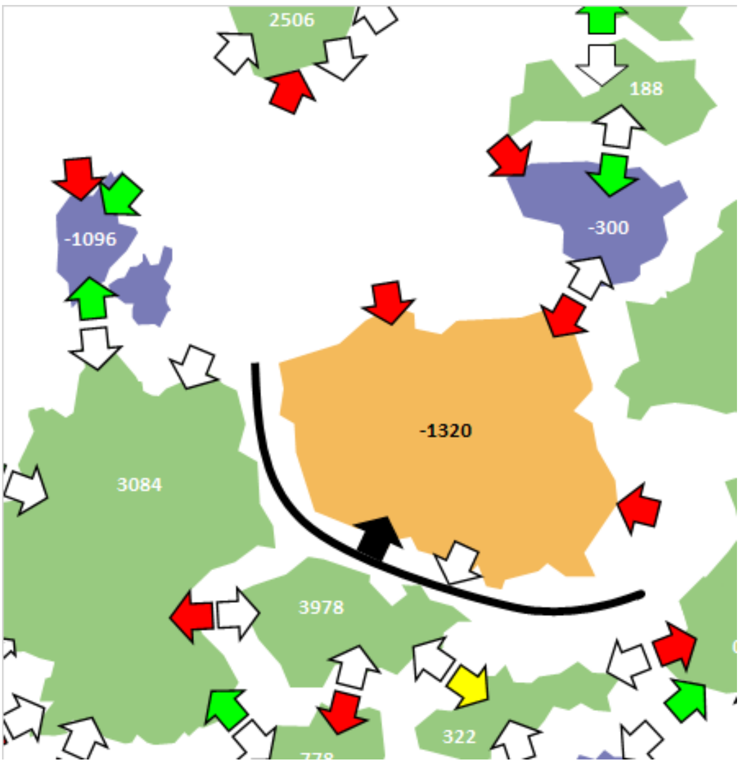
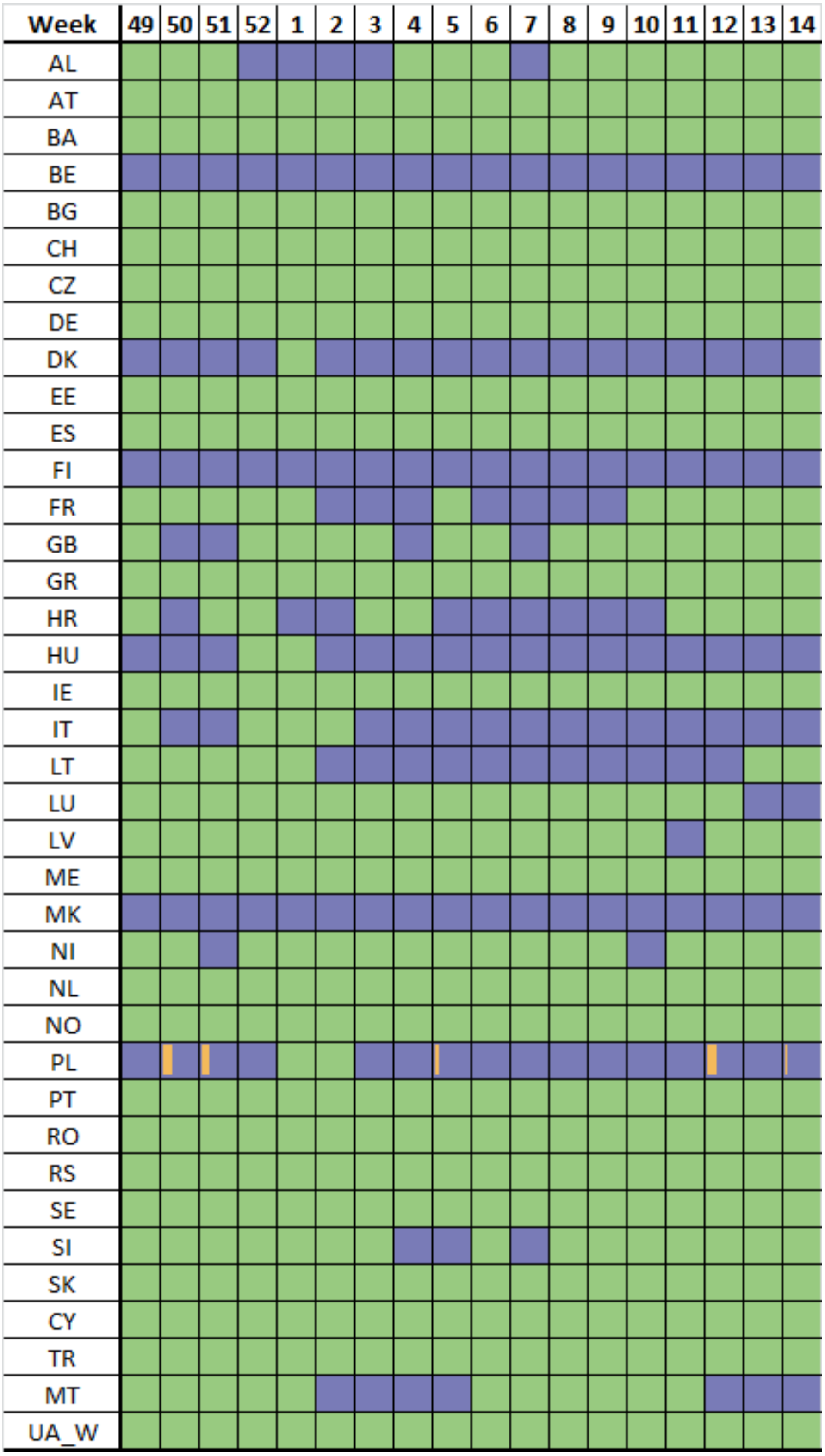


Figure 6: Detailed simplified merit-order results for PL under severe conditions (Week 5)

Table 3: Import needs under severe conditions



The European map below provides another view of the data shown in the above table. It indicates the countries expecting a need for imported energy in at least one week of the considered period or in all weeks of the considered period, respectively. As can be seen, the need for importable energy is quite limited and geographically distributed, resulting in a low probability of potential issues regarding generation adequacy for the coming winter period.

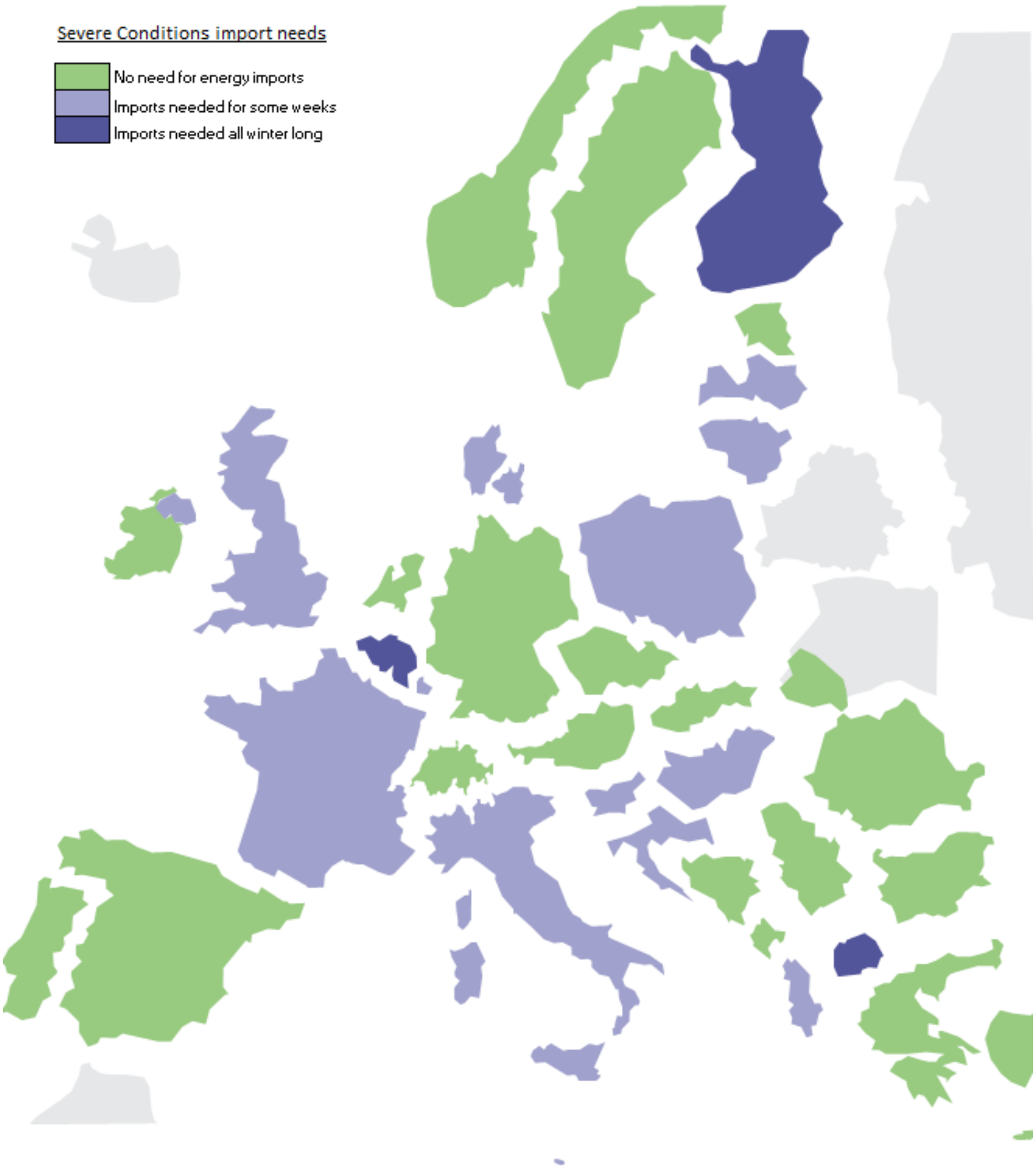


Figure 7: Generation adequacy map under severe conditions

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

In order to appreciate the reliance on extraordinary measures such as demand reduction and/or activation of strategic reserves, further analyses are presented in the next two chapters.

4.4. Demand side management and/or strategic reserves activation probability

From the quantitative data provided by the different TSOs, it became apparent that quite some countries reported demand side management measures and strategic reserves. For the base simulations, these numbers are taken into account in their remaining margins, and therefore are included when determining the status of a country in the tables above.

However, from the comments of the different countries it became clear that at least some of those demand side management measures and strategic reserves are made up of some type of emergency reserves that might only be used in case of a severe adequacy risk. It was therefore deemed useful to repeat the regional adequacy assessment while excluding these contracted strategic reserves to give an indication of the necessity of these measures for the coming winter.

Table 4 below depicts the simulation results for the described variant scenario. As could be expected, the adequacy risk for Poland increases when disregarding potential demand side management measures. For a further appreciation of the risk, please refer to the country-specific section concerning Poland in Appendix 1.

Moreover, a combined need to use demand side management and/or activate strategic reserves appears for Belgium, France and Great Britain for weeks 2, 3 and 4, and to a lesser extent for week 8. In other words, for those countries and those weeks, when no demand side management and no activation of strategic reserves is assumed, interconnection capacities might not be sufficient to meet demand. For the simulation, the deficit has been equally distributed over the countries in need with respect to their individual remaining capacities; in reality, this distribution can be different depending on the specific market conditions.

Figure 8 shows a detail of the simulated Belgian-French-British situation for **Week 4** when using the simplified merit-order approach. As depicted, all cross-border capacities into the

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

BE-FR-GB region are saturated (all import arrows surrounding the perimeter enclosed by the border of Belgium, France and Great Britain are red). The numbers shown in the countries represent the simulated exporting (positive) or importing (negative) position of every country. As stated earlier, the final distribution of the deficit energy over those three countries is determined based on the market parameters, and therefore the results of these simulations give no indication whatsoever how this deficit energy would be distributed.

For Belgium specifically, a need to activate its strategic reserves might also appear in nearly all weeks of winter if and when severe conditions materialise. This is mainly due to an expected total import balance for Belgium that might be reduced under severe winter conditions due to north-to-south oriented market flows in Central-Western Europe, resulting in considerable market-based transit flows through the Belgian system.

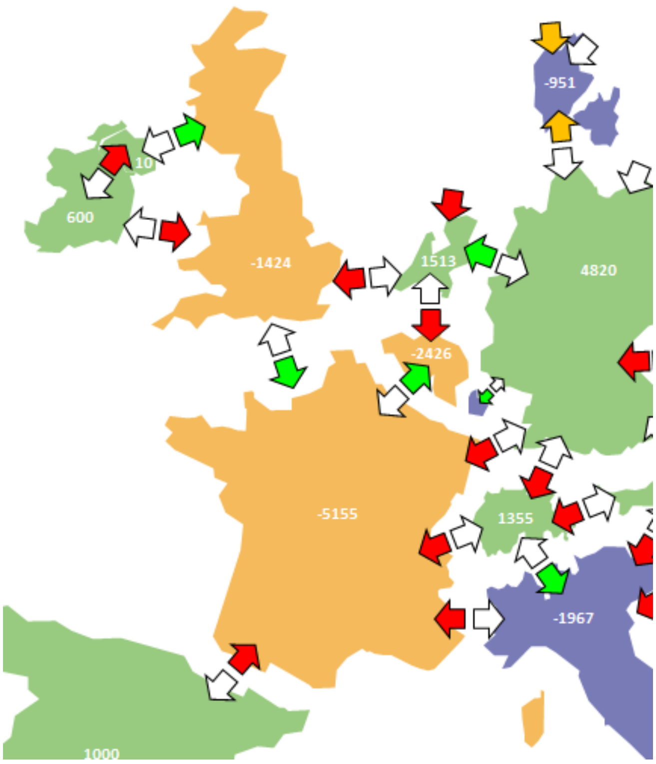


Figure 8: Detailed merit-order results for BE/FR/GB under severe conditions and without demand side management or strategic reserves (Week 4)

As this simulation only shows the results for the worst-case scenario of severe conditions among all countries, in the next section a probabilistic analysis will be carried out for Week

4 to indicate the need for imports and the probability of having to resort to demand side management and/or strategic reserves. This analysis will also reveal the relationship between temperatures and wind infeed at the evening reference time.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Table 4: Import needs under severe conditions without demand side management nor strategic reserve activations

Week	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14
AL																		
AT																		
BA																		
BE																		
BG																		
CH																		
CZ																		
DE																		
DK																		
EE																		
ES																		
FI																		
FR																		
GB																		
GR																		
HR																		
HU																		
IE																		
IT																		
LT																		
LU																		
LV																		
ME																		
MK																		
NI																		
NL																		
NO																		
PL																		
PT																		
RO																		
RS																		
SE																		
SI																		
SK																		
CY																		
TR																		
MT																		
UA_W																		

4.5. Probabilistic sensitivity analysis for countries or regions at risk

To investigate the situation for Belgium, France and Great Britain for Week 4 in more detail, further simulations have been carried out. As explained in the methodology, a large number of simulations (546 in total) were run, varying the temperatures and renewables infeed and assessing the impact on the remaining capacity in Belgium, France and Great Britain.

Figure 9, Figure 10 and Figure 11 show the results of the simulations for Belgium, France and Great Britain, respectively, with the total (onshore and offshore wind are weighted based on their installed capacity) wind capacity factor on the horizontal axis, and the population weighted daily average temperature on the vertical axis[7]. For every simulation that was run, a marker is shown:

- Grey if no imports are needed for that simulation;
- Green if less than 1.5 GW of imports are needed and sufficient energy can be imported to cover the demand;
- Purple if between 1.5 GW and 2.5 GW of imports are needed and sufficient energy can be imported to cover the demand;
- Blue if between 2.5 GW and 3.5 GW of imports are needed and sufficient energy can be imported to cover the demand;
- Orange if more than 3.5 GW of imports are needed and sufficient energy can be imported to cover the demand;
- Red if simultaneous high imports are needed for BE and FR and insufficient energy can be imported into both countries to cover the demand, and therefore the contracted strategic reserves and/or emergency load reduction measures might have to be used.

[7] Please note that in comparison with previous Winter Outlooks, the time interval around the reference time for which temperatures are retained in the simulation set is decreased from 5 hours to 3 hours (cf. section 3.4). This results in the fact that less extreme temperatures are simulated as can be seen in the simulation results.

It is clear that in all simulations Belgium needs to rely on imports, which makes Belgium structurally dependent on energy from neighbouring countries. France, on the other hand, can be self-contained down to an average daily temperature of about 0°C. For Great Britain, the need for imports depends on the combination of the average daily temperature and the wind infeed.

A first conclusion can be that no issue seems to appear in Great Britain, meaning that the importing needs for Great Britain are less correlated with those of Belgium and France. In other words, in the situations where Great Britain needs very high levels of imports, the probability is high that the needed energy can be found in the neighbouring countries.

Secondly, import needs in France are mainly linked to the daily average temperatures and less to the total wind capacity factor. It could be concluded that potential issues in BE and in FR are mainly linked to French temperatures. Starting from daily average temperatures of -2°C in France, the combined import needs of BE and FR become higher than the importable energy for those countries (represented by the red dots on the graphs below). The red dots should be interpreted as those simulations where both in BE and FR, simultaneous high import levels are required, leading to a potentially tight situation for both countries. In those scenarios, therefore, it may be needed to use the contracted strategic reserves and emergency load reduction measures that are put into place in Belgium and France, respectively. It is also clear that in those cases where adequacy might be at risk, it is of the utmost importance to provide maximal cross-border capacities to the market on the borders surrounding Belgium and France. It will probably be on those borders were maximal gains for social welfare can be found in case of scarcity issues.

Specifically for Belgium, under most conditions sufficient importing capacity should be present to avoid the need to activate the strategic reserves, except in the above mentioned situations. However, even for import needs below 3.5 GW, the activation of strategic reserves might become necessary if specific market conditions appear that limit Belgium's importing capacity. This may mainly occur when significant market-induced transit flows from The Netherlands to France are present.

It should be noted that these simulations always refer to the winter outlook reference time point only (19:00 CET). The national peak load could be at a different time, resulting in higher import needs for the concerned country. Additional need to use demand side management or strategic reserves might therefore appear under such circumstances. For

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

example, for Belgium, a peak load was reported at about one hour before the synchronous reference time, which is about 750 MW higher than the synchronous time point load for Belgium.

It is also important to stress that cross-border exchanges in the simulations that were run are constrained by estimated NTC values. A Central-Western Europe Flow-Based Market Coupling has been in place for a few months, what could significantly impact interconnection flows.

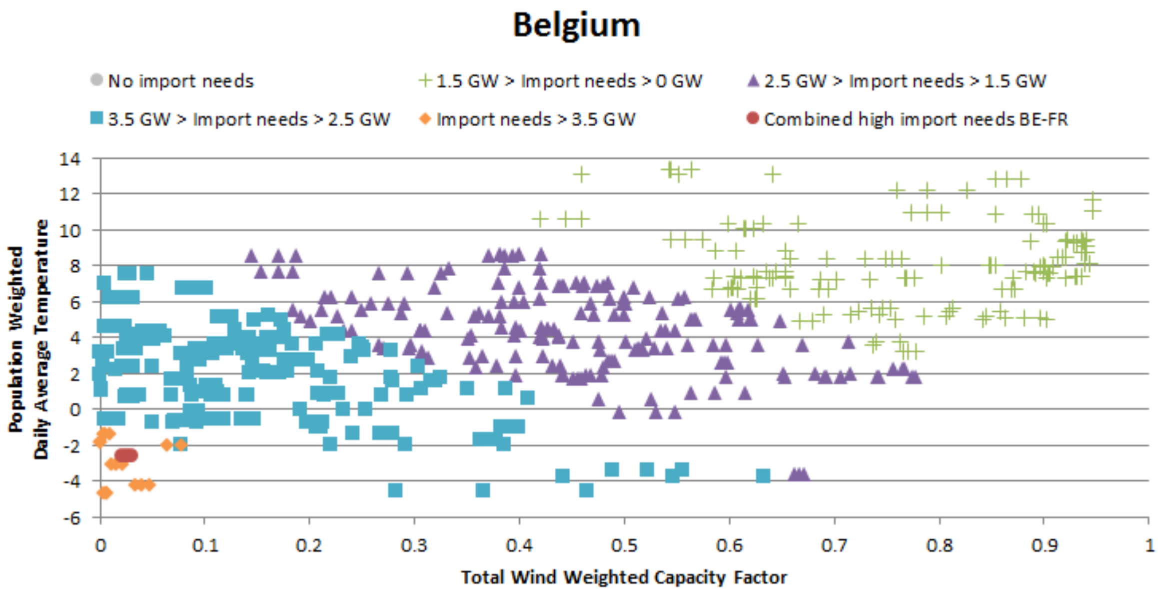


Figure 9: Probabilistic assessment of import needs for Belgium for the situation investigated (Week 4)

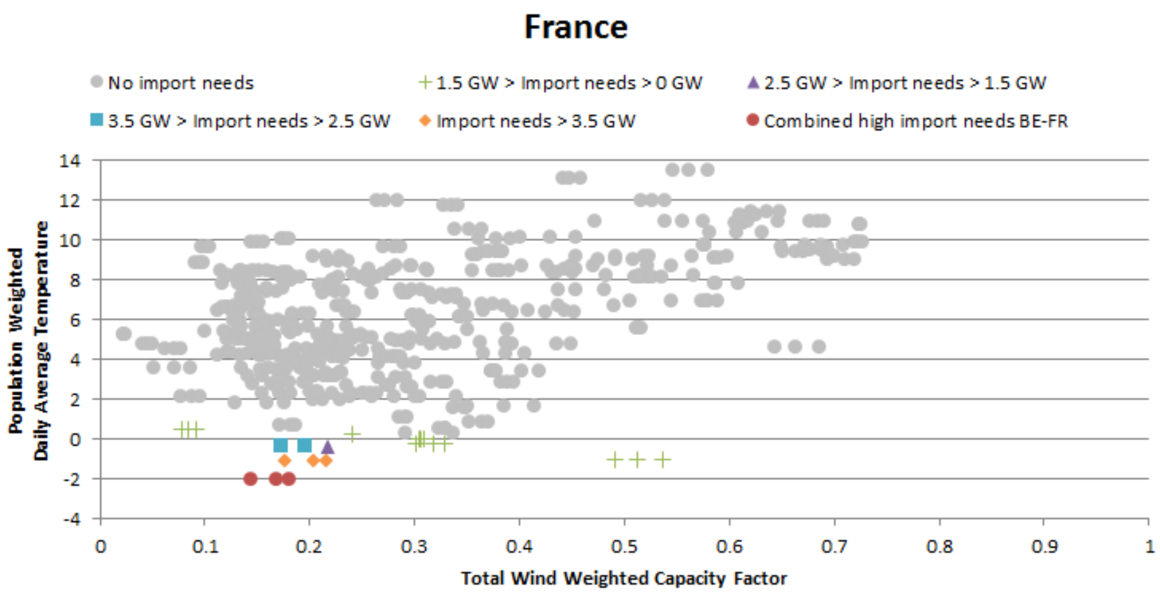


Figure 10: Probabilistic assessment of import needs for France for the situation investigated (Week 4)

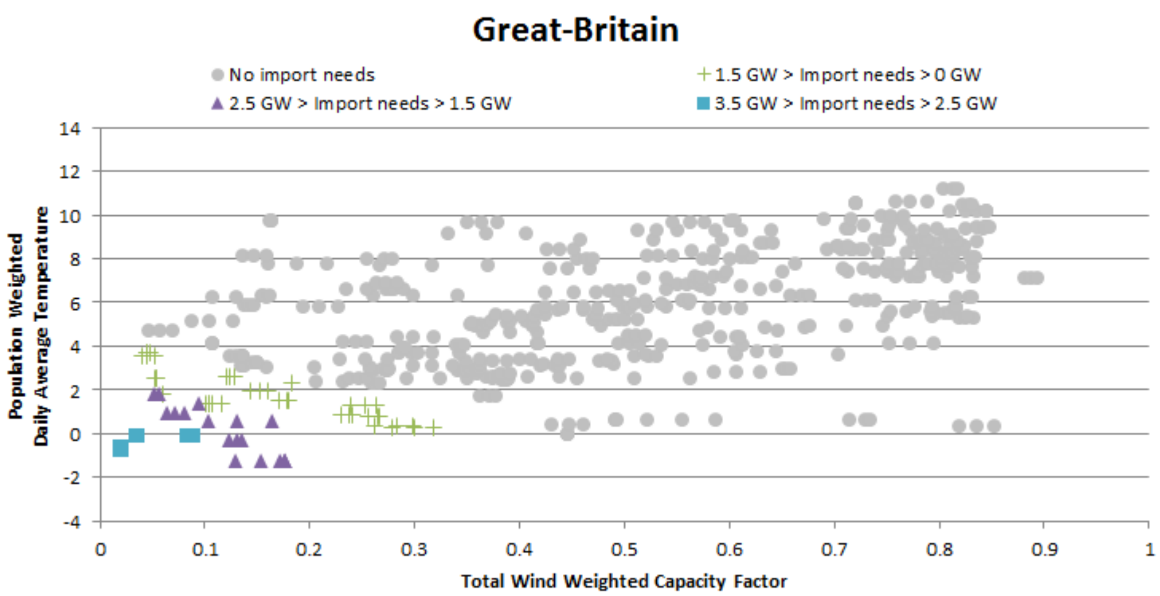


Figure 11: Probabilistic assessment of import needs for Great Britain for the situation investigated (Week 4)

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

4.6. Downward regulation margins

With increasing renewable generation in Europe, the probability of encountering issues relating to an excess of inflexible generation also increases. The results of the analysis of available downward regulation margins at the daytime reference time point are shown below in Table 5. Where a country is coloured green, it has sufficient downward regulation margin. The countries that are fully coloured in purple can export their excess energy, whereas for the countries that show partial orange results, the regional analysis revealed that their excess cannot be fully covered with exports considering the reported NTC values. The portion of the cell that is coloured in orange reflects the portion of the excess that cannot be covered by exports.

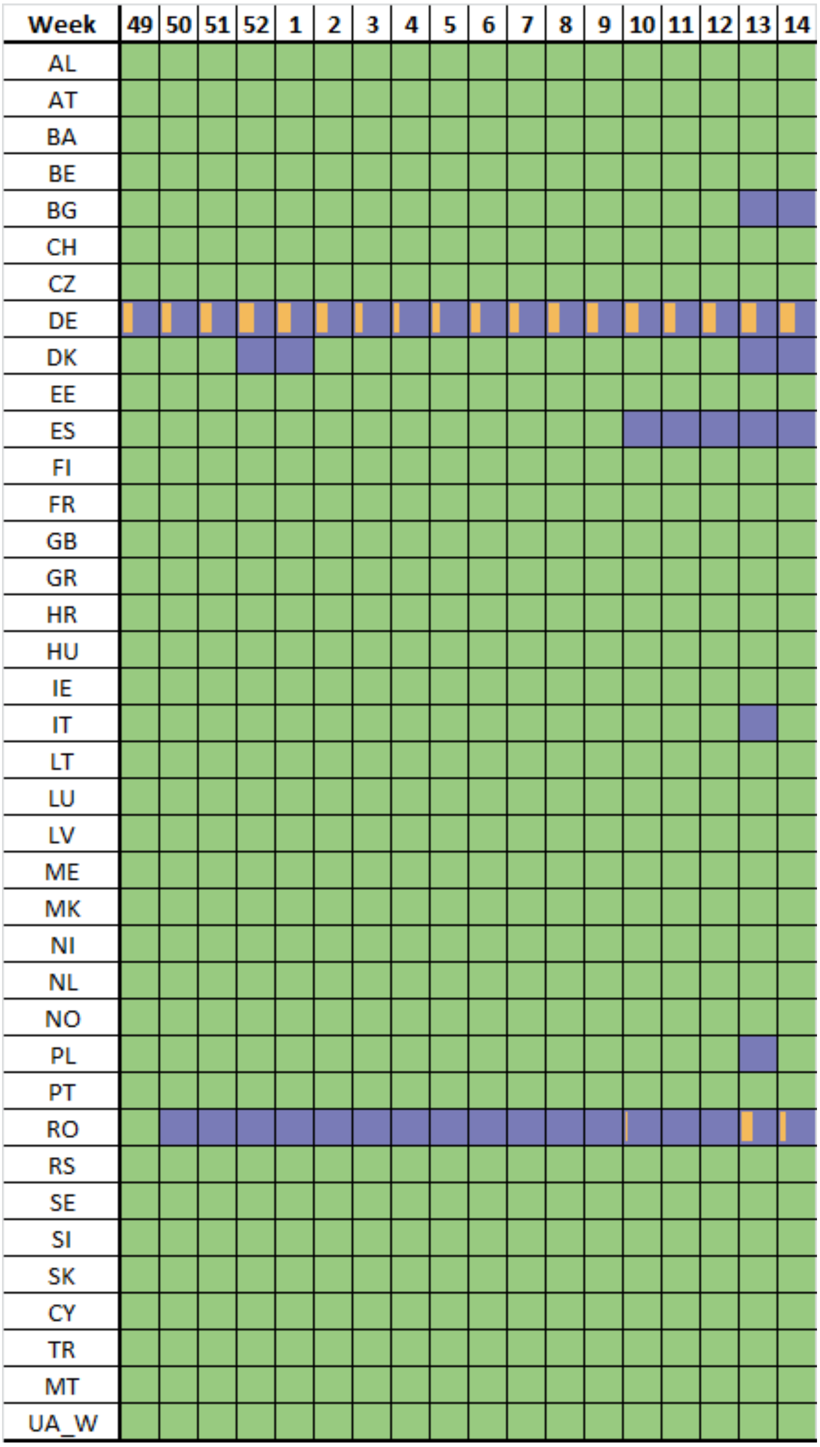


Table 5: Export needs at the daytime minimum

It can be observed that with wind and solar output set at a representative level across the ENTSO-E region, there are some countries that would be required to export excess inflexible generation under minimum daytime demands to neighbouring regions. For most countries, the estimated minimal NTC's, in combination with the possibility for neighbouring countries to absorb excess energy, result in a feasible ENTSO-E-wide situation. For Germany, and to a lesser extent for Romania, a potential issue regarding excess inflexible generation might arise in several weeks. For more information on the appreciation of the risk for those countries, please refer to the country-specific contributions in Appendix 1.

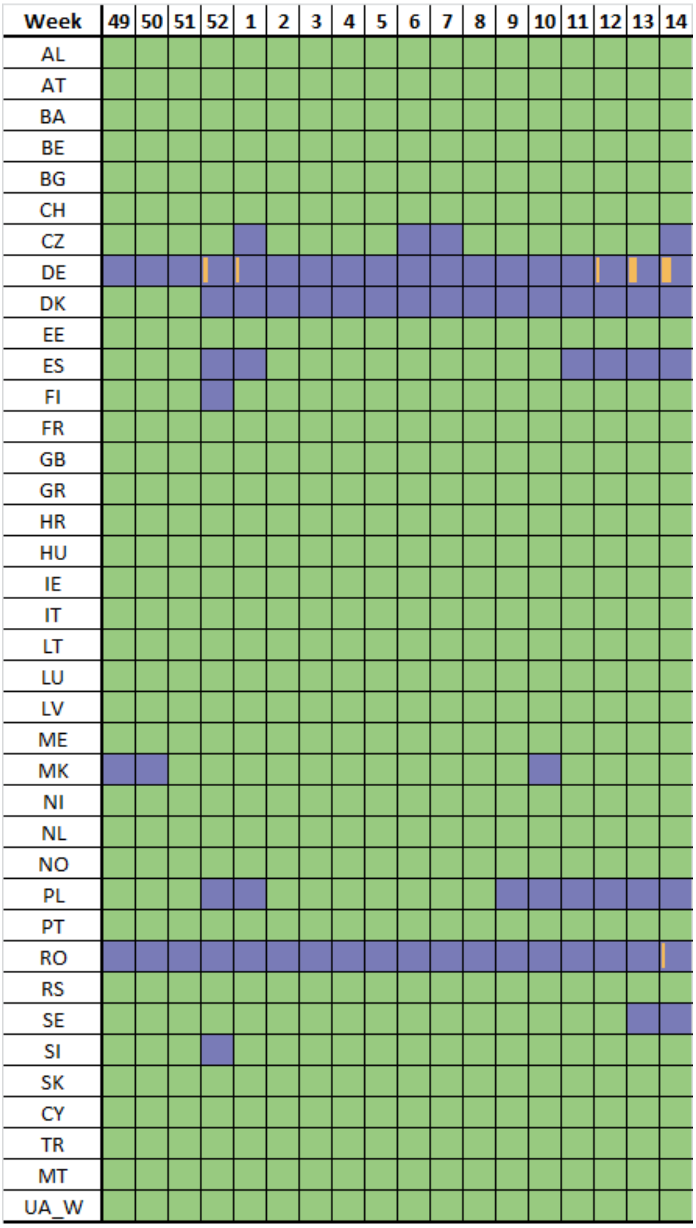


Table 6: Export needs at the nighttime minimum

The overnight minimum demand scenario yields similar results and conclusions as the daytime scenario: sufficient interconnection capacity is available to export excess inflexible generation to neighbouring countries under the investigated hypotheses. For Germany and Romania a potential issue regarding excess inflexible generation might arise, however, the risk would be significantly smaller compared to the daytime minimum scenario.

The below maps offer another view on the data shown in Table 5 and Table 6. They indicate the countries expecting a need to export energy in at least one week of the considered period or in all weeks of the considered period, respectively. As can be seen on these maps, the need to export energy is quite limited and geographically distributed, resulting in a low probability of potential issues on a pan-European scale regarding an excess of inflexible generation for the coming winter period.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

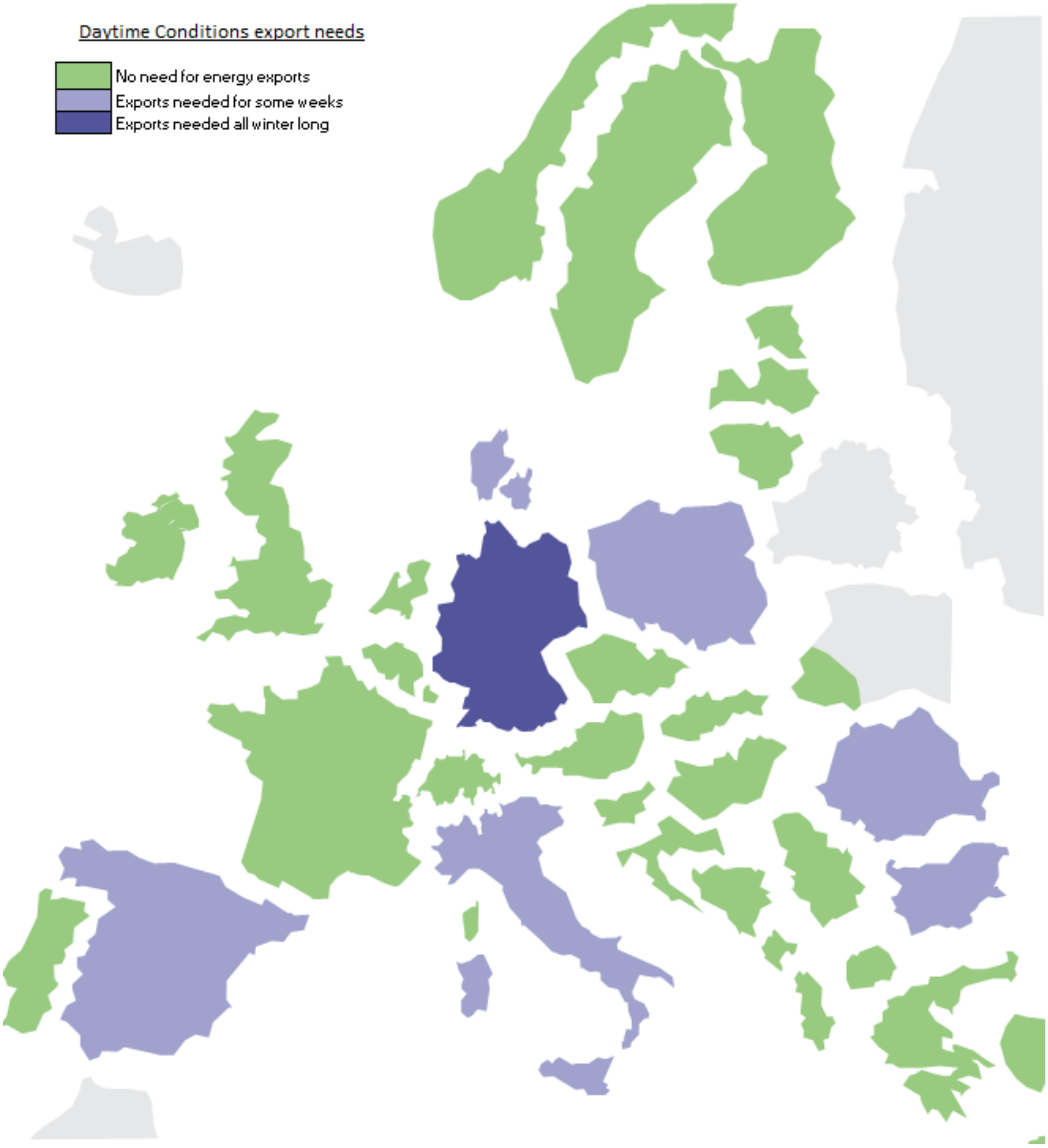


Figure 12: Overview of the export needs for the daytime scenario

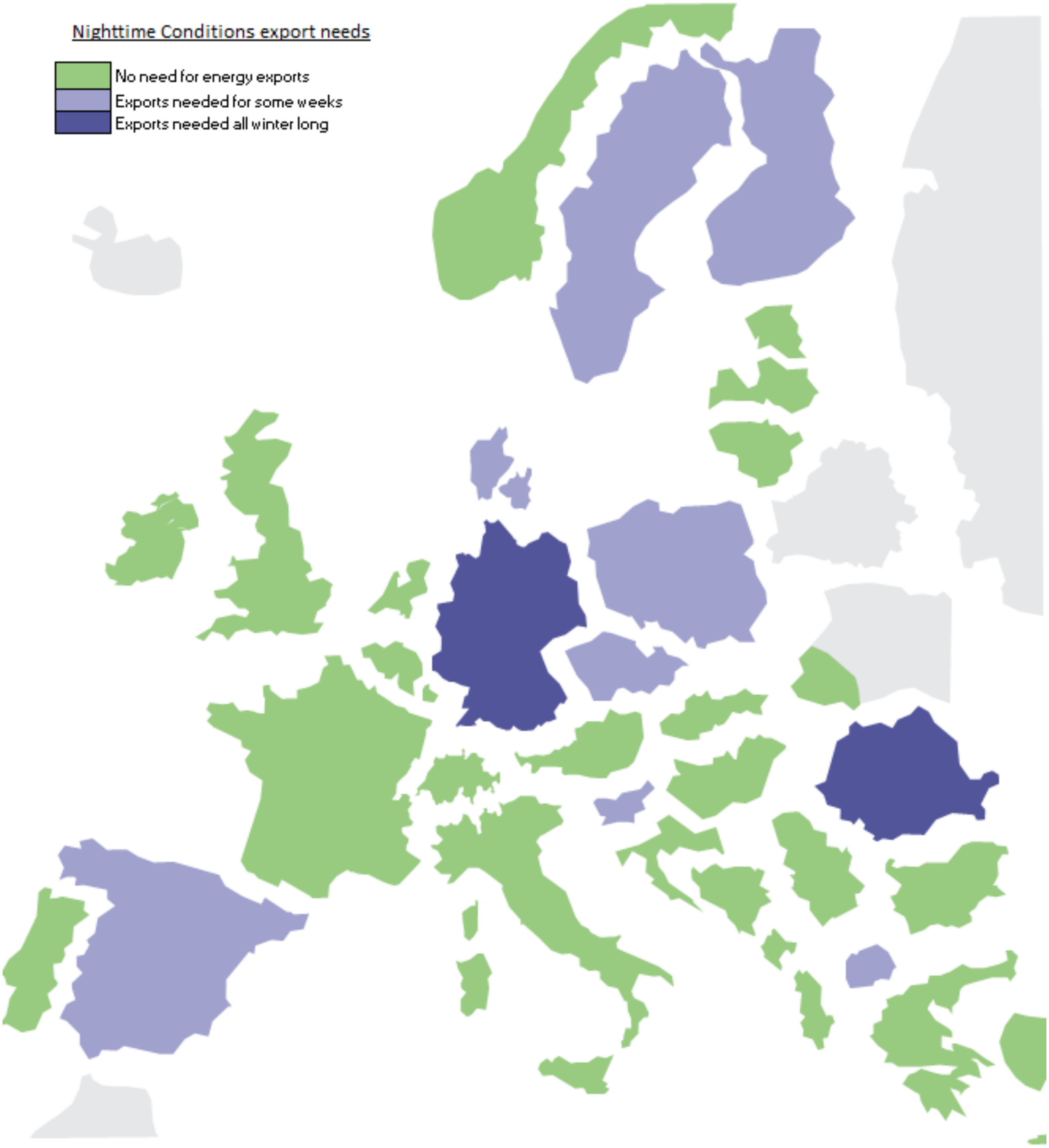


Figure 13: Overview of the export needs for the nighttime scenario

5. Summer 2015 Review

5.1. Belgium successfully managed the adequacy challenge end September

The ENTSO-E Summer Outlook 2015 predicted an increased adequacy risk under severe conditions for Belgium towards the end of the investigated period in September. In hindsight, these conditions materialised at the end of September and the middle of October.

During that period, several generation units were having a planned outage in combination with some planned infrastructure work on the Belgian High-Voltage grid to prepare the Belgian system for the upcoming winter. This led to very high international flows through the Belgian system that only remained barely controllable. International re-dispatch was needed on several days to relieve the transmission grid close to real-time in order to maintain system security.

For some days, a combination of very low wind and solar infeed in Belgium and the rest of Central-West Europe, with the aforementioned generation and transmission outages, has led to very high spot prices on the day-ahead market up to values about ten times as high as what could be considered normal prices. These prices correctly represented the tenseness of the generation adequacy in Belgium for those days, but finally Belgium managed to import sufficient energy from neighbouring countries to avoid any acute adequacy issues.

With the return in operation of major generation units and the return to a fully available transmission grid at the end of October, the situation has normalised before the start of winter, adequacy-wise as well as concerning system security.

5.2. Poland hit by summer 2015 heat wave

The severe conditions in August 2015 took place in Poland. A long heatwave caused a gradual increase of non-usable capacity. A rapid growth of outages on the evening of 9 August and the morning of 10 August caused that it was not possible to cover the forecasted load with generation capacities available within Poland and available imports (full import on HVDC link from Sweden as the outcome of the normal market process) with a sufficient level of reserves. Therefore the Polish TSO (PSE), according to Polish legislation, implemented load reduction in the peak hours of 10 August for industrial consumers. The situation continued until 12 August. During these days there was no possibility to offer any import capacity to the market on synchronous profile (with DE+CZ+SK) because of a congested DE-PL border caused by high unscheduled flows through Poland (as the result of market transactions concluded outside Poland) from the west to the south. Thus, simultaneously to load reductions a massive multilateral redispatch (up to 4 GW) with source in Austria, Slovenia, Switzerland and even in west of Germany and sink in east of Germany was activated by PSE these days to keep the DE-PL border in N-1 secure state. Only a limited amount of supportive power from Czech and Slovak TSOs was possible on short notice in hours when there was enough room for it on the DE-PL border. The well-known issue of the congested DE/PL border because of unscheduled flows was valid for most days of the reported summer period. From June to September the amount of energy required to limit these flows was 7 times higher compared to the same period in 2014 and 78 times higher when compared to the summer of 2013. Also the level of used re-dispatching power increased significantly, on 15 September it was the highest ever and amounted to 6237 MW. It is worth noting that even with such an unprecedented level of power, it was not enough to limit unscheduled flows to a safe level and that day, for more than 4 hours, the N-1 criterion on the PL-DE border was not fulfilled as there were no other operational measures to keep the system safe (more information can be found in Appendix 2).

5.3. Other general comments on summer 2015 climate and system adequacy conditions in Europe

Most countries reported a very dry and warm summer season compared to previous years, while Denmark and Great Britain experienced a cooler, windier and wetter summer. A small number of countries reported high precipitation and flooding. Most of the countries had no balancing problems or unexpected difficulties during the summer of 2015. Because of unexpected grid and load-flow situations, internal re-dispatch had to be applied in order to maintain the security of the supply in some countries.

The high temperatures during the summer led to an increase in electricity demand and a higher maximum peak than expected in several countries. Problems with the cooling water supply of power plants occurred, e.g., in Germany, but not in a critical dimension. Because of the gas shortage that occurred at the west branch of the gas supply system, two units (about 800MW capacity) were unavailable in Greece for four days. More electricity was produced from wind, e.g. in Denmark and Estonia, whereas in Spain and Portugal wind production was lower than average. In France there was a gap in demand up to 3800 MW because of a sudden cooling of -15°C compared to the previous day.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

6. Gas disruption risk analysis

6.1. Improvements thanks to a new trilateral agreement

In the previous Winter Outlook 2014-15, a gas disruption sensitivity analysis was performed to respond to the risks that could occur because of the Ukraine/Russia crisis.

For the coming winter an important agreement was signed between Russia, Ukraine and the EU so that the gas supply for the coming winter 2015/16 could be considered secured:

On 25 September 2015, after several rounds of trilateral and bilateral negotiations over the previous months, the EU-Ukraine-Russia talks agreed on the terms of a binding protocol to secure gas supplies for the coming winter.[8] However, in particular as the geopolitical situation remain sensitive, a simplified gas disruption analysis was performed for the upcoming winter, using ENTSOG results as inputs.

6.2. Methodology: a close cooperation with ENTSOG

In its recently published 'Winter Supply Outlook 2015/16 & Winter Review 2014/15' ENTSOG performed a gas disruption sensitivity analysis for following extreme high-demand situations:

- 2-week Cold Spell occurring during the second part of February with a simultaneous interruption of transit through Ukraine;

- 1-day Design Case (peak demand) occurring on the 31 January with a simultaneous interruption of transit through Ukraine.

ENTSOG used a European network modelling approach of gas supply, demand and infrastructures. Under high-demand situations and disruptions, the modelling is done on the basis of optimal crisis management, so that each country tries to minimise the impact on itself before exporting gas to other countries. Whilst avoiding a demand curtailment in each country, the given level of interconnection capacity is used as far as possible to minimise the relative impact on all other countries.

8 http://europa.eu/rapid/press-release_STATEMENT-15-5724_en.htm

ENTSO-E performed a qualitative sensitivity analysis based on the ENTSOG gas disruption risk analysis with the following inputs:

- list of countries where gas supply could be put at risk in the case of extreme conditions (high gas demand and transit disruptions of Ukraine);
- a range of probable percentages of gas disruption as a function of the country's gas demand.

For the countries at risk, these ENTSOG results were translated by ENTSO-E into the qualitative impact on the electric system, especially:

- the risk of reduction of gas-fired power units (e.g. CCGT, GT, CHP, etc), being aware that power generation represents only a limited part of the country's gas demand;
- the risk of an increase in electricity demand from households, industry and district heating as a consequence of the gas disruption. Typically each country follows a 'protected consumers' distribution procedure when spreading the gas disruption among the different sectors. The residential sector - as well as facilities like hospitals - is typically the most protected and the last to be affected by any gas disruption in each country. Gas power plants can also be protected consumers, depending on the national situations and regulations.

The aforementioned impacts of gas on electricity were based on TSO qualitative estimation per country.

6.3. Results: potential gas supply risk focused on South East Europe

Regarding the gas storage inventory on the 1 October 2015, the ENTSOG Winter Supply Outlook states a slightly lower EU-28 gas storage inventory level compared to the 5-year high of 1 October, 2014.

Concerning gas peak demand, recent improvements will improve the security of supply in Luxembourg and Denmark:

- Commissioning of the second stage of the Ellund project (DE-DK) in January 2016;
- Reduced demand expectations in Luxembourg.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

The ENTSOG analysis of gas transit disruption through Ukraine gave the following results in a peak demand situation:

Country	Share of possible gas demand curtailment in peak conditions	
	***without* disruption through Ukraine**	***with* disruption through Ukraine**
Bulgaria	No curtailment risk identified	50 to 75%
Greece	No curtailment risk identified	less than 25%
FYRO Macedonia	No curtailment risk identified	75 to 100%

The following countries, where disruption of gas transit through Ukraine could lead to gas demand curtailment, were analysed further by ENTSO-E:

- Bulgaria
- Greece
- FYRO Macedonia

6.4. Qualitative impact of gas curtailment on electricity supply

Assuming a 2-week cold spell with a simultaneous interruption of gas transit through Ukraine, an assessment of the impact on the adequacy of the electricity system was performed. The following inputs from respective ENTSOG and ENTSO-E Winter Outlook reports were available:

	Inputs from ENTSOG WOR15 report		Inputs from ENTSOE WOR15/16 report			
COUNTRY	2-week cold spell (GWh/day)	2-week cold spell average power (GW)	Electricity Net Generating Capacity from Gas (GW)	Peak demand under severe conditions (GW)	Lowest remaining capacity under severe conditions (GW)	Lowest simultaneous import capacity at peak load (GW)
Bulgaria: 50% to 75% gas demand curtailment	145	6.04	0.83	6.9	+2.09	1.12 (reduced to 0.62 GW without GR+MK imports)
Greece: less than 25% gas demand curtailment	156	6.5	4.95	9.2	+ 0.35	1.82 (reduced at 0.92 GW without BG+MK imports)
Macedonia: 75% to 100% gas demand curtailment	14	0.58	0.23	1.34	-0.40	1.1 (reduced at 0.6 GW without GR+BG imports)

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

The following country statements are based on ENTSO-E TSO contributions:

Bulgaria

In case of a total interruption of supply to gas-fired CHPPs, with the use of substitute fuel the effect of decreasing the total electricity power output for Bulgaria is estimated at 83MWe.

Besides, considering the important remaining capacity of electricity under severe conditions (above 2 GW) and the further simultaneous import capacity, no risk of adequacy was identified in Bulgaria in case of a 2-week cold spell with a simultaneous interruption of gas transit through Ukraine.

However, industrial gas consumers might have to reduce their consumption in this specific situation.

Greece

The gas supply of the Greek gas system comprises north pipes and an LNG terminal, including tank storage. The ability of this infrastructure to mitigate gas curtailment is already considered as part of ENTSOG simulation. Furthermore, other fuel (like diesel) can be used as backup to cover 25% to 30% of the electricity net generating capacity from gas.

Gas heating in the Greek household sector is moderate, and a possible partial shift to electricity for heating would slightly increase the Greek demand.

With a moderate gas curtailment risk (<25%), considering the above-mentioned mitigation measures as well as further available import capacity, no critical adequacy issue is expected in Greece even in the case of a 2-week cold spell with a simultaneous interruption of gas transit through Ukraine.

FYRO Macedonia

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Gas house heating is limited (about 60 MW[9]) and concentrated in the capital. The 230 MW electricity generation by gas is in one unit which has been out of operation for the last three years because of high market gas prices. Other gas demand (less than 300 MW) concerns the industry sector, and part of this demand can be substituted by heavy oil and a smaller part by electrical energy.

Regarding electricity demand under severe conditions, FYRO Macedonia is already depending on import to satisfy its system adequacy. Even if a total gas disruption would stress the electrical situation a bit more, it would not put the system at risk. However, industrial gas consumers might have to reduce their consumption in the case of a 2-week cold spell with a simultaneous interruption of gas transit through Ukraine.

6.5. European electricity system robust in case of gas disruption

In conclusion, the **sensitivity analysis showed a robustness of the European Electricity System in the case of a 2-week cold spell with a simultaneous interruption of gas transit through Ukraine.**

Three Southeast European countries were identified as possibly affected by partial gas curtailment in such a situation. However, these countries can rely on other fuels for electricity generation and only a limited number of households use gas for heating, so the electrical system adequacy and security can be maintained.

For the preparation of future Winter Outlook reports, ENTSO-E and ENTSOG strive to keep and increase their cooperation.

[9] ENTSO-E TSO source

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Appendix 1: Individual country comments on the Winter Outlook

Albania

For the coming winter the balance between generation and load will be managed both using our hydro power plants and importing. Considering the firm import contracts, the adequacy and security of the Albanian power system will not be threatened. In Albania there are not yet installed wind generators, and it is not expected to face inflexible generation at times of minimum demand. The maintenance of generation units and transmission systems will be avoided at that time. The cross-border capacities will be sufficient to make planned import and transit possible. The maintenance schedule of the generator units is set to minimum because most maintenance work has been accomplished during the summer period of the year, the only exception being the rehabilitation works in progress in Unit2 Komani HPP.

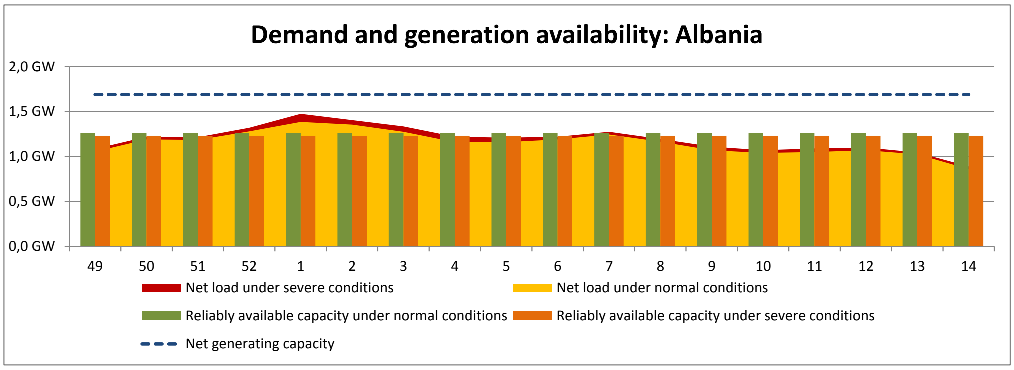
The most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

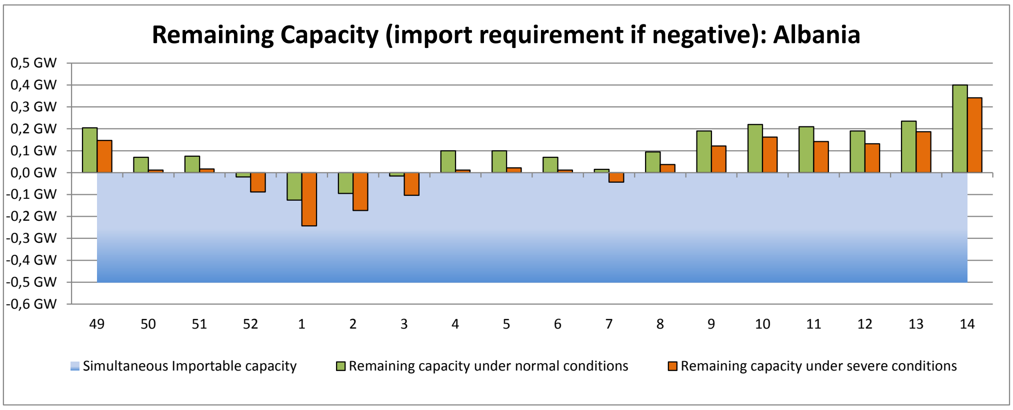
The most difficult foreseen period is the second part of December and the month of January 2016. During this period the lowest yearly temperatures are expected in Albania. In case of a deficiency of generation (low hydrology, loss of major units), there are no expected constraints related to shortages of transmission capacity or low generation availability, as all maintenance work was already performed during the summer and fall of the year.

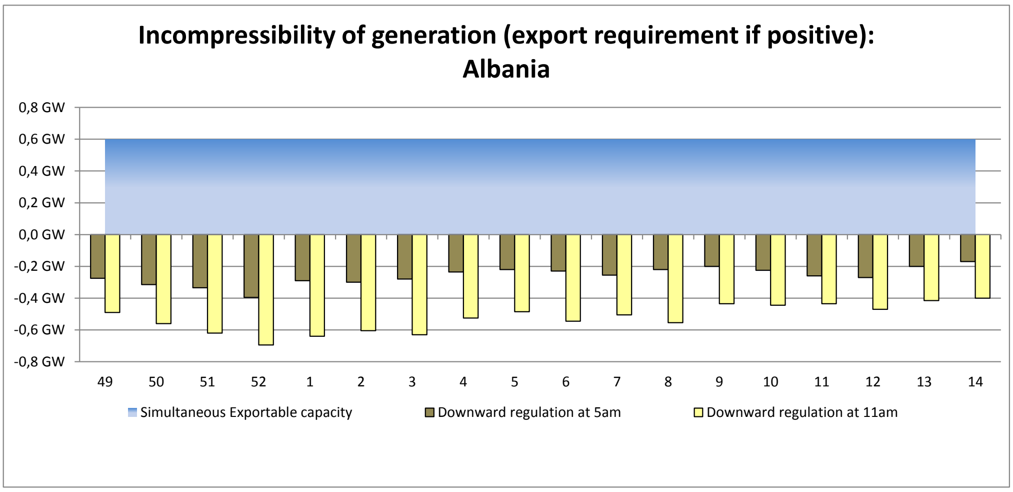
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

Inflexible generation at minimum demand periods is not expected. Indeed, generation depends on Hydro Power Plant, which is flexible regarding downward regulation. Furthermore, in export direction there is always enough available transfer capacity.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Albania
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Albania
0,5 GW
0,4 GW
0,3 GW
0,2 GW
0,1 GW
0,0 GW
-0,1 GW
-0,2 GW
-0,3 GW
-0,4 GW
-0,5 GW
-0,6 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Albania
0,8 GW
0,6 GW
0,4 GW
0,2 GW
0,0 GW
-0,2 GW
-0,4 GW
-0,6 GW
-0,8 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

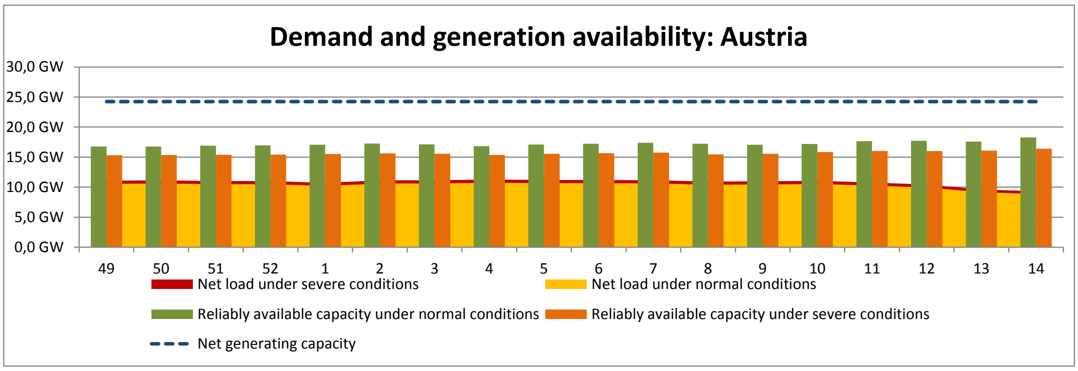
Austria

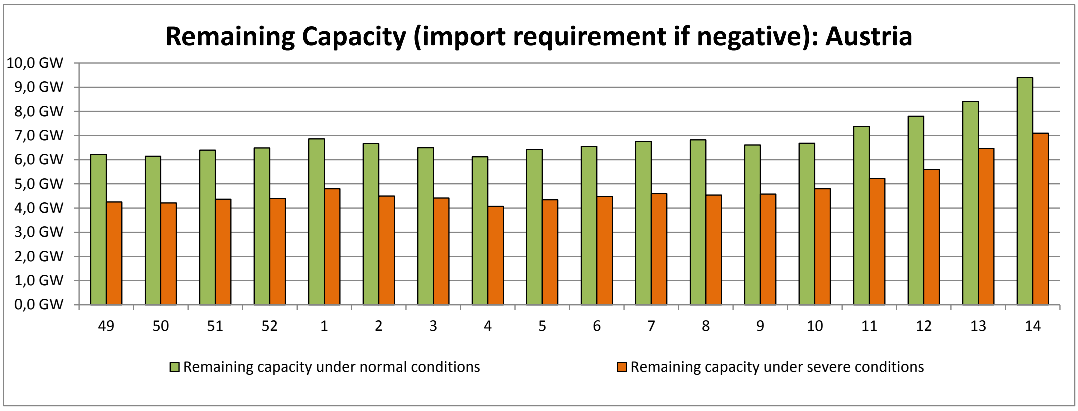
Under normal conditions the generation capacities are expected to be sufficient to meet the demand in Austria for winter 2015-2016. There is only a very small risk in case of a very high load (due to a long-lasting period of extreme low temperatures) in combination with reduced generation (due to dryness and lack of primary energy sources like natural gas). In general, APG observes a tendency for thermal power plants to be temporarily mothballed during winter times.

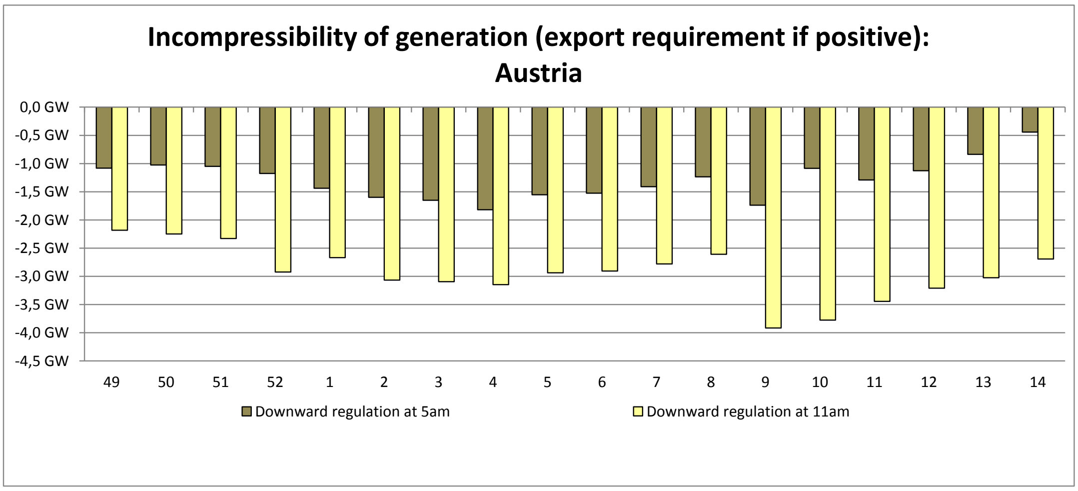
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

No major specifics are foreseen during winter 2015-2016.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

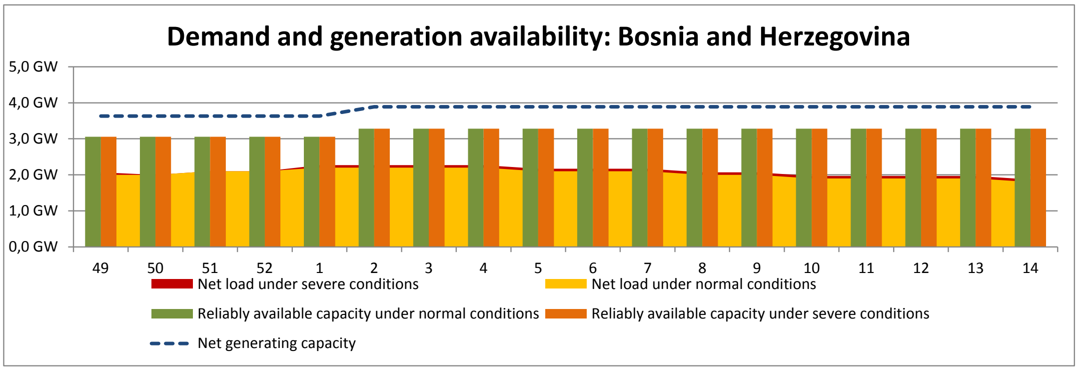

Demand and generation availability: Austria
30,0 GW
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity

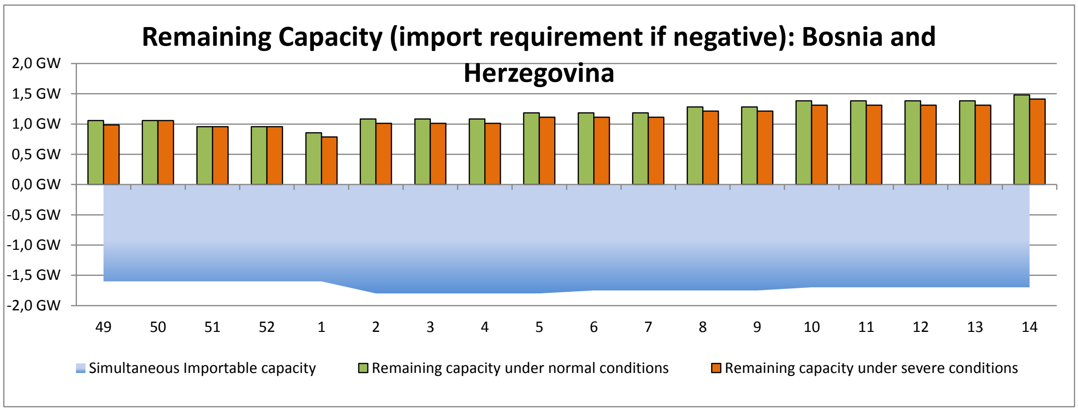

Remaining Capacity (import requirement if negative): Austria
10,0 GW
9,0 GW
8,0 GW
7,0 GW
6,0 GW
5,0 GW
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Remaining capacity under normal conditions
Remaining capacity under severe conditions

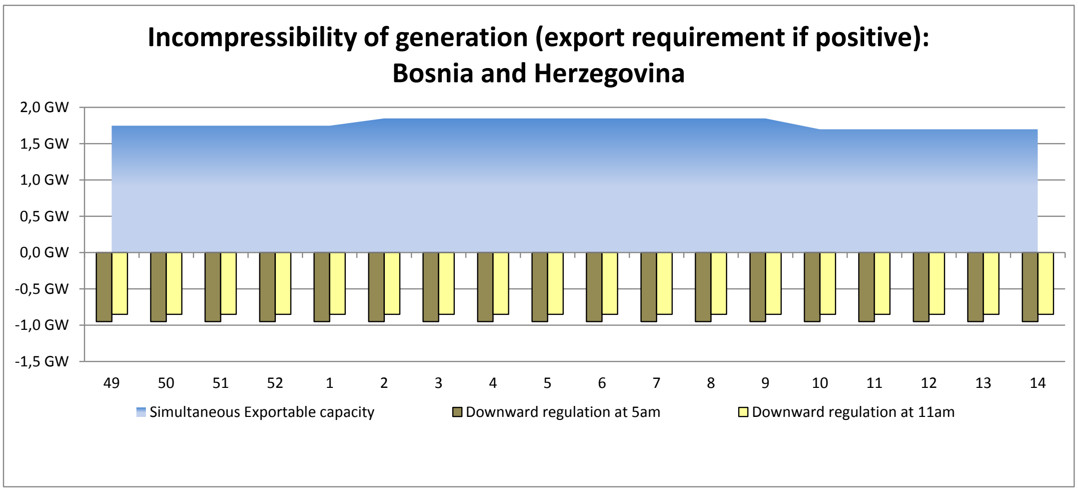

Incompressibility of generation (export requirement if positive): Austria
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
-2,5 GW
-3,0 GW
-3,5 GW
-4,0 GW
-4,5 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Downward regulation at 5am
Downward regulation at 11am

Bosnia and Herzegovina

Regarding power system adequacy in Bosnia and Herzegovina for the Winter 2015-2016, we do not expect any problem. At the beginning of 2016, a new TPP Stanari with a net generation capacity of 262 MW will be put into operation. We predict that our consumption will stay at approximately the same level as the previous year, and expect a positive power balance for the next winter period.







Belgium

In situations where severe conditions materialise, margins in Belgium for winter 2015-16 will potentially be tight.[10]

First, resulting from measurements done in June and July 2012, potential problems were detected with the reactor vessel of one of the nuclear power plants on the Doel site. Similar problems were also detected during the revision of a similar nuclear power plant at the Tihange site. As was already the case for winters 2012-2013 and 2014-2015, both units (adding up to more than 2000 MW) are still shut down. The Belgian instance that watches over nuclear safety is currently examining expert analyses, and a decision about re-starting the units awaits their approval. The situation for the coming winter is therefore still unclear; for the winter outlook these two units are assumed to remain out of service to reflect a worst-case scenario.

Secondly, compared to last winter about 280 MW of conventional generation units have been decommissioned. Also, according to the nuclear phase-out, two more nuclear power plants on the Doel site were out of service at the time the data for this report was collected. Currently, the Belgian government is completing the legal framework to recover these units for next winter. Notwithstanding the fact that the legal and regulatory process to reintroduce both units in the market is well underway, as it is not entirely certain yet that the units will be fully availably on the cold winter peaks, one of them was assumed—as a precaution—out of service for this ENTSO-E Winter Outlook Report to reflect a worst-case scenario. The second unit is assumed to return from maintenance in the middle of December. On the other hand, no new thermal units are planned to be commissioned.

For the adequacy analysis, the most recently available official information is used. As stated before, there are still some uncertainties around the availability of the nuclear units that are currently out of service.

[10] "On November 17, the Belgian nuclear safety authority announced that the two nuclear units (2000MW) are safe for re-opening. They will probably go into operation on December, 15. It has not been possible to rework the Winter Outlook based on this new information. More-over it is not clear at this moment which impact this will have on the lifetime extension of 2 older nuclear units (2*433MW). The global adequacy situation of Belgium for the coming winter will however improve drastically due to this event".

In March 2014, the Belgian parliament enacted a law introducing the concept of strategic reserves for the Belgian system. These additional reserves are comprised of generation units and demand response contracts amounting to 1535.5 MW in total for the coming winter. This volume increased with about 700 MW compared to last winter. The strategic reserves are taken out of the market, and can only be used when Belgium experiences risks of shortage to cover the Belgian load.

This capacity is included in the Elia contribution to the ENTSO-E Winter Outlook under the 'Load Reduction' category for both normal and severe conditions.

Since the commissioning of the CWE Flow-Based Market Coupling and major grid investments (the installation of a second Phase Shifting Transformer in Zandvliet & the new substation VanEyck), the best estimate of minimum import hypotheses are adapted. Under normal conditions, the maximal total import capacity for Belgium is set at 4.5 GW. This value can, however, only be reached if all circumstances are favourable. Therefore, for this Winter Outlook, a best estimate importing capacity value of 4 GW was generally assumed. It must, however, be noted that in the case of specific market conditions, it is expected that the total importable capacity for Belgium will be reduced due to north-to-south oriented market flows in CWE, resulting in considerable market-based transit flows through the Belgian system.

Under normal circumstances (average temperatures, average load, average forced outages and average renewables infeed), Belgium probably will already be structurally dependent on imports to cover the evening peak on weekdays when not using its strategic reserves. The expected import needs are estimated at about 1500 MW, which under those conditions should be perfectly feasible regarding cross-border capacities and regarding available energy in neighbouring countries. Under severe conditions, however (cold temperatures, low renewables infeed and high forced outages), and while fully using its above-mentioned strategic reserve capacity, Belgium will additionally depend on structural imports up to 2.9 GW at the Belgian peak load (2.35 GW at the Winter Outlook synchronous time point). These amounts of imports could be challenging considering the estimated cross-border flows of CWE and surrounding countries. Moreover, the corresponding energy should be available for purchase in the market.

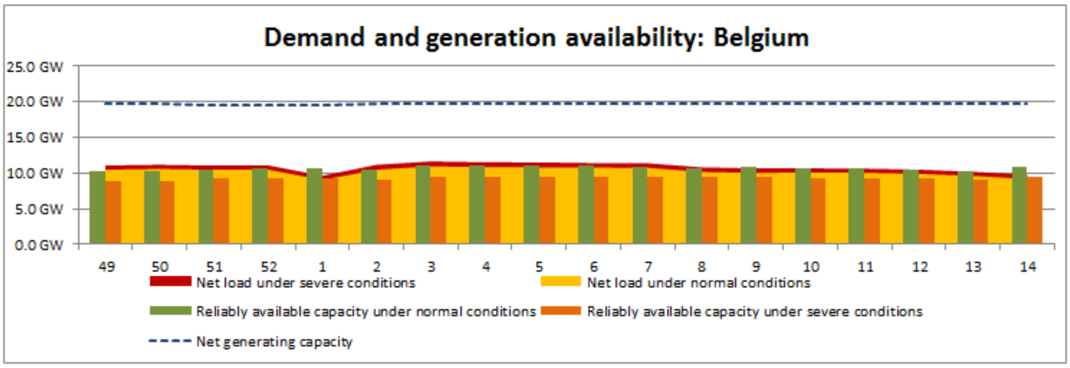
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors.

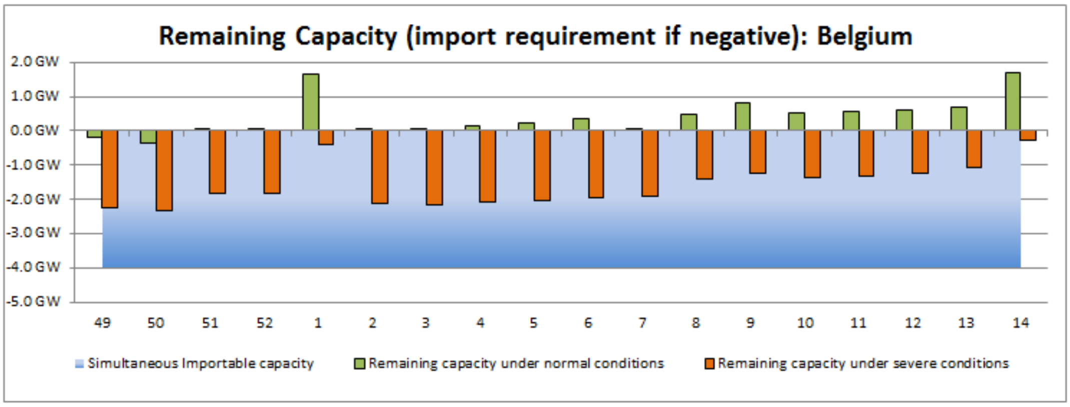
Apart from the holiday period, all weeks can potentially be stressed depending mainly on the meteorological conditions in Belgium and neighbouring countries.

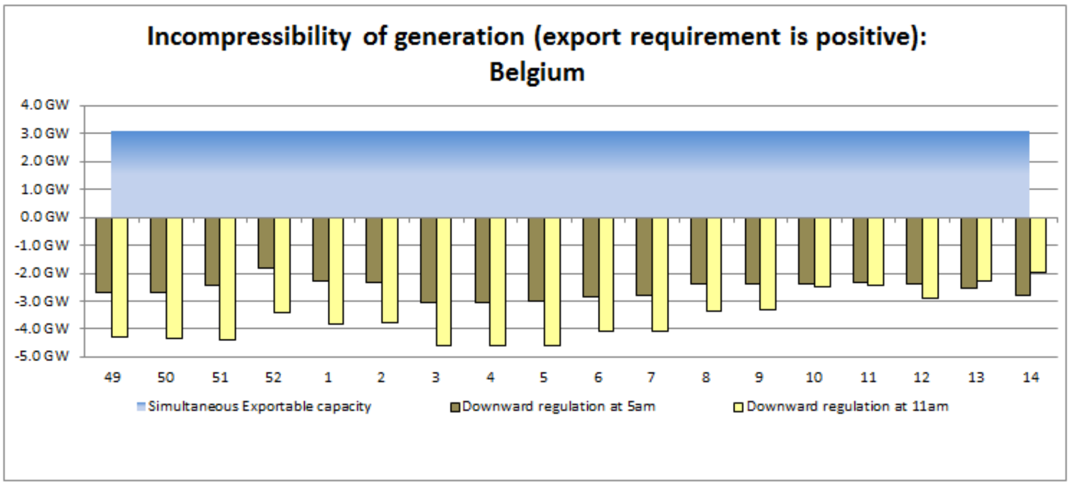
Belgium structurally relies on imports from other countries to cover its peak load. This tendency was already apparent in the past years, but it is currently higher because of large nuclear unavailability. The real-time exchanged energy is of course dependent on the market situation, and could therefore be completely different from the strictly theoretical necessity of importing energy to maintain generation adequacy.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

Regarding downward adequacy, the holiday periods are potentially the most prone to an excess of inflexible generation, but here too the probability of issues is heavily dependent on the return of the nuclear units to the market.







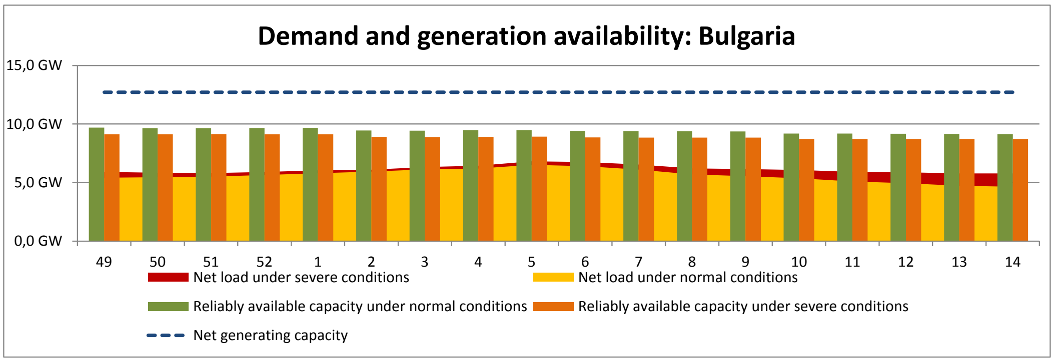
ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

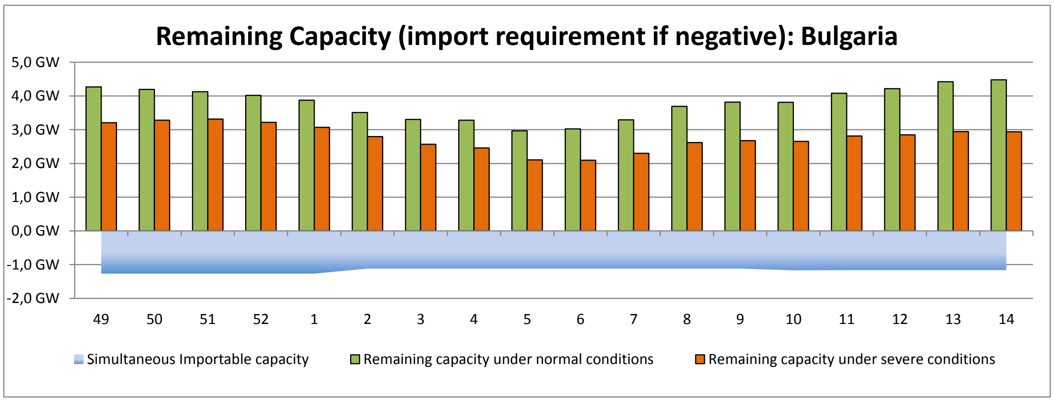
Bulgaria

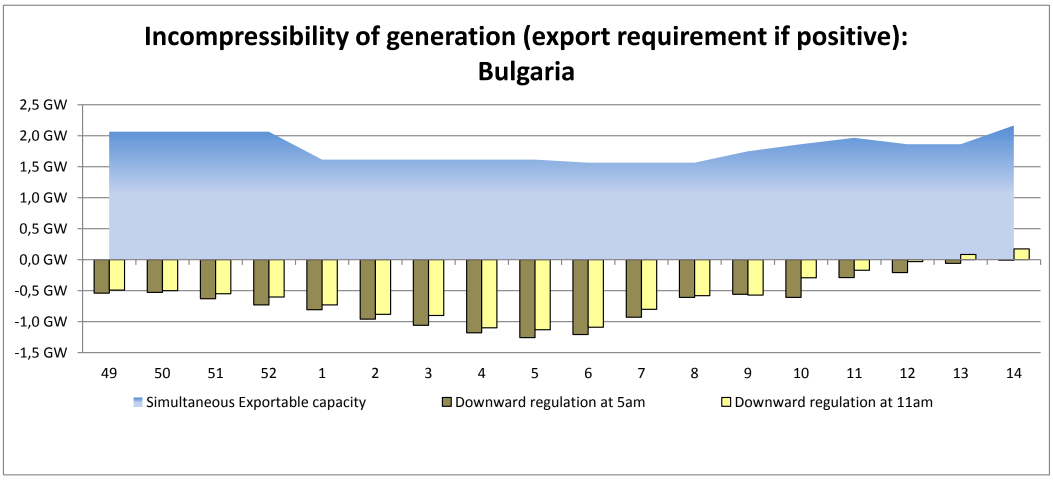
We do not expect adequacy problems for the forthcoming winter season in either normal or severe conditions. The maintenance schedule of all major generating units is well optimised and suggests sufficient resources to maintain the supply-demand balance adequately. A slight concern might be that a few of the large water reservoirs are below their target level for the season, but measures are being taken to correct this situation.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

We might experience situations of excessive generation capacity during midday and afternoon hours at the end of the examined period (weeks 13 & 14) due to high penetration of renewable energy sources (wind + solar = 1740 MW) if low levels of export energy are registered. This may lead to generation restrictions and curtailment imposed on all producers.


Demand and generation availability: Bulgaria
15,0 GW
10,0 GW
5,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Bulgaria
5,0 GW
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Bulgaria
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Croatia

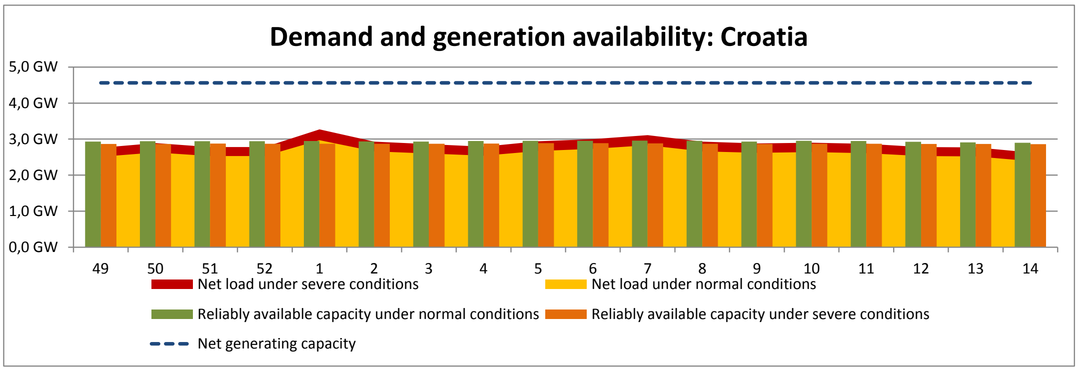
The Croatian transmission system operator expects that the system will stay stable during the next winter. At this moment (middle of September 2015), approximately one third of the capacity of hydro storages is filled. It is expected that during the autumn, the rainfalls will raise the water level in storages. Although there is in the system mainly enough installed capacity, some units will be not engaged and the energy from imports will cover the needs of consumers.

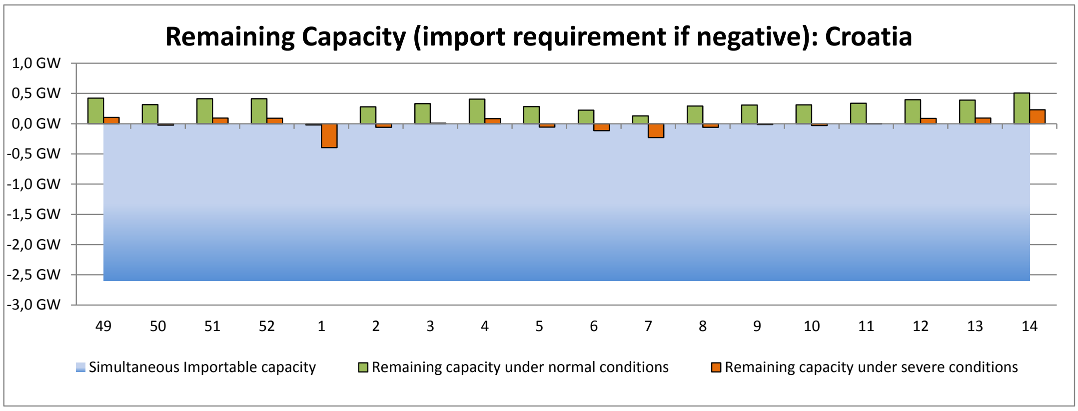
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

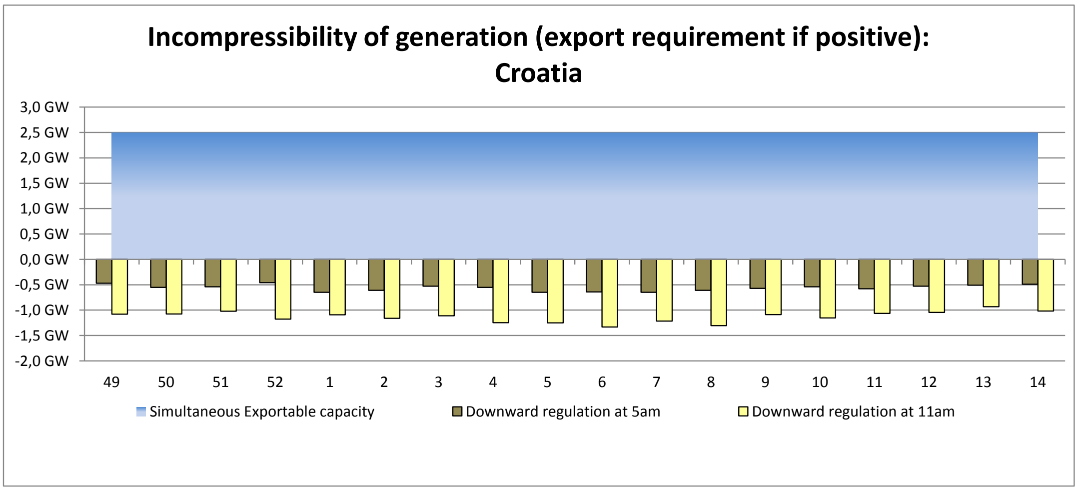
Periods with extremely low temperatures are recognised as the most critical. Since the engagement of some Croatian thermal power plants is not economical, the energy shortage will be compensated by imports. The transmission capacity of tie-lines is satisfying.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

The Croatian transmission system operator does not expect any problem with downward regulating capacity.



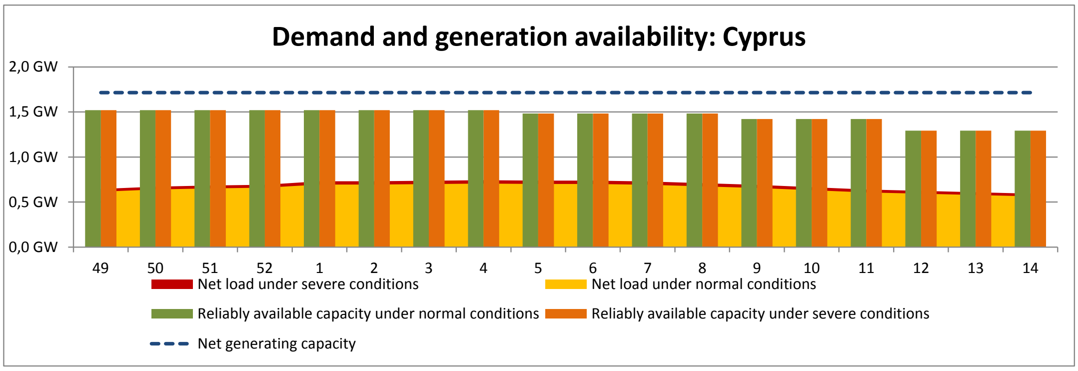


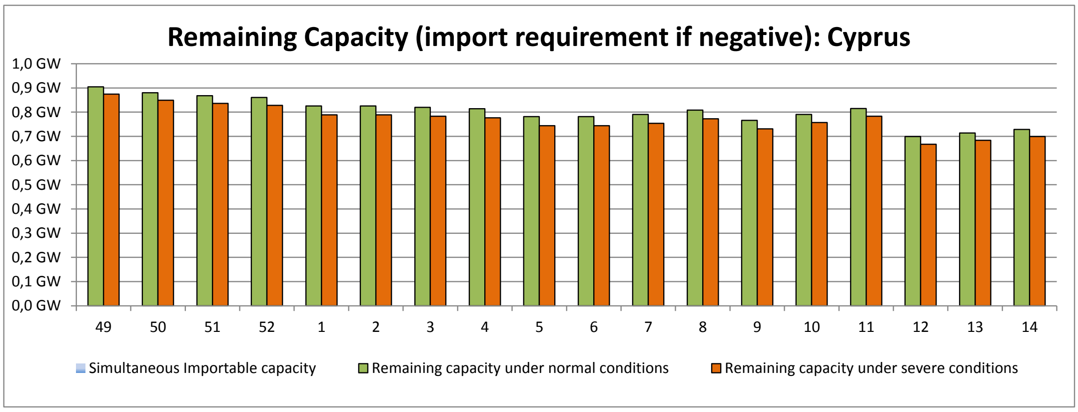


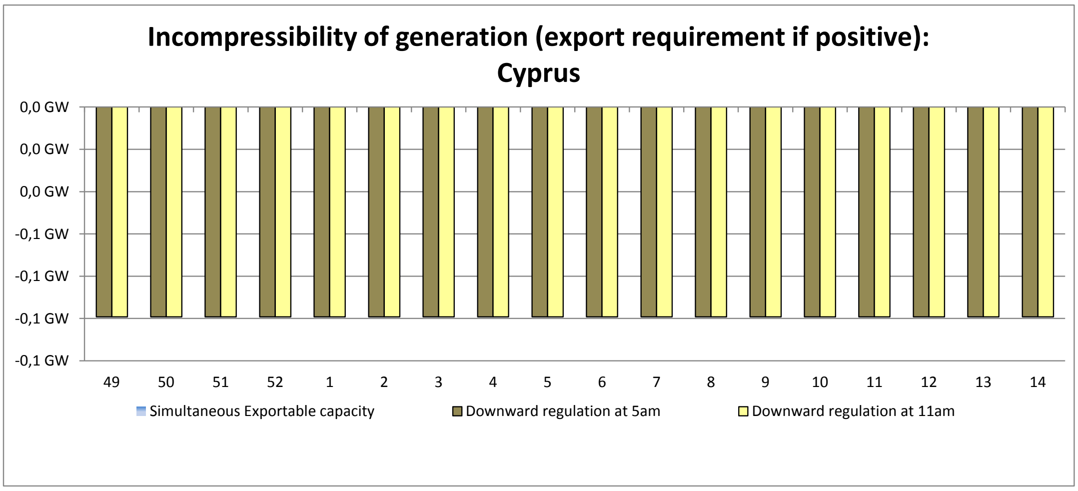
ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Cyprus

No critical adequacy issue for the forthcoming winter season is expected.







Czech Republic

The level of maintenance corresponds to the regular winter maintenance level. The highest level of maintenance is expected during weeks 49, 51 and 52. Hydro inflows are estimated at 50% probability, and we don't expect any issues with low hydro levels. Gas power plants in the Czech Republic are mainly used for peaking.

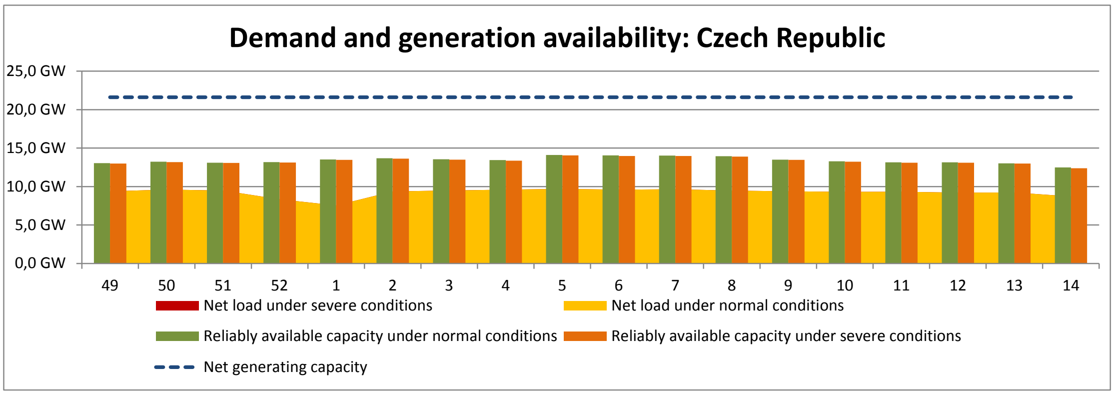
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

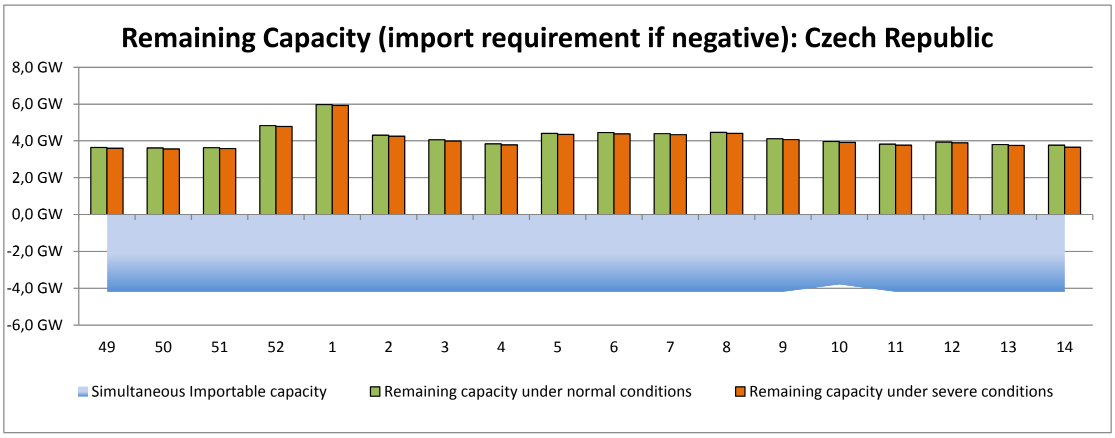
Adequacy is ensured for the entire period. The most stressed period could be during lowest and highest demand situations. ČEPS ensured a sufficient level of ancillary services to handle both critical situations.

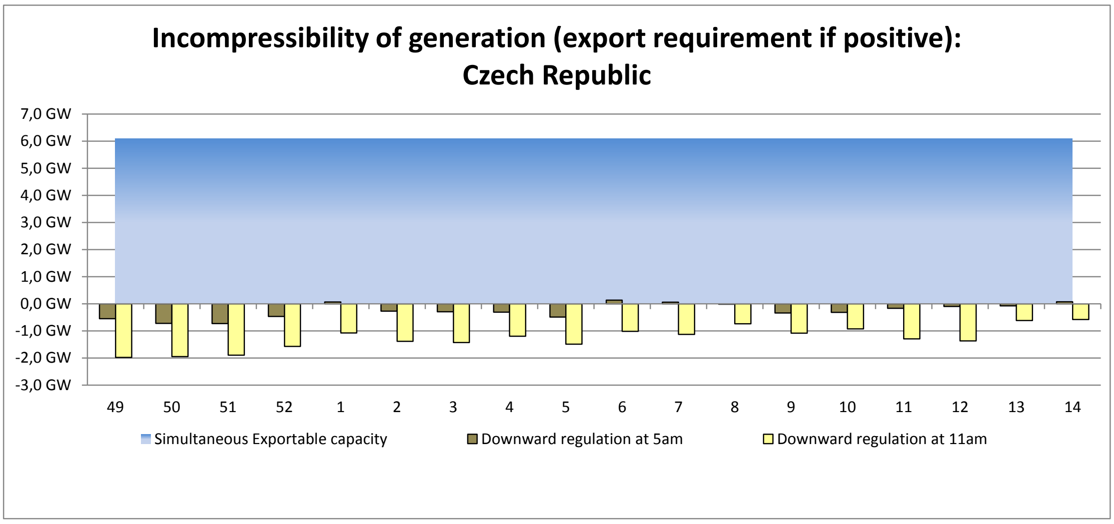
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

A sufficient amount of ancillary services for downward regulation is reserved for the winter period. Export is necessary to secure enough downward regulation.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Czech Republic
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Czech Republic
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Czech Republic
7,0 GW
6,0 GW
5,0 GW
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
-3,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Denmark

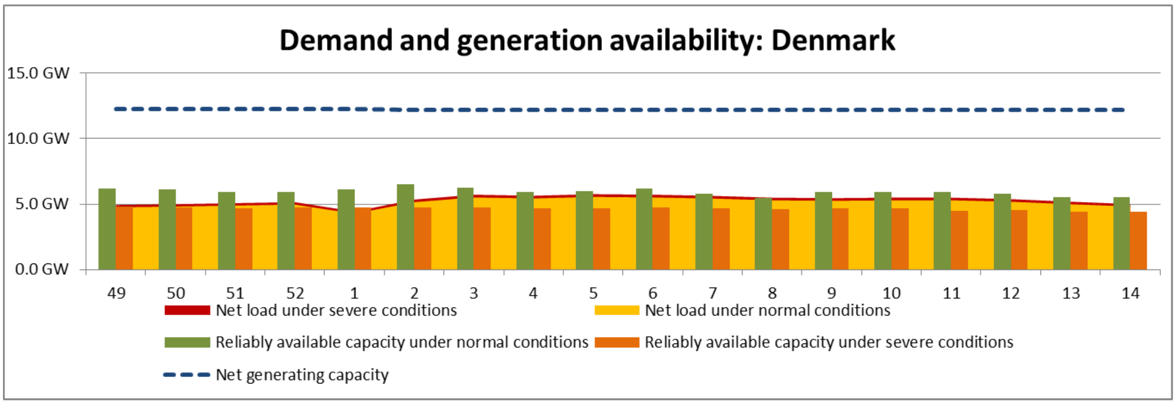
The Danish power balance is not expected to be challenged in the forthcoming winter. Most of the centralised power stations are available. Most of the interconnectors are expected to be available except the interconnectors to TenneT Germany (TTG), which is limited.

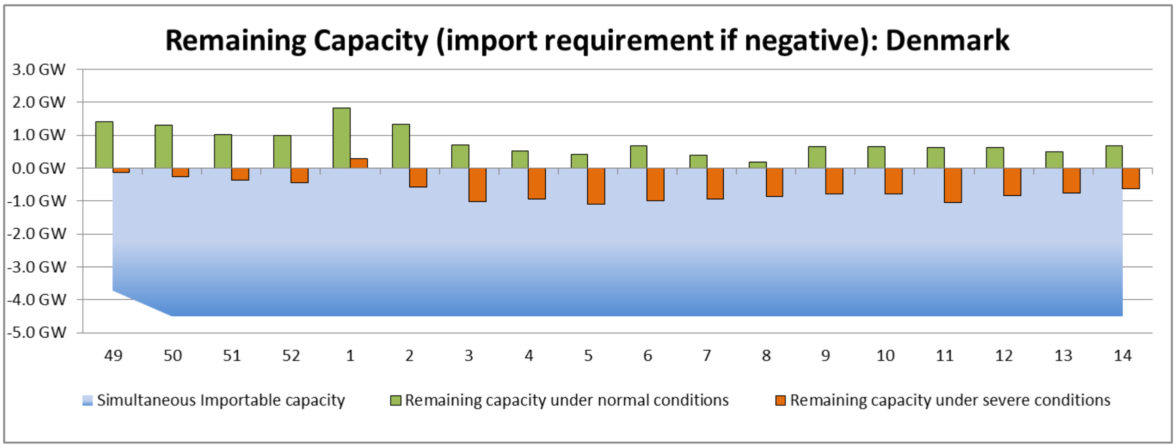
High wind production during Christmas and New Year can lead to overproduction but is not expected to cause significant problems.

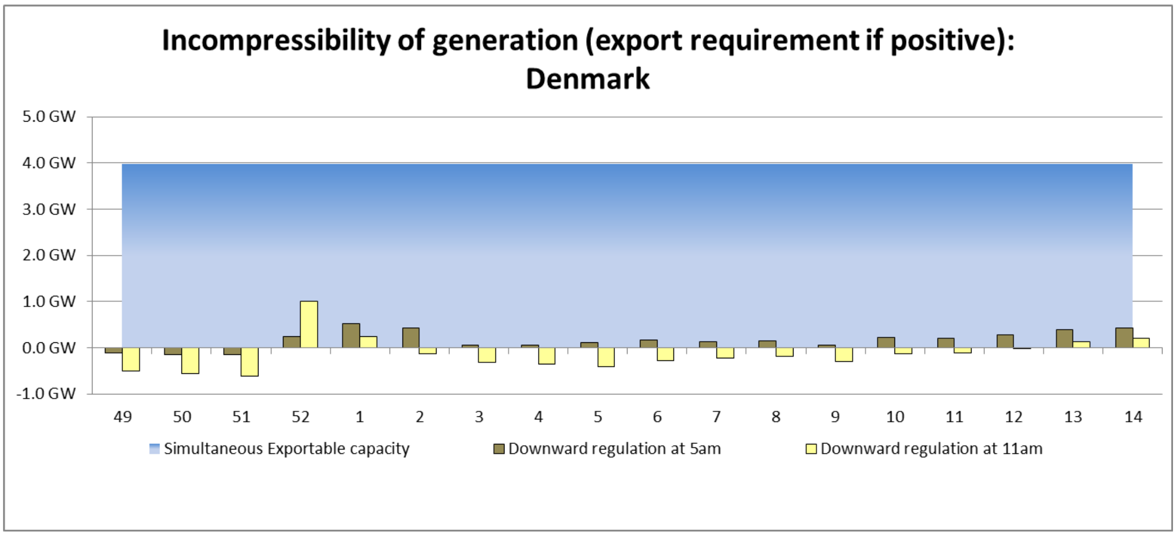
Until Christmas, some grid outages are expected but not at a higher level than normal.

A large amount of countertrade with TTG is expected over the winter. The reason for this is a combination of grid development and wind production in North Germany. The countertrade will mainly be directed from TTG to ENDK. TTG regularly limits the capacity on the border between DK West and Germany down to 0 MW, which is often not enough, hence, the need for countertrading.

The main challenge is implementing the new SCADA system. This will take significant preparation, and because of that there will be no commissioning of new infrastructure from 1 October to 1 December 2015. The SCADA system is expected to be implemented by the end of November 2015.


Demand and generation availability: Denmark
15.0 GW
10.0 GW
5.0 GW
0.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Denmark
3.0 GW
2.0 GW
1.0 GW
0.0 GW
-1.0 GW
-2.0 GW
-3.0 GW
-4.0 GW
-5.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Denmark
5.0 GW
4.0 GW
3.0 GW
2.0 GW
1.0 GW
0.0 GW
-1.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

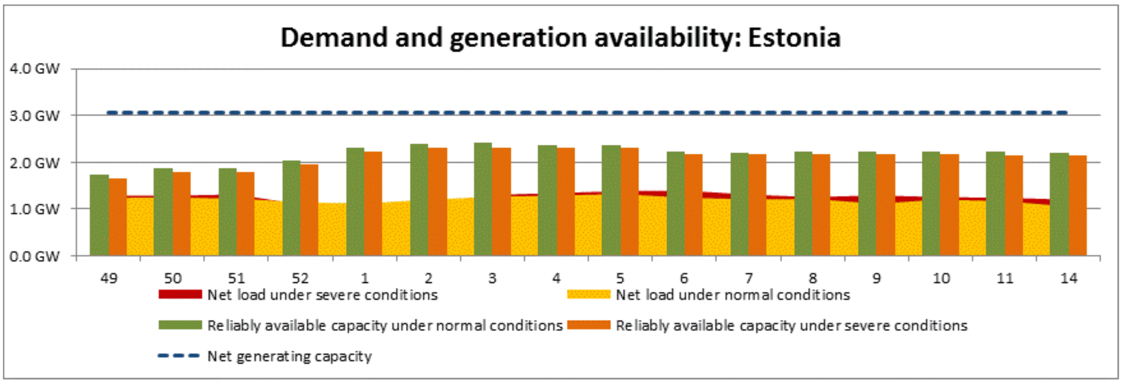
Estonia

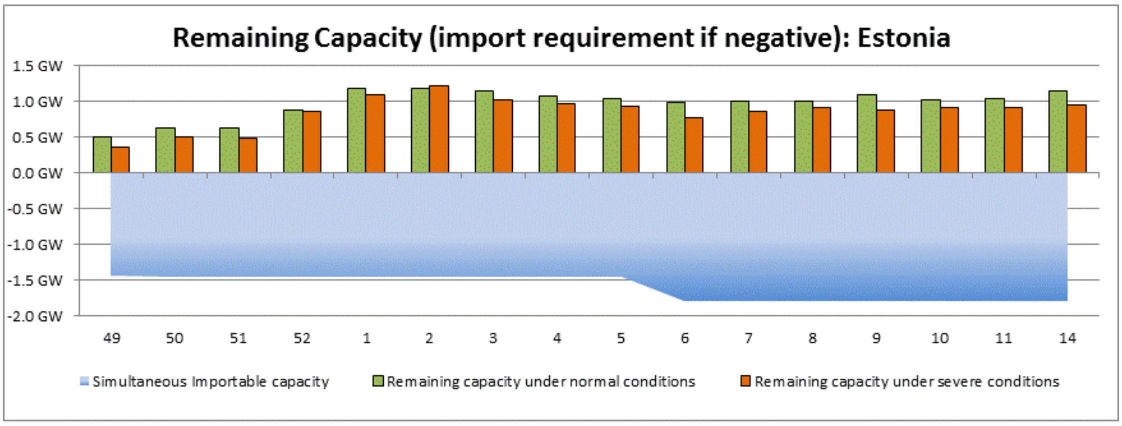
There is adequate capacity in Estonia over the winter period even with severe conditions. The highest level of maintenances remains in the beginning of December.

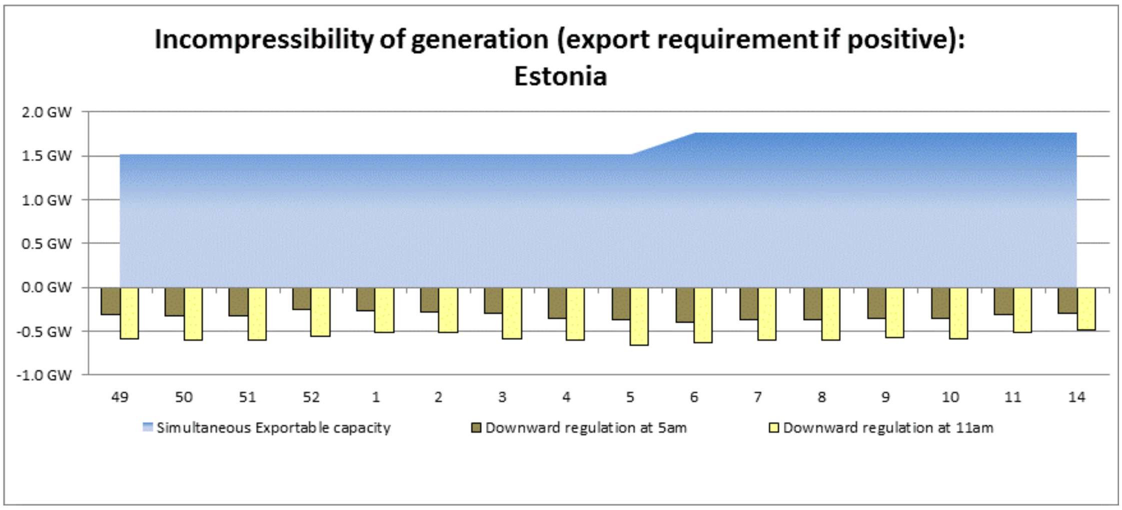
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

The most critical period is considered to be the end of January and the beginning of February, weeks 4-6, which is usually when the outdoor temperatures are lowest and the probability for peak load to appear is highest. Still, there is expected to be enough production capacity in the system, therefore no severely critical situation is foreseen for the upcoming winter.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Estonia
4.0 GW
3.0 GW
2.0 GW
1.0 GW
0.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Estonia
1.5 GW
1.0 GW
0.5 GW
0.0 GW
-0.5 GW
-1.0 GW
-1.5 GW
-2.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Estonia
2.0 GW
1.5 GW
1.0 GW
0.5 GW
0.0 GW
-0.5 GW
-1.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Finland

As in the previous winters, Finland is a deficit area in peak demand hours. Demand is highly dependent on outside temperatures and the most critical period is from week two to nine. The deficit is expected to be met with imports from neighbouring areas.

Compared to the previous winter, the deficit has increased as condensing power plants have been mothballed or shut down. In addition, the amount of strategic reserve (Finnish peak load reserve) has decreased.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

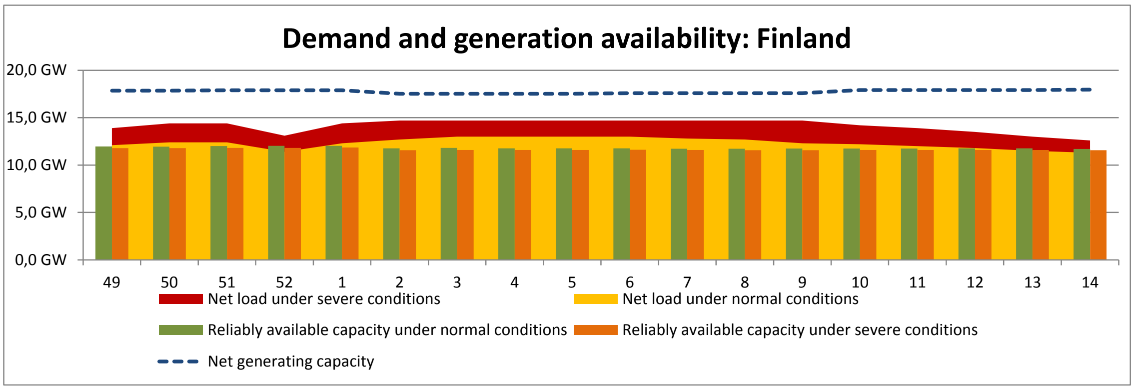
Import is needed to cover the demand in peak hours. The maximum deficit in severe conditions is 3.4 GW from week two to nine. The import capacity on interconnections, 5.1 GW, is sufficient to meet the deficit.

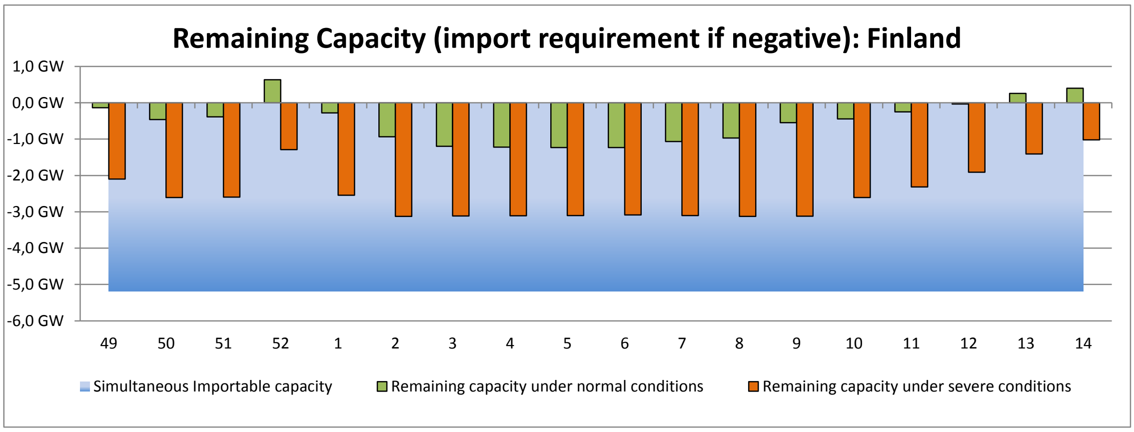
The required amount of imports is expected to be available from neighbouring areas also facing severe weather conditions. However, it should be noted that there are uncertainties with Russian imports due to capacity payments on the Russian electricity markets.

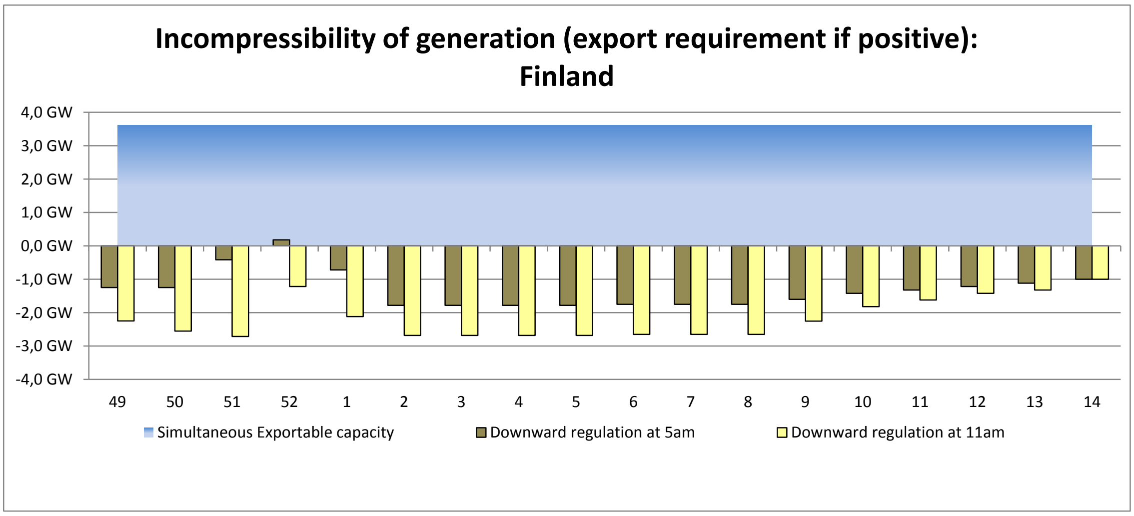
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

No specific problem should occur in the minimum demand hours. Installed wind and solar power capacity is still relatively low in Finland even though wind power capacity has increased remarkably.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Finland
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Finland
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
-3,0 GW
-4,0 GW
-5,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Finland
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
-3,0 GW
-4,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

France

The safety margins will be reduced in France compared to last winter. Fossil fuel capacity will be lower by around 1.3 GW because of the de-commissioning of hard coal power plants.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

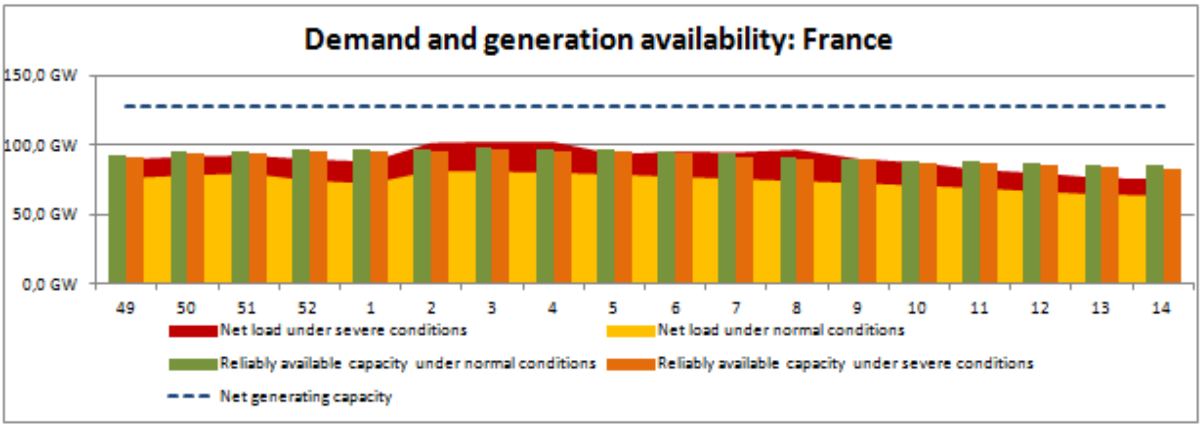
There is no critical situation identified for adequacy during winter under normal conditions.

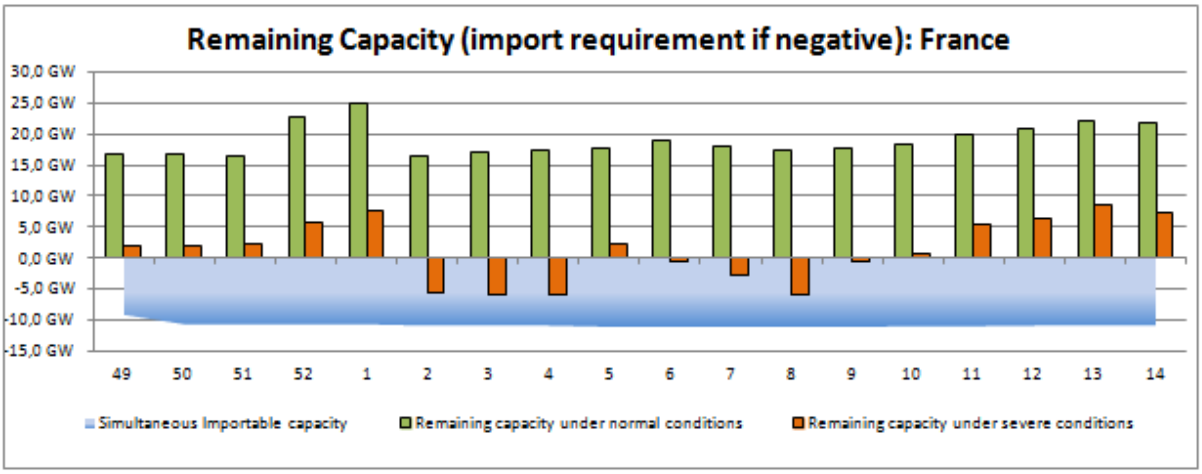
In severe conditions, the load is expected to highly increase due to France's important thermo-sensibility. Thus, in severe conditions for several weeks in January and at the end of February, the adequacy is dependent on imports by around 6 GW.

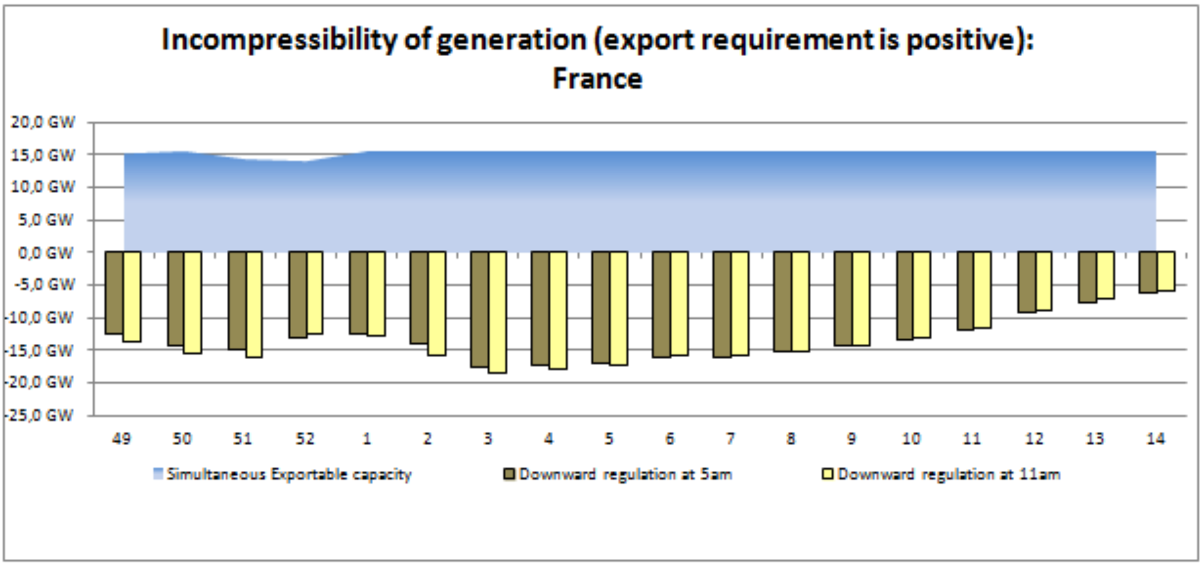
A load reduction tender call will be launched for 2016, and a low estimation of the result has been made. This result may offer more load reduction than estimated from 1 January 2016. Moreover, the progressive commissioning of the HVDC Spain-France interconnector starting in October 2015 will increase France NTC in 2016.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation.

No downward regulation issues are expected during the winter.


Demand and generation availability: France
150,0 GW
100,0 GW
50,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): France
30,0 GW
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
-15,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions

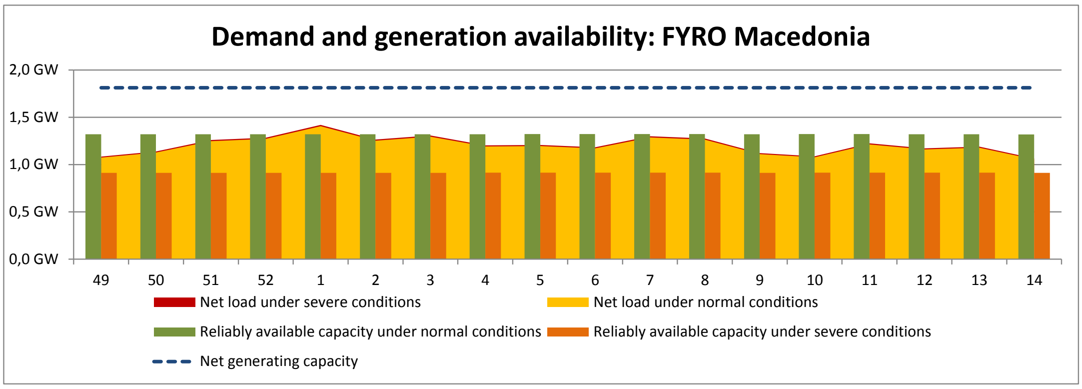

Incompressibility of generation (export requirement is positive): France
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
-15,0 GW
-20,0 GW
-25,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

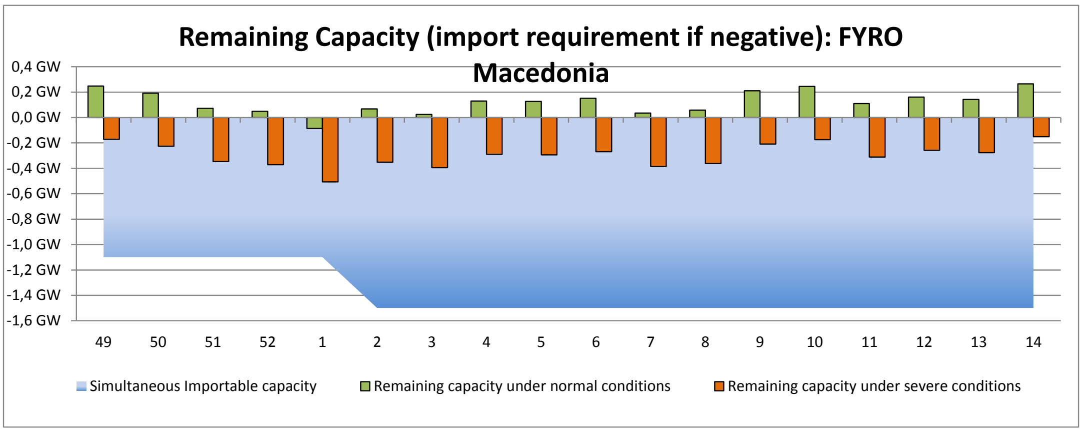
FYRO Macedonia

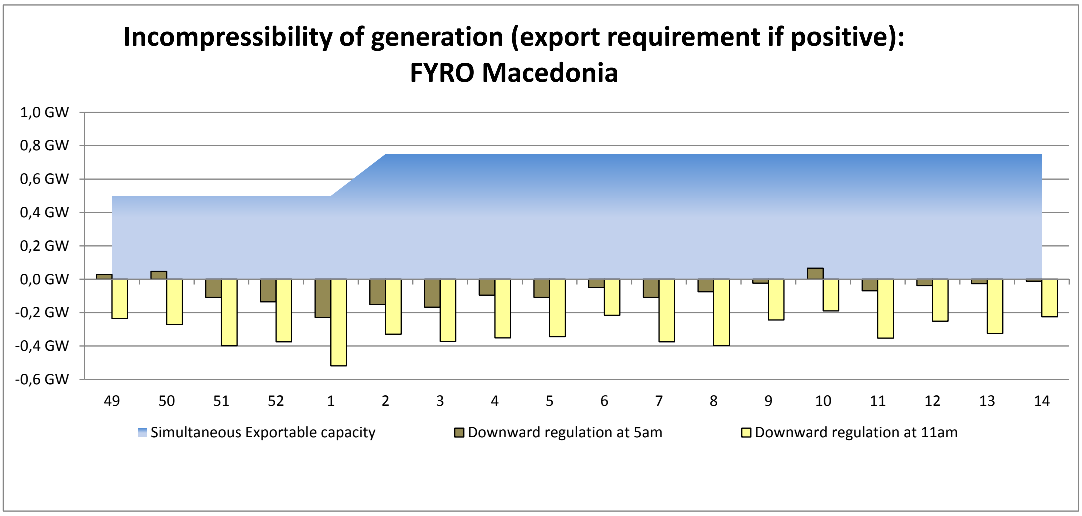
The maintenance schedule of the generation units is set to minimum. No problems in the transmission network are expected because all the maintenance work was finished during the summer period.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

The most critical period will be during the second half of December and first half of January. The current transmission capacity is sufficient to meet the needs for energy imports. Before the end of this year a new interconnection with Serbia should be operational. The existing interconnection with Serbia will become a connection between Macedonia-Kosovo, and the new interconnection will be between Macedonia-Serbia. In the operational plans the new interconnection is considered starting in January 2016.







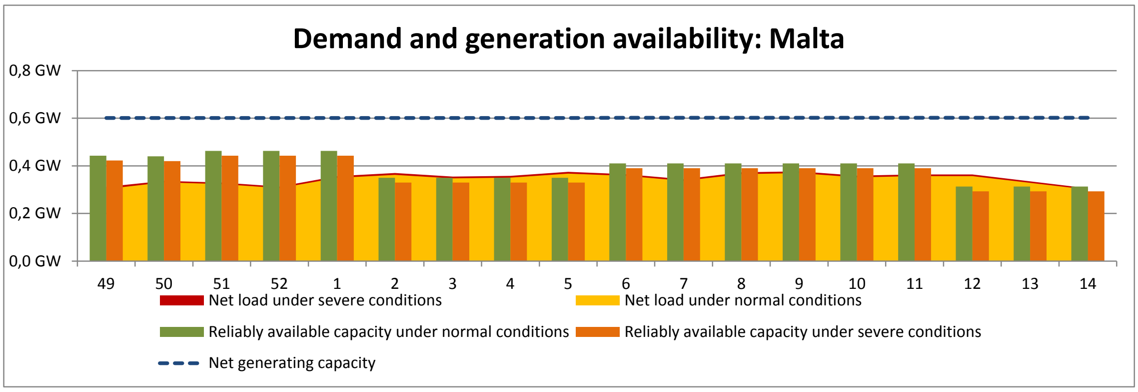
ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

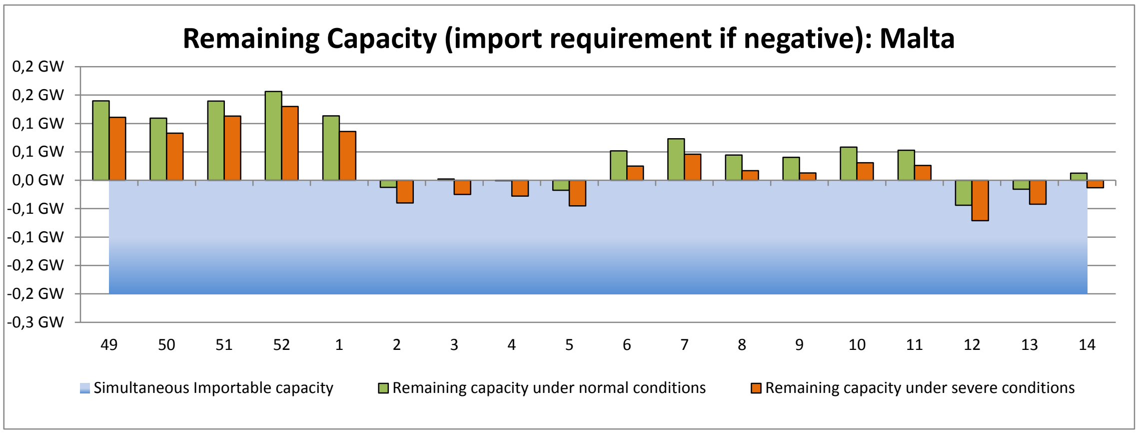
Malta

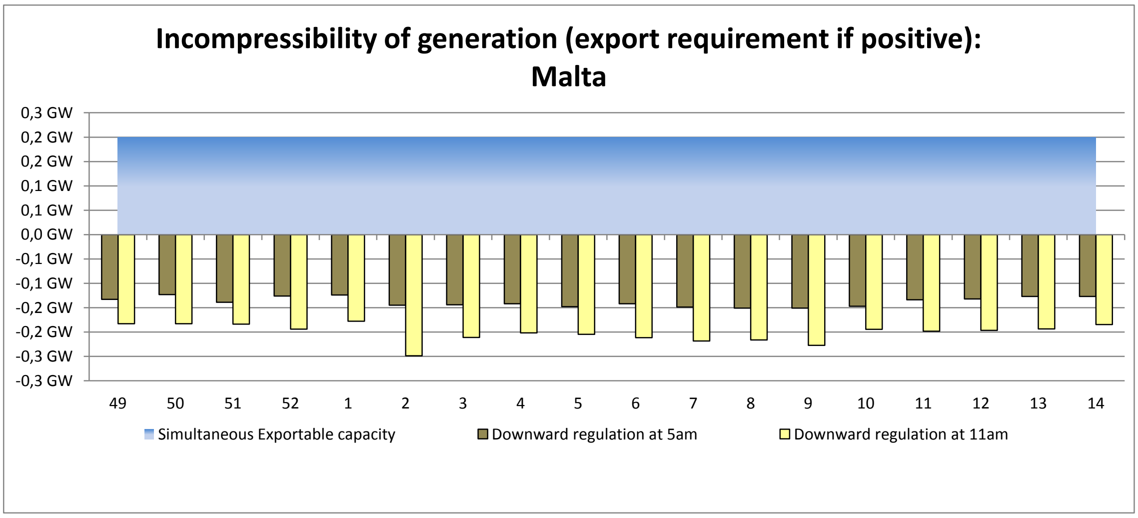
There will probably be higher levels of maintenance than during the previous winter since the new interconnector with Italy has been commissioned. During the last weeks of March 2016, four diesel engines will be converted from heavy fuel oil to liquefied natural gas or light fuel oil operation.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

There are no critical periods expected regarding adequacy.


Demand and generation availability: Malta
0,8 GW
0,6 GW
0,4 GW
0,2 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Malta
0,2 GW
0,2 GW
0,1 GW
0,1 GW
0,0 GW
-0,1 GW
-0,1 GW
-0,2 GW
-0,2 GW
-0,3 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Malta
0,3 GW
0,2 GW
0,2 GW
0,1 GW
0,1 GW
0,0 GW
-0,1 GW
-0,1 GW
-0,2 GW
-0,2 GW
-0,3 GW
-0,3 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Germany

The balance between generation and demand is generally expected to be maintained during the winter period in the case of normal and severe conditions.

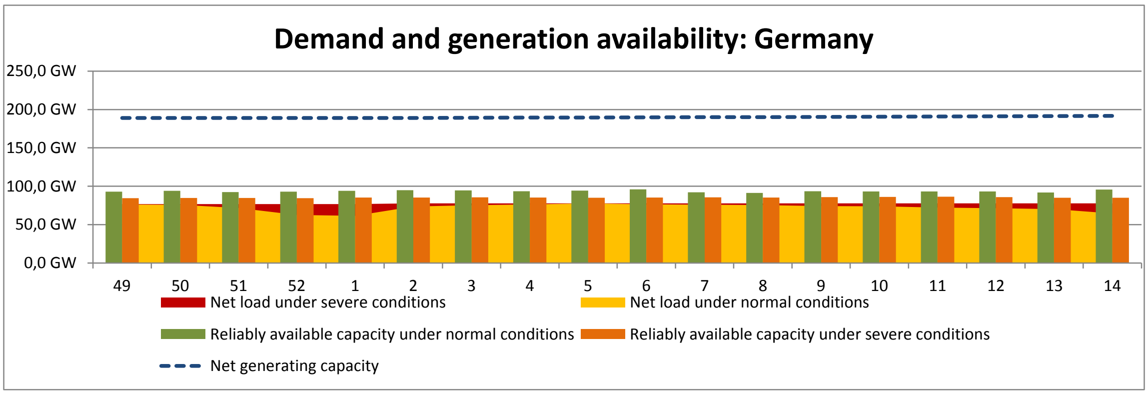
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

Based on the experience of past winters, the period around Christmas could be critical due to massive oversupply of the German control area. This could result in strong negative prices for electricity and could contribute to a high upward frequency deviation. In such a case, the German demand for negative control reserve might not be covered by the usually procured reserves. Therefore, a higher amount of reserves will be procured during this period. Additionally, there will be extended possibilities to reduce wind power infeed in such situations. In situations of high renewable energy sources infeed the north and high load in the south of Germany, the need of extensive remedial actions is expected to maintain (n-1)-security on internal lines and on interconnectors.

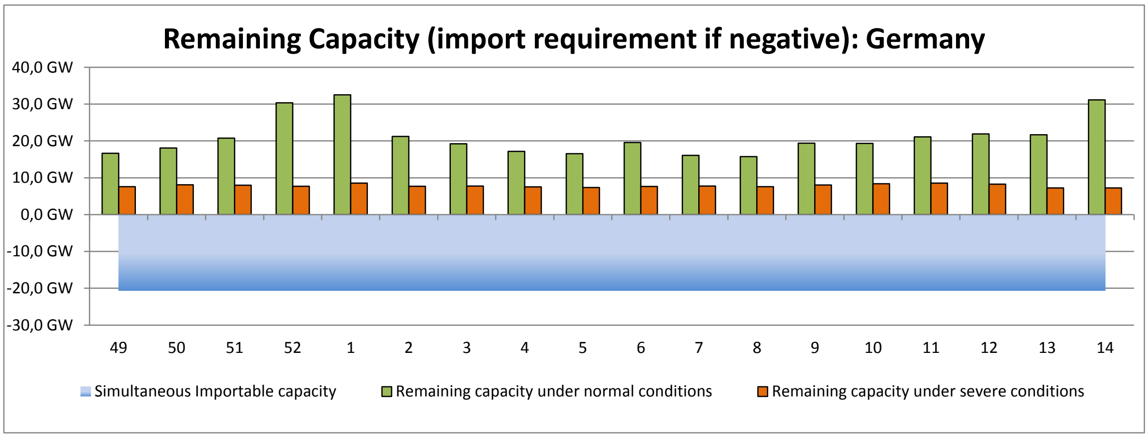
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

The interconnectors are expected to play an important role in the export of excess generation during minimum demand periods. According to the quantitative analysis of the downward regulation capabilities, especially at 11:00 CET on Sundays, a great amount of excess generation is expected. However, it has to be noted that in such cases it is also possible for German TSOs—due to specific laws and regulations—to reduce the renewable energy sources feed-in in order to mitigate any negative effects on the network.

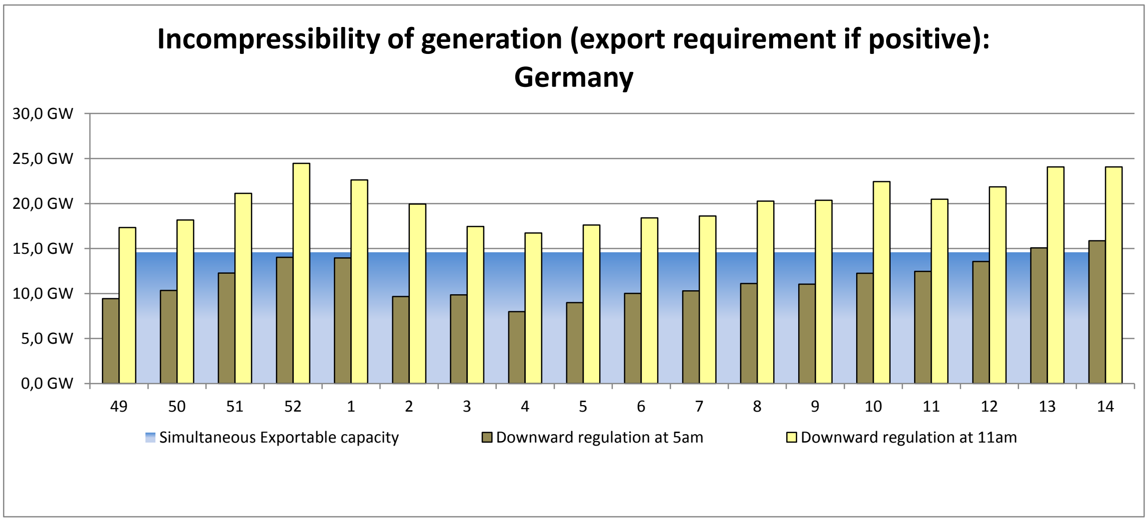
ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu



Demand and generation availability: Germany
250,0 GW
200,0 GW
150,0 GW
100,0 GW
50,0 GW
0,0 GW
49
50
51
52
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity



Remaining Capacity (import requirement if negative): Germany
40,0 GW
30,0 GW
20,0 GW
10,0 GW
0,0 GW
-10,0 GW
-20,0 GW
-30,0 GW
49
50
51
52
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions



Incompressibility of generation (export requirement if positive): Germany
30,0 GW
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
49
50
51
52
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Greece

The Greek system is expected to be in balance for the upcoming winter period (2015-2016). The level of indigenous national generation and the good hydraulic storage of hydropower stations will ensure adequacy and security of the Greek interconnected system, which is not threatened under normal or severe weather conditions. There is no planning for high-level of maintenance during the winter.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

The most critical period during the winter is the second half of December and January. Moderate imports are needed to meet operating criteria under normal conditions.

The role of interconnectors currently is not important for generation adequacy due to a decrease in demand over the past years.

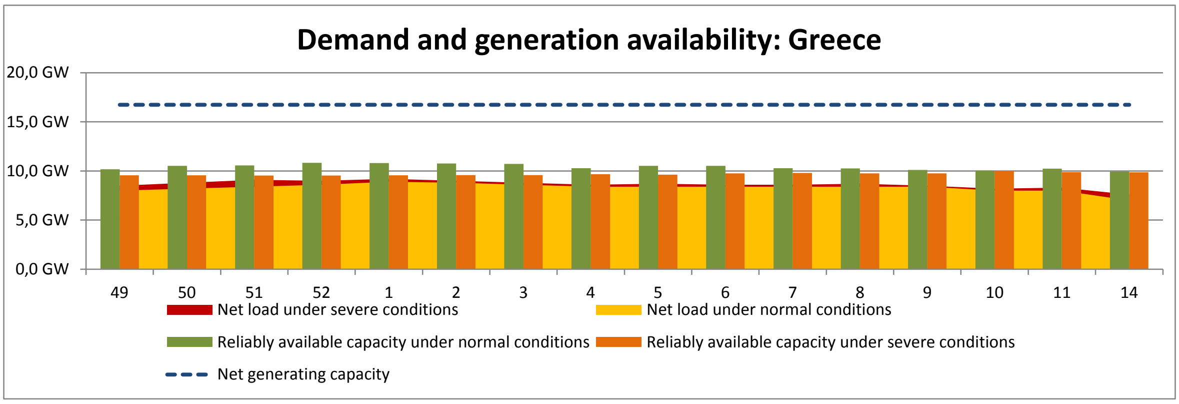
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

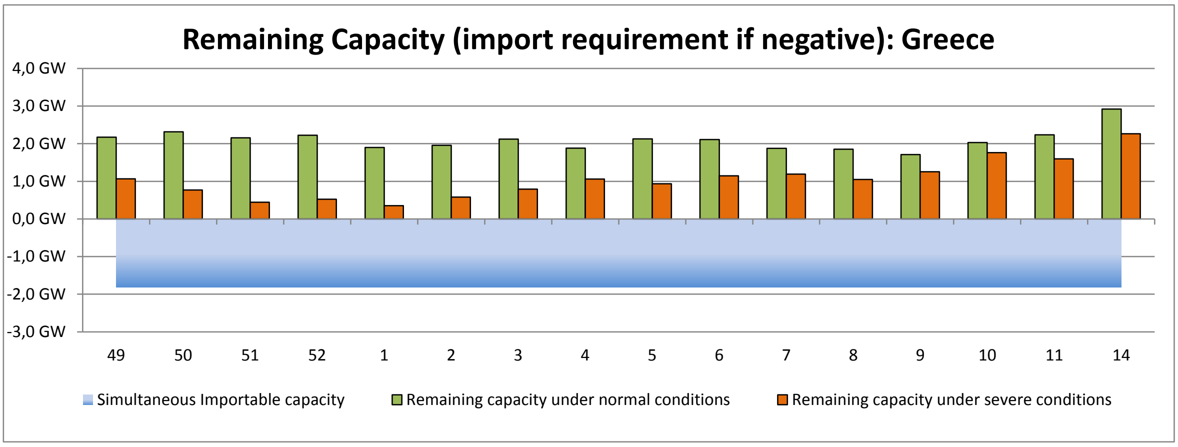
The most critical periods for downward regulating capacity are usually from 00:00 to 06:00 local time.

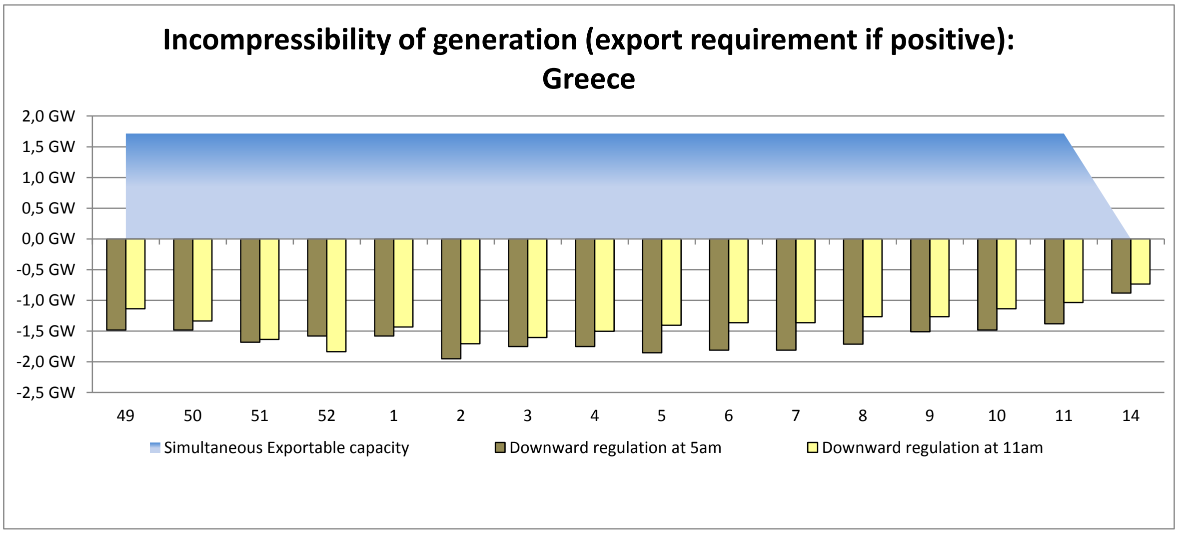
The countermeasures adopted are:

- Request of sufficient secondary downward reserve;
- Use of pump units.

The interconnectors are not used for reserve exchange.







ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Great Britain

The maintenance/outages are based on OC2 data provided by generators on 8 September 2015.

There are a few weeks with a high level maintenance, such as WK50 2015 (2.37GW), WK13 2016 (2.08GW) and WK14 2016 (3.59GW), which are mainly because of high-level maintenance of nuclear plants and hard coal units.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

Week 50 2015 has the lowest remaining capacity (2.66GW) due to relatively low reliable capacity and high load during the week. Imports from interconnectors will help.

Week 14 2016 has the highest adequacy due to a load drop during the week—the time change for BST will occur on 27 Mar 2016 right before WK14.

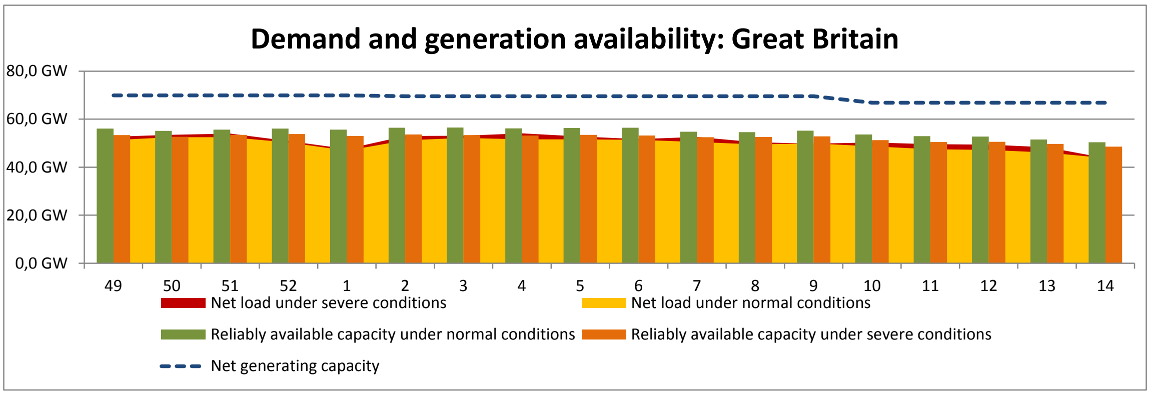
In severe conditions, the remaining capacities are negative during a few weeks such as Week 50 2015, Week 51 2015, Week 4 2016 and Week 6 2016. Week 4 2016 is the tightest, at -0.92GW. Imports from the interconnectors should cover this.

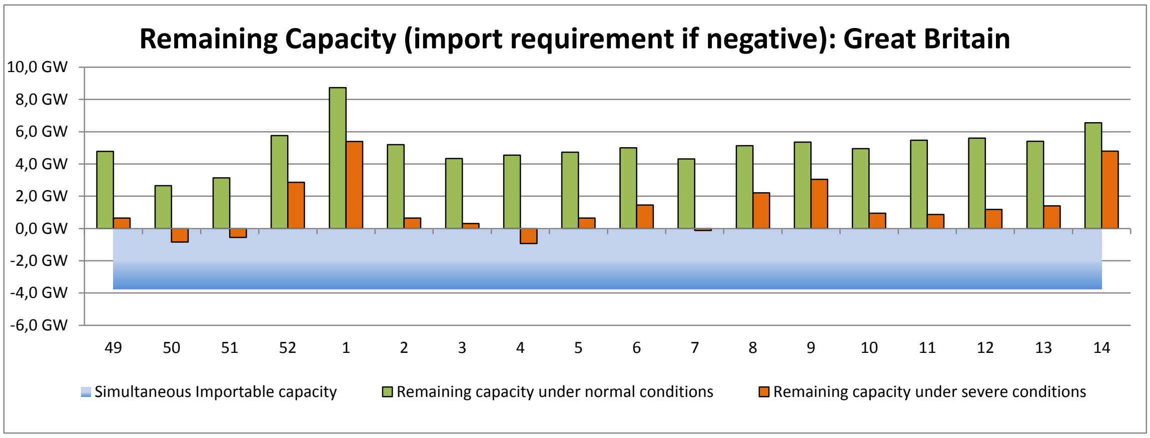
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

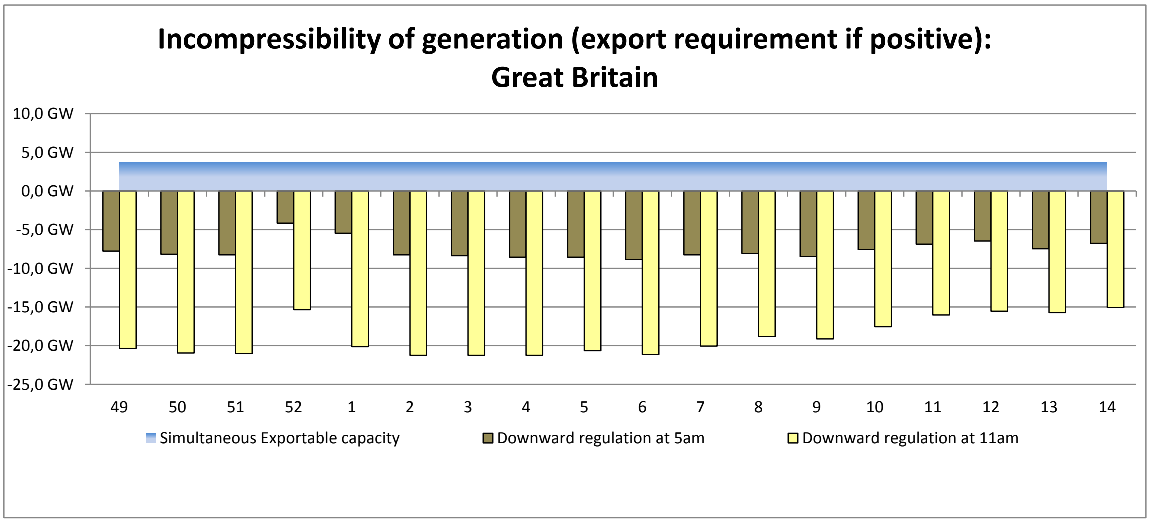
At night minimum period Week 52 2015 has the lowest downward regulation capabilities (4.165GW) due to the low load around the Christmas holiday.

At daytime minimum period Week 52 2015 has low downward regulation capabilities (15.345GW), but the lowest week is Week 14 2016 (15.045GW) due to the low load after the time change on 27 Mar 2016.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Great Britain
80,0 GW
60,0 GW
40,0 GW
20,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Great Britain
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Great Britain
10,0 GW
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
-15,0 GW
-20,0 GW
-25,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Hungary

In spite of the growing uncertainty on both the generation and demand side, as a result of market development on the one hand, and promotion of intermittent generation on the other, the Hungarian power system is expected to be safe during the next winter period.

However, there are a few risks that must be carefully managed by the TSO. These risks include:

- Availability of fuel, mainly of natural gas. During long-lasting cold winter periods, demand for natural gas becomes very high in households and power plants at the same time. Therefore, a well-functioning gas market, as well as satisfactory replacement fuel reserves at generators, are essential to keep the lights on. High-capacity gas storage was built so that the security of the gas supply could be increased.

- Overall cross-border capacity is satisfactory, however, allocation of cross-border capacity rights on the respective border sections may be an issue.

- The required level of remaining capacity can only be guaranteed by a certain amount of imports, mainly under severe conditions. Cross-border exchange is a matter of economy for market players. Their decision-making can be influenced by contractual conditions, e.g. on reserves.

- The outcome of the Ukrainian crisis may have a significant impact on the Hungarian electricity system. In case the gas supply wanes, the operation of gas-fired power plants is likely to become unpredictable, which in extreme conditions can cause up to 3000 MW capacity outage in addition with the decrease of electricity import coming from Ukraine. The unavailability of the necessary capacity at this rate for a relatively long period of time cannot be compensated by domestic sources or additional imports. If there is no continuous gas supply, Hungary could run out of alternative fuels within 2 weeks. Moreover, it is necessary to consider a further decrease of imports as a consequence of available capacity limitation in the gas-fired power plants of the adjacent electricity systems.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

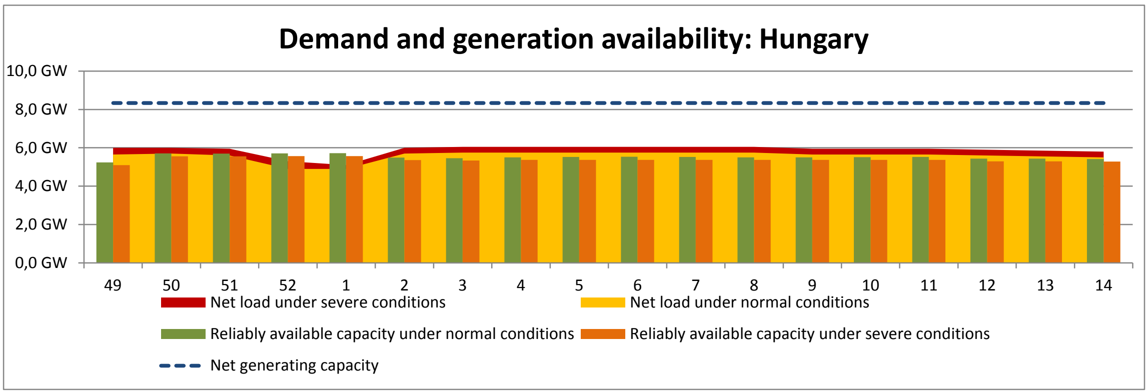
The reference adequacy margin at weekly peak is 0.5 GW, which is the capacity of the largest generation unit in the power system.

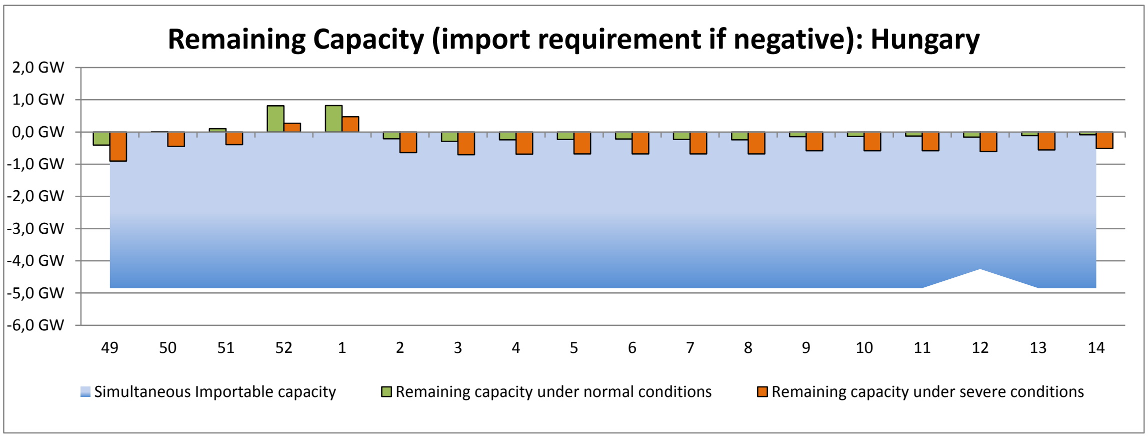
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

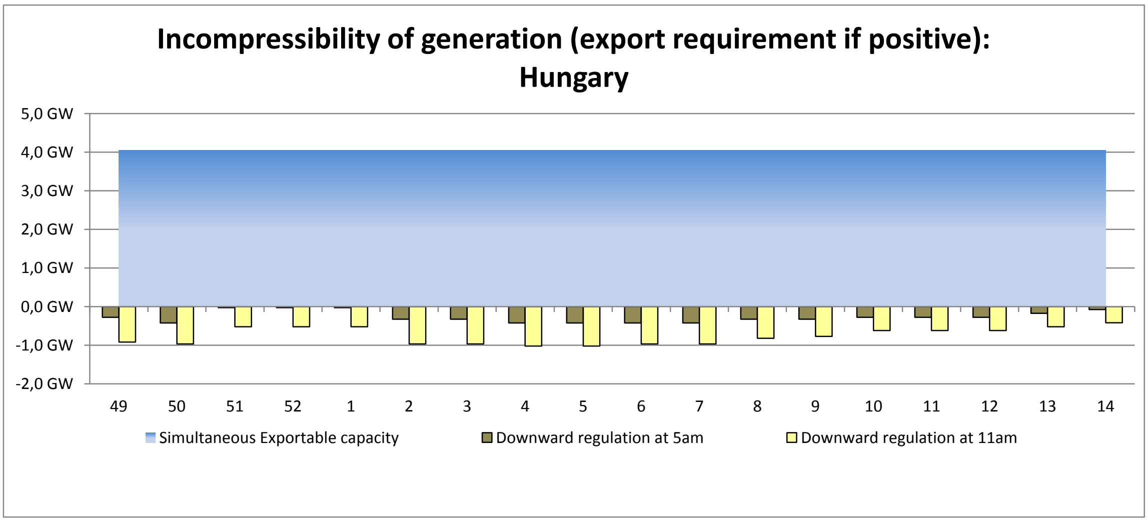
The level of maintenance is relatively low during the winter and spring; the highest period of maintenance is the first week of December (470 MW).

In the Hungarian electric power system, the required adequacy margin can be guaranteed only by a considerable amount of imports. It will take several years to overcome this historical feature, which is a result of missing competitive, highly flexible generation units.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Hungary
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Hungary
2,0 GW
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
-3,0 GW
-4,0 GW
-5,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Hungary
5,0 GW
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

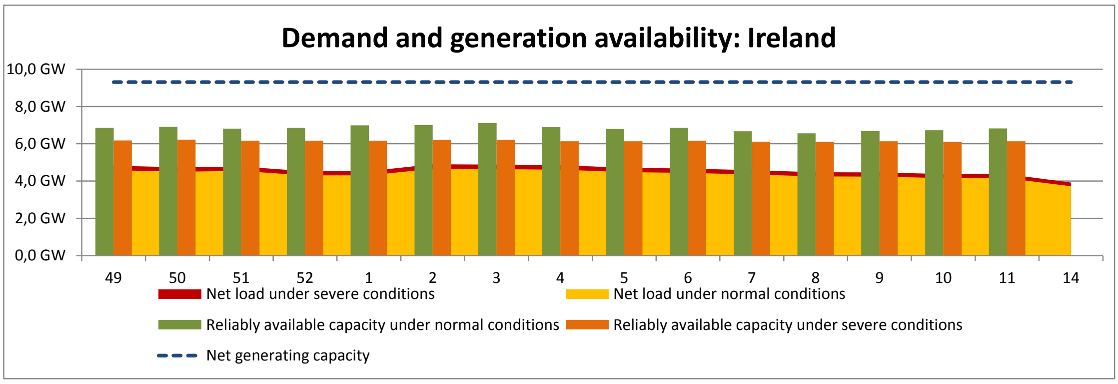
.

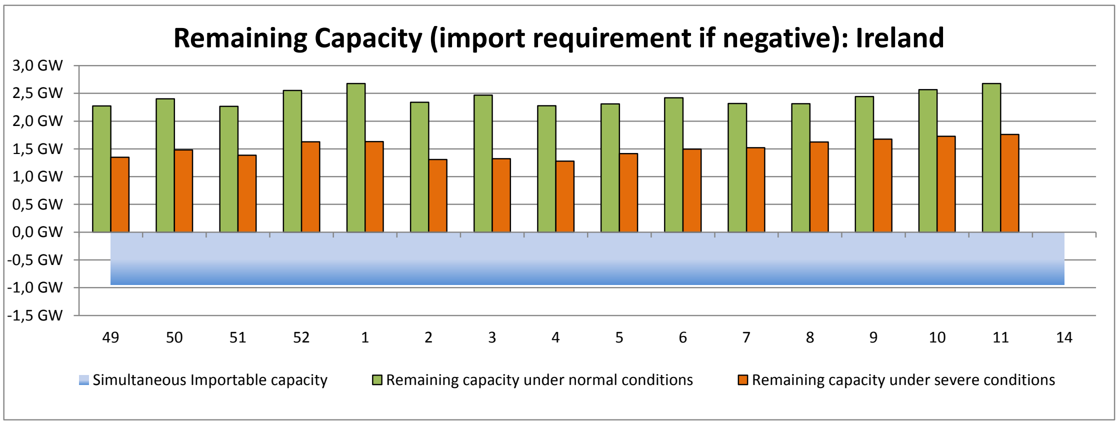
Ireland

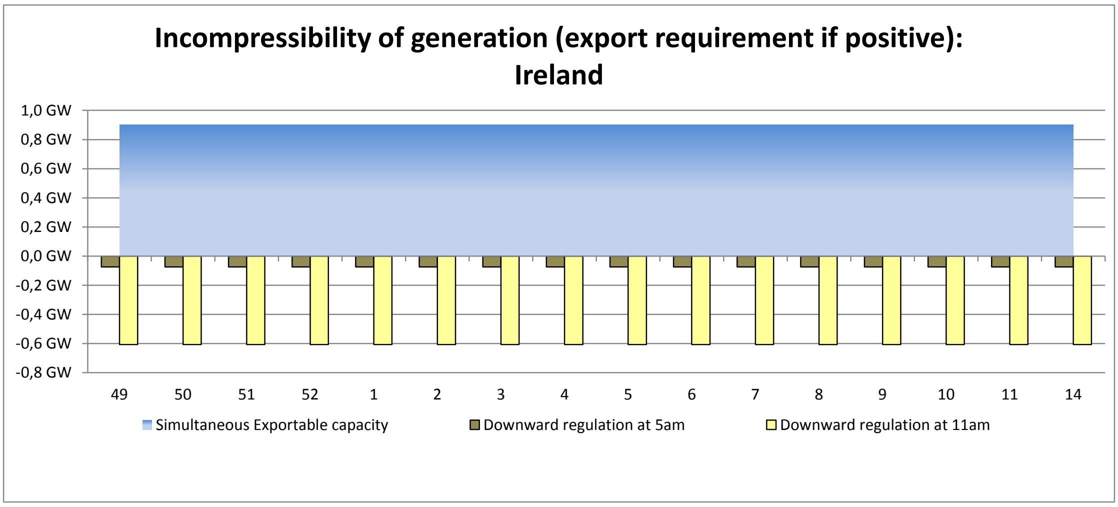
The capacity margin in Ireland is sufficient for the winter period and remains well above critical levels. Irish generators do not show a preference for winter outages. Maintenance will be scheduled for March and April 2016. Higher than usual maintenance, low hydro levels or low gas storage issues are not expected to be a problem for Ireland during this period.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

While the winter months represent peak demand in Ireland, there is no critical period for maintaining supply. As a countermeasure to the possibility of a winter shortfall in generating capacity, the Irish capacity payment mechanism will incentivise generators to remain available during the winter months. The Irish transmission maintenance schedule also excludes much of the winter period.


Demand and generation availability: Ireland
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Ireland
3,0 GW
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Ireland
1,0 GW
0,8 GW
0,6 GW
0,4 GW
0,2 GW
0,0 GW
-0,2 GW
-0,4 GW
-0,6 GW
-0,8 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Iceland

Due to reduced inflow to the hydro power plants (because of a cold summer and less snow melting than usual), the transmission system will likely be stressed this winter, leading to load curtailment.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

It is thought that the period from January to April will be the most stressed period. Priority load will be served, but curtailment of secondary load will probably be higher than usual.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

The same period as mentioned above. Iceland is an isolated power system, so we have to deal with the situation by curtailments.

Italy

The reduction of available capacity has continued over the past months with the decommissioning or mothballing of several power plants.

However, in normal conditions, no problem regarding system adequacy is expected in the Italian system, with reliable available capacity expected to be higher than peak load during the entire period.

Under severe conditions (extreme cold), the situation for the winter could lead to the need of certain numbers of imports in order to cover the peak load.

High renewables production (wind and solar) during low load periods, taking into account the level of other inflexible generation, could lead to a lack of adequate downward regulating capacity.

Concerning the external risk for the security of supply, it should be noted that the Italian generation fleet is heavily dependent on natural gas.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

In normal conditions, no problems regarding system adequacy is expected, and the least comfortable period is expected in mid-January.

Under severe conditions, the situation for the winter could lead to the need of imports for several weeks, with the highest need for imports that could be reached in case of very cold winter spell in March.

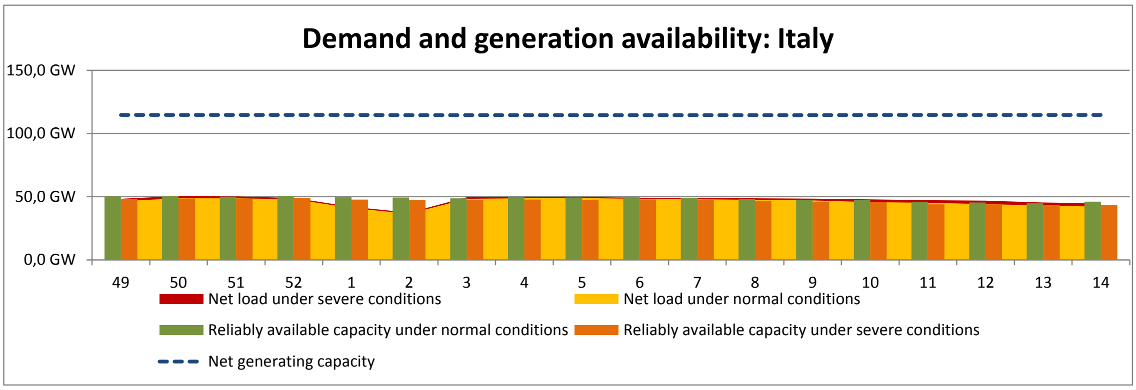
An appropriated planning (and coordination) of planned grid and generation outages has been performed, but in case of need, postponement and/or cancellation of maintenance could be used.

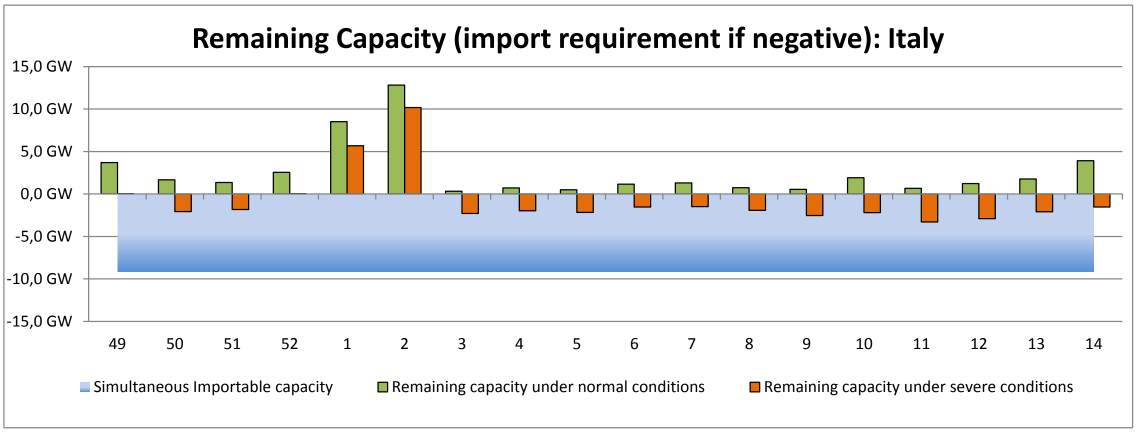
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

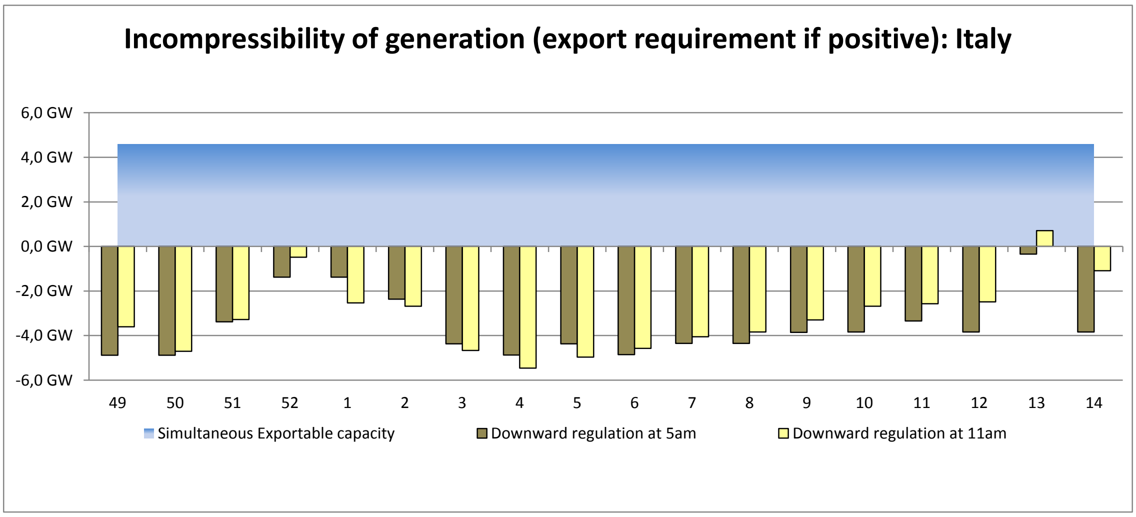
The worst weeks for downward regulation are expected to be the weeks of Christmas and Easter. In order to cope with this risk, the Italian TSO (Terna) prepared preliminary action

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

and emergency plans and, in case of need, will adopt the appropriate countermeasures. In order to guarantee system security, Terna could adopt enhanced coordination with neighbouring TSOs and special remedial actions, such as the curtailment of inflexible generation. Further special actions, such as NTC reductions, could be planned in cooperation with neighbouring TSOs.







Latvia

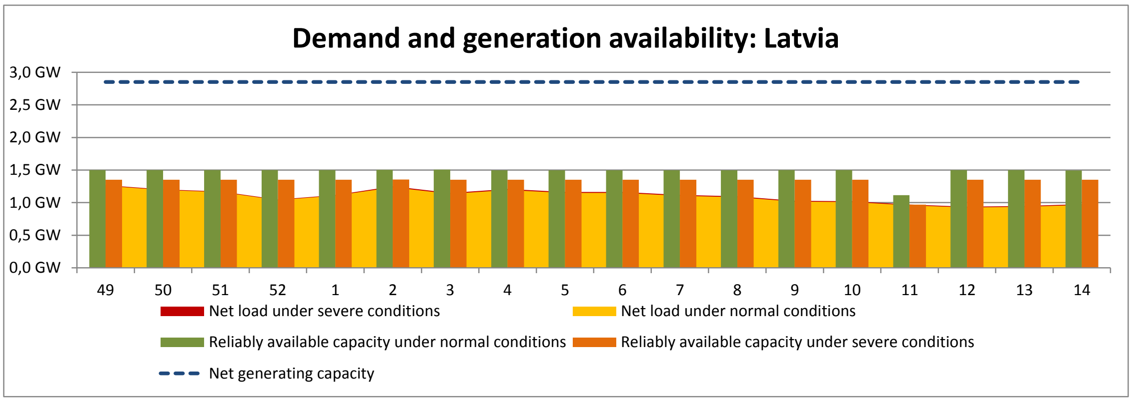
The total installed capacity for Latvian power system is around 2.85 GW for the entire winter period. The gas power plants are around 1.14 GW, the hydro power plants (run of river) are around 1.56 GW and the rest of the capacity is from other renewable energy sources (wind, bio fuel and solar) around 0.16 GW. Almost all winter there is no scheduled maintenance or overhauls on gas power plants, therefore the full capacity of fossil fuel will be available the entire winter period, except week 11 when one unit of RigaCHP2 is going on maintenance (418 MW). During the whole winter period two units from Hydro Power Plants on Daugava River are in maintenance. It is assumed that during the winter period the available capacity for normal conditions of Hydro Power Plants on the Daugava River is around 500 MW (the average historical production during the winter period), but in severe conditions the amount is reduced to 400 MW due to lower water inflow level. The full capacity of Hydro Power Plants of the Daugava River will be available from April until June, when a flood season is going on.

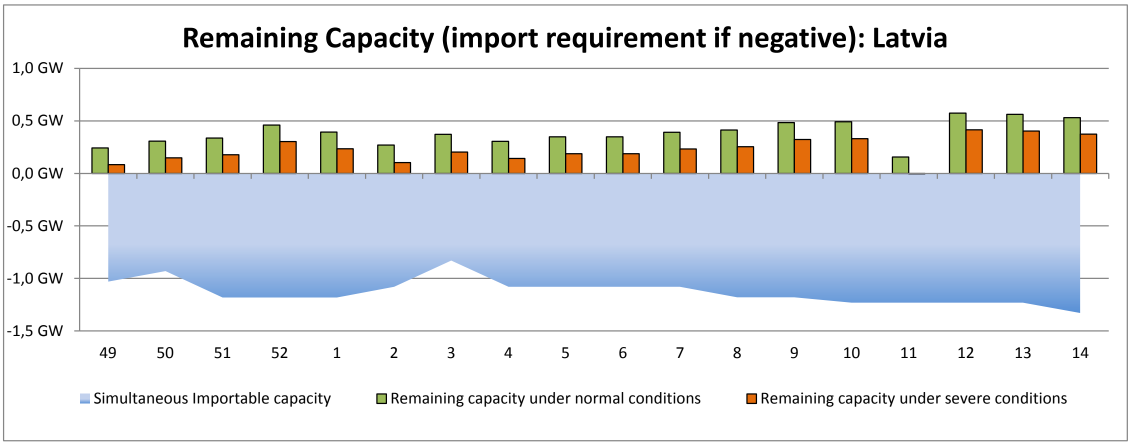
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

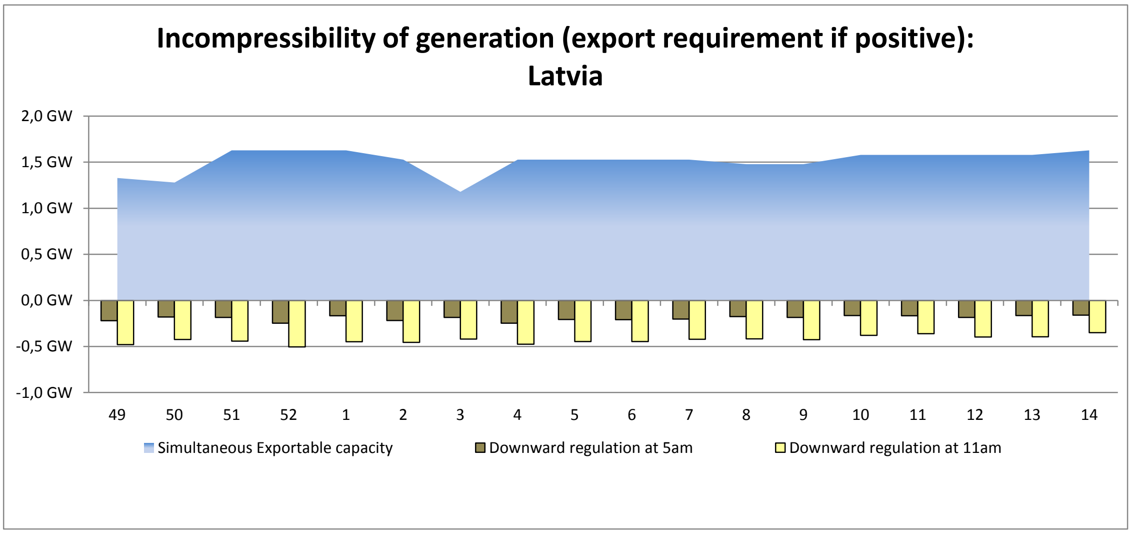
The most critical period for LV power system could be week 11 when one unit of Rigas CHPP2 is in maintenance (lack of capacity around 418 MW). The peak load in normal conditions can be covered in this case, but in severe load conditions the Latvian TSO relies on electricity imports from neighbouring countries via interconnectors. In the rest of the winter period the Latvian TSO doesn't see a problem covering peak load in normal and severe load conditions.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

The amount of inflexible generation in Latvia isn't high, therefore we don't see a problem with the operation of inflexible generation in the night and daytime minimum load hours.


Demand and generation availability: Latvia
3,0 GW
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Latvia
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Latvia
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Lithuania

The load estimation for normal conditions was based on statistical data from previous years, therefore no major increase is expected. For the coming winter season, the maintenance schedule in general is not intensive. According to the maintenance schedule, the largest generation inaccessibility (20% of NGC) because of maintenance will be in weeks 10, 11 and 12 when generating units of the Lithuanian Power Plant and the Kaunas Heat and Power Plant will be not available.

At the end of 2015, new HVDC interconnectors will start operation: Lithuania-Sweden and Lithuania-Poland. After completion of these projects, possibilities for cross-border trade will increase while dimensioning fault in Lithuania will also increase and the amount of capacity for system services in 2016 will increase from 470MW to 905MW.

Due to an increase of system services and generation unit maintenance, the 'deficit adequacy level' (imports needed) is expected in the Lithuanian power system at the beginning of 2016. During severe conditions this 'deficit adequacy level' at the reference point in time can reach up to 0.55 GW.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

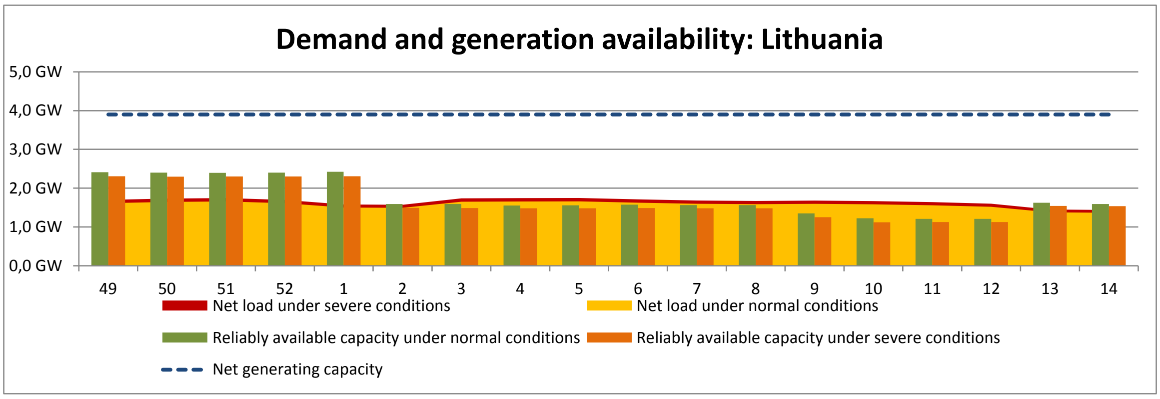
The first week of March will be the most critical from an adequacy point of view because of maintenance of the Lithuanian Power Plant and Kaunas Heat and Power Plant. Energy balance is expected to be covered by imports from neighbouring countries.

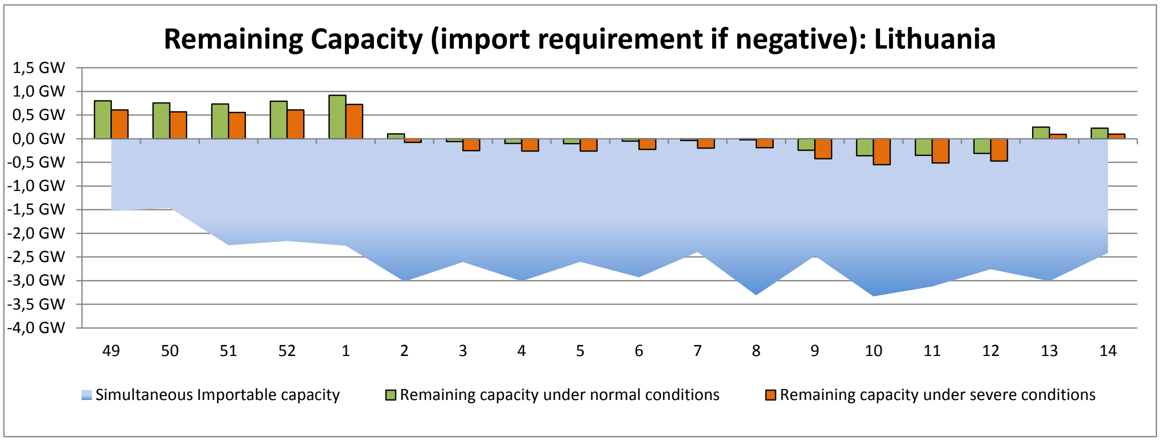
All import volume from third countries (Russia, Belarus) based on power flow calculations and allocated at the Lithuania-Belarus interconnection highly depends on the Estonia-Latvia interconnection capacity. Due to maintenance activities on the Estonia-Latvia interconnection lines and increasing ambient temperature, higher restrictions of the import capacity from third countries are foreseen in week 13.

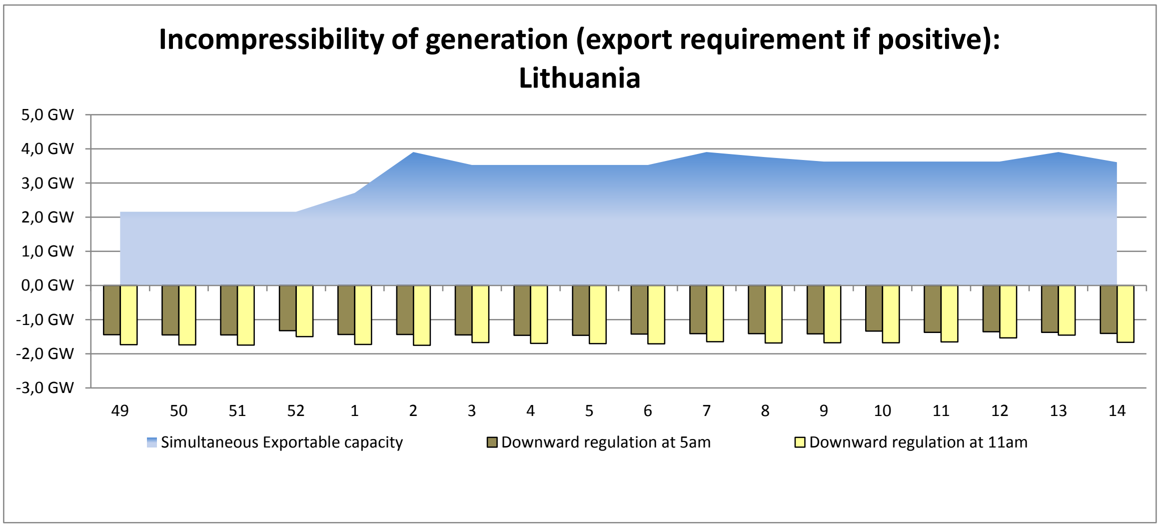
Moreover, the import ability of the Lithuania PS also depends on available generation in the Kaliningrad region. Import restrictions are foreseen during week 51 when generation of Kaliningrad TPP is planned to be reduced due to maintenance activities.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

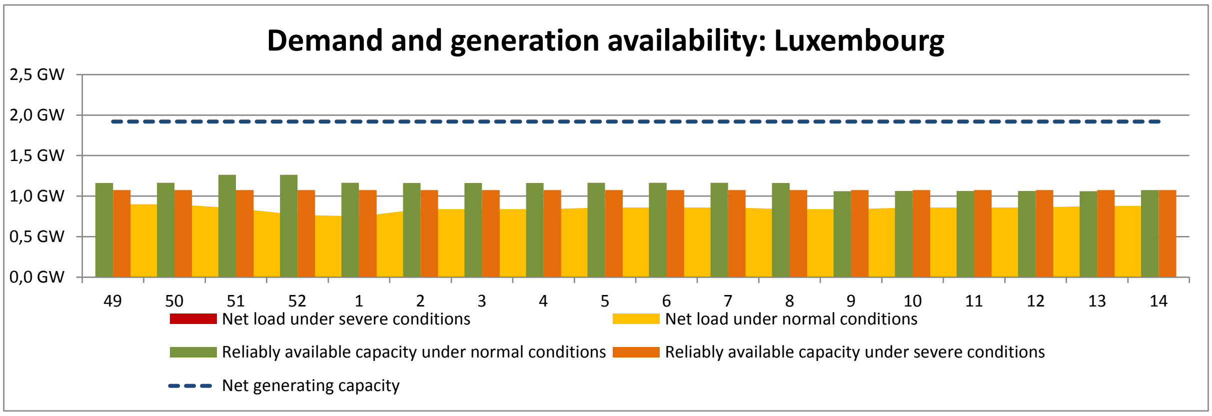
As Lithuania is an importing country with a fairly low amount of installed renewables, the role of interconnectors to manage an excess of inflexible generation is very low.

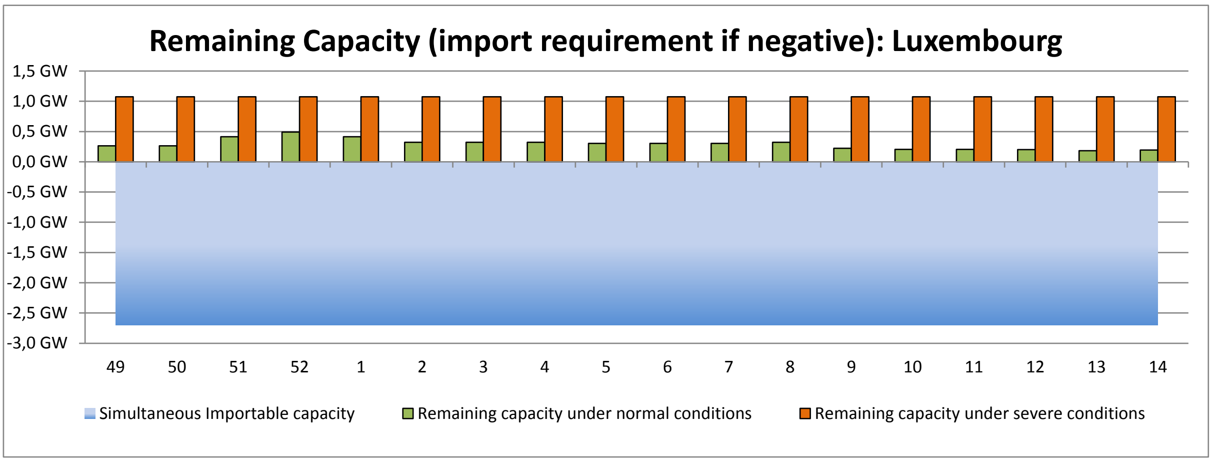


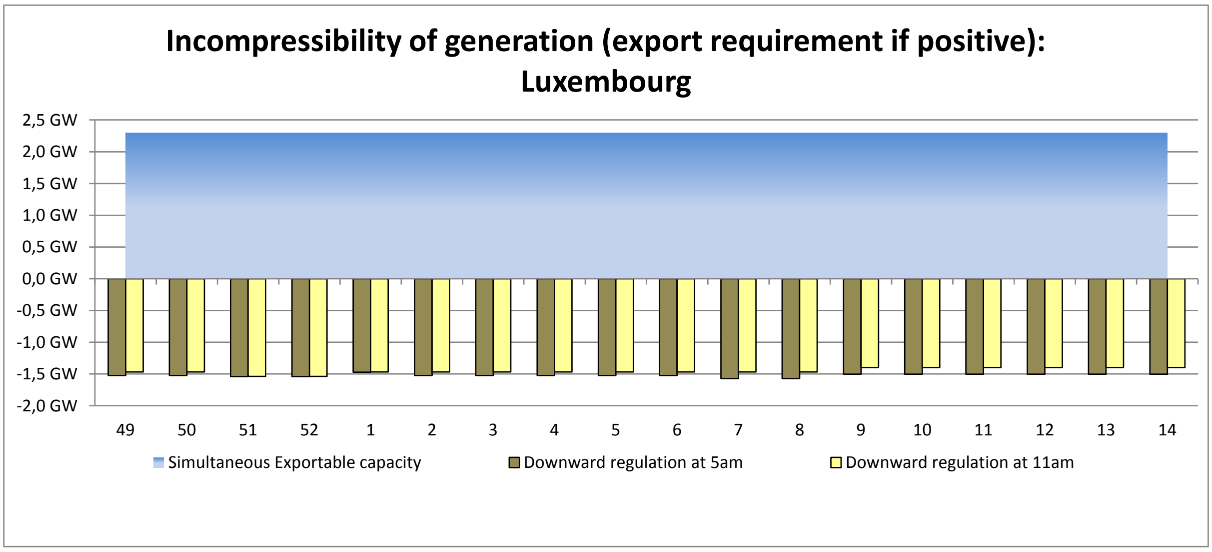




Luxembourg


Demand and generation availability: Luxembourg
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Luxembourg
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
-2,5 GW
-3,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Luxembourg
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Montenegro

The operation of the power system is expected to be secure and reliable over the entire winter period of 2015-2016. The best expectations are that generation-load balance problems, under normal conditions, are not expected in Montenegro during the winter of 2015-16.

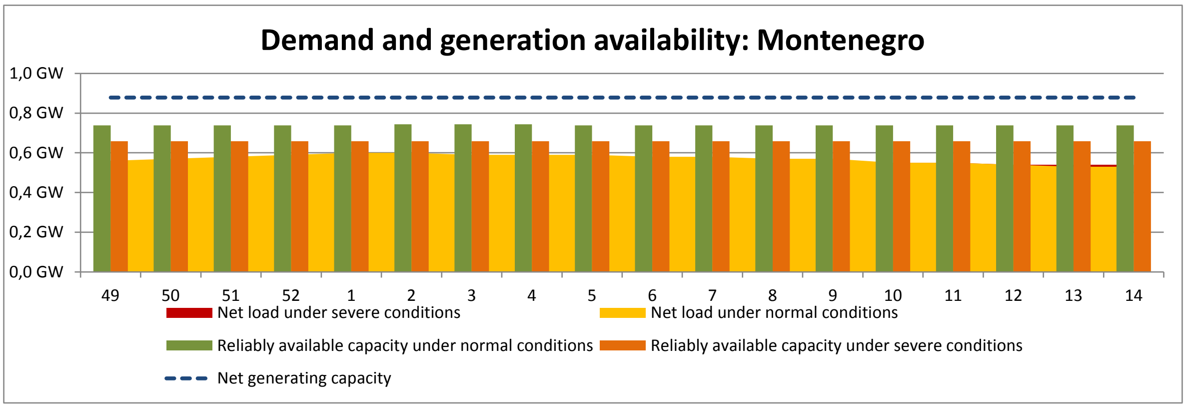
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

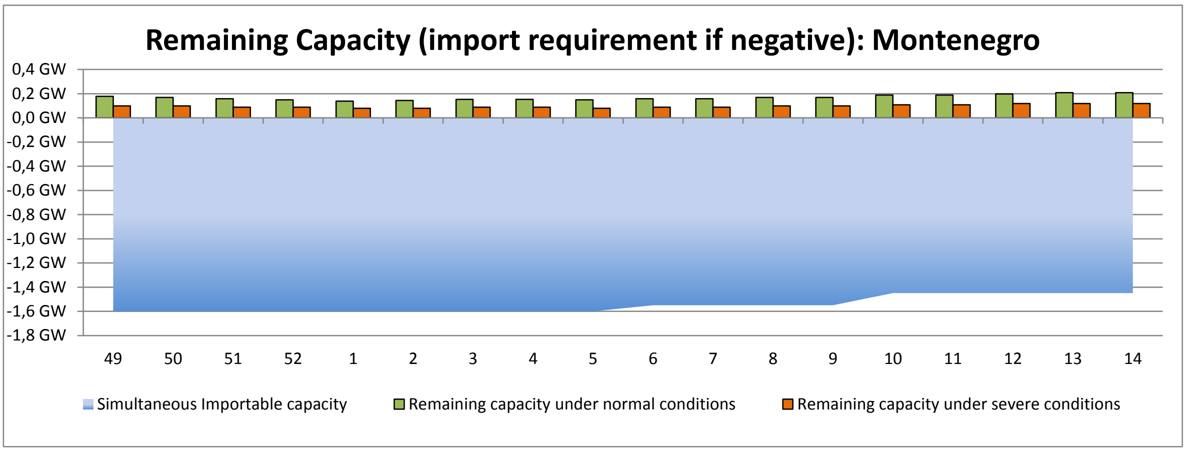
During winter there are no planned high levels of maintenance, and hydro levels are expected to be normal, therefore we don't expect any issues. No major variations of the interconnection capacities are expected during the winter of 2015-16.

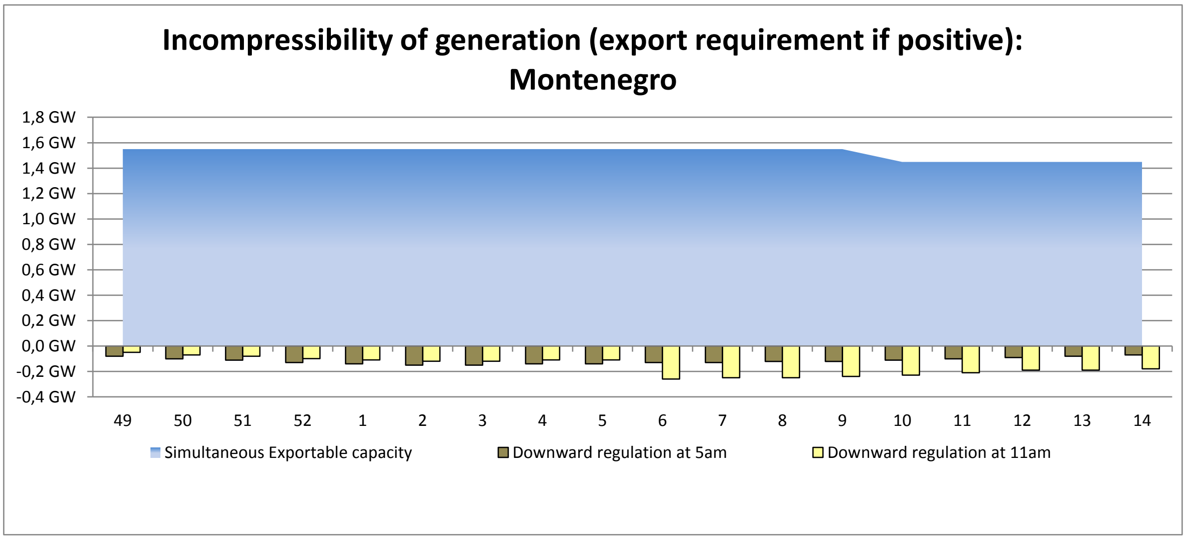
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

The most critical period is during the second part of December and January, depending on the weather conditions and temperature.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu







ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

The Netherlands

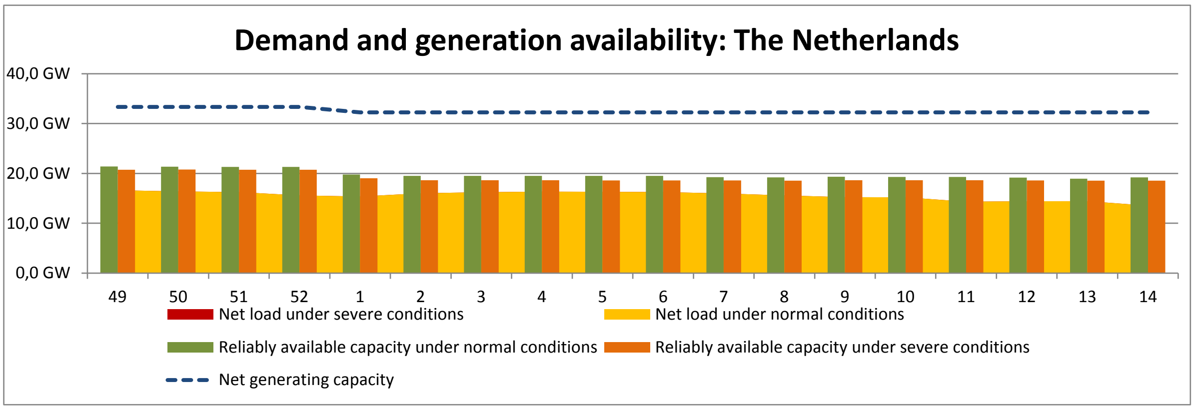
For the coming winter TenneT NL does not expect any difficulties with generation or load balance. Under normal or severe conditions, the amount of available generation capacity covers the demand peak. In close cooperation with the neighbouring TSO's, TenneT NL will see if extra capacity can be made available for intraday capacity trading. As of 21 May 2015 Flow Based has been introduced within the CWE region, this will influence the tradeable capacity on the region borders.

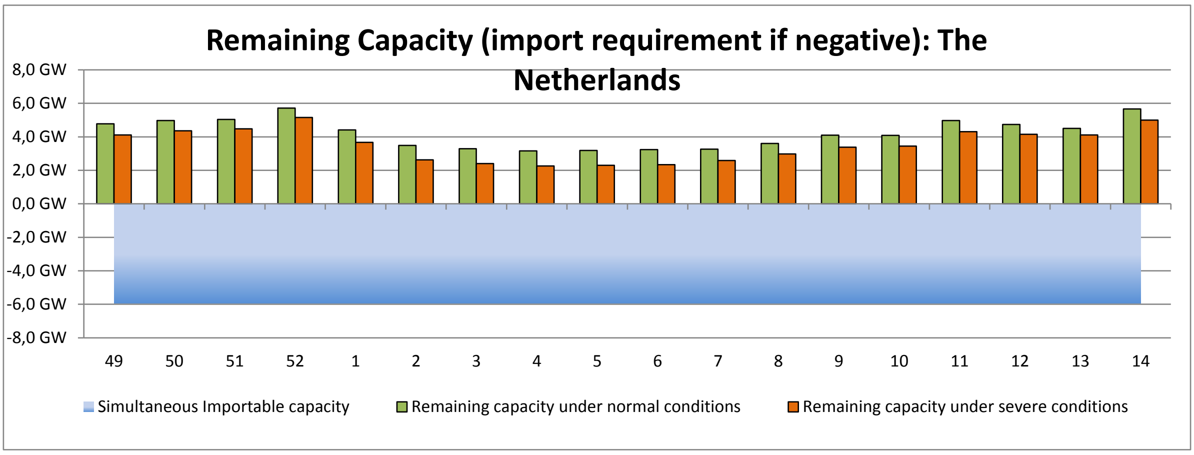
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

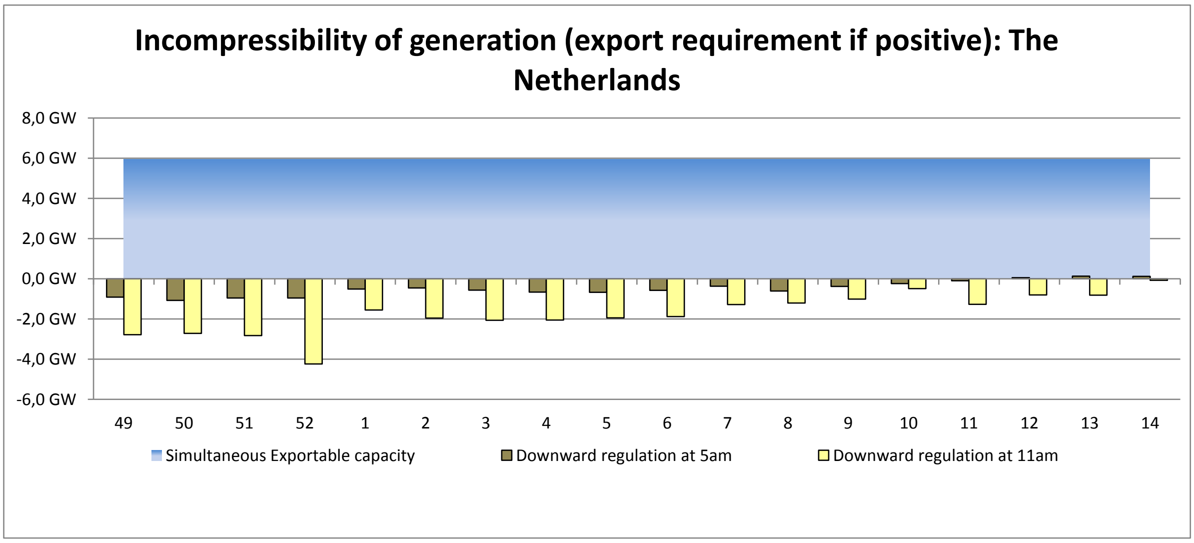
In most years the peak load happened in the winter period in the late afternoon hours (17-20 CET) in December or January, and the historical peak load still remains within the calculated peak load under severe or normal conditions and under the total amount of installed capacity within the Netherlands.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

The amount of inflexible generation is managed by the Program Responsible Parties and can still be handled within the minimum demand periods. Any excess of generation capacity will lower the market prices, and this will lead to export generation or the shutdown of installations.

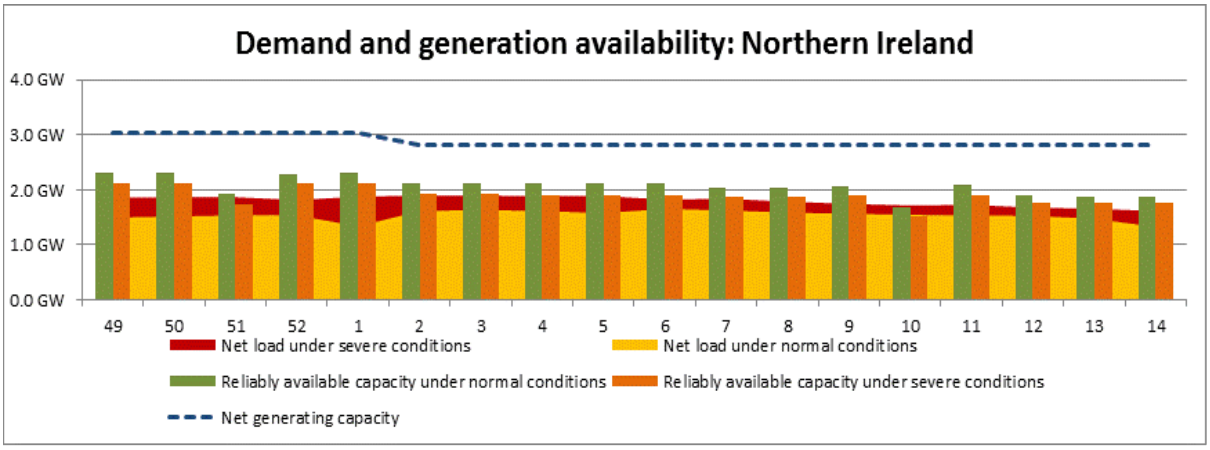

Demand and generation availability: The Netherlands
40,0 GW
30,0 GW
20,0 GW
10,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity

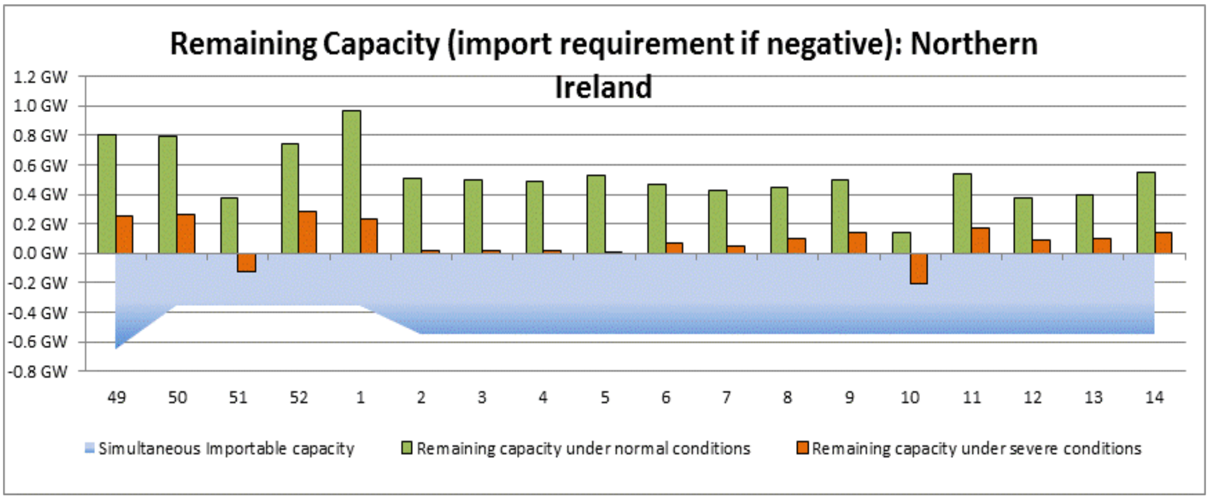

Remaining Capacity (import requirement if negative): The Netherlands
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
-8,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions

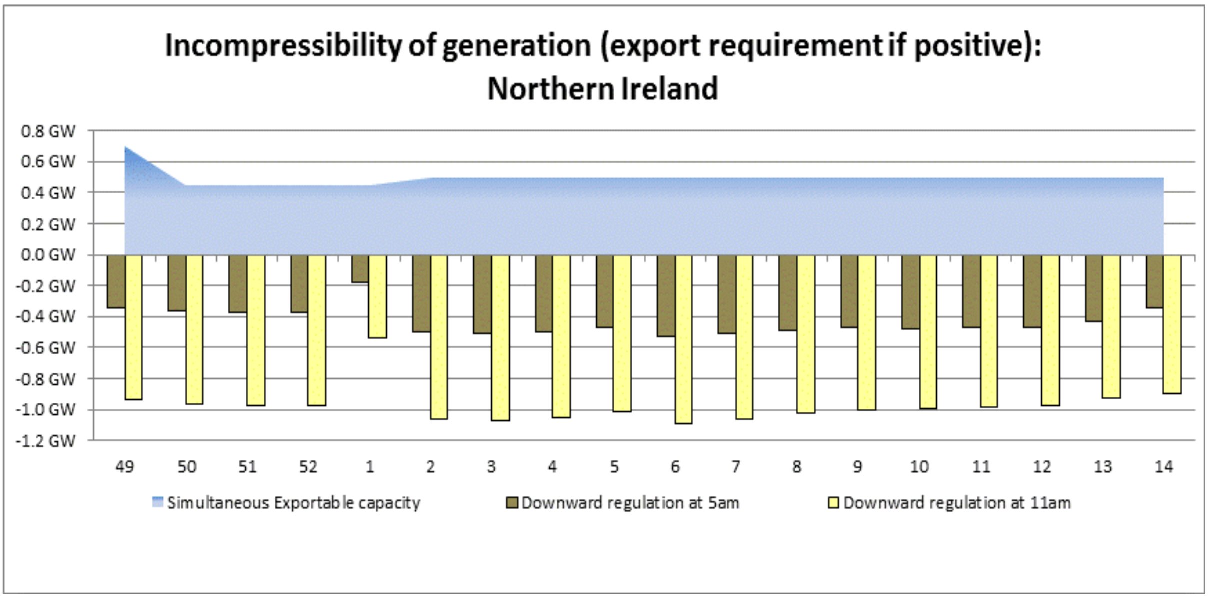

Incompressibility of generation (export requirement if positive): The Netherlands
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Northern Ireland

There is adequate capacity in Northern Ireland over the winter period. There are limited outages affecting the Generation Plant in Northern Ireland in this period.


Demand and generation availability: Northern Ireland
4.0 GW
3.0 GW
2.0 GW
1.0 GW
0.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Northern Ireland
1.2 GW
1.0 GW
0.8 GW
0.6 GW
0.4 GW
0.2 GW
0.0 GW
-0.2 GW
-0.4 GW
-0.6 GW
-0.8 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Northern Ireland
0.8 GW
0.6 GW
0.4 GW
0.2 GW
0.0 GW
-0.2 GW
-0.4 GW
-0.6 GW
-0.8 GW
-1.0 GW
-1.2 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Norway

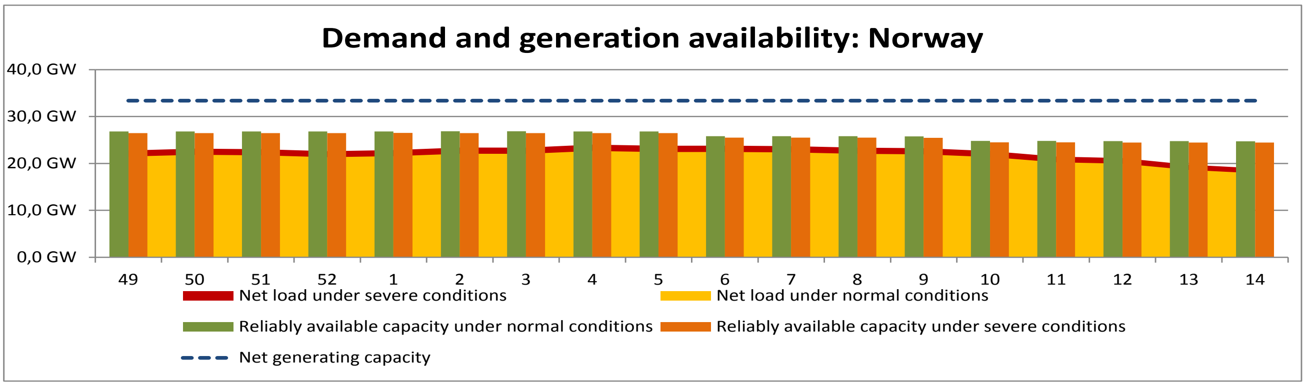
The current situation with high hydropower surplus, low power prices and high export of power is expected to continue during the fall and winter.

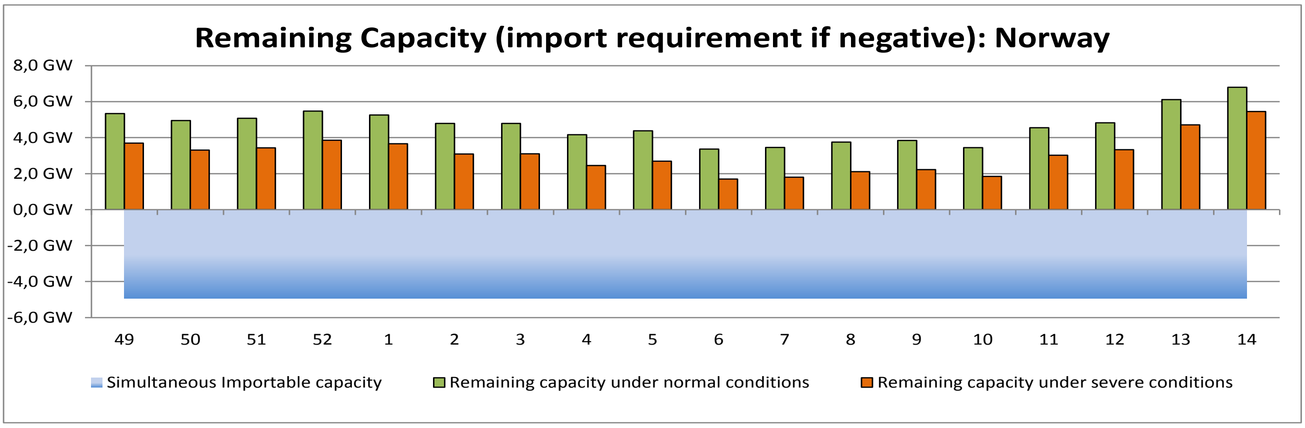
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

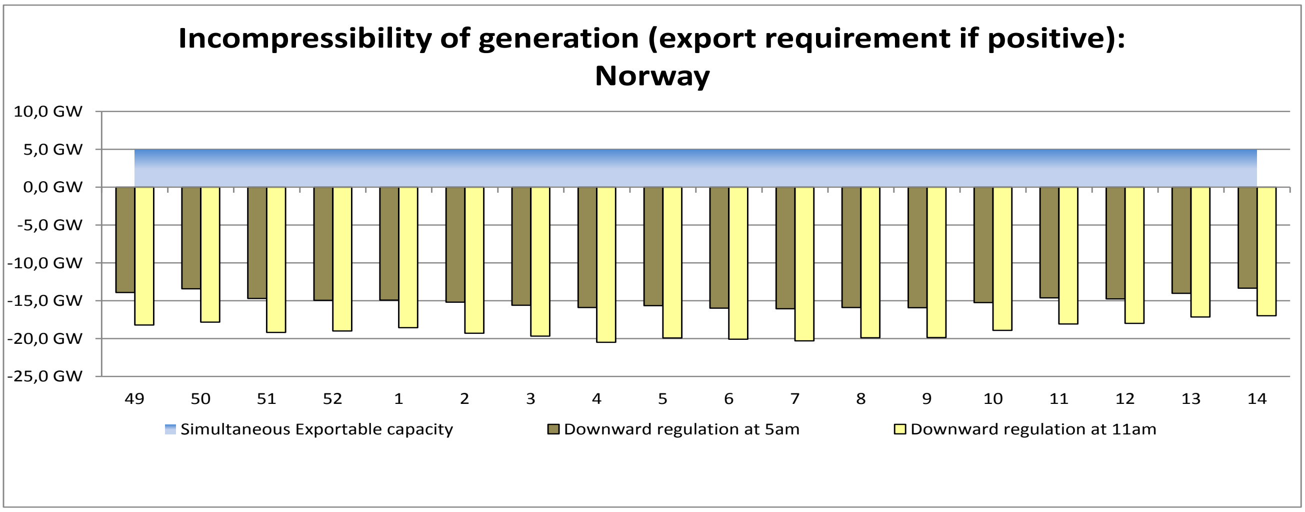
A sudden and long-lasting change to cold and dry weather combined with several severe generating outages in Norway or Sweden can change the current surplus to a shortage situation within a few months.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

No critical periods for downward regulating capacity are identified and will probably not be a problem in the winter.


Demand and generation availability: Norway
40,0 GW
30,0 GW
20,0 GW
10,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Norway
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Norway
10,0 GW
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
-15,0 GW
-20,0 GW
-25,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Poland

Individual country comments: general situation

Network condition

For years the Polish power system has been affected by unscheduled flows (loop and transit) through Poland from the west towards southern border. The reason of these flows are market transactions concluded outside of Poland, which are connected to the development of renewable energy sources in the northern part of Continental Europe (CE). Very often power flows from the northern part of CE to the south (coming from these transactions) cause a violation of N-1 criteria—there is no proper coordination of capacity calculation and allocation process in CE.

These flows are limiting Polish import capacity, which could not be offered to the market on synchronous profile (with DE+CZ+SK). For years the Polish TSO (PSE) has not been able to offer import capacity in yearly and monthly horizons (recently in day-ahead as well) because imports to Poland increase physical flows on the PL-DE border, which is already congested by unscheduled power flows. Offering import capacity to the market may take place only during intraday auctions and depends on the current level of unscheduled flows from Germany through Poland.

Unscheduled flows cause a violation of N-1 criteria on the Polish borders. To manage such situations, PSE uses operational measures, as follows:

1. DC loop flow (HVDC rescheduling) PL→DE (50Hertz)→DK→SE→PL, relevant agreement signed in September 2009. This measure consists in HVDC rescheduling and an accompanied change of the DE/PL schedule. This measure mainly relies on capacity available in SE/PL and DE/DK DC cable. It is a non-cost remedial action.

2. Bilateral cross-border re-dispatch (CBR) between PSE and 50Hertz, relevant agreement signed in May 2008 and updated in 2014. This measure consists of an increase generation in Poland and a decrease generation of 50Hertz. This measure relies on available generation in Poland (the most effective is using power plants located next to the border) and the possibility to decrease generation in Germany, and can also be limited by PSE and CEPS (in order not to have more congestion there). It is a costly remedial action.

3. Multilateral re-dispatch carried out within the frame of Multilateral Remedial Actions agreement (MRA). The MRA agreement between TSOs in the TSC area (TSC-TSO Security Cooperation) was signed in June 2012, with regular updates ever since. This measure is used as a last resort to relieve German-Poland interconnection by decreasing generation in 50Hertz and increasing it in other TSO control areas (usually Austria, Switzerland or other German TSO areas). This measure relies on power available in the above TSOs and the possibility of decreasing generation in Germany. It is the highest costly remedial action of all measures.

4. PSE has been informed many times that due to increased unscheduled power flows and the needs to activate remedial actions, PSE operates closer and closer to the security limit and it is only a matter of time until the available level of remedial actions will not be enough to decrease unscheduled flows to fulfil N-1 criteria. As described in the Summer Review, such a case happened on Tuesday, 15 September, when all available actions, which could limit unscheduled flows, were exhausted and the N-1 criterion was not fulfilled on the PL-DE border.

The PSE indicated numerous times that the real sustainable solution to the problem of unscheduled flows is implementation of the correct coordination of capacity calculation and allocation in the meshed centre of the Continent, i.e. flow-based approach in the proper region, which means Continental Europe East, West and South with properly configured bidding zones (control blocks at least). Until this method is implemented, urgent actions are required to ensure enough remedial actions to keep N-1 security state on DE-PL. Otherwise the secure operation of all of Continental Europe is endangered due to the risk of cascading trippings leading to Continental-wide splitting like 4 November 2006, with consequences that are difficult to assess.

<u>Role of interconnections</u>

The Polish TSO is strongly connected with the CE synchronous region using 10 HV tie-lines, of which 6 refer to voltage 400 KV. As mentioned at the beginning, the PSE cannot use existing transmission capacity for imports because of unscheduled flows (loop and transit) through Poland from Germany towards the southern border. Other Polish interconnectors in use are: DC cable to Sweden, 220kV line to Ukraine, on which only import is possible (Ukrainian units can be connected synchronously to the Polish system). By end of 2015, a new connection with Lithuania will begin operation. This will be a 400 kV double circuit line connecting two different synchronous areas via back-to-back units on the

Lithuanian side with 500 MW capacity. As the 'best estimate of NTC' for Winter Outlook PSE provides a seasonal forecast of NTC, which takes into consideration unplanned transit flows through the PSE control area. Additionally, December's forecast includes network constraints caused by planned switching off of the cross-border and/or internal lines (or other elements). Such constraints for 2016 will be agreed upon until the end of November 2015. Both factors limit the transmission capacity of the Polish system in the yearly planning horizon.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

Normal conditions

In normal conditions at all reference points, PSE forecasts the surplus power and does not expect any problems balancing the system this winter.

Severe conditions

Under severe conditions, PSE observes a negative balance for all analysed reference points except for points, which are holidays (6 January) or days preceding holidays (23, 30 December). In some of these days, importable capacity forecasted in a yearly horizon may not be enough to balance the system, because import capacity on the synchronous profile is significantly limited by unscheduled flows through the Polish power system (read more about unscheduled flows in the paragraph 'operational conditions'). It is worth noting that the power balance used for simulations of adequacy on a regional level refers to reference hour (19:00). The results of the Polish power balance at peak time will be worse for all analysed winter periods except the middle of February, when peak load is taking place at 19:00. The highest differences refer to the beginning of December—at about 500 MW (peak time between 16:00 and 17:00 CET) and the end of March— 1000 MW (peak time around 20:00). Both figures showing Remaining Capacity, at 19:00 and at peak time, are presented at the end of the Polish comments to the Winter Outlook.

Extremely severe balancing conditions in the winter period may take place in the case of a long cold spell leading to a significant deterioration of the Polish power balance. This causes an increase of load with a simultaneous decrease of generating capacities due to a higher forced outage rate of generators and the increase of non-usable capacity. The growth of non-usable capacity this winter may refer to hydrological constraints resulting from an extremely dry summer and its continuation into autumn (low level of water in rivers used for cooling some thermal power plants). In this case, the risk of a full freeze of rivers rapidly increases, and this could be a key issue when the power balance during severe conditions is predicted. To keep the balance at a safe level, the Polish TSO can use operational procedures, to cope with a power shortage, e.g. activate an additional power in units, which are classified as non-usable capacity in the yearly horizon forecast, manage winter maintenance plans and overhauls or activate contracted DSR. In addition PSE could use their interconnections to realise emergency delivery of power from neighbouring countries, of which possible import on synchronous profile strongly depends on the level of unscheduled flows from the west to the south because imports to Poland increase physical flows on the PL-DE border congested already by unscheduled flows. Last summer showed that PSE cannot count on the necessary level of imports on the synchronous profile even as emergency delivery. Only a limited amount of energy from CEPS and SEPS were possible under the condition of simultaneous MRA taken at the same time to limit unscheduled flows from Germany. It is important to underline that even this combined action cannot be treated as sure because it depends on the availability of up regulation power in the TSC area and the possibility to decrease generation in 50Hertz. Therefore, PSE has asked TSOs in the TSC area to take actions, which will allow PSE to count on not less than 1000 MW of imports on the synchronous profile, at least in emergency situations.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

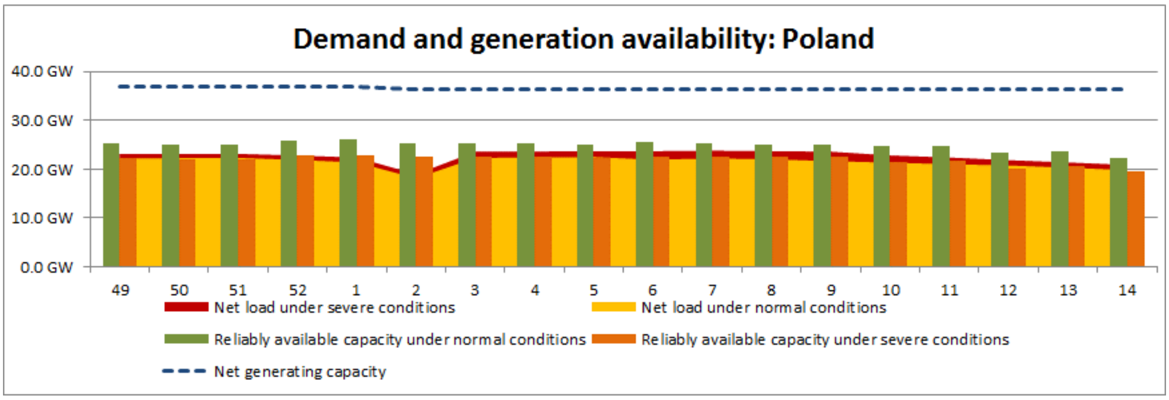
PSE does not prepare a forecast for downward regulation capabilities in yearly and monthly horizon (only during daily planning), so provided data is an estimate only. PSE can confirm that there are some stress days during the year (especially during Christmas, Easter and holidays in May), when low demand and simultaneously high wind conditions could cause a balance problem in the Polish power system, especially as wind generation factor used in national downward analysis amounts to 85% of NGC.

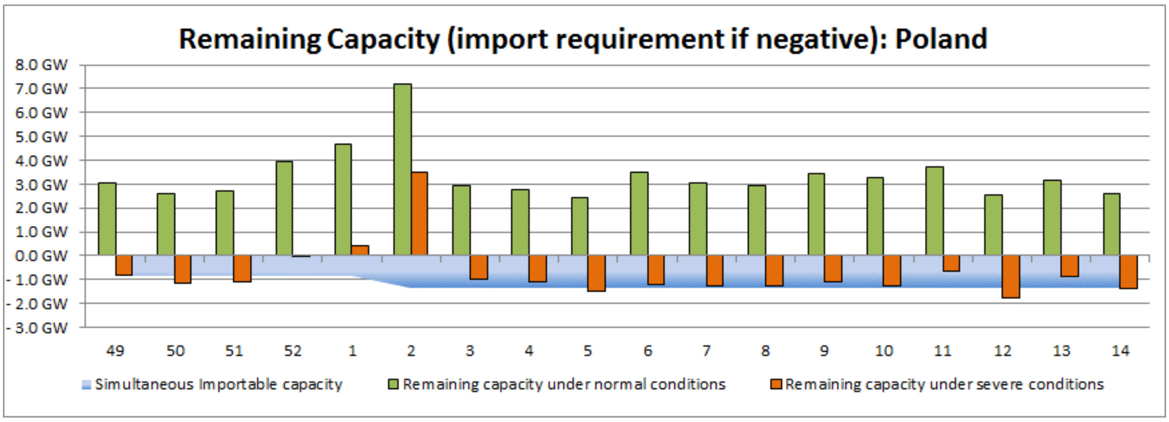
Owing to the lasting increase of wind NGC in Poland and assumed pessimistic factor for wind utilisation (85%), the national downward analysis at 5:00. CET shows a possible need to export in some reference points. Nevertheless these problems will be managed during operational planning, when a precise forecast of wind generation will be known. PSE also has operational procedures to keep the system at a safe level (including wind farms switching off as a last resort). PSE does not expect problems with a balance at 11:00 CET. on Sundays. Solar generation is not a problem because the NGC of solar is negligible in the Polish balance.

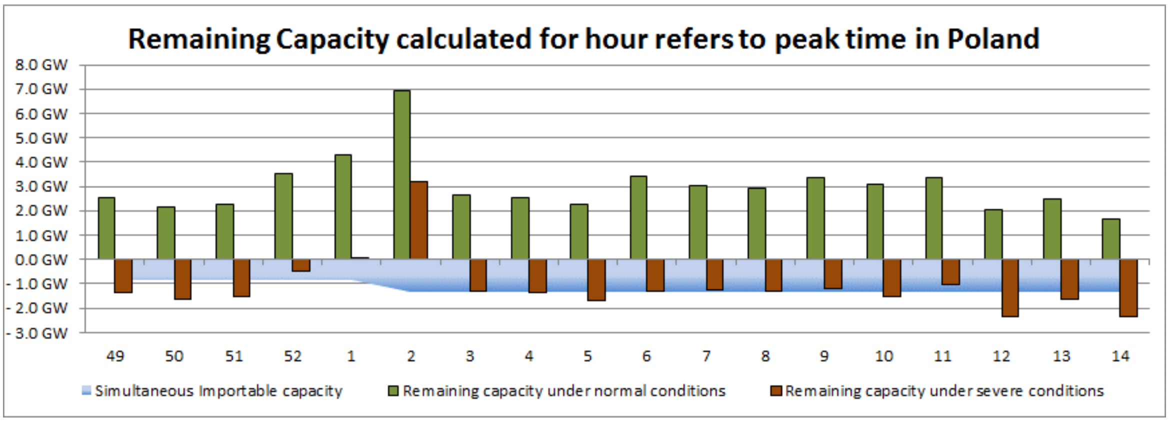
A short description of the assumptions for input data

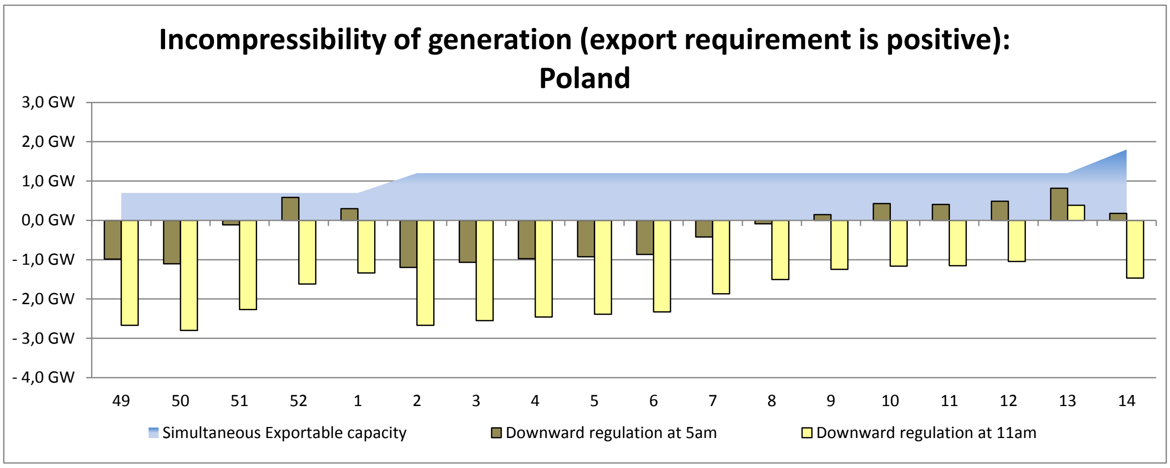
In Poland forecast system balance plans (called yearly coordination plans) are done for the whole year on a monthly basis, until the 30 November every year, and is published on the PSE S.A. web site. Prepared data concerns average values from working days at peak time. On the 26th of every month PSE publishes monthly coordination plans, which include the precise information on peak times for all days of the next month. Further specification is done within the operational planning (weekly and daily). Plans prepared by PSE are single scenario plans.

Because Outlook Reports require daily data, PSE has prepared a special assessment for Winter Outlook, where the daily data of NGC, maintenances, load and 'best estimate of NTC' are available. It is important to underline that there is still a yearly planning horizon. Reserves (primary and secondary) are in line with Operational Handbook requirements. Outages and non-usable capacity under normal and severe conditions are estimated based on statistical data. Due to differences between the ENTSO-E power balance methodology and methodology for constructing coordination plans, so the results couldn't be compared directly.


Demand and generation availability: Poland
40.0 GW
30.0 GW
20.0 GW
10.0 GW
0.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Poland
8.0 GW
7.0 GW
6.0 GW
5.0 GW
4.0 GW
3.0 GW
2.0 GW
1.0 GW
0.0 GW
-1.0 GW
-2.0 GW
-3.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Remaining Capacity calculated for hour refers to peak time in Poland
8.0 GW
7.0 GW
6.0 GW
5.0 GW
4.0 GW
3.0 GW
2.0 GW
1.0 GW
0.0 GW
-1.0 GW
-2.0 GW
-3.0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions



Portugal

From the perspective of REN, in the next winter, generation/demand balance is expected to be met without problems.

Demand should have a small increase from last year values but, on the supply side, we have a more substantial increase in generating capacity (we must highlight the reinforcement of assets 'Frades' and 'Salamonde' with new reversible units totalling 1000 MW), so the situation is expected to be even more comfortable than in previous years.

By the end of September 2015, hydro storage was at 55% of its full capacity.

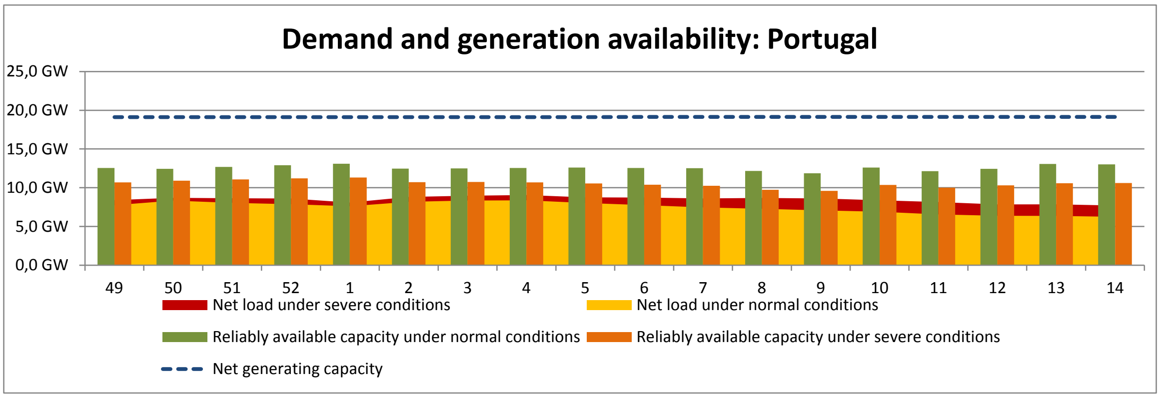
Besides grid constraints, generation constraints in the Portuguese system are essentially related to the unavailability of the primary source in water and wind power plants, as gas supply is not an issue.

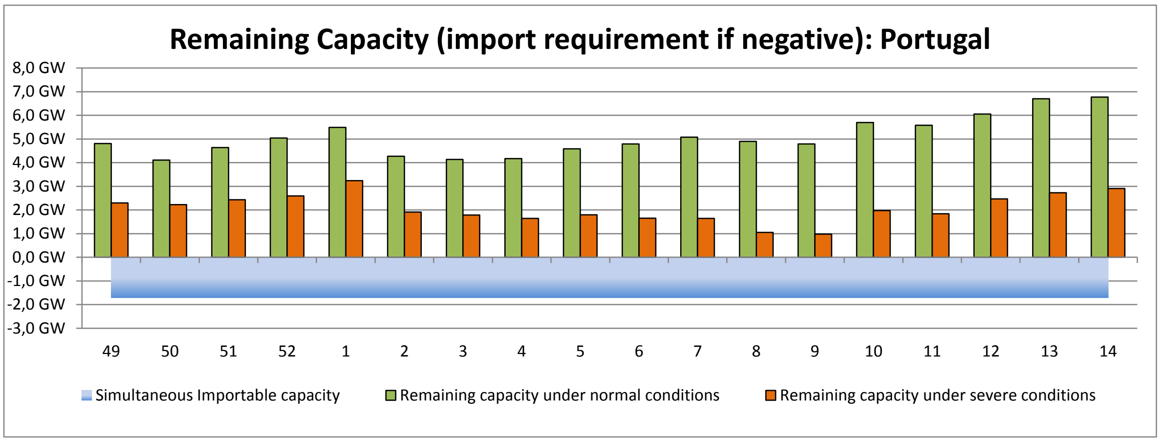
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

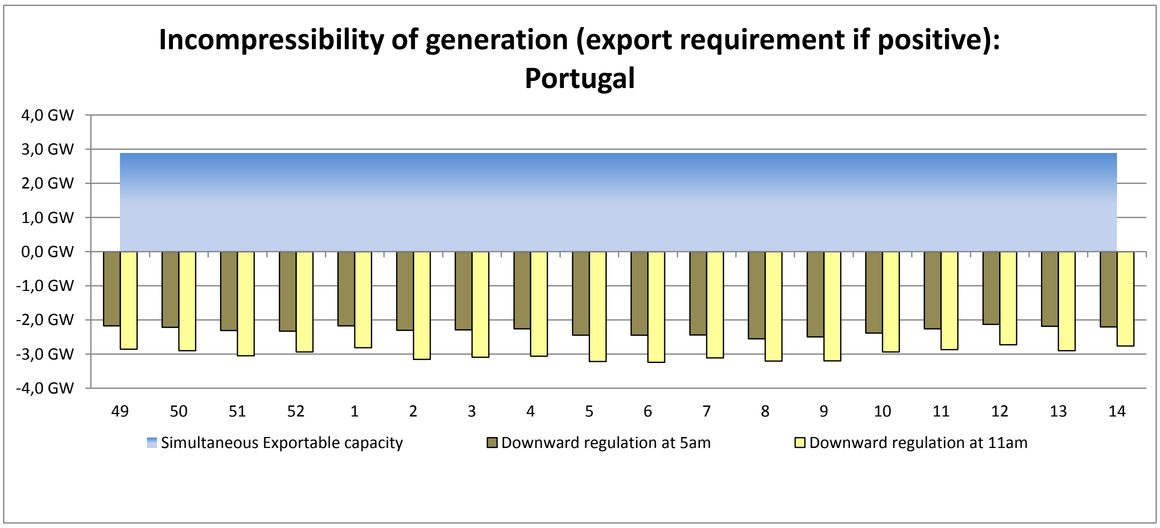
No critical periods were identified.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

No problems are envisaged with inflexible generation, as minimum demand, and the now reinforced pumped storage capacity, have enough room to accommodate excess of wind output with remaining must run units in all scenarios.







ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Romania

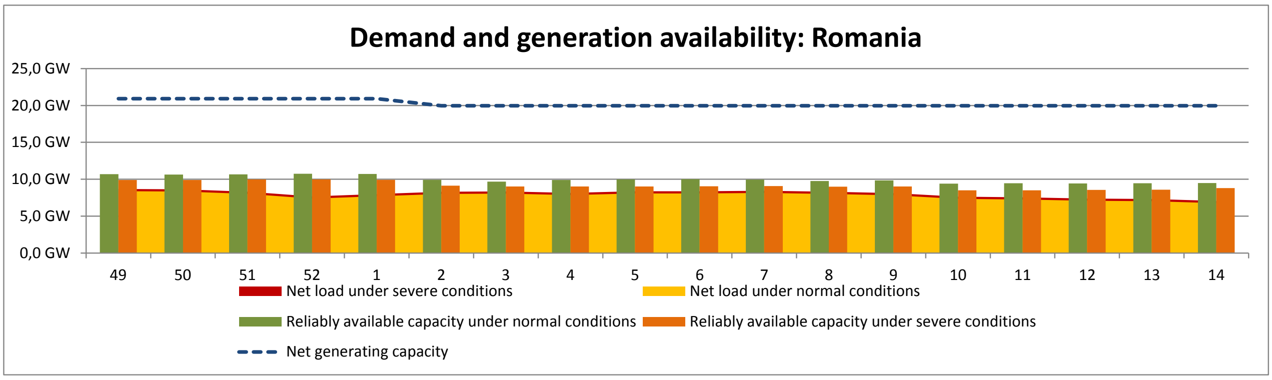
The maintenance programs for hydro and thermal units were performed mainly during the summer season. For the coming winter of 2015-2016, it is possible to have low hydro levels and low flows due to a dry and hot summer season.

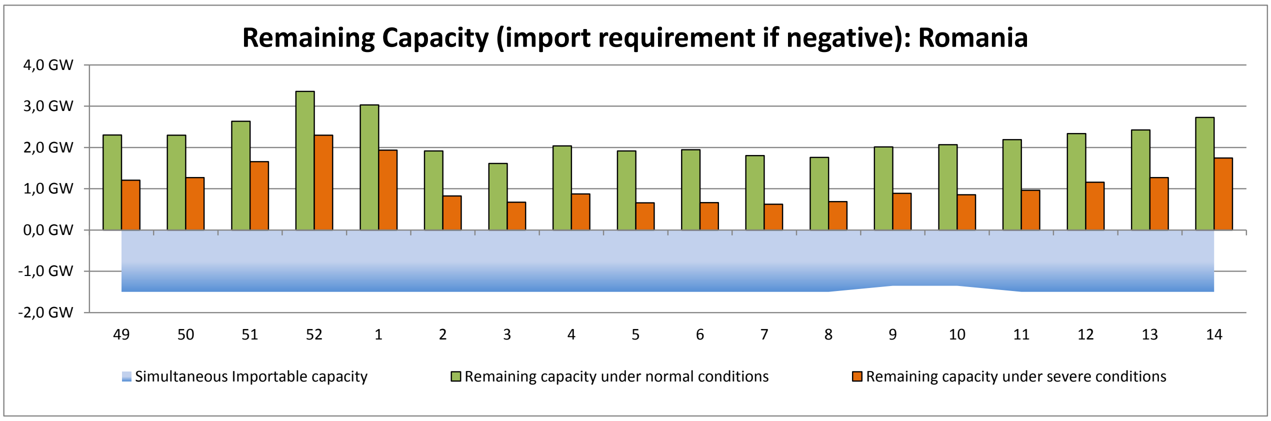
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

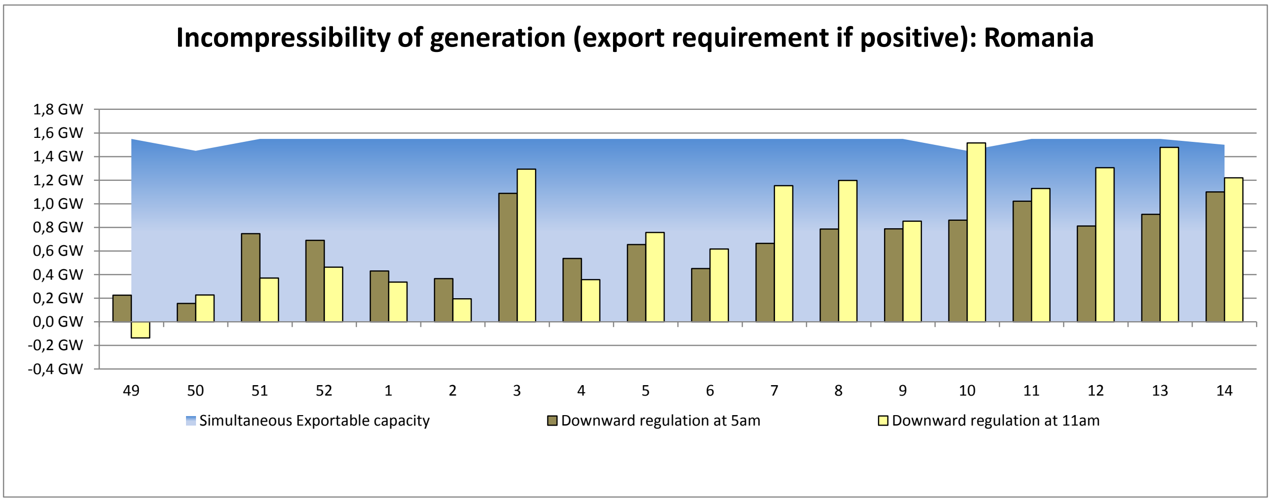
Critical periods of time may occur in bad weather conditions of temperatures below -15ºC for more than 5 consecutive days.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

One critical period for downward regulating capacity may occur during the minimum demand at 11 CET for the 10th week, if the wind and solar generations are at the level taken into account in the adequacy assessment. Similar situations may occur during the winter holiday intervals. In such situations, the market rules are applied to reduce proportionally the renewable generation (wind and solar) in order to maintain the power system balance.


Demand and generation availability: Romania
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Romania
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Romania
1,8 GW
1,6 GW
1,4 GW
1,2 GW
1,0 GW
0,8 GW
0,6 GW
0,4 GW
0,2 GW
0,0 GW
-0,2 GW
-0,4 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Serbia

For the upcoming winter, we don't expect problems covering demand. Moreover, a moderate amount of energy exporting is expected under normal weather conditions.

- Maintenance of power units and the transmission network is planned to be completed before a significant increase in demand. Only a major overhaul of the two hydro generators is planned throughout the winter. But lost power of 200 MW does not significantly affect the adequacy.

- It is estimated that a gas shortage may increase electricity consumption up to 300 MW, and further increase over this margin in the winter peak is not possible because of constraints in the distribution system (experience from the gas crisis in 2009).

- Problems covering demand can occur at extremely high peak loads under severe weather conditions, and then energy imports will be required.

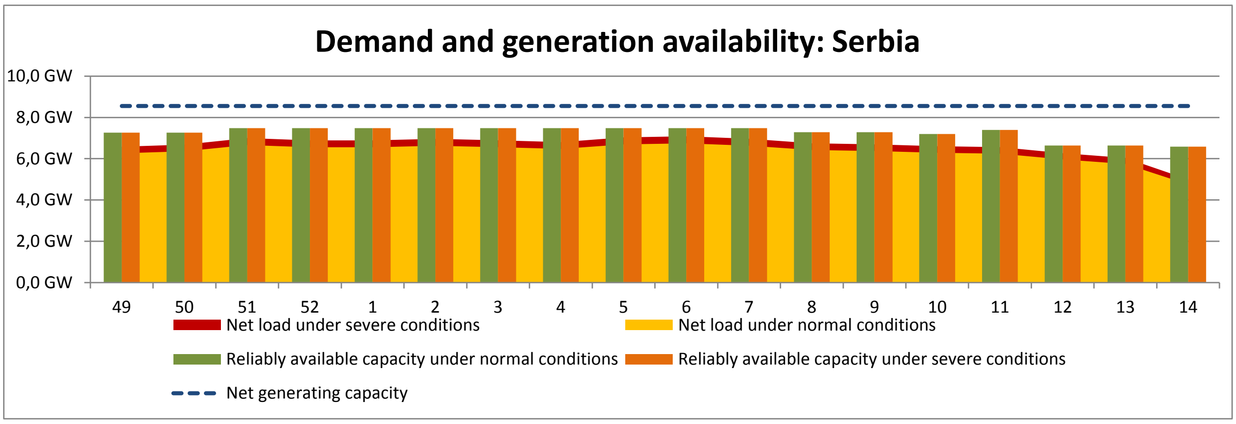
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

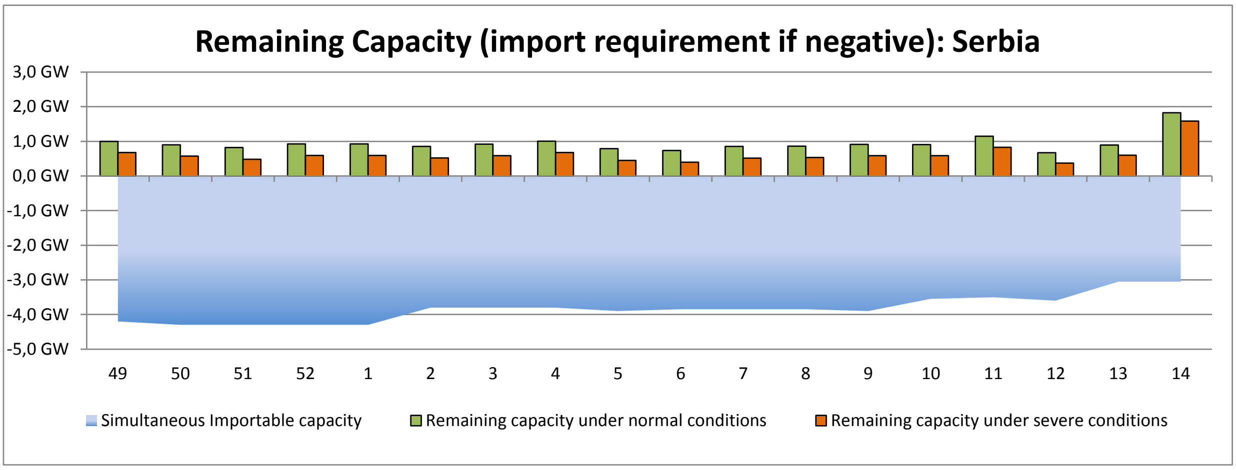
In the period from late December to February, under severe weather conditions, extremely low temperatures might cause very high peak loads, which couldn't be covered by domestic generation and energy imports, will be required to achieve generation-load balance. In that case, energy needs will be purchased on the Serbian market or from neighbouring TSOs through contracts for exchange of emergency energy.

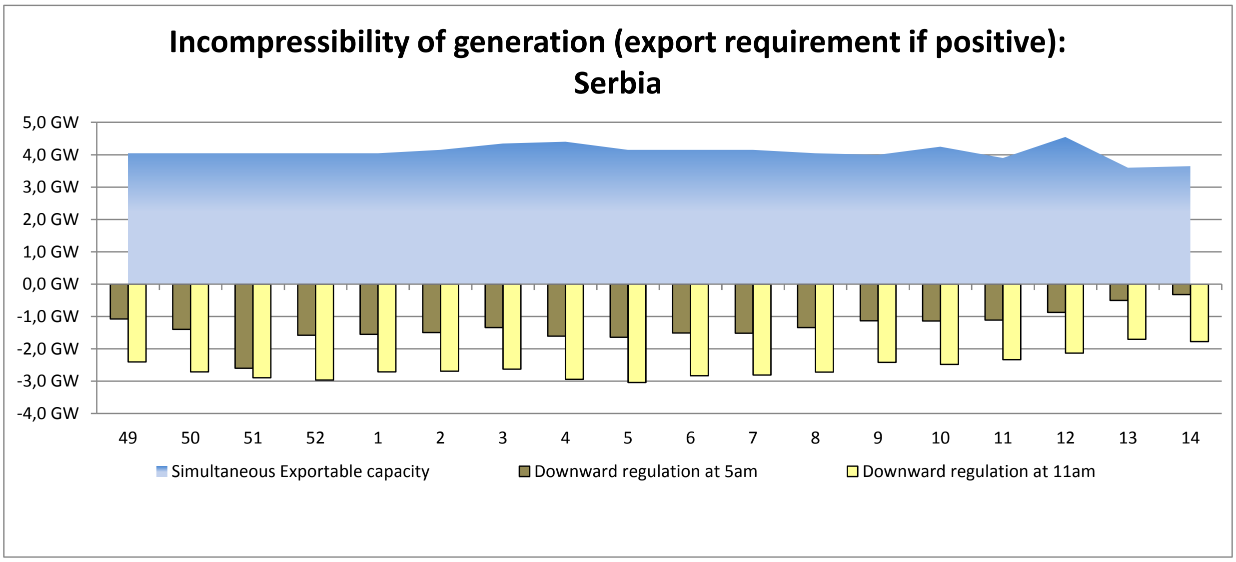
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

In general, there are no needs for energy exports during low demand periods. The surplus of energy is compensated for by domestic pumping storage.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu







ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Slovakia

We assume that the generation capacity will be sufficient to meet the expected peak demands for the winter and to ensure the appropriate level of security of supply. The generation capacities are sufficient to cover peak loads under normal and severe conditions.

Under normal conditions no problems regarding load generation balance are expected in Slovakia for winter 2015/2016. The weekly peak load is calculated for both normal and severe conditions. The peak demand is expected to occur during weeks 5 to 7. We do not expect any problems related to shortages of transmission capacity or low generation availability. All maintenance work has already been performed during the summer. The hydro forecast has been made based on historical annual data, and we expect hydro generations at the same level as previous years.

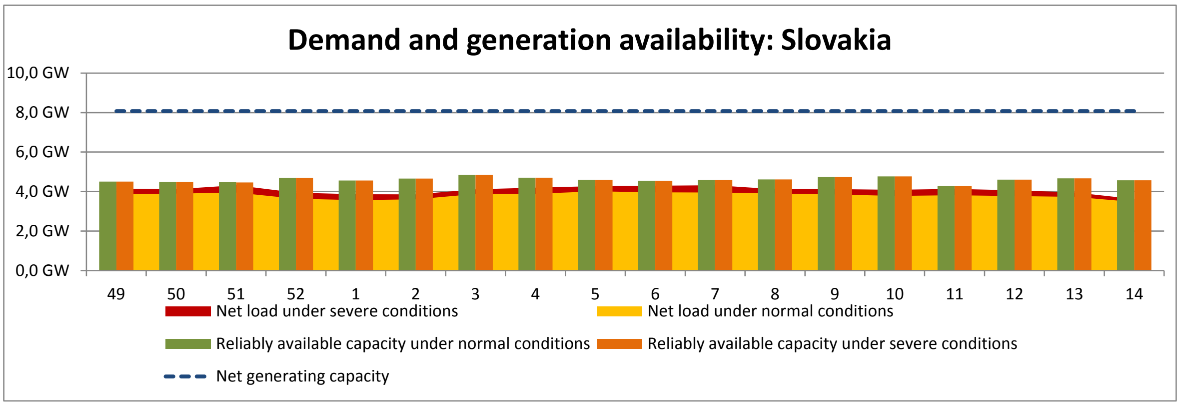
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

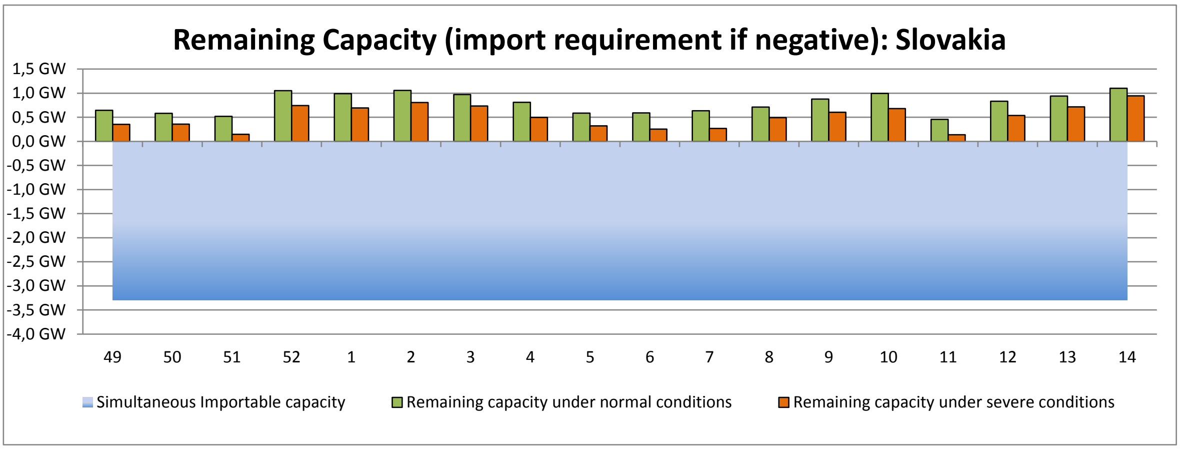
No specific critical periods are expected in Slovakia for the winter of 2015/2016. In general, the interconnections are sufficient for the import/export of electricity.

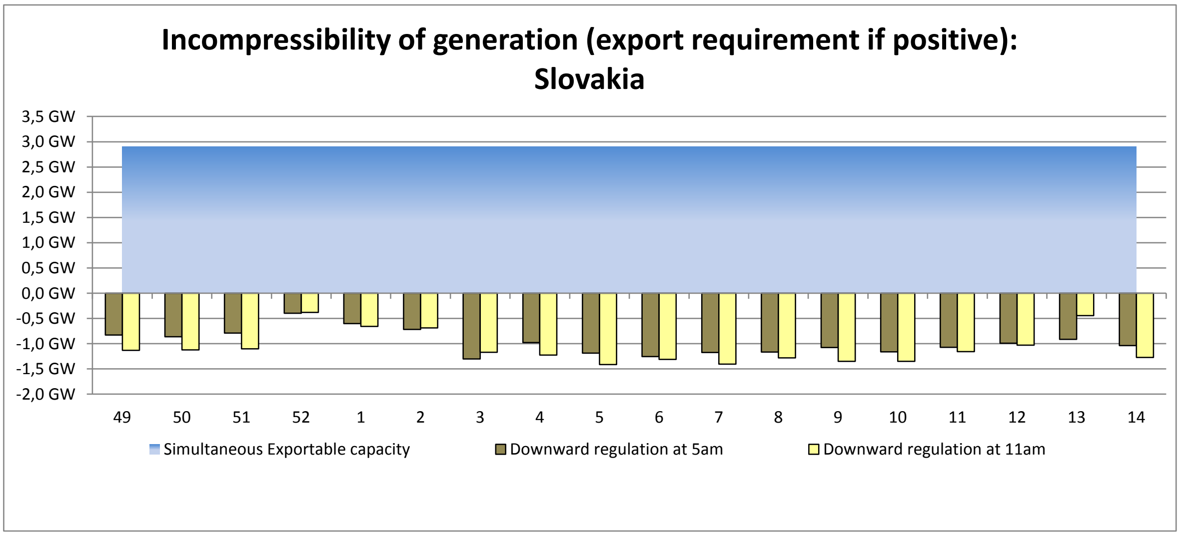
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

No specific period is considered critical during the winter period. No problems concerning interconnectors are expected.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Slovakia
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity

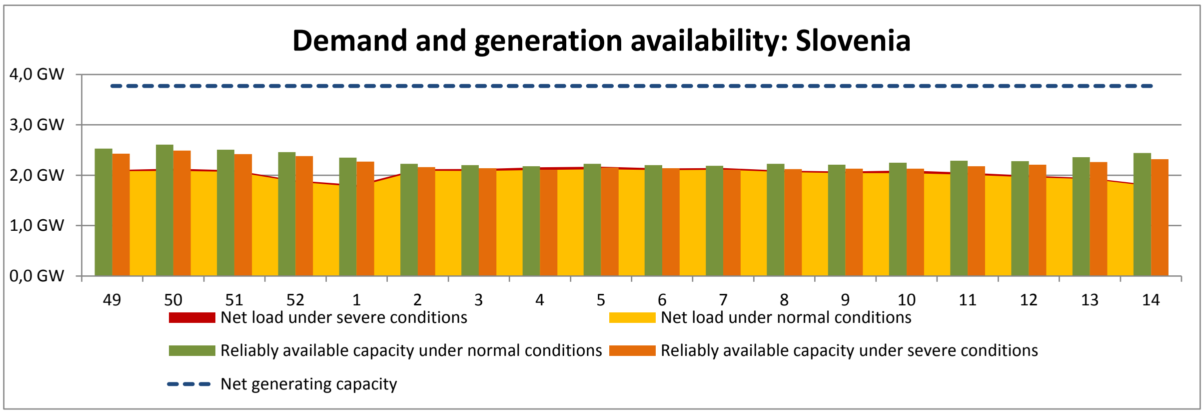

Remaining Capacity (import requirement if negative): Slovakia
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
-2,5 GW
-3,0 GW
-3,5 GW
-4,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions

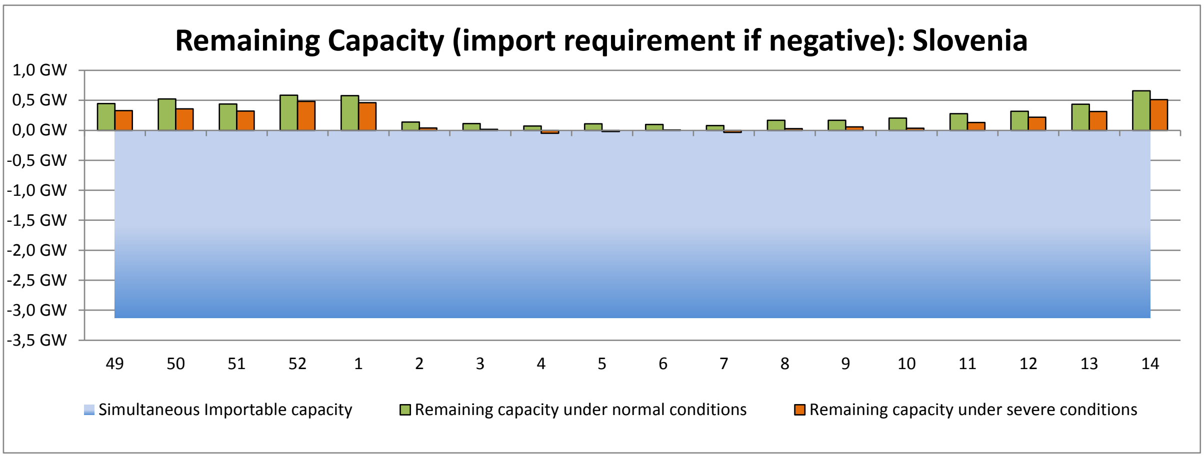

Incompressibility of generation (export requirement if positive): Slovakia
3,5 GW
3,0 GW
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

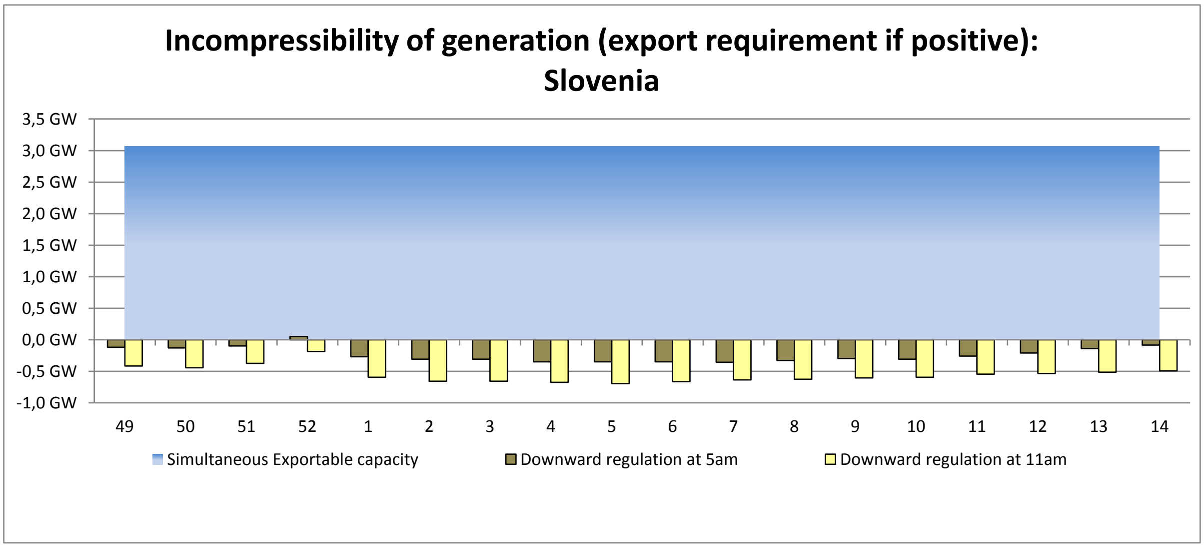
Slovenia

The Remaining Capacity should be positive during the entire winter period. The lowest Remaining Capacity is expected during weeks 4 and 7. In this period, lower hydro production and higher consumption are expected due to low hydrology and low temperatures. Peak load in the winter period is expected in the second half of January and in February. No problems are expected in system operation security or security of supply.

Imports will help cover the load in peak time. There is sufficient import NTC available on the interconnectors.


Demand and generation availability: Slovenia
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Slovenia
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
-1,5 GW
-2,0 GW
-2,5 GW
-3,0 GW
-3,5 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Slovenia
3,5 GW
3,0 GW
2,5 GW
2,0 GW
1,5 GW
1,0 GW
0,5 GW
0,0 GW
-0,5 GW
-1,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Spain

From the point of view of generation adequacy, there's no detected risk situation in the Spanish peninsular system for the upcoming winter. Good generation/demand adequacy can be expected regardless of imports from neighbouring countries. If average conditions are considered, the remaining capacity will be over 15 GW. In the case of simultaneous extreme peak demand, very low wind generation (around 10% of wind installed capacity), drought conditions and a high thermal forced outage rate, the assessed remaining capacity is still over 7.8 GW.

The demand values have been increasing during 2015 after the significant drop that took place during the past years due to the economic and financial crisis. It is expected that the total demand in 2015 will increase. Nevertheless, the demand peak values expected for winter, with low temperature values and a probability to be reached of 1%, are the same as expected for last year.

The most important risk factors for next winter in the Spanish system are hydro and wind conditions, sensitivity of load to temperature in extreme weather conditions and gas availability to the combined cycle thermal plants during situations of low RES.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

Given that there's no risk situation concerning generation adequacy, the period with the lowest remaining capacity is the first half of December and March due to increased overhauls.

Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

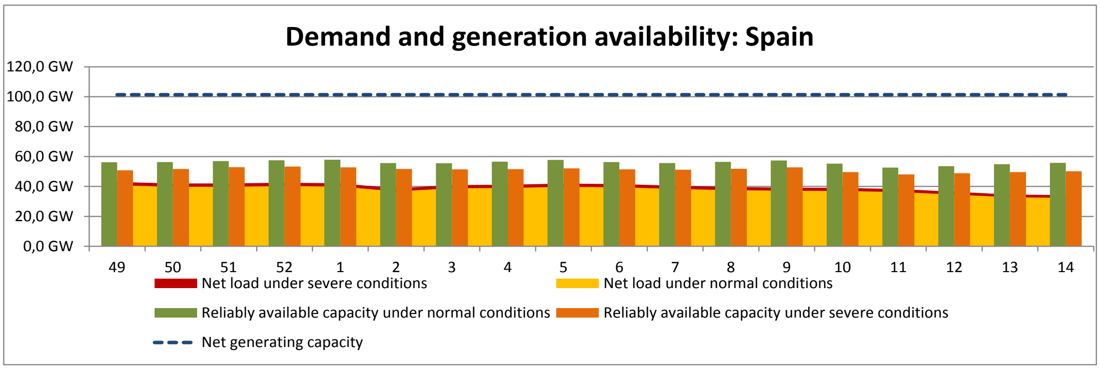
Concerning minimum demand periods with high probability of renewable energy sources spilling, March is the most critical month.

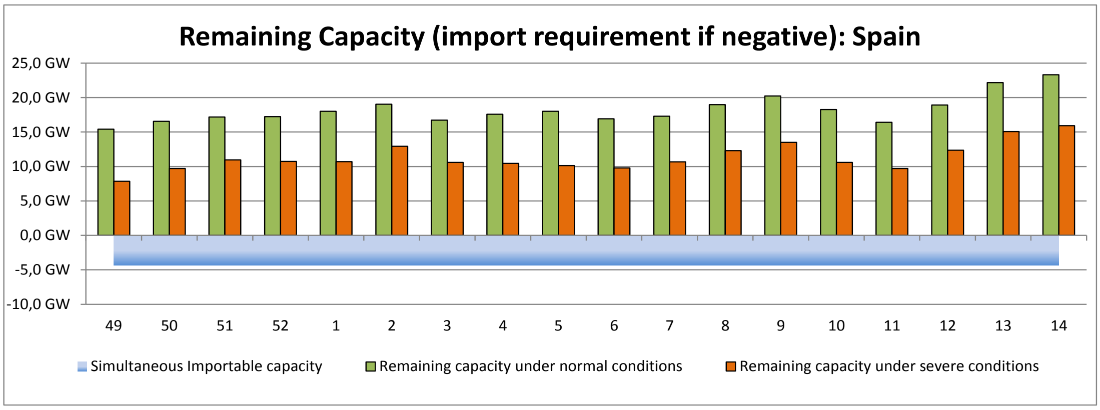
ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

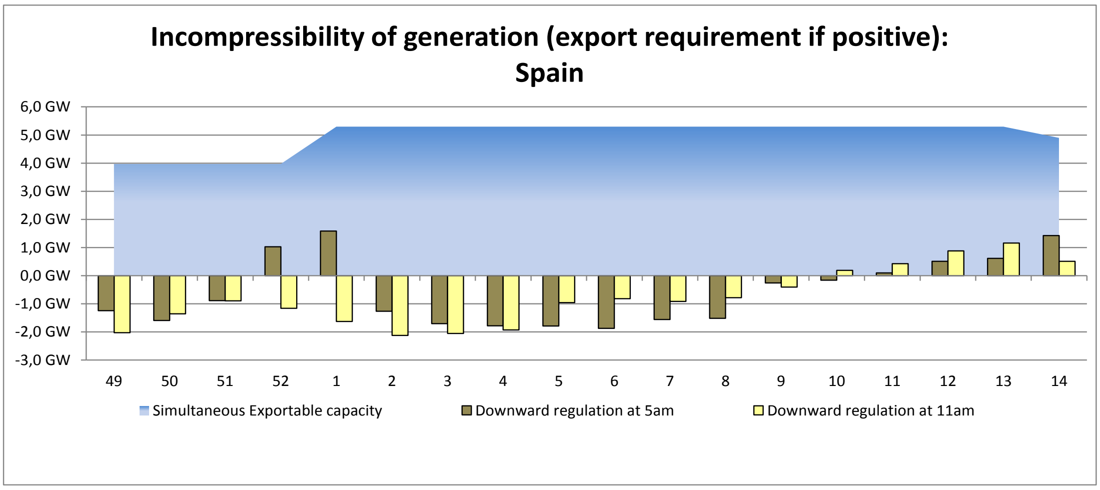
The export capacity of interconnectors is a key factor in order to avoid spilling renewable energy, mainly wind power. Another point worthy of mention is the importance of energy storage—mainly pump storage plants—in order to properly manage the excess of inflexible power. The installed capacity of hydro pump storage plants in Spain is around 5000 MW.

The Spanish TSO has a specific control centre for renewable sources (CECRE), which is permanently monitoring the renewable energy sources production. Downward regulation reserves may be composed of renewable power plants; first thermal production is reduced upon security criteria compliance. If additional reduction is needed, renewable energy sources Control Centre (CECRE) sends a new set point and supervises renewable production to keep a balanced situation.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Spain
120,0 GW
100,0 GW
80,0 GW
60,0 GW
40,0 GW
20,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Spain
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Spain
6,0 GW
5,0 GW
4,0 GW
3,0 GW
2,0 GW
1,0 GW
0,0 GW
-1,0 GW
-2,0 GW
-3,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Sweden

The domestic power balance is expected to be positive in both normal and severe winter conditions for the chosen reference point in time. Please note that this does not represent the peak load hour in Sweden, and the power balance during peak load is not as good as shown in the figures. For severe conditions at national weekly peak load, approximately 1 GW of imports are needed in the most strained weeks. This is considered sufficient due to the strong import capacity of more than 9 GW. The results are not the same as in Svenska Kraftnät's annual domestic report regarding power system adequacy, but the severity of the scenarios in both reports are essentially the same.

A critical factor in predicting the Swedish domestic power balance is the availability of the Swedish nuclear power plants. The nuclear power plant Oskarshamn 2 will permanently discontinue electricity production and will not be in operation this winter. This affects Sweden's ability to be self-supporting during peak load and makes the availability of Swedish nuclear power more essential than before. However, in this Winter Outlook analysis, the capacity from Oskarshamn 2 was assumed to be available since the official decision of closure was made after the data submission. Moreover, reduced availability of nuclear units (which are located in the middle/south) reduces transmission capacity in the Swedish national grid.

The hydro power reservoir levels in Sweden are, in early autumn, approximately 5 percentages above the median value for the period 1990-2012, which means that the availability of hydropower is good. As almost all hydropower units are located in the north and most of the demand is located in the south, the transmission capacity from northern to southern Sweden is of great importance to the Swedish power balance. For that reason, maintenance work that reduces the transfer capacity (from north to south) is avoided during the winter period, as not to increase the risk of power shortages. Maintenance work on production units that might jeopardise generation adequacy is also avoided as much as possible during the winter period.

Sweden will not be directly affected by a reduced gas flow. The large CCGT plants can run on alternative fuels.

Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

The electricity demand in Sweden is strongly dependent on outside temperatures. Peak load occurs at periods with very cold weather, and these periods might happen any time between December and March, which is why it is difficult to point out in advance which weeks are expected to be most critical.

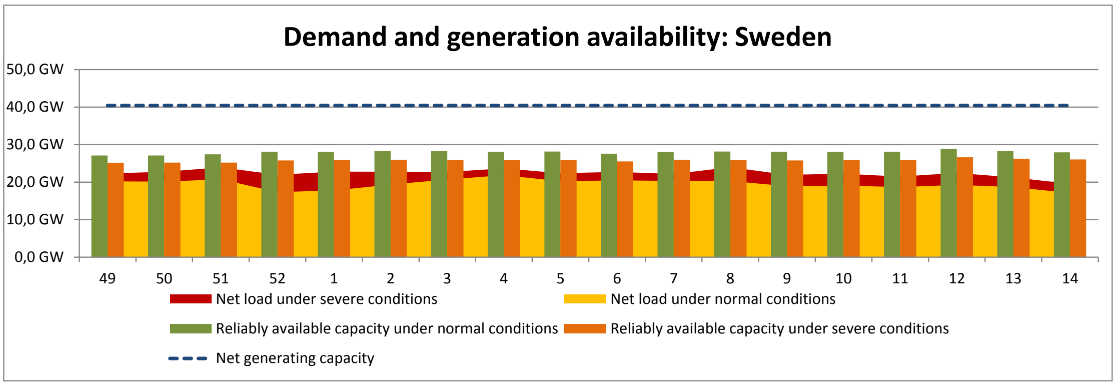
To secure power adequacy, Svenska Kraftnät contracts a so-called Peak Load Reserve every winter, consisting of production capacity and load reduction. The Peak Load Reserve can be activated on the Nordic electricity market, Nord Pool Spot (NPS), when there is a risk for curtailment. This happens very rarely (last time was in 2009, and according to NPS there has been little risk of curtailment since then). The Peak Load Reserve can also be activated by Svenska Kraftnät during operation for balancing purposes. This winter (2015-2016) the Peak Load Reserve consists of 660 MW production capacity and 340 MW load reduction. The Peak Load Reserve consists exclusively of reserve bids that most likely would not be available to the market without the economic compensation they are given.

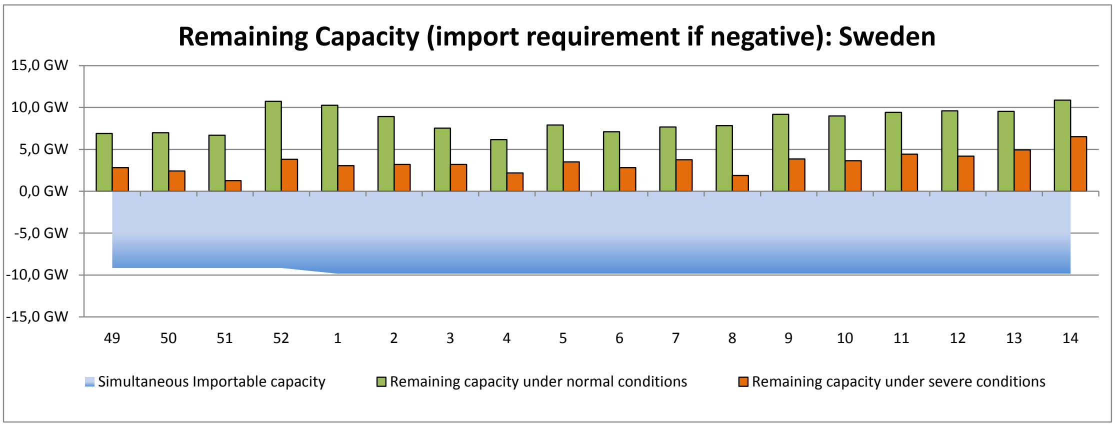
Although Svenska Kraftnät predicts Sweden to be independent of imports for the peak load hour for normal winter conditions, the interconnectors play an important role. Interconnectors contribute to even out prices and are also very important for balancing purposes (to enable an exchange of balancing power between the Nordic countries). A new connection between Sweden and Lithuania with a maximum transportable capacity at 700 MW is planned to be in operation at the end of 2015/beginning of 2016. The first part of an additional internal Swedish link, the SouthWest Link, is also planned to be operational at the end of December 2015.

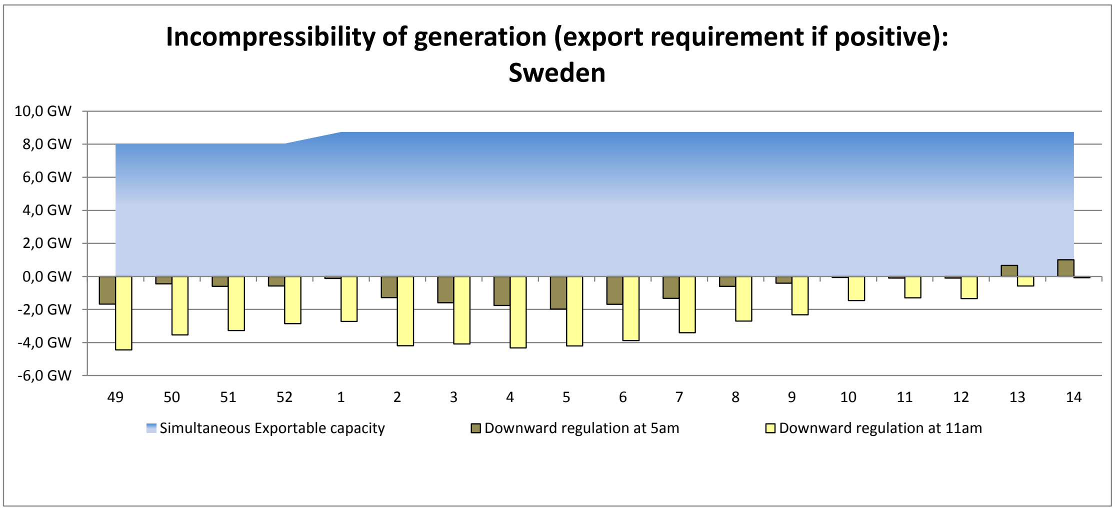
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

Svenska Kraftnät is not expecting any down regulation issues thanks to a high share of flexible hydropower. Export is, however, required for some weeks in the severe scenario where the excess of inflexible generation is at most 1 GW. This is considered sufficient due to the strong export capacity.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu


Demand and generation availability: Sweden
50,0 GW
40,0 GW
30,0 GW
20,0 GW
10,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity


Remaining Capacity (import requirement if negative): Sweden
15,0 GW
10,0 GW
5,0 GW
0,0 GW
-5,0 GW
-10,0 GW
-15,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions

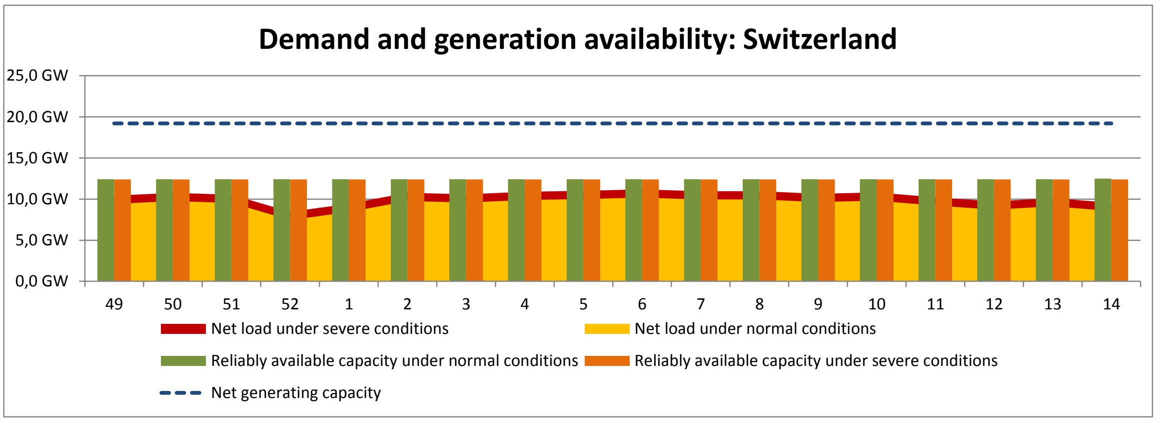

Incompressibility of generation (export requirement if positive): Sweden
10,0 GW
8,0 GW
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

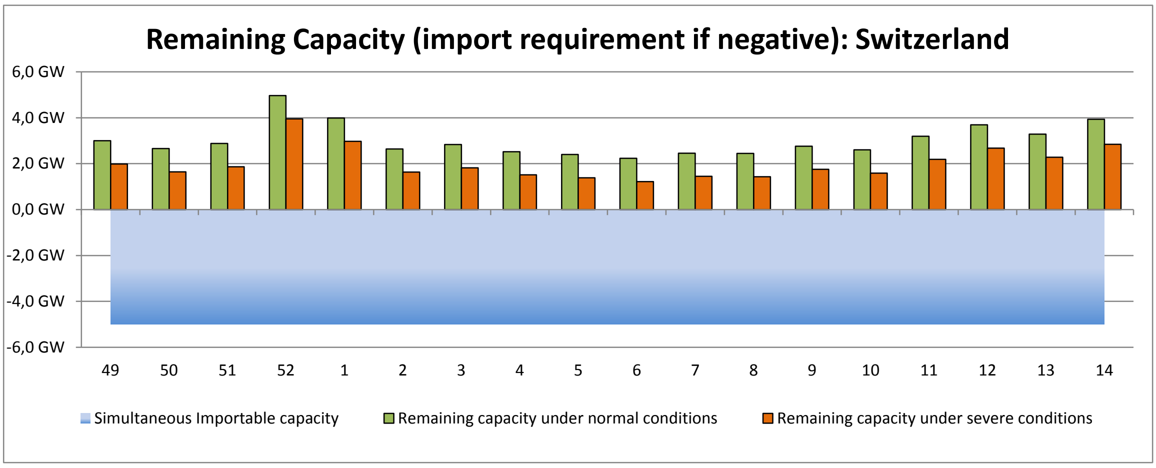
Switzerland

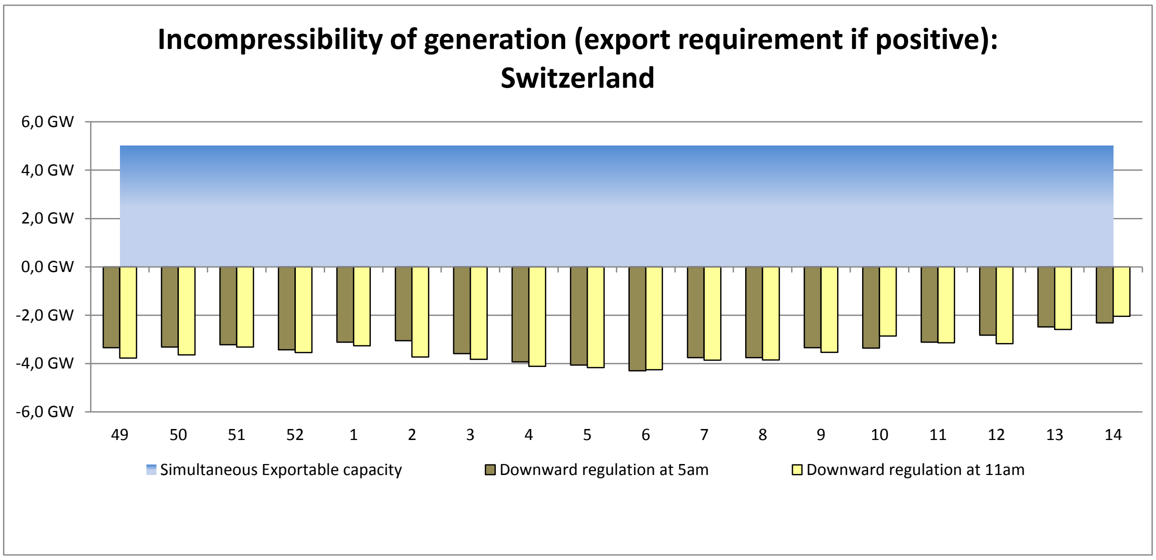
Using the current adequacy methodology, no special problem are detected.

Deterministic capacity-based assessments [MW] cannot reveal potential problems faced by hydro-dominant countries like Switzerland. In particular, for Switzerland it is very important to also consider energy constraints [MWh]. The typical winter deficit in Switzerland, which is observed in the results of the PLEF regional adequacy study (published in March 2015), cannot be properly reflected or inferred by the numbers provided according to the deterministic capacity-based assessments.

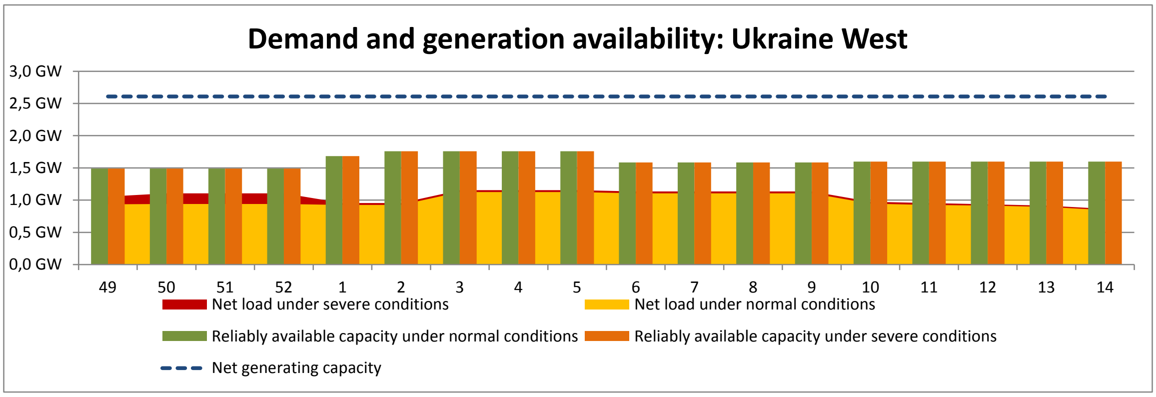
An extension of the methodology, including probabilistic assessments, is currently under step-wise implementation within ENTSO-E. The implementation of a full probabilistic methodology is challenging since it requires consideration of all stochastic variables within the Pan-EU scope. The scope of the probabilistic approach in this report focuses on assessing the sensitivity of the assessment for countries/regions that may have adequacy issues from the regional approach. Future extensions of both deterministic and probabilistic assessments aim to include better considerations of the energy constraints [MWh] e.g. in line with the methodology applied in the PLEF regional adequacy study (published in March 2015), according to the implementation roadmaps of the consulted ENTSO-E target methodology.

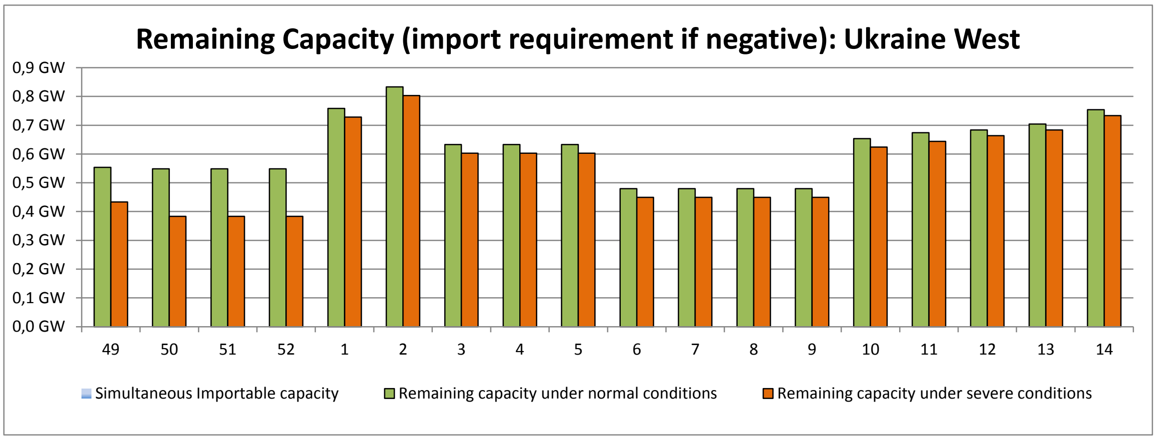

Demand and generation availability: Switzerland
25,0 GW
20,0 GW
15,0 GW
10,0 GW
5,0 GW
0,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Net load under severe conditions
Net load under normal conditions
Reliably available capacity under normal conditions
Reliably available capacity under severe conditions
Net generating capacity

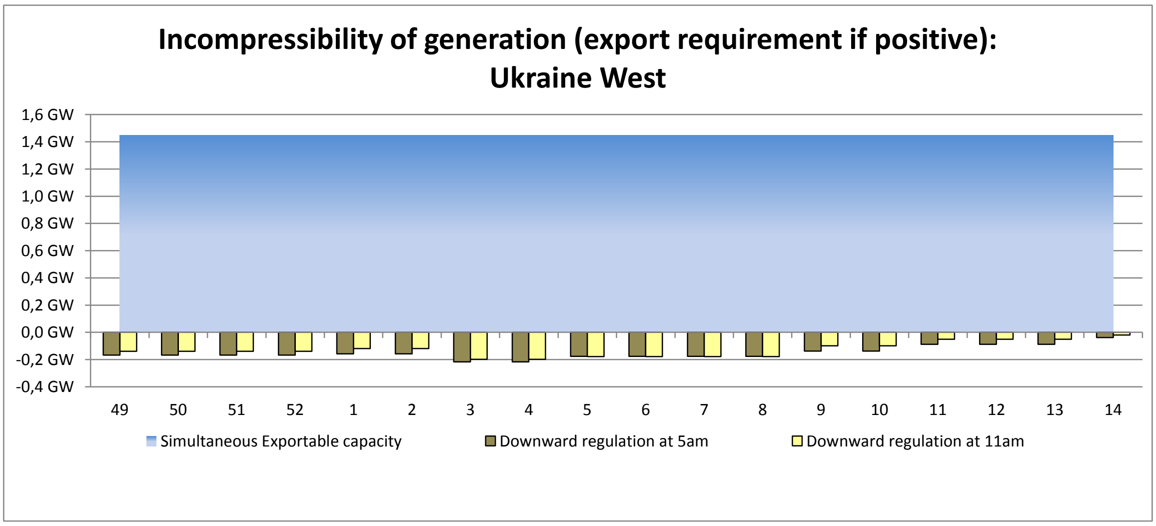

Remaining Capacity (import requirement if negative): Switzerland
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Importable capacity
Remaining capacity under normal conditions
Remaining capacity under severe conditions


Incompressibility of generation (export requirement if positive): Switzerland
6,0 GW
4,0 GW
2,0 GW
0,0 GW
-2,0 GW
-4,0 GW
-6,0 GW
49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Simultaneous Exportable capacity
Downward regulation at 5am
Downward regulation at 11am

Ukraine West







Turkey

There is very limited gas storage and also a high dependency on Russian and Iranian gas pipelines. Therefore, in case of a contingency in pipelines, a risk of inadequate generation can be observed.

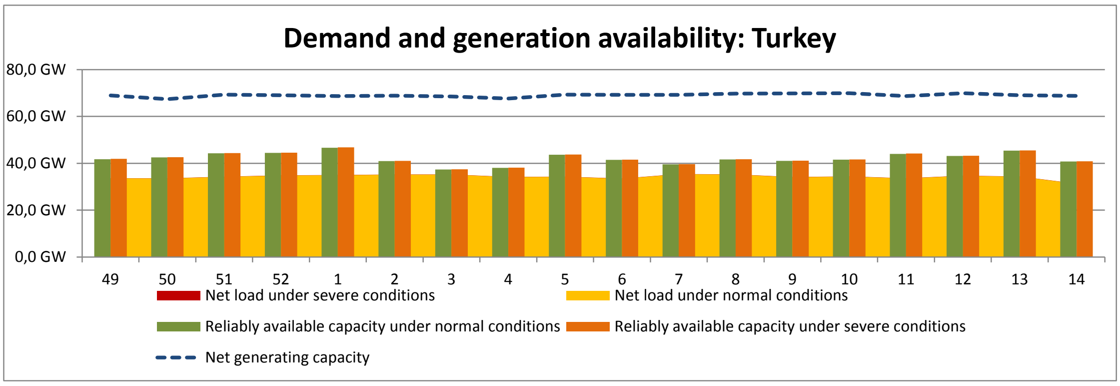
Most critical periods for maintaining adequacy, countermeasures adopted and expected role of interconnectors

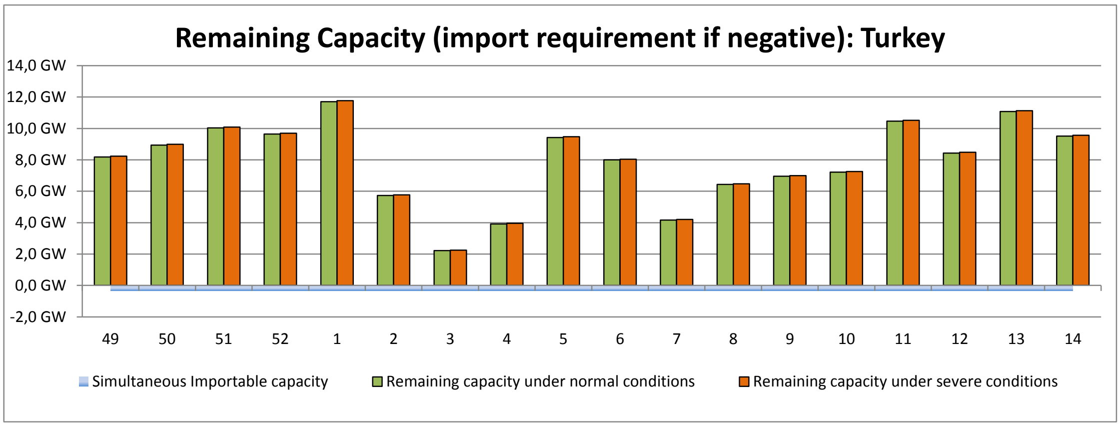
Summer peak loading condition (July-August)

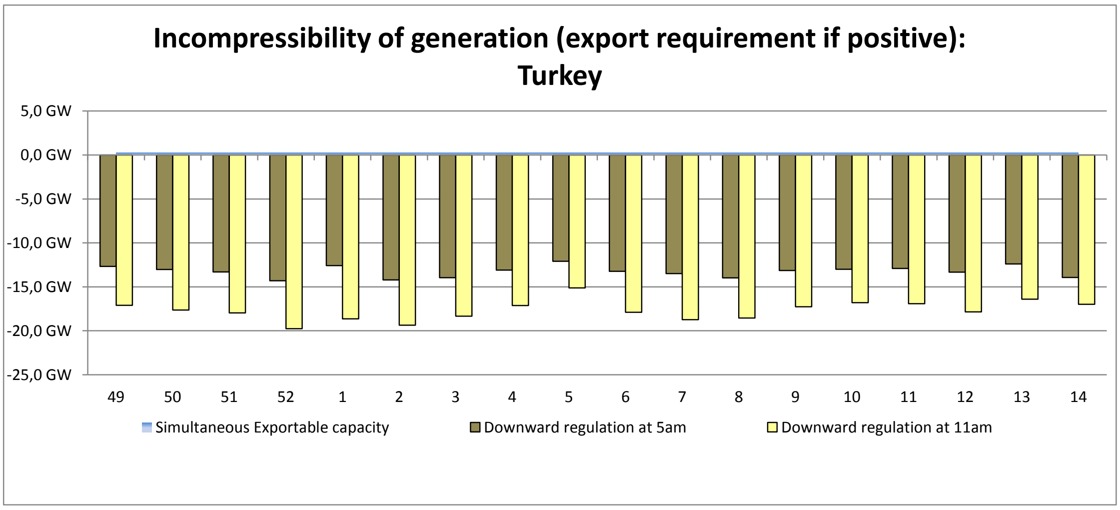
Most critical periods for downward regulating capacity, countermeasures adopted and expected role of interconnectors in managing an excess of inflexible generation

We do not have any critical periods.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu







ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Appendix 2: Individual country comments on the Summer Review

Albania

General comments on the summer 2015 climate and system adequacy conditions:

The summer season of this year is considered a relatively hot one, regarding the ambient temperatures and with the main energetic parameters of the power system. The hottest day of last summer was July 21, with a high temperature of 39°C. For reference, on that day the average temperature is 30°C.
Inflows in the Drin River cascade, which is the main source of the country's generation, were somewhat above the predicted ones, which helped us to maintain relatively high levels in the reservoirs of this cascade, and consequently to maintain a high level of energetic reserve of the country.

Comments on specific events occurring during the summer 2015 and resulting outages:

During the summer there were no unexpected situations that put the power system in a difficult situation. Peak load and electricity consumption was normal for the summer. There was no problem with interconnection capacity; the maintenance of interconnectors was accomplished according to schedule, as were the main part of the interior lines.

Austria

General comments on the summer 2015 climate and system adequacy conditions:

The summer of 2015 was one of the hottest summers since the beginning of weather forecasting. Not only did the temperatures peak, but the duration of temperatures above 30°C led to all-time highs.

Comments on specific events occurring during the summer 2015 and resulting outages:

During the summer there were several tie-line outages in Austria and also in neighbouring countries, which led to critical load flows. Therefore, many re-dispatch measures were taken.

Belgium

General comments on the summer 2015 climate conditions:

Summer 2015 was generally quite warm with periods of high temperatures and a lot of heat storms. Mainly towards the end of summer and the beginning of the fall, some periods with very low wind and solar infeed were experienced.

Comments on specific events occurring during the summer 2015 and resulting outages:

As a consequence of avoiding overhauls during the winter period, a lot of maintenance was planned in the months of April through May. Due to this high volume of overhauls, margins were tight during these months.

Towards the end of the investigated period in September, the ENTSO-E Summer Outlook 2015 predicted an increased adequacy risk under severe conditions for Belgium. In hindsight, these conditions materialised at the end of September and in the middle of October.

During that period, several generation units were still having a planned outage in combination with some planned infrastructure works on the Belgian High-Voltage grid to prepare the Belgian system for the winter. This led to very high international flows through the Belgian system that only remained barely controllable. International re-dispatch was needed on several days to relieve the transmission grid close to real-time in order to maintain system security.

For some days, a combination of very low wind and solar infeed in Belgium and the rest of Central-West Europe with the aforementioned generation and transmission outages has led to very high spot prices on the day-ahead market, up to values about ten times as high as what could be perceived as normal prices. These prices correctly represented the tenseness of the generation adequacy in Belgium for those days, but finally Belgium managed to import sufficient energy from neighbouring countries to avoid any acute adequacy issues.

With the return in operation of major generation units and the return to a fully available transmission grid at the end of October, the situation has normalised before the start of winter, adequacy-wise as well as concerning system security.

New infrastructure that has been or will shortly be commissioned:

- New substation Horta (end of May)
- New substation Van Eyck (end of August)
- New 380 kV line between Van Eyck and Gramme (foreseen for mid-October)
- Second Phase Shifting Transformer in series with the first in Zandvliet (foreseen for end of October)

Bosnia and Herzegovina

General comments on the summer 2015 climate and system adequacy conditions:

During the summer of 2015 there were no unexpected situations that affected the power system in Bosnia and Herzegovina. The minimum load of 878 MW was registered on June 1 at 4:00, while the maximum load was registered on July 16 at 15:00, and it was 1764 MW. Monthly power balances were positive during this period.

Bulgaria

General comments on the summer 2015 climate and system adequacy conditions:

The electricity demand for the summer period of June 2015-August 2015 increased by 2.7 % compared to the same period in 2014 (comparison based on normal temperature-adjusted monthly consumption). It was a very hot and dry summer with long heat waves. The hottest working day was 21 July (Tuesday) with temperatures: Tmin =19.2°C , Tave=28.3°C, Tmax=35.9°C. For this day the peak load was 5018 MW (observed at 13 p.m. CET) and the daily consumption was 102353 MWh. No balancing problems were experienced during the studied period and no generation was curtailed. There were no critical outages in the transmission network or interconnection lines. During the whole period Bulgaria exported electricity to neighbouring countries.

The current hydro levels in some of the big reservoirs are below the target due to the hot and dry weather conditions.

Croatia

General comments on the summer 2015 climate and system adequacy conditions:

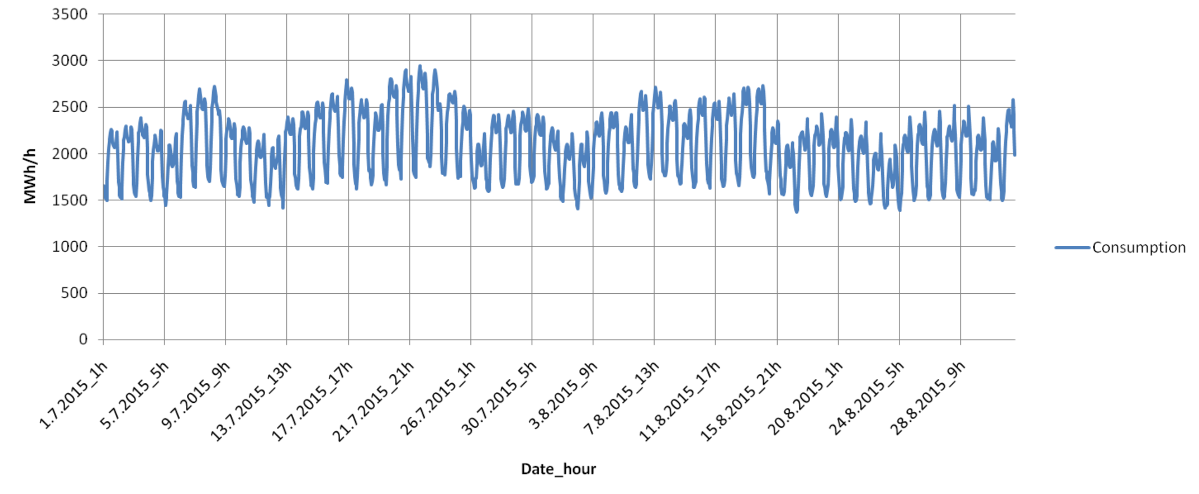
Extremely high temperatures occurred during July 2015. That was the main reason for the higher consumption of the Croatian power system (Figure 1.). Greater imports of electricity were also noticed during the entire summer.

Comments on specific events occurring during the summer 2015 and resulting outages:

Generally, there were not a lot of unplanned outages in the Croatian power system.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Figure 1. - Consumption of Croatian power system (Summer 2015)



Czech Republic

General comments on the summer 2015 climate and system adequacy conditions:

Summer conditions were influenced mainly by high temperatures in August. The average daily temperature was 23.95°C. The maximum hourly temperature was up to 37°C. The water level was extremely low during July and August mainly due to high temperatures and minimal rain.

Comments on specific events occurring during the summer 2015 and resulting outages:

Summer conditions were influenced mainly by high temperatures in August. The problem of gas supply did not occur during the summer. No major problems in generation or networks occurred during the summer.

Denmark

General comments on the summer 2015 climate and system adequacy conditions:

The summer of 2015 was cooler and windier than last summer. There were no problems in the transmission system because of the weather, and there have only been a few operational disturbances.
The power balance was steady over the summer. There were a few days with slightly high prices, but in general the electricity prices were very low. The low prices were due to a lot of wind generation, which again resulted in a situation in which most of the central power plants did not run. In week 36, we experienced, for the first time, that the transmission system was driven without a single central power plant in Eastern DK. The overhaul work during the summer was at a normal level. There are still massive limitations on the border to Germany because of the upgrades in Northern Germany. Due to the limitations in Northern Germany, there have been high amounts of countertrade (up to 400-500 MW in situations with a lot of wind generation).

Estonia

General comments on the summer 2015 climate and system adequacy conditions:

This summer the average temperature was 14.29°C, while the maximum measured temperature was around 28°C and the minimum 2.6°C. The warmest month was August.

Comments on specific events occurring during the summer 2015 and resulting outages:

The wind conditions during this summer were quite good compared with last year, and 39% more electricity was produced from wind in July. No extreme temperature occurred during this summer: May, June and July were quite cool, but in August the average temperature was higher (ca 3°C) than the summer average temperature. The load was not significantly different than expected and was similar to previous years. The peak load during the summer (01.06. until 01.09.) was 1,068 GW, which occurred on 28.08.2015 at 12:30 CET. The minimum demand was 0.48 GW, which occurred on 27.07.2014 at 04:35.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Finland

General comments on the summer 2015 climate and system adequacy conditions:

There were neither adequacy problems nor deviations from expectations during the summer of 2015. Temperatures in July and June were below average, whereas the end of summer was warm. Summer was also rainy, and there were floods in northern Finland in early August.

Comments on specific events occurring during the summer 2015 and resulting outages:

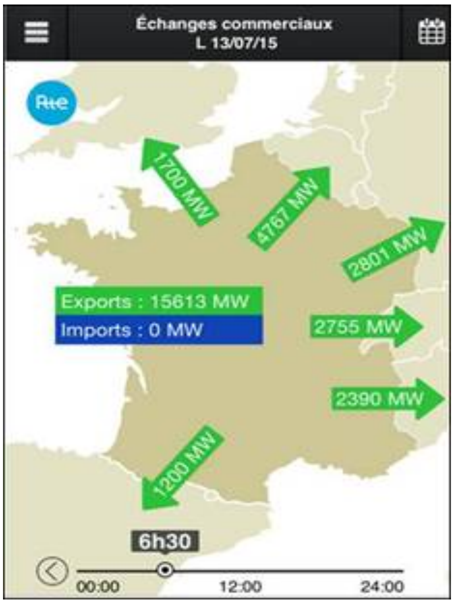
Several overhauls of both production units and transmission lines were carried out in the summer as predicted. All incidents were managed with normal system operation procedures.

France

General comments on the summer 2015 climate and system adequacy conditions:

Summer 2015 included two heat waves in July as well as cool and rainy weather in August. An exception was made in the northeast of France where the weather was very dry and warm with a new heat wave in August. The temperatures were 1.5°C higher on average than the normal conditions: summer of 2015 was the second hottest summer after 2003. Globally, the precipitations were close to the normal conditions in the country.

These weather conditions, in addition to a high nuclear power production and low consumption, with a minimum of 30,000 MW on the 16 August, resulted in a monthly balance of RTE that was highly exporting all summer. Since the launch of Flow-Based in May 2015, on the 13 July very high export levels were reached, with an export level between 9200 MW and 15,600 MW mainly in the CWE area (see the below diagram). The historical value of 15,600 MW was attained between 6 am and 7 am CET.



Comments on specific events occurring during the summer 2015 and resulting outages:

On 8 July, there was a gap in demand between actual and expectations of more than 2000 MW from 8:30 CET to 23:45 CET, with a maximum gap of 3800 MW at 1 pm. This gap was mainly due to the sudden cooling of -15°C compared to the previous day: indeed the calculation model has some limitations in the case of strong transitions. Moreover, the thermo-sensibility part of the consumption was underestimated. In the beginning of July, some degradations of equipment were caused by the extreme temperatures and its important variations at night. These incidents led to 700 MW of load shredding in the West area and some outages due to damages. Generally all summer, and particularly in August, pre-agreed contractual commitments have permitted to limit overvoltage.

FYRO Macedonia

Comments on specific events occurring during the summer 2015 and resulting outages:

During the summer period this year the Macedonian Power System did not happened unexpected and unplanned events with significant (regional) character. All intended maintenance and overhauls work was completed according to the plans. This summer had mild temperatures, which, during June and July, respectively, delayed the use of air conditioners. Interconnection was available during the whole period and there was not any difficulty regarding NTC quantity, cross-border allocation or relationship with market participants.

Germany

General comments on the summer 2015 climate and system adequacy conditions:

This year's summer was dry and hot in Germany. Rainfall was 14% below average and mean temperature was 18.5°C which is 2.2°C more than the average of the years 1961 to 1990. Therefore, problems with the cooling water supply of power plants occurred but not to a critical level.

Comments on specific events occurring during the summer 2015 and resulting outages:

Last summer the installed capacity of photovoltaic plants has further increased to a value of about 38.1 GW. The German government has decided to stop subsidies for new photovoltaic plants when an installed capacity of 52 GW has been reached. Large parts of Germany experienced in the first third of July and in the first week of August the hottest days since records began to be kept. The daily maximum increased to 35°C or more. On 5 July a new national temperature record of 40.3°C was set.

Due to tight power balance in Poland, caused by a longer dry spell, only limited bilateral re-dispatch potential was available to limit unscheduled flows through Poland. This led to a higher amount of multilateral re-dispatch with other TSOs (south to Germany) to keep N-1 security on the profile Germany-Poland.

Greece

General comments on the summer 2015 climate and system adequacy conditions:

During last summer there were normal climatic conditions without anything extreme and the temperature was normal for the season.

Comments on specific events occurring during the summer 2015 and resulting outages:

The only problem that arose during the summer was the gas shortage that occurred at the west branch of a gas supply system, and as a result 2 Units (~800MW capacity) were unavailable from 01/09/2015 to 04/09/2015.

Great Britain

General comments on the summer 2015 climate and system adequacy conditions:

The summer of 2015 was both cooler and wetter than either of the two previous summers, although not exceptionally so. In June there was plenty of dry, settled and sunny weather in the south but it was more unsettled across Scotland. However, after a brief heatwave on 1 July, both July and August were often cool, unsettled and with heavy rain at times. Mean temperatures were below average for all three months; the UK anomalies were: June (-0.4°C), July (-0.7°C) and August (-0.2°C). There were some notably cold nights during mid to late July. Summer rainfall totals were above average for most areas. June was drier than average for most of the UK. Then in both July and August most of the country was wetter than average. The UK rainfall anomalies were: June (75%), July (140%) and August (120%). Summer sunshine totals were near average for the UK overall.
- Source from the Met Office the summary of Summer 2015.

Comments on specific events occurring during the summer 2015 and resulting outages:

There were 25 unplanned generation outages (averaged 570MW/day) and 25 planned generation outages (averaged 400MW/day) in June, 26 unplanned generation outages (averaged 580MW/day) and 22 planned generation outages (averaged 556MW/day) in July and 28 unplanned generation outages (averaged 630MW/day) and 20 planned generation outages (averaged 420MW/day) in August;
No generation closed and only one unit (110MW) was re-commissioned in past Summer.

The summer went as planned regarding margins, only there were a couple of localised downward margin issues in July and August which were due to local constraints and high wind conditions in the northwest corner of Scotland. There was an unplanned outage on the French Interconnector (8 July).

Hungary

General comments on the summer 2015 climate and system adequacy conditions:

The summer temperature of 2015 was higher than the previous years so there was a high energy demand for the Hungarian power system. Outages of generators were rather low. The grid was reliable and controllable.

Comments on specific events occurring during the summer 2015 and resulting outages:

In August the actual demand was higher than the expected demand, because the temperature was higher than normal this month. The peak load in the summer (6447 MW) almost exceeded the peak load of the last winter (6461 MW).There weren't any significant outages. They were between 100 and 500 MW.

During the summer of 2015, due to unexpected grid and load-flow situations, internal re-dispatch had to be applied in order to maintain the security of supply in some cases.

Iceland

General comments on the summer 2015 climate and system adequacy conditions:

Due to a cold summer, the snow has not been melting as usual. This has not had any effect on the operation of the grid this summer, but is likely to induce need for load curtailment in the coming winter.

Comments on specific events occurring during the summer 2015 and resulting outages:

The summer is the best period for maintenance of the transmission system in Iceland. This summer there has been some maintenance work as well as reinforcements on the system on all voltage levels (from 33 kV up to and including 220 kV). Thus, the system has been operated accordingly, without any need for curtailment.

Ireland

General comments on the summer 2015 climate and system adequacy conditions:

The last period was broadly in line with expectations.

Italy

General comments on the summer 2015 climate and system adequacy conditions:

The adequacy evaluation for the winter period has not evidenced particular risk for capacity adequacy and load covering. The summer season recorded values of the average temperatures higher with respect to the same period of the previous year with a consequent increase in demand.

Comments on specific events occurring during the summer 2015 and resulting outages:

The summer of 2015 recorded a significant increase (about 5.6%) in electricity demand over the same period of 2014. This is mainly due to a considerable rise in temperatures, especially for the month of July, August and the first week of September. Throughout the month of July, in particular, the values of maximum temperature were always higher than 4°C with respect to July 2014. In this conditions the peak of consumption was reached, on 21 July, with 59 353 MW (+15.3% respect previous year), and the peak of daily energy. The balance of the physical exchanges showed an increase of 17.2% compared to the same period of the previous year. Italy’s northern interconnection has been mostly characterised by import conditions from the neighbouring systems bordering at the northern interconnection. On several occasions, due to high generation from renewable sources, the Italian interconnection has recorded exports to the neighbouring systems.

Latvia

General comments on the summer 2015 climate and system adequacy conditions:

The actual air temperature was similar to the historical annual air temperature in June and July, but in August the air temperature was much higher than the historical annual air temperature.

Comments on specific events occurring during the summer 2015 and resulting outages:

The power system's actual load was lower than the forecasted load in normal and severe conditions for the whole summer, except 12th of August 2015, when the actual load exceeded the forecasted load in normal and severe conditions. The increase of load can be explained by a higher average air temperature in August. The actual load has been lower than the forecasted load for normal conditions by 8% on average. The actual peak load didn't exceed the forecasted peak load for normal and severe conditions and the actual peak load was lower by 5% on average. On 24 June 2015 a very low actual load was observed, and the reason for that was a midsummer holiday in Latvia when usually the load minimums are fixed. The big, significant faults in the interconnectors were not observed. The real import capacities to LV have been higher than planned but the real export capacities have been lower than planned. These deviations of plan didn't cause trouble in the Latvian power system and the available capacities were used efficiently.

Lithuania

General comments on the summer 2015 climate and system adequacy conditions:

In the summer of 2015 the total consumption increased 1.8%. The average temperature in June and July was 1°C lower than it was in 2014. The maximum load was reached in the beginning of July, whereas the minimum load was reached in the middle of July as was expected in the Summer Outlook 2015. The maximum load was 1449 MW and it was as predicted under severe conditions, while the minimum load was 784 MW and it was slightly higher than expected under normal conditions (770 MW). The average summer balance portfolio consisted of 57% of local generation and 43% of imports from neighbouring countries. The largest part of imported (65%) electricity was from Russia.

Comments on specific events occurring during the summer 2015 and resulting outages:

No unexpected situations happened in Lithuanian power system during 2014. It can be seen that water infeed from June through August 2015 was the lowest it's been since 2003 and was 60% lower than the historical average, therefore the generation of hydro power plants was at minimal level.

Montenegro

General comments on the summer 2015 climate and system adequacy conditions:

The weather was in general sunny with much higher temperatures than in previous years. The highest temperature recorded in July was 43°C. Statistically July was the warmest month in Montenegro, but for years it has been accustomed to the strongest heatwaves in August, which is usually the highest recorded air temperature. Until now it was 42.2°C in August 2003.

Comments on specific events occurring during the summer 2015 and resulting outages:

Although the demand resulted in higher values than expected, there were no unexpected situations. There were no critical outages/events in the Montenegrin transmission network during the summer. Most of the planned work was completed in accordance to the maintenance schedule for 2015. Availability of interconnectors has been more than adequate and there was no problem with the implementation of the cross-border transactions.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Malta

General comments on the summer 2015 climate and system adequacy conditions:

During the last summer temperatures were always within the usual Mediterranean countries' ranges. There was hardly any rain. During the whole year there were no floods/snow or ice.

Comments on specific events occurring during the summer 2015 and resulting outages:

There is never planned maintenance in the summer. Heavy and light fuel oil units were always readily available. There were no abnormal conditions. No extreme temperatures were noted (this summer was rather less harsh than usual). There was an increase in demand of around 6% with respect to last year and this was due to a flourishing economy and increase in tourists. The peak periods were during the evening at around 21:00hrs and the peak demand occurred in July. Only one disconnection from the Sicily-Malta interconnector occurred due to a thunder strike. The higher than expected imports were due to financial reasons. No serious outages occurred. Although the dispatch was concentrated on the interconnector it is capable of satisfying any demand by the plants. Gas is not used in Malta; it is scheduled to be used in late 2016.

The Netherlands

General comments on the summer 2015 climate and system adequacy conditions:

The summer of 2015 was a relatively warm summer, with some warmer (tropical) periods but relatively large fluctuations in temperature. No difficulties within the Dutch grid occurred during this period.
The expected summer period peak was around 15,700 MW, but the actual peak was somewhat higher at around 16,259 MW, which occurred on the 2 July (11 to 12:00 CET). The maximum temperature on that day was 33.1°C. The lowest load during the summer was reached on 2 August (9,032 MW)

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Comments on specific events occurring during the summer 2015 and resulting outages:

As of 21 May 2015 the Flow-Based Market Coupling method has been introduced in the CWE region. Flow-Based Market Coupling is an important step in integrating the European energy markets and transitioning to the infeed of more renewable energy in the European electricity network in a solid and sustainable manner.

(http://www.tennet.eu/nl/news/article/flow-based-methodology-for-cwe-market-coupling-succesfully-launched.html)

Norway

General comments on the summer 2015 climate and system adequacy conditions:

Due to late melting of the snow, the hydropower reservoirs in Norway were below normal this summer. On the other hand, the total hydrological balance has been good because of a high snow reservoir. At the end of week 36 the snow reservoir was 4 TWh above normal and the water reservoir was about 5 TWh above normal (91% of maximum). A high surplus of the hydrological balance has resulted in very low power prices and high export of power.

Comments on specific events occurring during the summer 2015 and resulting outages:

Apart from planned maintenance, there were few severe outages in generating and transmission capacity this summer. There was some limitations in transmission capacity due to expansion of existing lines. In addition, there were some limitations within Norway and between Norway and Sweden due to unfavourable flow, preventing the use of some system protection.

Poland

Power balance situation in Poland

A long heatwave throughout Poland and an unfavourable hydrological situation of the main rivers from the beginning of August 2015 caused a worsening of operational conditions of generating facilities, power networks and low generation in wind farms. When planning the operation of the Polish power system, TSO used all measures available, including, among others:

1. Activated all available generating units (including the generating units not directly dispatched by TSO).

2. Postponed, in consultation with the power plants planned overhauls.

3. Ordered to activate the contracted Demand Side Response (i.e. load reduction at the request of the TSO).

4. Ordered, to maximum possible extent, the supply of emergency power from neighbouring TSOs (CEPS and SEPS).

Simultaneously with taking the above power balance counter measures, a large-scale multilateral re-dispatching was implemented to keep flows on German-Polish border at a secure level, as this border was heavily congested due to unscheduled power flows (loop and transit). Hence, it was impossible to import more supportive power on synchronous profile (Germany, Czech Republic, Slovakia) than limited amounts from southern neighbours as mentioned above.

All the measures taken by TSO have not provided the possibility to cover the domestic demand in Poland with sufficient reserves level. Therefore on Sunday, 9 August, according to Polish legislation, it was decided (for the first time since the 1980s) to implement plan of limitations of power supply in peak hours for industrial consumers. It should be emphasised that at night from Sunday to Monday (9 to 10 August 2015) outages of generation capacities increased further, exceeding the forecasted level even for severe conditions (predicted in Summer Outlook 2015). By implementing the above-mentioned limitations, which reached about 2100 MW, stable operation of the Polish power system was maintained. Within the next days, after eliminating failures in the power plants, limitations of the power supply were gradually reduced and since 13 August they have not occurred again. It is important to emphasise that severe conditions have continued (until first week of September) and the power balance was still quite tight.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

PSE registered new historical, morning peak load during the summer of 2015 on 1 September —20.9 GW at 13:15 CET.

Network condition

For years the Polish power system has been affected by unscheduled flows (loop and transit) through Poland from the West towards the southern border. The reason for these flows are market transactions concluded outside Poland, which are connected with the development of renewable energy sources in Continental Europe (CE). Very often power flows from the northern part of CE to the South (coming from these transactions), which violates N-1 criteria—there is no proper coordination of capacity calculation and allocation process in CE.

During the summer of 2015 these flows were also limiting Polish import capacity, which could not be offered to the market on synchronous profile (with DE+CZ+SK). PSE was not able to offer import capacity in yearly, monthly or day-ahead horizon because imports to Poland increase physical flows on the PL/DE border, which is already congested by unscheduled power flows. The offering of import capacity to the market may take place only during intraday auctions and depends on the current level of unscheduled flows from Germany through Poland.

Unscheduled flows cause a violation of N-1 criteria on the Polish borders. To manage such situations PSE uses operational measures as follows:

1. DC loop flow (HVDC rescheduling) PL→DE (50Hertz)→DK→SE→PL, relevant agreement signed in September 2009. This measure consists in HVDC rescheduling and accompanied change of DE/PL schedule. This measure mainly relies on capacity available in SE/PL and DE/DK DC cable. It is a non-cost remedial action.

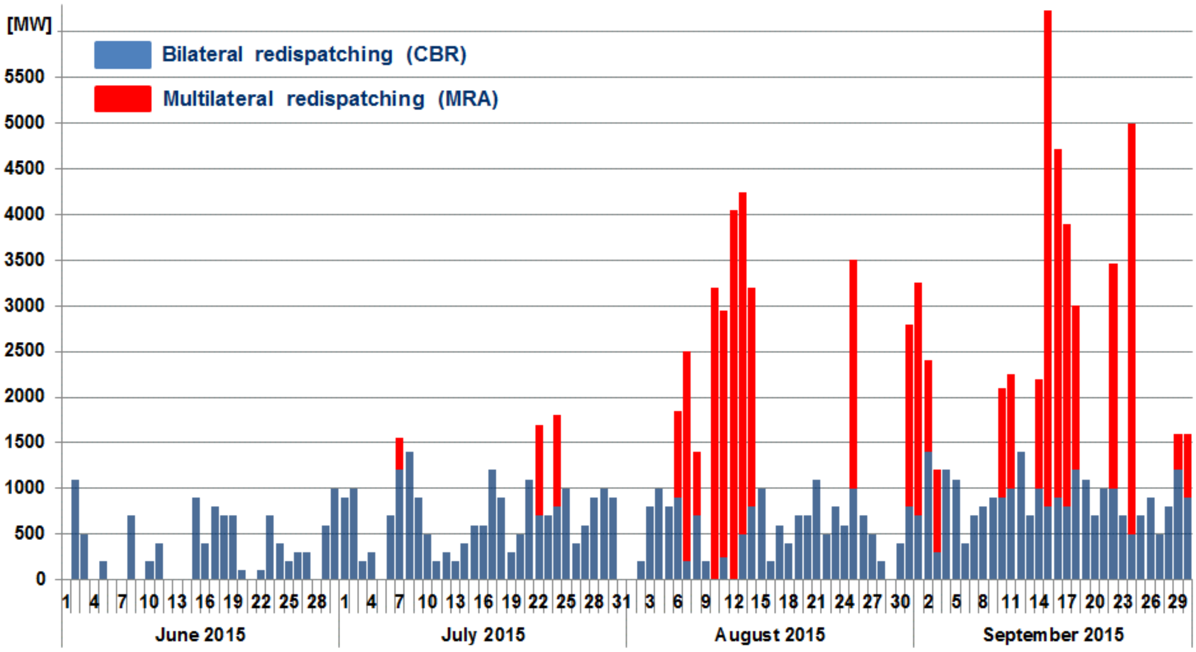
2. Bilateral cross-border re-dispatch (CBR) between PSE and 50Hertz, relevant agreement signed in May 2008 and updated in 2014. This measure consists of increased generation in Poland and decreased generation of 50Hertz. This measure relies on available generation in Poland (the most effective is using power plants located next to the border) and the possibility to decrease generation in Germany and can also be limited by PSE and CEPS (in order not to create more congestion there). It is a costly remedial action.

3. Multilateral re-dispatch carried out within the frame of the Multilateral Remedial Actions agreement (MRA). The MRA agreement between TSOs in TSC area (TSC-TSO Security Cooperation) was signed in June 2012, with regular updates since. This measure is used as a last resort action to relieve German-Poland interconnection by decreasing generation of 50Hertz and increasing it in other TSOs' control areas (usually Austria, Switzerland or other German TSO areas). This measure relies on power available in the above TSOs and the possibility to decrease generation in Germany. It is a costly remedial action, with the highest costs of all measures.

During the summer of 2015, an excessive level of unscheduled flows caused the need to use remedial actions to fulfil N-1 criteria almost every day. Below are the number of days when CBR and/or MRA had to be activated (DC loop flow was usually not possible in daytime hours due to the full usage of PL/SE HVDC link in a southbound direction in problematic hours):

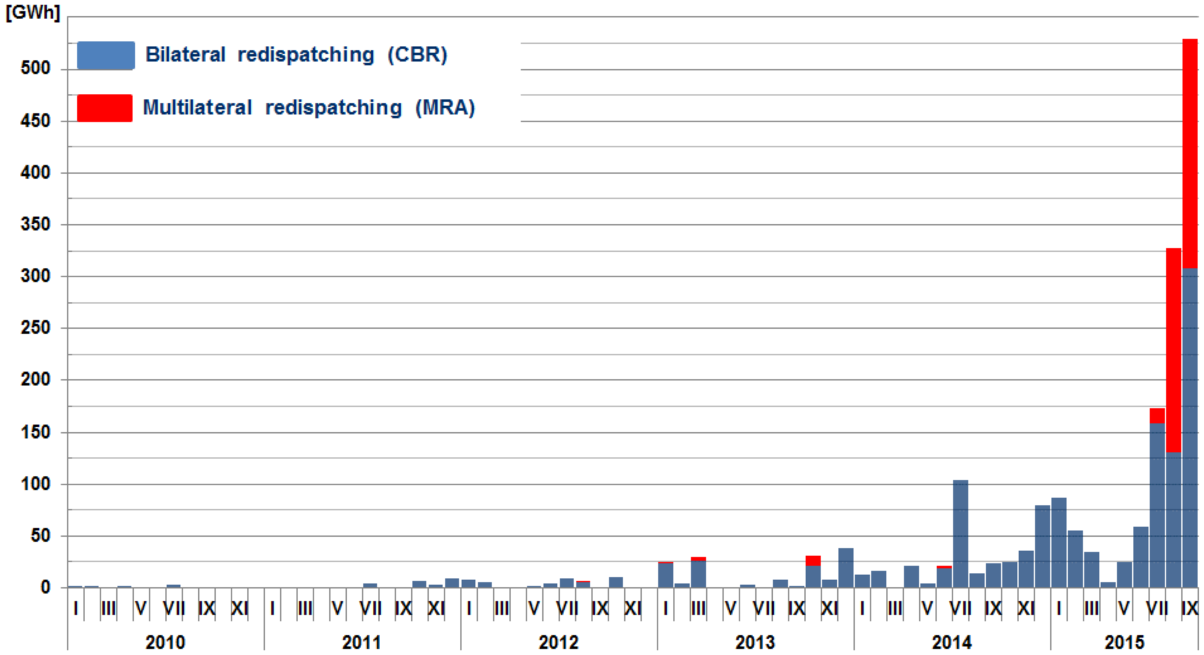
1. 20 days from among 30 in June (67%)
2. 29 days from among 31 in July (94%)
3. 29 days from among 31 in August (94%)
4. 30 days from among 30 in September (100%)

The figure below presents the maximum power of CBR+MRA in each summer day, which must be activated to keep N-1 criteria in a secure state.



The message from this figure is that 1000 MW of CBR has become a daily routine in the summer months, sometimes complemented or even fully replaced by MRA. On Tuesday, 15 September, maximum power of CBR and MRA amounted to an unprecedented level of 6237 MW (800 MW and 5437 MW respectively). It is important to emphasise that CBR can be exhausted either due to lack of generating capacity available in Poland for up regulation or loading PSE/CEPS profile beyond n-1 secure limit. So a routine operation in this part of CE has required application of massive re-dispatching on a daily basis, which means PSE has operated at the limit for most of the daytime hours and Polish TSO has not been able to cope with 'out of dimensioning events' like the loss of 2.2 GW of generation capacity from 9 to 10 August.

The result of such frequent usage (and on such a high level) for CBR and also MRA is a rapid increase of energy volume necessary to realise these remedial actions what is shown on the figure below (without energy activated within DC Loop Flow).

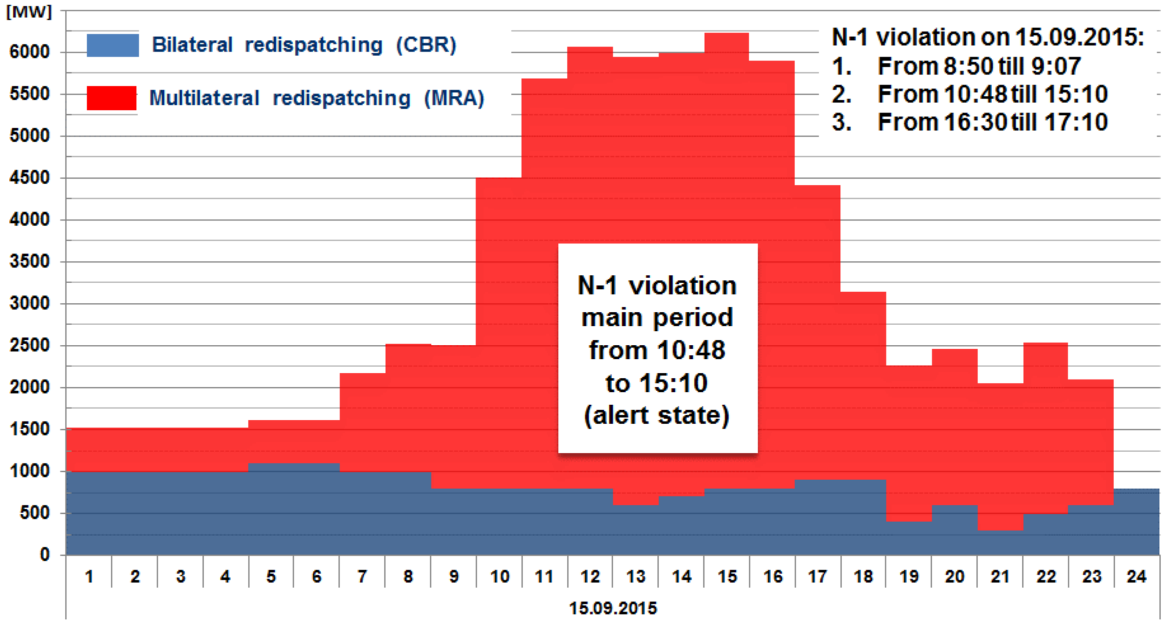


It is worth noting that 'efficiency' of CBR amounts to about 50%, meaning that to reduce unscheduled flows on the PL/DE profile by 100 MW, 200 MW of CBR is required. 'Efficiency' of MRA is much less (strongly depends on the area, where up regulation is available), 3 to 5 times more MWs are needed to have the same effect. Estimated costs for triggering bilateral and multilateral re-dispatch have reached unprecedented levels this summer, which partly charges customers in Poland. The question can be asked about social welfare benefits for customers outside Poland (coming from market transactions concluded beyond Poland) in relation to costs bear in Poland to reduce the negative influence on the Polish power system (and the whole CE synchronous area as well). In addition, it could be said that Polish consumers are cut off from the European electricity market (referred to as CE), because most capacities to Poland possibly offered to the market are consumed by the above-mentioned unscheduled flows. This is not a case of low-level of interconnectivity (factor calculated by European Commission as relation of importable NTC to Net Generating Capacity), because Polish TSO is strongly connected with the CE synchronous region using 10 HV tie-lines, of which six refer to voltage 400 KV. Referring to the balance problem that occurred in Poland last summer, PSE was asked by stakeholders why the Polish system with summer peak load at the level of c.a. 20 GW operating in 400 GW area synchronous interconnection is not able to import 1 GW even under emergency conditions? The important question is, how is it connected with the European idea of regional balancing?

PSE has informed many times, also in Summer Outlook 2015, that due to increased unscheduled power flows and the need to activate remedial actions, PSE operates closer and closer to the security limit and it is only a matter of time until available levels of remedial actions will not be enough to decrease unscheduled flows to fulfil the N-1 criteria.

Unfortunately such a case happened on Tuesday, 1 September, after exhausting all internal generation resources for bilateral re-dispatch (original potential for CBR throughout peak hours was at the level of 500 MW) and due to exhausting of all MRA resources in the TSC area (maximum 2550 MW during peak hours), PSE had to activate emergency energy delivery from Ukraine and emergency Demand Response contracts in order to increase bilateral re-dispatch with 50Hertz to an 800 MW level. All this took place on the day marked by extremely tight power balance of PSE, putting again the whole European continental power system at risk if the above re-dispatches were not possible due to unavailability of resources in Poland or other countries supplying the necessary re-dispatching power. Such a situation is not a hypothetical one as it in fact happened on that very day, when the availability of an agreed level of MRA was endangered. Fortunately the agreed level of MRA was completed, however close to real time. This is not acceptable when managing a secure operation of the interconnected European power system, and a sustainable solution is urgently needed.

Two weeks later, on Tuesday, 15 September, a situation with exhausted CBR and MRA was repeated, and even worse, that unprecedented level of remedial actions, amounting to 6237 MW, was not enough to limit unscheduled flows through Poland to the safe level—N-1 criterion was not fulfilled for more than for 4 hours. PSE had no other measures to manage this situation. That time the secure operation of the whole Continental interconnection was endangered (the risk of cascading trippings leading to Continental wide splitting like 4 Nov 2006 with difficulty to assess consequences). The figure below shows the hourly level of remedial actions on that day with a marked N-1 violation main period.



Portugal

General comments on the summer 2015 climate and system adequacy conditions:

This summer, despite the very dry conditions, the hydro generation stood 26% above the average, mainly due to the high inflows in the Douro which resulted from the activity in the Spanish storages upstream. But this time of the year, values are very low. For wind generation, conditions were slightly negative with a wind power generation level of about 96% of the average value.

From last year's values, the demand was 3.7% and 1.7% higher in July and August, respectively, mainly due to the weather conditions. In August, the renewable sources supplied 35% of demand, the non-renewable 55% and the remaining was supplied by imports.

Romania

General comments on the summer 2015 climate and system adequacy conditions:

In June 2015, the average air temperature was higher than normal values in almost all of the country and the rainfall was mostly within the normal range. July 2015 was characterised by the heat wave long intervals, therefore the July demand has increased significantly compared to the previous month demand. Total rainfall amounts were lower than normal ones in most of the regions. Also, August 2015 was characterized by long intervals of heatwaves, and total rainfall amounts were lower than normal in most of the regions. Despite the high temperatures because of the long heatwaves, the Romanian power adequacy was not affected due to a well-balanced generation structure that relied on a mix of energy sources and on various types of power plants. Also, during the summer of 2015, the Romanian Power System was able to export electricity.

Comments on specific events occurring during the summer 2015 and resulting outages:

The planned generation overhaul followed up the maintenance plans. The requirements to cover the internal demand, the system reserve amount and the export requests were fulfilled at any time. The network maintenance and investments were carried out according to the plans. Thus during the last summer, the reinforcement work for a 400/110 kV substation in the Southern-Eastern part of the Romanian Power System was completed, in an area characterised by large-scale wind farms. The substation was rehabilitated by new primary and secondary equipment and an additional transformer unit increased the grid security level. During the summer of 2015, Romania was an exporting country with an export NTC usage level higher than 95%.

Serbia

General comments on the summer 2015 climate and system adequacy conditions:

In general, the last summer happened as expected, without major problems. During June and early July, temperatures were moderate and loads were lower than expected, so significant amounts of energy were exported.

In the second half of July and early August a tropical wave hit the region and temperatures increased significantly but were not extreme, thus loads were below severe conditions values. Even during this warm period, energy exports continued, but to a much lesser extent.

However, the drought period during the tropical wave significantly reduced the levels of rivers and hydro storages. This triggered energy imports in September although the temperatures and the loads were then normal.

Comments on specific events occurring during the summer 2015 and resulting outages:

Low hydro output in September but no specific outage.

Slovakia

General comments on the summer 2015 climate and system adequacy conditions:

The summer of 2015 was very dry and much warmer than in the previous year. On some summer days the maximum daily temperatures reached the historical maximum temperature recorded in Slovakia. Average temperatures during the summer months from June to September were about 20.5°C (the previous year it was 18.2°C). The first months of the summer period were very warm, and the average temperatures were as follows: June 18.9°C, July 22.3°C, August 22.7°C and September about 18.1°C (in the previous year: June 17.8°C, July 21.0°C, August 18.0°C and September 16.0°C). August had the highest difference of average monthly temperatures (4.7°C higher than in 2014).

Comments on specific events occurring during the summer 2015 and resulting outages:

The high temperature had a main impact on consumption. There was an increase in the consumption of electricity all summer. A high increase in consumption was recorded in August 2015 (5.9%) in comparison to the same month of the previous year. Conversely, the total production of electricity during the summer months in 2015 in Slovakia decreased compared to the previous year. A slight increase in production was at non-identifiable (solar) power plants, in contrast, the highest decrease of production was recorded at hydro and nuclear power plants. For example, in August 2015 the production of hydro power

plants was only in total 222 GWh (-57.1 %), compared to August 2014 (517 GWh). The summer peak load was recorded on Wednesday, 22 July 2015 at 13:00, 3,791 MW (30th week); the forecast for this week was 3,540 MW. The total predicted value of the summer peak was 3,610 MW in the 37th week. In the mentioned period the peak loads were much higher than the outlook, probably due to a hot weather period and expanding use of air-conditioners. Recorded weekly peaks of loads in the summer of 2015 were also higher than in the summer of 2014 (maximum 107%).
The electricity was imported all summer to the power system of Slovakia. Imports of electricity were all summer in 2015 compared to the summer of 2014, when imports were recorded only in June and slightly in September. In the summer of 2015, imports of electricity were in total more than 1,000 GWh (in the summer of 2014 it was 240 GWh). The highest increase of imports of electricity was recorded in June (312 GWh) and July (319 GWh). The share of imported electricity on the consumption in these months was 13.9% and 13.6%. These imports in the summer of 2015 were caused by high temperatures, lower production and increased consumption compared to the previous year. In spite of that, in the summer of 2015 the Slovak TSO did not ask for any emergency assistance (imports of electricity) from neighbouring TSOs. Due to high physical flows the reconfigurations (changes) of the basic transmission system connection in 400 kV substations Lemešany, Varín were performed four times in the summer of 2015.

Slovenia

General comments on the summer 2015 climate and system adequacy conditions:

The average summer temperatures in Slovenia were high above the average, but as expected, no critical situations occurred in the Slovenian power system.

Comments on specific events occurring during the summer 2015 and resulting outages:

On 8 June a defect in high-voltage equipment caused an outage of the distribution transformer station Pekre and of the surrounding transmission lines, which resulted in ENS of approximately 57 MWh. Besides that, a nuclear power plant Krško was preventively stopped between 17 and 19 July due to replacement of temperature sensors. Meanwhile,

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

the power system remained secured. No other specific events or unexpected situations occurred during the last period.

Spain

General comments on the summer 2015 climate and system adequacy conditions:

The temperatures were much higher than average during the summer, especially in July. The average temperature during July was 3ºC higher than the historical average value, and demand was accordingly high (quite similar to the extreme peak demand that was forecasted). Last summer was also a higher than average drought period. However, no adequacy problems occurred.

Comments on specific events occurring during the summer 2015 and resulting outages:

Water inflows were lower than average during the summer. However, given that the hydro reserves were quite high at the beginning of the summer, their evolution was normal and the present level is similar to the historical average. Wind production was lower than the average values during the summer (about 17% of installed capacity, being the average value about 20% during summer).
The average temperature was 23ºC during June (5.3% higher than average), 27ºC during July (10% higher than average) and 25.3ºC during august (2% higher than average). Extreme temperature values were reached during July, and the demand peak value was 40,200 MW, reached on 21 July at 13:33. No adequacy problems occurred.

Sweden

General comments on the summer 2015 climate and system adequacy conditions:

The average temperature during the summer of 2015 was lower than the previous three years. June and July were colder than normal while the second half of August was warmer than usual. In July, most parts of Sweden had more rain than normal but it did not affect the operation of the power grid significantly. Fewer lightning strikes than usual resulted in a very small number of power system disturbances caused by lightning.

Comments on specific events occurring during the summer 2015 and resulting outages:

The favourable weather conditions resulted in a smaller number of disturbances than usual. The incidents that did occur were handled without widespread impact. As expected, there were no issues with power adequacy and no load shedding was required. As mentioned in the previous Summer Outlook Report, the level of maintenance was normal and relatively evenly distributed over the period and most maintenance was performed with good results. The hydro reservoir levels were filled later than usual as the summer arrived late in Sweden, thus the hydro power production was higher than usual during the summer. This resulted in high export levels due to low electricity prices. On a few occasions, nuclear power production was lower than expected although no maintenance was planned, in conjunction with low price levels.

Situations with high voltages were expected during nights on occasions with low load on long transmission lines. A few situations with high voltages did occur but not as frequently as the previous summer. There were some limitations in transfer capacity because of maintenance work in the grid and on nuclear units, which led to different price areas. Thermal limitation was the dimensioning factor for transfer capacity for most of the time during July and August.

The interconnections between Sweden and Norway were mainly used for imports, while Sweden was exporting to Finland and Poland most of the time. The interchange with Denmark and Germany shifted between import and export.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Appendix 3: Daily average temperatures for normal weather conditions – reference sets

Calculation of country's population weighted monthly average temperatures daily average temperatures

The steps for calculating the normal population weighted monthly average temperatures are as follows:

1. Collect data for the number of population ($\mathbf{NP_{country}}$) based on the latest census of each country.[11]

2. Define the number of cities in each country to be weighted ($\mathbf{NC_{weighted}}$). The lower threshold for calculating the weight is set to 3,000,000 inhabitants.

NC_weighted=INT(NP_country/3000000)+1

3. Take data for the population ($\mathbf{CP_i}$) of each of the first $\mathbf{NC_{weighted}}$ biggest cities (cities preliminarily arranged in descending order by number of inhabitants)

4. Define the weighting coefficient (Ki) of each city using the formula:

$$\boldsymbol{K_i = \frac{CP_i}{\sum_i CP_i}} \quad , i = 1 \text{ to } \mathbf{NC_{weighted}}$$

5. Collect data for the normal monthly average temperatures of the selected cities[12]:

$\boldsymbol{NMAT}_{\mathbf{ij}}$, ***i* = 1** to $\mathbf{NC_{weighted}}$, ***j* = 1** to **12** (**1 = January, 2 = February**, ….)

6. Define the country's population weighted normal monthly average temperatures

11 The source of data for the number of the countries and the corresponding cities population is www.cia.gov/library/publications/the-w orld-factbook/, world.bymap.org, www.citypopulation.de

12 Source: the climatology database of the World Meteorological Organization (WMO), based on 30 years of observation (www.worldweather.org). There is also a free access to these data via many other specialised websites for meteorological information.

$$CPWNMAT_j = K_i \times NMAT_{ij} ,$$

i = 1 to $NC_{weighted}$, j = 1 to 12 (1 = January, 2 = February,..)

The resulting population weighted normal daily average temperatures, which will be derived from the population weighted normal monthly average temperatures, are obtained as

$$CPWNMAT_{ij}$$

j = 1,2,3,……, $ND_{i\ month}$, i = 1 to 12 (1 = January, 2 = February,..)

ND_{imonth}- number of days of month j

1. Assign the population weighted normal monthly average temperatures $CPWNMAT_{ij} = CPWNMAT_j$

to the dates corresponding to the middle of each month:

$CPWNDAT_{1\ 16} = CPWNDAT_1$ 16 January

$CPWNDAT_{2\ 14} = CPWNDAT_2$ 14 February

$CPWNDAT_{3\ 16} = CPWNDAT_3$ 16 March

$CPWNDAT_{4\ 15} = CPWNDAT_4$ 15 April

$CPWNDAT_{5\ 16} = CPWNDAT_5$ 16 May

$CPWNDAT_{6\ 16} = CPWNDAT_6$ 15 June

$CPWNDAT_{7\ 16} = CPWNDAT_7$ 16 July

$CPWNDAT_{8\ 16} = CPWNDAT_8$ 14 August

$CPWNDAT_{9\ 15} = CPWNDAT_9$ 15 September

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

$CPWNDAT_{10\ 16}$ = $CPWNDAT_{10}$ 16 October

$CPWNDAT_{11\ 15}$ = $CPWNDAT_{11}$ 15 November

$CPWNDAT_{12\ 16}$ = $CPWNDAT_{12}$ 16 December

2. Define the population weighted normal daily average temperatures $CPWNMAT_{ij}$

by linear interpolation between the 12 values corresponding to mid-month dates

3. Calculate two values for the annual average temperature (AAT) based on the two sets of data:

$$AAT_{monthly} = (\sum CPWNMAT_i/12) \text{ , i = 1 to 12}$$

$$AAT_{daily} = (\sum\sum CPWNMAT_{ij}/365) \text{ , i = 1 to 12, j = 1 to } ND_i$$

month

4. Calibrate $CPWNMAT_i$ in order to reach the equality:

$$AAT_{daily} = AAT_{monthly}$$

by shifting $CPWNMAT_{ij}$ up or down with the correction value:

$$DT_{shift} = (AAT_{monthly} - AAT_{daily}) / 365$$

Polynomial 6-th order approximation is applied to the time series of $CPWNMAT_{ij}$ (i = 1 to 12, j = 1 to NDi month). The resulting set of 365 smoothly approximated values is ready to be used as the first reference set for the Normal Daily Average Temperatures valid for Normal Weather conditions TEM_{REF_SET1}

Methodology for load sensitivity calculation

Because of the clearly defined diurnal pattern of the activities typical for the residential and business customers, the temperature sensitivities of hourly loads experience similar profiles— lower values during the night and higher values during the 'active' hours of the day. The highest temperature sensitivity is observed for the peak loads during the working days, and since this is the reference load for the short-term and long-term adequacy reports, the method for calculating the sensitivity of this type of load is presented below. The steps of calculation for any country are as follows:

1. Define the peak load for every day of the reference year;

2. Remove values for Saturdays, Sundays and official holidays for the assessed country from the time series of peak loads (P_{peak}) and daily average temperatures (T_{avd}), creating in this way resulting time series only for working days;

3. Arrange the daily average temperatures in ascending order with corresponding arrangement of the peak load values;

4. Using a step-wise linear regression iteration procedure, the following two important points are defined (for countries concerned by cooling need in Winter):

- **saturation temperature for cooling zone** (**T_{satur}**)—this is the value above which further increase of the temperature does not cause an increase in the electricity demand (practically all available cooling devices have been switched on). This saturation concerns few countries in Southern Europe.

- **starting temperature for the cooling zone (**T_{start}**)**—this is the value above which the cooling devices are started.

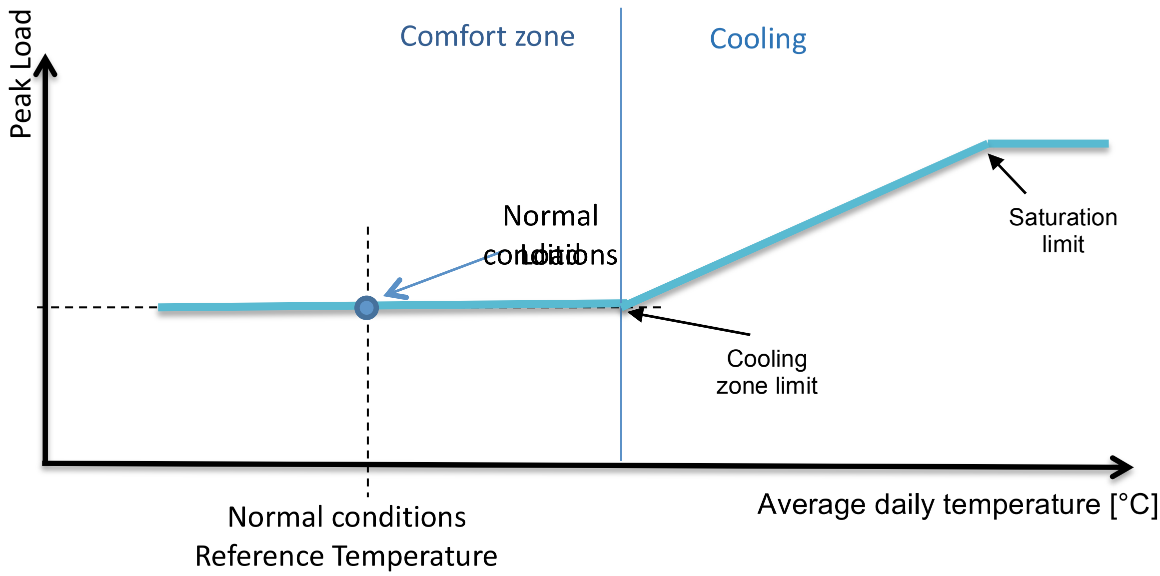
5. Model the relation between the peak load and the daily average temperature in the range **T_{start} - T_{satur}** by simple linear regression:

$$P_{peak} = a + b^* T_{avd}$$

where the regression coefficient **b** being the **peak load temperature sensitivity** is valid for the cooling zone.

In this calculation the rescaled values of the population weighted normal monthly average temperatures T_{avd} are used.

The figure below provides a visual explanation of the main points above.



ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Appendix 4: Glossary

Downward Regulation Reserve: The Active Power reserves kept available to contain and restore System Frequency to the Nominal Frequency and for restoring power exchange balances to their scheduled value;

Downward Regulation Margin (also **Downward Regulation Capability):** indicator of the system flexibility to cope with excess of generation infeed during low demand time. Corresponds to difference between [off-peak load; pumping] and [must run generation; variable generation; downward regulation reserve].

Firm import/export contracts: Bilateral contracts for the import or export of electrical energy, agreed for a certain period of time in advance;

Generation adequacy: An assessment of the ability of the generation in the power system to match the Load on the power system at all times;

Highest expected proportion of installed renewable generation running: Maximum expected renewable in-feed which should be taken into account in downward regulation analysis. This is set at 65% for the wind and 95% for the solar as a default value but can be replaced as various TSOs will have historic experience of higher or lower output from renewables across the assessed period;

Capacity factor: The ratio of the available output capacity and installed capacity over a period of time for various types of power plants (used primarily to describe renewable output in this report);

Incompressibility of generation: used in the present report as a synonym of downward regulation margin.

Load Management: Load Management forecast is estimated as the potential load reduction under control of each TSO to be deducted from the load in the adequacy assessment;

Load: Load on a power system is the net consumption corresponding to the hourly average active power absorbed by all installations connected to the transmission grid or to the distribution grid, excluding the pumps of the pumped-storage stations. 'Net' means that the consumption of power plants' auxiliaries is excluded from the Load, but network losses are included in the Load;

Must Run Generation: the amount of output of the generators which, for various reasons, must be connected to the transmission/distribution grid. Such reasons may include: network constraints (overload management, voltage control), specific policies, minimum number of units needed to provide system services, system inertia, subsidies, environmental causes etc;

National Generating Capacity (NGC): The Net Generating Capacity of a power station is the maximum electrical net Active Power it can produce continuously throughout a long period of operation in normal conditions. The National Generating Capacity of a country is the sum of the individual Net Generating Capacity of all power stations connected to either the transmission grid or the distribution grid;

Net Transfer Capacity (NTC): The Net transfer capacity is the maximum total exchange program between two adjacent control areas compatible with security standards applicable in all control areas of the synchronous area, taking into account the technical uncertainties on future network conditions;

Non-usable capacity at peak load under normal conditions: Aggregated reduction of the net generating capacities due to various causes, including, but not limited to temporary limitations due to constraints (e.g. power stations that are mothballed or in test operation, heat extraction for CHPs); limitations due to fuel constraints management; limitation reflecting the average availability of the primary energy source; power stations with output power limitation due to environmental and ambient constraints, etc.;

Pumping Storage Capacity: Net Generating Capacity of hydro units in which water can be raised by means of pumps and stored, to be used later for the generation of electrical energy;

Reference Points: Reference points are the dates and times data are collected for:

– Sundays in Winter on the 5^{th} hour (05:00 CET) and on the 11^{th} hour (11:00 CET)

– Wednesdays in Winter on the 19^{th} hour (19:00 CET)

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

Reliably Available Capacity (RAC): Part of National Generating Capacity that is actually available to cover the Load at a reference point;

Remaining capacity (RC): The RC on a power system is the difference between the RAC and the Load. The RC is the part of the NGC left on the system to cover any programmed exports, unexpected load variation and unplanned outages at a reference point;

Run of River: A hydro unit at which the head installation uses the cumulative flow continuously and normally operates on base load;

Severe conditions are related to what each TSO would expect under a 1 in a 10 year scenario.[13] For example, the demand will be higher than under normal conditions and in certain regions, the output from generating units (e.g. wind) may be very low or there may be restrictions in thermal plants which operate at a reduced output under very low or high temperatures.

Simultaneous exportable/importable capacity: Transmission capacity available for exports/imports to/from other Control Areas is expected to be available each week. It is calculated taking into account the mutual dependence of flows on different profiles due to internal or external network constraints and may therefore differ from the sum of NTCs on each profile of a Control Area or country;

System services reserve under normal conditions: The capacity required to maintain the security of supply according to the operating rules of each TSO. It corresponds to the level required one hour before real time (additional short notice breakdowns are already considered in the amount of outages).

Time of Reference: Time in the outlook reports is expressed as the local time in Brussels.

Variable generation: generation of renewable energy sources, mostly wind and photovoltaic, which output level is dependent of non-controllable parameters (e.g. weather)

[13] It is difficult to be very specific and hence a description of the scenario being considered should be provided in the data collection questionnaire by each TSO, if *for example* the 1 in 10 year scenario recommendation is not used, and a TSO only calculates at a 1 in 20 year demand level.

ENTSO-E AISBL • Avenue de Cortenbergh 100 • 1000 Brussels • Belgium • Tel +32 2 741 09 50 • Fax +32 2 741 09 51 • info@entsoe.eu • www.entsoe.eu

entsoe

Reliable Sustainable Connected